**UNIVERSIDADE DE LISBOA**

**Faculdade de Medicina de Lisboa**

# Psychological Features of Functional Voice Disorders

Mafalda Bordalo Andrea

Orientadora: Professora Doutora Maria Luísa Caruana Canessa Figueira da Cruz Filipe

Tese especialmente elaborada para a obtenção do grau de Doutor no ramo de Ciências e Tecnologias da Saúde, especialidade de Desenvolvimento Humano e Social

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*To my Father*

# PREFACE

# Preface

The voice is one of the most important instruments of communication and expression, being subject to various influences.

Voice disorders are common pathologies with diverse etiologies (e.g., inflammatory processes, tumors, neurological alterations, behavioral conditions, and also psychological factors) that may affect the individual's health and quality of life with repercussions on the capacity to meet daily needs. The symptomatology is variable as well as the degree of severity.

Functional voice disorders (FVDs) have a significant relevance in the field of voice disorders due to their high prevalence. They are also of interest in the area of mental health because of the existing co-morbidity. This vocal pathology is classified into three types of presentations: psychogenic voice disorders, primary and secondary muscle tension voice disorders.

The aim of this Thesis was to study the relationship between psychological features and functional voice disorders (FVDs) and to characterize the three types of FVDs from a psychological perspective with the administration of standardized instruments. To achieve our purpose, sociodemographic information was collected and we proceeded to vocal acoustic evaluation and to the assessment on self-perception of quality of life related to vocal disorder.

After the approval of the Ethics Committee, the study took place at the Department of Ear, Nose, Throat, Voice and Communication Disorders (ENT Department), Santa Maria Hospital (HSM), Otolaryngology University Clinic, Faculty of Medicine of the University of Lisbon, under the supervision of Professora Doutora Maria Luísa Figueira.

This Thesis consists of nine chapters, beginning with **Summaries** formed by an "**Abstract"** and a more extended summary in Portuguese "**Resumo**".

**Chapter 1** presents **"Foreword"** where the researcher shares reflections about the psychological work with patients with voice disorders, resulting from a combination of the theoretical revision and the experience acquired over eight years as a member of the multidisciplinary vocal assessment team at the ENT Department (HSM).

**Chapter 2** consists of the systematic **"Introduction"** in the field of voice, vocal production, and voice disorders. It presents a history of the development of the classification of voice disorders up to the current concept of functional voice disorders classified into three types: psychogenic, primary and secondary muscle tension voice disorders. Its etiology, prevalence, symptoms and signs, vocal profile, as well as treatment and prognosis are analyzed. The relationship between psychiatric disorders and functional voice disorders are reviewed devoting attention to affective and anxiety disorders, personality disorders and also affective temperament. This chapter ends with the analysis of the impact that functional voice disorders have on quality of life.

**Chapter 3** addresses **"Research Questions and Goals"** with reference to problem definition, research goals, and to the operationalization of the studied variables.

**Chapter 4** is dedicated to **"Methods"**. It includes the description of the setting, design and procedure. The evaluation protocol comprises vocal acoustic evaluation, collection of clinical data, psychological evaluation (list of clinical and self-assessment tests), self-evaluation of quality of life, and ENT evaluation. A general reference of the statistics procedures that were used in the analysis of the results is also provided.

**In Chapter 5** the **"Results"** our results are presented according to the goals of this Thesis. In the first section, we made the characterization of the subjects, followed by a discussion in the light of current knowledge (Study 1). Each of the following former sections (five Studies) corresponds to a research study and are all organized in six stages: introduction, procedure, statistical analysis, results, discussion and conclusion. This chapter includes data from the paper "Functional Voice Disorders: The Importance of the Psychologist in Clinical Voice Assessment", published in the Journal of Voice from The Voice Foundation, 2017, as well as from "Self-perception of quality of life in patients with functional voice disorders: the effects of psychological and vocal acoustic variables", published in the European Archives of Oto-Rhino-Laryngology, in 2018.

**Chapter 6** is dedicated to **"General Discussion and Conclusions"**. Here the findings are discussed based on literature review. Reflections are presented integrating the different areas of evaluation that contributed to a better knowledge of patients with functional voice disorders.

**"Limitations and Future Research"** are explored in **Chapter 7**. The author reflects on the procedure involved in this Thesis by pointing for its limitations and strengths. Hypotheses of future approaches arise with the purpose of ensuring the continuity of researches in functional voice disorders.

In **Chapter 8** the **"Clinical Implications"** are presented**.** The multidisciplinary vocal assessment team was advocated as a way of promoting effective treatment adapted to the reality of patients with functional voice disorders. Clinical suggestions are made regarding the dimensions that in our perspective should be evaluated in patients with functional voice disorders.

**"References"** are listed in this last section.

# ACKNOWLEDGEMENTS

## Acknowledgements

Being a lonely process, this journey also involved a great deal of sharing and contact with so many different people who in different ways contributed to the final outcome. To all those involved, I wish to express my deepest thanks.

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To **Professor Doutor António Barbosa**, the first psychiatrist to receive patients with voice disorders in Hospital de Santa Maria (HSM), I am grateful for his constant availability when I needed support for my/our patients.

I thank the **ENT specialists and residents** at HSM for all their support and for recognizing and valuing the role psychology plays in multidisciplinary vocal assessment.

To **Cristina Villa Simões** and **Elizabeth Moscoso**, both of whom are speech therapists at HSM, I would like to express my appreciation for their tireless dedication in helping me in collecting the sample and for all their suggestions.

I had the good fortune to work with two incredible audiovisual technicians, **Rui Peneda** and **Ruben Cordeiro** (posthumous) (HSM), whom I thank for always ensuring the best possible assessment conditions.

I thank the **Audiology technicians** at HSM for all their support throughout the entire process.

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I thank **Débora Franco**, who wrote her PhD at the same time as I did. It was a pleasure to share doubts, experiences and advice concerning voice disorders.

To the whole **Department of Ear, Nose, Throat, Voice and Communication Disorders** (HSM), I am grateful for their support and for providing me with a role model of innovation, efficiency and wisdom.

To **all patients**, I extend my heartfelt thanks for agreeing to take part in this study. Many of them have gone from being participants to becoming my patients. I hope I have been able to help them as much as they helped me in achieving this clinical research.

To **my Family** and **Friends**, I want to express my eternal gratitude for the constant source of strength, encouragement and unconditional support.

# SUMMARIES

**Resumo**

**Abstract**

# Resumo


## Introdução

As disfonias funcionais (FVDs - functional voice disorders) são doenças frequentes que apresentam uma incidência variável entre os 10 e os 40% no total das patologias vocais diagnosticadas em consultas de Otorrinolaringologia.

Têm uma maior prevalência no sexo feminino sendo mais frequentes em idades compreendidas entre os 30 e os 50 anos. São caracterizadas por alterações ao nível da qualidade vocal, as quais se refletem na qualidade de vida de doentes que têm uma anatomia e fisiologia da laringe aparentemente normais.

Para o estudo das disfonias funcionais, às quais têm sido atribuídas várias designações, seguimos o "Diagnostic Classification System for Voice Disorders (DCSVD)", desenvolvido e apresentado por Baker et al. em 2007. Este sistema valoriza a existência de fatores fisiológicos, comportamentais (abuso e mau uso vocal) e psicológicos (depressão, ansiedade e personalidade).

De acordo com esta classificação as disfonias funcionais (FVDs) estão divididas em: disfonia psicogénica (PVD - psychogenic voice disorders) na ausência de patologia estrutural ou neurológica da laringe, e em disfonias por tensão muscular (MTVDs - muscle tension voice disorders) caracterizadas por alterações de tensão muscular ao nível da laríngе (hiper e hipofuncionamento). Por sua vez, as MTVDs dividem-se em disfonias por tensão muscular primária (MTVD1 - primary muscle tension voice disorders) em que ocorre um incompleto encerramento da glote (fenda glótica) observado na videolaringoscopia e, em disfonias por tensão muscular secundária (MTVD2 - secondary muscle tension voice disorders) em que ao nível das cordas vocais se verifica a existência de patologia benigna (nódulos e pólipos) decorrente de alterações no processo de fonação.

## Objetivos

Foi realizado um estudo exploratório, descritivo e transversal com uma amostra não probabilística com a finalidade de analisar as relações entre fatores psicológicos e as disfonias funcionais (FVDs). Neste trabalho as três apresentações de FVDs foram avaliadas do ponto de vista psicológico, das características vocais e do seu impacto na qualidade de vida, tendo ainda sido analisados os dados sociodemográficos.

**Método**

Este trabalho foi desenvolvido no Departamento de Otorrinolaringologia, Voz e Perturbações da Comunicação (Departamento de ORL) do Hospital de Santa Maria e na Clinica Universitária de ORL da Faculdade de Medicina da Universidade de Lisboa.

Foram estudados doentes com queixas vocais seguidos na consulta externa do Departamento de ORL e que após a observação otorrinolaringológica (vídeolaringoscopia através de endoscópios rígidos ou de fibroscópios) lhes foi diagnosticada disfonia funcional.

Foi elaborada uma história clínica baseada numa entrevista semiestruturada com o objetivo de caracterizar as alterações vocais (ex: sintomas vocais; tratamentos atuais e passados em terapia da fala; patologia vocal familiar), as alterações psicológicas (ex: tratamentos psicológico, psiquiátrico ou ambos; prescrição de psicofármacos; patologia psiquiátrica familiar) e ainda dados sociodemográficos, de comportamentos e estilo de vida (Study 1).

A incidência de patologia afetiva e ansiosa assim como a severidade dos sintomas depressivos e ansiosos foram respetivamente analisadas através de "Mini International Neuropsychiatric Interview" (MINI) e por duas escalas clínicas, "Hamilton Depression Rating Scale" (HAM-D) e "Hamilton Anxiety Rating Scale" (HARS) (Study 2).

O "Millon Multiaxial Inventory (MCMI-II)" foi utilizado para determinar o perfil de personalidade de doentes com disfonias funcionais (FVDs) e para identificar os traços e perturbações responsáveis pela vulnerabilidade associada ao desenvolvimento desta doença (Study 3).

Para a avaliação dos temperamentos afetivos foi utilizada a escala "Temperament Evaluation of Memphis, Pisa, Paris and San Diego - Auto questionnaire (TEMPS-A)" (Study 4).

Procedeu-se igualmente à avaliação acústica da voz através do programa Praat (Study 5). As médias das frequências fundamentais (F0) e do primeiro formante (F1) para as vogais sustentadas /i/, /a/ e /u/ foram comparadas entre grupos e com os dados normativos para a população portuguesa (valores para indivíduos do sexo feminino sem patologia vocal e com rouquidão).

O "Voice Handicap Index (VHI-30)" foi aplicado para avaliar a perceção que o próprio doente tem do impacto da sua patologia vocal na qualidade de vida e para determinar em que grau os aspetos funcional, físico e emocional da voz afetam a sua vida (Study 6).

**Resultados**

Um total de 83 doentes do sexo feminino, com idades compreendidas entre os 18 e os 83 anos, com uma média de 52,51 anos (desvio padrão = 14,27) foram considerados elegíveis para participarem neste estudo. Os doentes foram classificados e agrupados em três grupos: disfonia psicogénica (PVD) com 39 doentes (47%), disfonia por tensão muscular primária (MTVD1) com 16 doentes (19%) e disfonia por tensão muscular secundária (MTVD2) com 28 doentes (34%).

A maioria dos doentes era casada, com uma vida profissional ativa (≈ 60%) e como habilitações possuíam o terceiro ciclo (PVD e MTVD1) ou ensino secundário (MTVD2). Verificou-se que cerca de 50% dos doentes eram acompanhados por terapeuta da fala e aproximadamente um quarto (24,1%) tinha apoio psicológico, psiquiátrico ou ambos. Os doentes com disfonias funcionais (FVDs) apresentaram queixas de fadiga vocal e de alterações de intensidade em valores superiores a 87,5% assim como rouquidão, tendo no que se refere a este sintoma, existindo diferenças entre os grupos (PVD = 89,7%, MTVD1 = 68,8% e MTVD2 = 100,0%) (Study 1).

Dos três grupos, o grupo de disfonia por tensão muscular primária (MTVD1) registou uma maior incidência de episódio depressivo major (atual) assim como de perturbação de humor com sintomas psicóticos (atual) e ainda perturbação de pânico (a vida inteira), ansiedade generalizada (atual) e perturbação de pânico com agorafobia (Study 2). Os doentes com MTVD1 apresentaram níveis moderados de depressão e de ansiedade ligeira enquanto que os doentes dos outros dois grupos (PVD e MTVD2) revelaram níveis ligeiros de sintomatologia depressiva e a ansiedade classificados como "normal". No grupo de disfonias psicogénicas (PVD) o risco de suicídio foi significativo ao nível de incidência e de severidade.

A perturbação de personalidade obsessiva-compulsiva teve uma prevalência marcada nos doentes em geral assim como os traços de personalidades dependente e evitante. A personalidade paranoide foi frequente enquanto traço e perturbação da personalidade nos grupos com disfonia psicogénica e por tensão muscular primária (MTVD1) (Study 3). Atendendo à influência da severidade da sintomatologia depressiva e ansiosa, do ponto de vista estatístico foram definidos valores médios para estas duas variáveis com base nos resultados do total da amostra, estando as perturbações de personalidade esquizóide e esquizotípica mais frequentemente associadas ao grupo com disfonia psicogénica (PVD).

Os doentes com disfonias funcionais (FVDs) apresentaram temperamentos depressivo e ansioso em níveis ligeiro ou moderado (Study 4). Nos grupos com disfonia psicogénica (PVD) e com disfonia por tensão muscular secundária (MTVD2) os doentes revelaram uma maior vulnerabilidade para o desenvolvimento de temperamento depressivo, quando os níveis de severidade dos sintomas depressivos e ansiosos foram estatisticamente controlados.

Os valores médios obtidos para F0 estiveram em consonância com os valores de referência para as três vogais sustentadas: o grupo com disfonia por tensão muscular primária (MTVD1) teve médias de F0 superiores à dos restantes grupos enquanto que o grupo com disfonia por tensão muscular secundária (MTVD2) registou sempre valores médios de F0 tendenciamente mais baixos, tendo a diferença entre grupos sido mais marcada na vogal sustentada /u/ (Study 5). Relativamente às médias do primeiro formante (F1) foram detetadas diferenças significativas nas três vogais: /i/ e /u/ (entre os grupos PVD e MTVD1 e entre MTVD1 e MTVD2) e na vogal /a/ (entre os grupos MTVD1 e MTVD2), com o grupo com disfonia por tensão muscular primária (MTVD1) a registar valores médios de F1 sempre mais elevados. Na avaliação da intensidade da tosse, os grupos com disfonias psicogénica (PVD) e por tensão muscular secundária (MTVD2) não apresentaram diferenças.

Na sua maioria, os doentes com disfonias funcionais (FVDs) apresentaram um impacto moderado na qualidade de vida, tendo-se registado médias mais elevadas na subescala física (Study 6). Os grupos apresentaram diferenças na avaliação feita para o impacto da subescala funcional, verificando-se que foram os doentes com disfonia por tensão muscular primária (MTVD1) a referirem a ocorrência de maiores alterações.

**Conclusões**

Os resultados obtidos evidenciaram a relação entre fatores psicológicos e as disfonias funcionais.

Tendo em conta a incidência de patologia afetiva e ansiosa, a severidade dos sintomas depressivos e ansiosos assim como a identificação de traços e de perturbações de personalidade, consideramos que a avaliação psicológica deve ser incluída no estudo de doentes com disfonia funcional.

Este estudo permitiu identificar as características comuns bem como realçar os aspetos específicos a cada um dos três grupos de doentes com disfonias funcionais: disfonias psicogénicas, disfonias por tensão muscular primária e secundária. Para além das

diferenças anatomofuncionais e ao nível da qualidade vocal, foram identificados fatores psicológicos associados aos três grupos de FVDs o que reforça a classificação proposta por Baker et al. (2007), tendo o conjunto destas características implicações clínicas e terapêuticas.

Assim os doentes com disfonias funcionais devem ser avaliados por uma equipa multidisciplinar constituída por otorrinolaringologistas, terapeutas da fala e psicólogo. Este modelo permite determinar se numa primeira fase o tratamento se deve focar nos processos físicos, comportamentais e/ou emocionais envolvidos na produção vocal.

Dentro da abordagem multidisciplinar, cabe ao psicólogo identificar, compreender e manejar os fatores psicológicos associados à sintomatologia vocal dando resposta às necessidades do doente e suporte ao seu sofrimento, assegurando a promoção de uma melhor qualidade de vida.

**Palavras-chave:** Disfonias funcionais, Disfonia psicogénica, Disfonia por tensão muscular primária, Disfonia por tensão muscular secundária, Fatores psicológicos.

# Abstract

## Introduction

Functional voice disorders (FVDs) are common vocal pathologies in the ENT outpatient clinics, with incidence ranging from 10% to 40% of the total patients with voice disorders. They have a female predominance (3:1) and are more frequent between the third and fifth decades of life. FVDs are characterized by apparently normal laryngeal anatomy and physiology while the patients present significant impairment in vocal and life qualities.

The Diagnostic Classification System for Voice Disorders (DCSVD) proposed by Baker et al. in 2007 considers the existence of physiological, behavioral (abuse or misuse) and psychosocial (depression, anxiety and personality disorders) factors in their etiology, and recognizes and values the existence of three different types of FVDs. According to this system, patients with FVDs were classified as: psychogenic (PVD) in the absence of a structural or neurological pathology or as muscle tension voice disorders (MTVDs), a condition characterized by abnormal laryngeal tension. MTVDs can be subdivided in primary muscle tension voice disorders (MTVD1) with the vocal folds presenting an incomplete vocal fold closure, or as secondary muscle tension voice disorders (MTVD2), when the inadequate vocal technique and excessive phonatory effort leads to the development of benign vocal fold lesions (e.g., vocal nodules or polyps).

## Objectives

An exploratory, descriptive, and cross-sectional study with a purposive sampling was developed to analyze the relationship between psychological features and functional voice disorders (FVDs). The three presentations of FVDs were characterized from a psychological perspective. The sociodemographic characteristics were identified, and an evaluation of vocal quality and its impact on quality of life have been performed.

## Methods

The procedure took place in the Department of Ear, Nose, Throat, Voice and Communication Disorders of the Santa Maria Hospital (HSM), and Otolaryngology University Clinic of the Faculty of Medicine of the University of Lisbon,

The recruitment of patients was made by ENT specialists or residents and/or by speech therapists, who accompanied these patients. The videolaryngoscopy using rigid

endoscope or flexible fiberscope was used for the diagnosis and classification of each patient with FVDs.

For the characterization of the subjects, a clinical history was made based on a semi-structured interview designed to collect information related to sociodemographic characteristics, health behaviors, vocal and psychological data (Study 1).

The incidence of affective and anxiety disorders and the severity of depression and anxiety symptoms were analyzed with the Mini International Neuropsychiatric Interview (MINI) and both Hamilton Rating Scales (HAM-D for depression and HARS for anxiety), respectively (Study 2).

The Millon Multiaxial Inventory (MCMI-II) was used to determine the personality profile of patients with FVDs and to identify the personality traits and disorders acting as vulnerability factors for their development (Study 3).

Affective temperaments were assessed with the Temperament Evaluation of Memphis, Pisa, Paris and San Diego - Auto questionnaire (TEMPS-A) (Study 4).

Vocal acoustic evaluation was made using Praat software (Study 5). Means of fundamental frequency (F0) and that of the first formant (F1) for the sustained vowels /i/, /a/ and /u/ were compared within groups and with normative database for Portuguese population (normal and dysphonic).

The Voice Handicap Index (VHI-30) was used to evaluate the self-perception of quality of life and impairment associated to functional, physical and emotional vocal domains (Study 6).

**Results**

A total of 83 females, aged between 18 and 83 and with a mean age of 52.51 years (standard deviation = 14.27), were eligible for inclusion. Patients were clustered into three groups: PVD group with 39 patients (47%), MTVD1 group with 16 patients (19%), and MTVD2 group with 28 patients (34%).

Our sample was constituted by patients with 3$^{rd}$ cycle (PVD and MTVD1) or secondary level (MTVD2) education, with an active professional life (≈ 60%) and most were married (Study 1). Nearly half of the patients were attending speech therapy sessions and 24.1% were receiving mental health treatments (psychology, psychiatric or both). FVDs patients noted as frequent the vocal fatigue and intensity changes in percentages greater than 87.5%. Dysphonia was also reported and variability existed in the comparison of groups (PVD = 89.7%, MTVD1 = 68.8% and MTVD2 = 100.0%).

From the three groups, the group of patients with primary muscle tension voice disorders (MTVD1) had a higher incidence of current major depression and mood with psychotic symptoms as lifetime panic disorder, current generalized anxiety and panic disorder with agoraphobia (Study 2). These patients (MTVD1) also presented worse severity levels of depression (moderate) and anxiety (mild) compared to the patients from the two other groups (PVD and MTVD2) that were evaluated as having mild depression and anxiety at "normal range" of severity. In the group of patients with psychogenic voice disorders (PVD) the suicidal risk was prevalent, either at the level of incidence or severity.

Obsessive-compulsive personality disorder as well as narcisistic, dependent and avoidant traits were prevalent among groups (Study 3). Paranoid as personality trait and as a personality disorder were most frequent among patients with psychogenic (PVD) and primary muscle tension (MTVD1) voice disorders. When depression and anxiety levels were set at a mean value, schizoid and schizotypal personality disorders appeared associated with PVD.

Depressive and anxious temperaments were found at mild or moderate levels among FVDs patients (Study 4). PVD patients revealed vulnerability for depressive temperament when levels of depression and anxiety were statistically controlled.

Our results were in consonance with the referenced data, with MTVD1 presenting high means F0 and MTVD2 low means F0, with the difference being more pronounced in the sustained vowel /u/ (Study 5). For the first formant (F1), statistical differences were found for the three vowels: /i/ and /u/ (PVD and MTVD1, and between MTVD1 and MTVD2 groups) and in the vowel /a/ (MTVD1 and MTVD2 groups), with MTVD1 to reached higher frequency means. In cough intensity, PVD and MTVD2 did not revealed differences between them.

FVDs patients reported a moderate impairment in quality of life with high mean values in the physical subscale (Study 6). The MTVD1 had a significant statistical handicap in the functional subscale compared to the two other groups (PVD and MTVD2).

**Conclusions**

Our work underlines the relationship between psychological features and functional voice disorders.

The incidence of affective and anxiety disorders, the severity of depression and anxiety symptoms and the personality disorders identified in our sample highlights the importance of its assessment in these patients.

The common and the specific characteristics of FVDs groups were identified, revealing that their differences go beyond anatomo-functional presentations and voice quality, a condition that supports the classification system applied. Together these characteristics have clinical and therapeutic implications.

The vocal multidisciplinary assessment should integrate ENT specialists, speech therapists and the psychologist. This evaluation makes it possible to determine whether the treatment should primarily focus on the physical, behavioral and/or emotional processes involved in vocal production.

The psychologist has to identify, understand, and manage the psychological features on which the vocal symptom is based or linked to, ensuring the promotion of a better quality of life.

**Keywords:** Functional voice disorders, Psychogenic voice disorders, Primary muscle tension voice disorders, Secondary muscle tension voice disorders, Psychological features.

# Abbreviations

| | |
|---|---|
| **AHDH** | Attention Deficit Hyperactivity Disorder |
| **ANCOVA** | Analysis of Covariance |
| **ANOVA** | Analysis of Variance |
| **BR** | Base Rate Scores |
| **CAPE-V scale** | Consensus Auditory-Perceptual Evaluation of Voice |
| **cm** | Centimeter |
| **DCSVD** | Diagnostic Classification System for Voice Disorders |
| **dB** | Decibel |
| **DSM** | Diagnostic and Statistical Manual of Mental Disorders |
| **DSM-III** | Diagnostic and Statistical Manual of Mental Disorders, 3rd edition |
| **DSM-IV** | Diagnostic and Statistical Manual of Mental Disorders, 4th edition |
| **DSM-IV-TR** | Diagnostic and Statistical Manual of Mental Disorders, 4th ed., text review |
| **DSM-5** | Diagnostic and Statistical Manual of Mental Disorders, 5th edition |
| **ELS** | European Laryngological Society |
| **ENT Department** | Department of Ear, Nose, Throat, Voice and Communication Disorders |
| **EMG** | Electromyography |
| **F0** | Fundamental Frequency |
| **$F0_C$** | Referenced value for F0 from the study of Carmona (2003) |
| **$F0_G$** | Referenced value for F0 from the study of Gouveia (2004) |
| **$F0_{GA}$** | Referenced value for F0 from the study of Guimarães and Abberton (2005) |
| **F1** | First Formant |
| **$F1_{DM}$** | Referenced value for F1 from the study of Delgado-Martins (1973) |
| **$F1_{EB}$** | Referenced value for F1 from the study of Escudero and Boersma (2009) |
| **F2** | Second Formant |
| **F3** | Third Formant |
| **F4** | Fourth Formant |
| **FML** | Faculty of Medicine of the University of Lisbon |
| **fMRI** | Functional Magnetic Resonance Imaging |
| **FVDs** | Functional Voice Disorders |
| **GRBAS scale** | Grade, Roughness, Breathiness, Asthenia, Strain |
| **HAM-D** | Hamilton Depression Rating Scale |
| **HARS** | Hamilton Anxiety Rating Scale |
| **HNR** | Harmonic-to-noise ratio |
| **HSM** | Santa Maria Hospital |

| | |
|---|---|
| **Hz** | Hertz |
| **ICD-10** | The International Classification of Disease, 10th version |
| **Mac OS** | Macintosh operating system |
| **MCMI-II** | Millon Multiaxial Inventory (II) |
| **MINI** | Mini International Neuropsychiatric Interview |
| **Mt** | Moderate classification |
| **MTD** | Muscle Tension Dysphonia |
| **MTVDs** | Muscle Tension Voice Disorders |
| **MTVD1** | Primary Muscle Tension Voice Disorders |
| **MTVD2** | Secondary Muscle Tension Voice Disorder |
| **No** | No clinical significance |
| **OVDs** | Organic Voice Disorders |
| **PD** | Personality Disorders |
| **PDTS** | PD-Trait specified |
| **Praat** | Software used in speech analysis and synthesis |
| **PT** | Personality Traits |
| **PVD** | Psychogenic Voice Disorders |
| ***SD / SD*s** | Standard Deviation / Standard Deviations |
| **Sl** | Slight classification |
| **SPSS** | Statistical Package for the Social Sciences |
| **SSRI** | Selective Serotonin Reuptake Inhibitors |
| **STAI** | State-Trait Anxiety Inventory |
| **Std** | Standard value |
| **TEMPS-A** | Temperament Evaluation of Memphis, Pisa, Paris and San Diego - Auto questionnaire |
| **TMD** | Temporomandibular dysfunction |
| **VHI-30** | Voice Handicap Index (30 items) |
| **VHI-P** | Voice Handicap Index-Partner |
| **VoiSS** | Voice Symptom Scale |
| **VPQ** | Vocal Performance Questionnaire |
| **V-RQOL** | Voice Related Quality of Life |
| **VTD** | Vocal Tract Discomfort Scale |
| **WHO** | World Health Organization |
| **.wav** | Waveform audio file format |

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# CHAPTER 1

## Foreword

# Foreword

Voice disorders are very common pathologies. Studies indicated that nearly 8% of adults are affected, a value that increases to 30% when it comes to worldwide lifetime prevalence (Byeon, 2015; Misono et al., 2014).

There are several causes associated with voice disorders, and psychological features are receiving progressively more attention.

The association between voice disorders and psychiatric disorders is frequently mentioned by authors as Arnold Aronson, Nelson Roy, Marie Dietrich, and Janet Baker. The majority of the authors argue that psychological features are acting as a cause, maintenance or consequence of functional voice disorders. The co-morbidity makes the participation of the psychologist essential in its assessment. As the incidence of functional voice disorders ranges from 10 to 40% of the total patients in the ENT outpatient clinics (Baker, Oates, Leeson, Woodford, & Bond, 2014; Sarriegui, Madorrán, Torices, & Samitier, 1996), the collaboration of the psychologists is insufficient. The psychologist should be included in the voice team, sharing information and discussing the treatment planning.

The increasing experience acquired by the Department of Otolaryngology, Santa Maria Hospital (HSM), Lisbon, Portugal in communication disorders from hearing deficits and voice disturbances from childhood to old age, led to the Department being officially named as the Department of Ear, Nose, Throat, Voice and Communication Disorders (ENT Department) in 2006.

The World Voice Day established in 2003 contributed to the awareness of voice and voice disorders. Its annual celebrations with free screenings open to the general population, scientific events for voice professionals, “The project World Voice Day at School” with the participation of students and teachers and the annual delivery of a “Voice Award” to a well-known public figure, initiatives in which the ENT Department has always been involved giving a new dynamic and notoriety to the voice.

The voice gained visibility, leading to a greater number of patients being more attentive to their voice and voice quality and consequently seeking for diagnosis and

therapeutic guidelines. This permitted the diagnosis of different voice disorders at earlier stages.

As a member of the Department of Ear, Nose, Throat, Voice and Communication Disorders, I worked directly with ENT specialists and speech therapists. The multidisciplinary vocal assessment team also works in collaboration with other medical specialties as allergology, pneumology, gastroenterology, endocrinology, psychiatry, neurology, stomatology and maxillo-facial surgery, oncology as well as with other non-medical but clinical specialties like audiology, physiatry, nutrition, and social work.

The multidisciplinary teamwork was very challenging and resulted in a fruitful experience for all parties involved. Firstly, the exchange of information between the different areas of knowledge allowed to deepen the concepts of voice and voice disorders, with each team element becoming more informed and sensitized to the areas of expertise of the other members. Secondly, the sharing of information necessary to patient care and for the monitoring of the evolution of symptoms/illness contributed to improve the therapeutic strategies.

With the experience acquired, the discussion of cases that raised emotional and/or relational issues progressively increased. ENT specialists could now count on the psychological evaluation of patients with functional voice disorders as well as patients with signs of mental illness or resistance to treatment. Speech therapists often reported that some patients were looking for another intervention setting to share more intimate issues of their lives that reflected various emotional difficulties.

The recognition of the role of the psychologist led to an increase in requests for psychological evaluation and intervention made by ENT specialists and speech therapists.

At the same time, the collaboration provided by the Psychiatric Department of the Santa Maria Hospital (HSM) stands out. It led to a considerable number of patients being assessed in mental and physical aspects of their psychological problems, getting psychotropic medication, psychotherapy or other medical treatments.

The hypothesis of the present study “Psychopathological Features of Functional Voice Disorders” are the result of the daily experience acquired working with patients with functional voice disorders.

# CHAPTER 2

## Introduction

*Voice*
*Voice Disorders*
*Functional Voice Disorders*
*Psychiatric Disorders and Functional Voice Disorders*
*Functional Voice Disorders and Quality of Life*

# 1. Voice

When addressing "Psychological Features of Functional Voice Disorders", we were aware of the extension of the theme resulting from the interrelationship between different areas of knowledge that require a multidisciplinary approach.

The ENT specialists manage signs and symptoms, the speech therapists implement vocal rehabilitation techniques and the psychologist must identify the psychological features associated with the different presentations of functional voice disorders (FVDs).

## 1.1 - Voice Definition

The primary function of the voice is communication (Rammage, Nichol, & Morrison, 1987), a basic competence that is present since birth and that develops throughout life.

Behlau, Madazio and Oliveira (2015) enhanced voice as an exclusive human sound while Clark and Murray (2000) pointed out the voice as a way to interact with others serving many capacities.

In the social network the listener's attitude is influenced 55% by the emotional expressions (e.g., gestures, posture and facial expressions), 38% by the vocal characteristics and only 7% by the speech content (Andrews, 1995; Seifert & Kollbrunner, 2005).

There are distinctive features in a voice, namely patterns of pitch, intensity and intonation (Baker, 2016) that may indicate some stable characteristics of the speaker such as gender, age, personality characteristics, sociocultural background, intelligence and education (Deary, Wilson, Carding, & MaCkenzie, 2003), as well as physical and psychological circumstances (Amir & Levin-Yundof, 2013; Baker, 2016; Rodríguez-Parra, Adrián, & Casado, 2007). Even information on the reproductive value, like body configuration and sexual behavior, can be inferred through the voice (Hughes & Gallup, 2008). This is why in 1990 Aronson assigned to the voice the symbolic meaning of “personality mirror”.

In fact, in addition to facial and body expressions, the voice allows to identify the emotional state of the individual (Scherer, 1995 as cited in Behlau & Gasparini, 2008). Through the voice, emotions like anger, sadness, fear, surprise, joy, shame, humiliation,

affection and humour are revealed (Mathieson, 2001). This conveys the conceptualization of voice made by Moses in 1954 as an "emotional barometer".

All these characteristics strengthen the voice's role in relationships and in communication itself, while projecting the identity and revealing the emotional state of the speaker (Kreiman & Gerratt, 2003; Teixeira, Nunes, Coimbra, & Moutinho, 2008).

As an instrument, voice can make a difference when a speaker enhances signs and meanings. From an individual perspective, the voice allows the sharing of thoughts and reveals who we are and what we are feeling.

## 1.2 - Voice Production

To understand the vocal production and to characterize functional voice disorders it is fundamental to make the anatomical and physiological description of the voice.

The respiratory system comprises: the upper respiratory tract constistuted by the larynx, oropharynx, oral cavity and nasal cavities; and the lower respiratory tract with the trachea, bronchi and lungs. The two respiratory tracts function interdependently, which means that changes in one system will immediately affect the functioning of the other.

The larynx is located in the anterior portion of the neck above the trachea, between the 3$^{rd}$ and 6$^{th}$ cervical vertebrae, extending from the base of the tongue to the trachea. This means that the larynx is continuous to the trachea below and the pharynx above. In women and in children the larynx is positioned at a higher level and in males the size increases after puberty by over two times that of the females. The differences between genders remain after this important period of growth and development, with the length of the vocal fold in adults with an approximate size of 17 to 21 mm in males and of 11 to 15 mm in females (Sapienza & Ruddy, 2009) which results in less tissue mass to dampen a larger amount of vibratory force (Roy, Merrill, Gray, & Smith, 2005). In women the vocal folds are affected by variations in the levels of sex hormone. Lã, Sundberg, Howard, Sá-Couto, and Freitas (2012) affirmed that changes in vocal production depend on the hormonal shifts that rise during menstrual cycle and also in pregnancy.

The larynx is a complex and multi-structured organ (Sapienza & Ruddy, 2009) that serves different functions essential to our existence (Colton, Casper, & Leonard, 2006; Feierabend & Malik, 2009; Simonyan, 2014): control of the lower respiratory tract, preservation and protection of the lower airway from being accessed by foreign substances

(e.g., food particles and secretions), swallowing and deglutition, the fixation of the thorax for effort closure during throat clearing, coughing, vomiting or sneezing and vocalization.

The larynx acts as a sphincter due to its protective functionality. Sapienza and Ruddy (2009) explained that this behavior is involuntary as it happens during a reflexive activity (e.g., cough) while the phonatory function has a voluntary beginning.

Voice is a response to a command from the cerebral cortex to vocalize (Omori, 2011) that requires: a source of energy that goes upwards from the lungs, a vibratory element (two vocal folds), and a system of amplification and resonance constituted by all the structures located above the vocal folds. Imamura and Tsuji (2011) explained that during voice production the vocal folds convert the aerodynamic energy generated by the expiratory flow into acoustic energy.

The framework of the larynx is formed by nine cartilages (three unpaired: cricoid, thyroid, epiglottis; and three paired: arytenoids, corniculates, cuneiforms) that are bound by ligaments, membranes and muscles.

Laryngeal muscles are divided into intrinsic and extrinsic laryngeal muscles. Intrinsic laryngeal muscles ensure the movement of the laryngeal cartilages being responsible for the tension of vocal ligaments and also for the size and shape of the glottis. This group of laryngeal muscles coordinates the adduction and abduction of the vocal folds and its vibratory characteristics.

Extrinsic laryngeal muscles control the laryngeal movements such as the elevation and lowering of the larynx. These muscles guarantee a stable position of the larynx.

The importance of the action of the laryngeal muscles is increasingly valued and is the basis for the classification of various types of voice disorders.

The larynx plays the role of voice generator (Jassar, England, & Stafford, 1999; Steczko, Szaleniec, Streck, & Jurczack, 2014) with pulses being the result of successive openings and closures of the vocal folds (Belin, 2006).

The two vocal folds, white in appearance, are formed by different layers of elastic fibers coated by epithelium. The space between the vocal folds is called glottis.

When the two vocal folds do not approach each other in the midline, emerges a gap between them compromising the vocal quality due to a high mechanical stress at this midpoint (Van Houtte, Van Lierde, D'Haeseleer, & Clayes, 2010). This space is called glottal gap (chink), while the voice acquires a typical characteristic called breathiness. The incomplete vocal fold closure may arise without visible lesions in the vocal folds, but may

also exist in the presence of vocal nodules, polyps or cysts diagnosed by videoendoscopy. These facts are important for understanding the classification of functional voice disorders.

The movement of the vocal folds and the vibration of the mucosal are key elements in voice production and are controlled by the biomechanical properties of the vocal folds, the magnitude of the air pressure beneath them and by the neural control (Kumar, Bhat, & Mukhi, 2011).

All anatomical structures located below and above the vocal folds influence the vocal quality (e.g., pulmonary pathology may decrease the ability of air to flow and nasal obstruction can alter resonance). The articulation structures such as the soft palate, tongue, teeth and lips should also be noted in the evaluation of voice production.

Throughout life, the larynx and all parts of the vocal tract undergo age-related changes as the size of the vocal folds, the dimensions of the vocal tract structures and small changes also occur in the histology of the vocal folds.

Presbyphonia is the designation used to describe the voice of an older person that presents a marked deterioration in the functional and acoustic properties of the voice in the absence of any other pathology. This is a normal consequence of aging that interferes with communication and with quality of life (Fernández, Cobeta, & Vaca, 2014).

The aging process associated with physical and physiological changes leads to variations in vocal acoustic characteristics (Mathieson, 2001). In the vocal tract will occur changes in the larynx, respiratory system, resonance cavities, and in the articulatory organs. Specifically in the larynx, there is a decrease in the vibratory amplitude and an asymmetry in the mobility of vocal folds associated to the deterioration of the ligaments and the loss of lubrication due to mucosal atrophy (Fernández et al., 2014). These changes lead to the development of compensatory vocal behaviors like an increased control over phonation as an attempt to ensure the former usual pitch (Mathieson, 2001).

The vocal sound depends on the physical structure and on the functionality of the vocal tract. That is why the complexity of the larynx and the vocal tract assures distinctive features to each voice.

# 2. Vocal Quality

In the assessment of voice and voice disorders, vocal quality has been progressively included in the evaluation protocols pointing to the impairment in vocal production.

## 2.1 - Vocal Characteristics

Voice does not correspond solely to the sound produced by the larynx, it is the acoustic result of the entire vocal tract (Mathieson, 2001).

Linguistics focus on the particularities of speech with multiple and different purposes. The production and perception of speech is intrinsically linked to phonetics as well as to vocal quality.

Phonetics aims to study the concrete sounds of speech, from its production to its recognition being divided into three areas: articulatory, perceptual and acoustic. The articulatory examines the movements of the articulatory organs and their configurations; the perceptual focuses on how speech sound is captured and recognized by the auditory system; and the acoustic analysis the properties of the sound (Mateus, Falé, & Freitas, 2005).

Voice quality results from the interaction between the acoustic voice stimulus and the characteristics of the listener (Sofranko & Proseck, 2012), since it comprises both perception and production characteristics (Gomes, Carneiro, & Dresch, 2016).

The judgment of a normal or abnormal voice depends on the listener, the speaker's characteristics as well as on specific features of the voice produced (Colton et al., 2006).

For Mathieson (2001), a normal voice requires: clarity, audibility, stability, flexibility of pitch, loudness and quality, and to be appropriate to others of similar age, gender, and cultural group. For Šepić, Pankas Tićac and Starčevic (2011) a voice with a solid resonance, appropriate level and with vocal diversity has good quality.

The assessment of vocal quality begins with subjective perceptual measures. Two types of analysis were developed: the auditory-perceptual and the acoustic analysis.

The voice material used in the vocal acoustic analysis are the continuous speech, also named running speech, and the sustained vowels.

Continuous speech is affected by several factors such as voice onsets and offsets, interruptions, voiceless phonemes, phonetic context, and prosodic modulations in

fundamental frequency and in vocal intensity (Maryn & Roy, 2012; Maryn & Weenink, 2015). In continuous speech, it may be found signs of abnormal vocal quality associated to different voice disorders by analyzing the pitch and loudness variations (Zhang & Jiang, 2008).

Sustained vowels remain widely used as they are more controlled and reasonably stable (Kent & Read, 1992; Maryn & Roy, 2012). Researchers usually recommend the examination of a stable part of an isolated vowel or a consonant (Moers et al., 2012). Sustained vowels are articulated with an open vocal tract shaped by the position of articulators and produced under controlled fundamental frequency and intensity (Franca, 2002).

In acoustic analysis, the preference for sustained vowels over continuous speech is justified, as they are relatively time-invariant vocal phonation. In fact, sustained vowels are not affected by breath (Vasilakis & Stylianou, 2009), speech rate, vocal pauses and phonetic context and they do not contain non-voiced phonemes, rapid voice onsets and offsets, prosodic fundamental frequency and/or amplitude fluctuations as continuous speech does (Maryn, Roy, Bodt, Cauwenberge, & Corthals, 2009).

The choice of sustained vowels or continuous speech depends on the characteristics of the acoustic material to be analyzed.

Stable vowel sounds represent the ideal acoustic material for voice quality assessment since they prevent the interactions between the larynx and the vocal tract (Franca, 2002). Yet, they do not represent real-life phonation or day-to-day speech (Gillespie, Dastolfo, Magid, & Gartner-Schmidt, 2014; Moon at al., 2012; Zhang & Jiang, 2008).

In addition, the existence of normative values in a given language for vowel sound is important to establish what is considered as a normal voice in both clinical and research settings (Finger, Cielo, & Scwarz, 2009).

**Auditory-perceptual analysis**

The auditory-perceptual evaluation of voice is one of the most traditional approaches in the analysis of voice quality (Nemr, Simões-Zenari, Cordeiro, Tsuji, & Ogawa, 2012). It depends on the expertise and training level of the judger (Nemr et al., 2012) and on the characteristics of the evaluator (Pontes, Vieira, & Gonçalves, 2002). These lead to some limitations as the low intra and inter judges' consistency, and the absence of objective measures.

The most common perceptual-auditory procedures used to evaluate the levels of vocal severity are the Grade, Roughness, Breathiness, Asthenia, Strain (GRBAS scale) proposed by the Committee for Tests of Phonatory Functions of the Japan Society of Logopedics and Phoniatrics in 1969, and the Consensus Auditory-Perceptual Evaluation of Voice (CAPE-V scale) developed by the American Speech-Language-Hearing Association in 2002 (Ziwei, Zheng, & Pin, 2012). Compared to the GRBAS, the CAPE-V scale provides information on the tasks, procedures and scaling routine (Kempster, Gerratt, Abbott, Barkmeier-Kraemer, & Hillman, 2009), ensuring a greater sensitivity in detecting small differences in the voice (Nemr et al., 2012).

Although there is no ideal or a single valid method in the judgment of auditory-perceptual features of voice quality (Kempster et al., 2009), together the two scales cover all types of voice disorders regardless their etiology (Nemr et al., 2012).

**Vocal acoustic evaluation**

The vocal acoustic evaluation is a non-invasive objective assessment measure for different voice realities. It quantifies the vocal characteristics based on mathematical and physical values (Steczko et al., 2014), reflecting the acoustic voice signal captured by a digital recording system (Maryn, Roy, Bodt, Cauwenberge, & Corthals, 2009).

The use of acoustic analysis dates back to the 90s, a time where great technological and scientific advances occurred. These technological improvements enable an easy and secure collection and also the storage of data that were previously restricted to voice laboratories located in universities and hospitals (Behlau et al., 2015). Moreover, they allowed the development of several voice assessment software that are time-efficient and user-friendly (Eadie & Doyle, 2005). The best-known are the Praat developed by Boersma and Weenink (Boersma & Heuven, 2001), the Multi-Dimensional Voice Program (MDVP, Kay Elemetrics), the Doctor Speech Sciences (Tiger Elemetrics) and the CSL 4300 (Kay Elemetrics) (Finger et al., 2009).

The quantification of the voice signals through acoustic analysis software (Finger et al., 2009) provides visual and numeric information in the vocal analysis (Petrović-Lazić, Kosanović, & Babac, 2009). One of the main tools of this analysis is the spectrograph by allowing the translation of the sound pattern into visual graphics, reflecting the fundamental frequency, the harmonics, and the high intensity areas of speech sound (Pontes et al., 2002).

Since normal voice ranges widely, information about patterns of normality is essential for the interpretation made by the vocal or forensic professionals.

**Vocal acoustic parameters**

Many vocal acoustic parameters have been developed to assure accurate acoustic diagnoses (Moon et al., 2012).

In voice laboratories the most common measures are the fundamental frequency, the vocal intensity, and the perturbation parameters (noise measures) (Finger et al., 2009). Fundamental frequency proved to be a robust parameter but the same does not happen with noise measures. For Franca (2002) these parameters are clinically useful as objective indicators of rate variation in vocal fold vibration leading to the identification and characterization of laryngeal pathology.

**Fundamental frequency**

Fundamental frequency (F0) is the most uniform acoustic parameter being an important measure for phonetics in general and for forensic phonetics in particular due to its robustness in voice recognition work (Gomes et al., 2016).

Teixeira, Oliveira and Lopes (2013) characterized fundamental frequency as the number of cycles of opening and closing of the glottis that causes the vocal folds to produce a sound wave which repeats itself during a defined period of time that is measured in hertz (Hz). It reflects the human voice pitch (Brockmann, Storck, Carding, & Drinnan, 2008). If on the one hand fundamental frequency is the acoustic correlate of the vocal fold vibration, on the other pitch is its perceptual correlate (Gomes et al., 2016).

Fundamental frequency depends on age, gender, language, stress, and upon speech tasks such as sustained vowels, reading, conversation or singing (Guimarães & Abberton, 2005). It is also influenced by the individual's emotional state. In fact, in face of emotions with high arousal such as joy and anger the fundamental frequency reaches a higher value, while in the presence of emotions with less arousal like sadness the fundamental frequency decreases substantially (Waaramaa, Laukkanen, Alku, & Väyrynen, 2008).

Dehqan, Ansari and Bakhtiar (2010) claimed that this acoustic parameter plays an important role in the functional and anatomical assessment of the larynx as it is a result of the interaction among vocal fold length, mass, and tension during speech production.

Besides fundamental frequency, voice perturbation parameters, vocal intensity and formants are the vocal parameters more routinely used.

**Voice perturbation parameters**

Voice perturbation parameters characterize the vocal quality and provide additional information to the laryngeal videoendoscopy by quantifying the regularity and the stability of vocal fold vibration (Brockmann-Bausser & Drinnan, 2011). They are often used in describing vocal characteristics (Teixeira et al., 2013) both in the clinic and in scientific settings.

The first perturbation parameters introduced were the jitter and the shimmer (Zhang & Jian, 2008) and later the harmonic-to-noise ratio (HNR) (Moers et al., 2012). They are useful as the increase of irregularity or noise is associated to changes in the vocal fold mass or tension (Brockmann-Bauser & Drinnan, 2011).

**Vocal intensity**

Vocal intensity is directly related with the subglotic pressure, the resistance of the vocal folds to such pressure and with the configuration of the vocal tract (Guimarães, 2007). It corresponds to the sound pressure level measured in decibels (dB) reflected in the sharing of emotions (Waaramaa et al., 2008). The intensity of the sound waves is indicated in the spectrogram by the darkening of the frequency bands (Pontes et al., 2002). The intensity varies with the increase of tension in laryngeal tonus that generates higher glottic resistance and consequently more intensity (Wertzner, Schreiber, & Amaro, 2005).

**Formants**

Formants have the potential to reflect the individual's vocal characteristics and identity (Macari, Karam, Tabri, & Hamdan, 2015). They depend on the size and shape of the vocal tract but also on age and gender (Valença et al., 2016).

Vowel sounds can be said in a variety of notes (voice pitches), however they can be distinguished from one another due to their overtones or formants (Ladefoged & Johnson, 2011). This means that each vowel is associated with a distinctive formant pattern that allows its recognition (Kent, 1993). In fact, according to Summers, Bailey and Roberts (2012) formants carry the most important information about speech-sound identity.

Once the filter function of the vocal tract is defined by the ressonant cavities (Summers et al., 2012), from the theoretical point of view there are an infinite number of

formants, but in reality no more than 3 to 5 are considered in the voice analysis (Kent, 1993).

Each formant is identified by a number (Mathieson, 2001), has a center of frequency (formant frequency) and a bandwidth. The first formant (F1) depends on tongue height, jaw opening and laryngeal constriction; the second formant (F2) varies more with the position of the tongue (Kent, 1993) and with the lengthening of the pharynx (Bele, 2006), providing information that allows the identification of the speaker (Mathieson, 2001); the third formant (F3) is associated with the size of the oral cavity; the fourth formant (F4) depends either on the vocal tract length, as the other formants, or on the vocal tract dimension (Bele, 2006; Guimarães, 2007). From all the formants, F1 and F2 are recognized as the most important for the vowel perception (Kiefte, Enright, & Marshall, 2010).

The technological advances in voice clinics and in voice laboratories contributed to great accuracy in diagnosis and consequently in better treatment selection (Carding, 2003). Baker (2016) defended that vocal analysis should be carried out as small changes in pitch, in voice quality, or intonation may result from psychological stress response or as a sign of physical and/or mental health changes.

## 2.2 - Voice Assessment Protocol

In 2009, the American Academy of Otolaryngology - Head and Neck Surgery, developed a Clinical Practice Guideline for Hoarseness (dysphonia), which included a detailed medical history, the identification of a voice symptom by the patient or clinician and the visualization of the larynx (Schwartz, Rosenfeld, Dailey, & Cohen, 2009).

### Clinical history

The anamnesis contains information on the voice disorder, related health issues, personal history, occupation, hobbies and family background, and data on the onset and on the course of the vocal symptom.

The patient should report all elements regarding the improvement or worsening of his/her vocal symptom, including its impact on daily life namely in social and/or professional settings. This specific data should be analyzed in association with the subjective meaning of the voice disorder assigned by the patient himself/herself.

Colton et al. (2006) emphasized that in the presence of a vocal symptoms it is crucial to seek a balance between active, attentive and sensitive listening. It is important to listen to the vocal symptom itself and to the vocal fluctuations that can emerge during the interview. Note that changes in emotional expression and in posture may also occur and need to be analyzed, interpreted and their meaning returned to the patient (Morrison & Rammage, 1994). Franco et al. (2014) argued that "posture has been understood as an important component of voice quality, especially from deeper ongoing studies of functional dysphonia". The same authors defended that postural measures may be useful in vocal assessment protocols and also for the therapeutic strategies for the treatment.

The clinical history, jointly built up by the ENT specialist, the speech therapist and the psychologist and/or the psychiatrist, is the most effective means to obtain medical, vocal behavioral and psychological information related to the vocal pathology.

**Laryngeal examination**

Technological advances in laryngeal examination and in the evaluation of the vocal function enabled the ENT specialists to have a vast set of non-invasive and anesthesia-free methods for visualizing the larynx. Mirror laryngoscopy has been the routine technique for more than a century, but nowadays the laryngeal examination benefits from new imaging techniques as the rigid endoscopy, the flexible nasolaryngoscopy, and the stroboscopy. The quality of the captured images depends on the examiner's experience and the techonology used.

In the laryngoscopic exam, the ENT specialist observes the anatomy and movement of the vocal folds and the supralaryngeal structures. The ENT specialist should not focus only on the abnormality of the voice quality but also on the non-verbal laryngeal sounds like cough and laugh (Scott, Deary, Mackenzie, & Wilson, 1997). Besides the laryngeal examination, the evaluation should include the external examination and palpation of laryngeal extrinsic muscles, neck, mandible, and the observation of the facial gestures during speech. All these structures and muscles may be compromised in muscle tension voice disorders.

Guimarães (2007) pointed out that in the clinical context, voice evaluation should involve information gathered through interviews, assessment of laryngeal physiology (e.g., laryngoscopy), perceptual evaluation, functional examination, acoustic evaluation and self-assessment of the psychosocial impact of a disturbed voice.

**Psychological evaluation**

Standard psychological instruments make it possible to identify and in some cases to quantify the current psychological features and the impact that voice disorder has on the patient's life.

A battery of psychological test is defined according to the individual characteristics, evaluation goals and by the existence of adapted and validated tests for the target population. This requires an extended knowledge of the instruments, practice in their application and experience in interpreting the results.

During the psychological evaluation, motivations, primary and secondary gains, and prognostic factors associated with the vocal symptoms should be assessed and valued. In fact, there are several negative prognostic factors. Butcher, Elias and Cavali (2007) identified: detachment of distress towards voice symptoms, dysphonia or aphonia with long time duration, persistent symptoms with no period of near or even normal voice, previous unsuccessful treatments, resistance upon psychological influence, the presence of primary and/or secondary gains, lack of confidence in the therapist and poor motivation for change.

Interview techniques such as clarification, interpretation and careful confrontation contribute to overcome these difficulties and constraints and to promote the treatment compliance.

# 3. Voice Disorders

In order to define voice disorders it is extremely important to perceive the evolution of its concept as well as the classification of vocal pathologies. The existence of different classification systems compromises the understanding and treatment of these patients.

## 3.1 - Historical Perspective

Historically, the classical argument for the classification of voice disorders corresponded to the dichotomy between organic and non-organic. For some authors, non-organic and functional were synonym designations but for others it did not. This led to a lack of consensus in the classification of voice disorders regarding the distinction between "functional" and "non-organic".

Organic voice disorders (OVDs) were defined as a result of alterations in the larynx as well as acute or chronic inflammations of the vocal folds, vocal trauma, and/or by the presence of benign or malignant tumors. In non-organic voice disorders there were no evidence of organic (anatomical and/or physiological) laryngeal disorder and/or neurological pathologies.

In 1990, Aronson defended that when the voice is abnormal despite normal laryngeal anatomy and physiology, a diagnosis of functional dysphonia should be made (Willinger, Völkl-Kernonstock, & Aschauer, 2005). Other authors defend the use of the functional term to define a voice disorder in which a "diverse group of clinical profiles that collectively imply a disturbance of vocal function due to usual misuse of voluntary muscles in the oral and pharyngolaryngeal muscle complex, in the breathing system, and in more general postural muscle groups" (Morrison & Rammage, 1994).

Butcher (1993, as cited in Baker, 2002) agreed with Aronson by stating "a functional voice disorder is due more to muscle misuse or tension or to psychogenic etiology". Aronson added, "it is more a question of degree to which the underlying emotional stresses contribute to the onset and perpetuation of the excessive laryngeal tension" (Baker, 2002).

Several terms have been used to define functional voice disorders like "hysterical aphonia or dysphonia", phononeurosis", "phonasthenia", medically unexplained", "non-

organic", "psychosomatic aphonia", "hysterical conversion reaction", "psychogenic", "hyperfuncional", and "muscle misuse or muscle tension disorders" (Baker, 2002, 2008).

All these labels have been used as synonyms of functional, converging to the idea of vocal behavior (abuse or misuse) to be found at the center of the anatomically and physiologically intact vocal apparatus. In the presence of inappropiate or abnormal muscle tension associated to poor vocal technique, compensatory maneuvres may be developed in the larynx (Behlau et al, 2015; Koufman & Blalock, 1991; Koufman & Isaacson, 1991).

It should also be noted that most of the terminologies that are used to define functional voice disorders pointed to the association between psychological features and functional voice disorders.

Scott et al. (1997) defended that high neuroticism, anxiety, depression and alexithymia are associated with functional voice disorders. However these findings do not explain why the larynx is the target organ of this distress. Voice is sensitive to stress and to emotional expression, which means that a functional voice disorder may arise as a response to negative emotions resulting from stressful life events (Baker, 2016).

According to the fourth and revised edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM) (4th ed., text rev.; DSM-IV-TR; American Psychiatric Association, 2000) functional voice disorders are included in the diagnostic category of somatoform disorders, conversion disorder with motor symptom or deficit (code 300.11) (Willinger et al., 2005). The diagnosis of somatoform disorders requires the presence of a physical symptom that suggests a medical condition which is not fully explained by that general medical condition, by another mental disorder, or even by the direct effects of a substance use (4th ed., text rev.; DSM-IV-TR; American Psychiatric Association, 2000; Willinger et al. 2005). This leads patients with somatoform disorders to present more often their physical complaints in a general medical setting than in the mental health context.

In the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (5th ed.; DSM-5; American Psychiatric Association, 2013) it is clear that the identification of psychological factors associated with conversion reaction symptoms is no longer required (Baker, 2016).

The International Classification of Disease (ICD-10; World Health Organization, 1992) considers somatoform disorders as mental diseases characterized by repeated somatic symptoms in the absence of an organic disease, or a somatic pathology which is insufficient to explain the severity of the symptoms as well as the discomfort and concern of the patient (Carvajal, Sanfuentes, Eva, Jara, & Stepke, 1992).

## 3.2 - Classification of Voice Disorders

Voice Disorders are multidimensional and their classification contributes to characterize the etiology, the anatomic and the functional presentations. The establishment of a classification system has implications for the diagnosis and treatment.

It is frequent to come across a classification that points solely to a single causal factor, not valuing the existence of other factors. This is true when it comes to voice disorders where many causative factors are often associated. Causal factors such as technical and postural misusage, muscular hypertonicity linked to psychological arousal, neuromuscular abnormalities such as dystonia or tremor and organic processes including vocal nodules, polyps, cysts or tumors (Morrison, 1997) can not be ignored or devalued.

Efforts were made to establish a classification with worldwide acceptance. Baker (2002) pointed out that some authors had proposed a single classification system but the proposals ultimately reflected resemblances of different underlying theoretical models.

For Smits, Marres and Jong (2012) a diagnostic classification has to be unifying and flexible. The same authors argued that with a classification system for voice disorders it will be possible to group the voice disorders with common primary causes and then to identify the individual factors associated with the etiology of each voice disorder.

There are some classifications of voice disorders that consider the type of onset, the precipitating and maintenance factors and also the vocal characteristics. These classifications were developed to provide helpful clues for the differential diagnosis between functional, organic, and neurological voice disorders (Baker, 2016).

The Classification Manual of Voice Disorders of the American Speech-Language-Hearing Association, edited by K. Verdolini, C. Rosen and R. Branski in 2006, renews the effort to present and clarify all the conditions that can affect the vocal quality. This classification also stresses the need for an accurate differentiation of psychogenic conditions and their relationships with voice for proper diagnosis, treatment and prognosis of the vocal conditions (Verdolini, Rosen, & Branski, 2006). Thus, psychological assessment is considered essential as some voice disorders arise partially or wholly as a manifestation of a psychiatric disease. The same authors expressed doubts concerning their classification by pointing out “it is anticipated that further entries will be added in later editions, and some of the current entries may be deleted” (Verdolini et al., 2006).

In 2007, J. Baker, D. Ben-Tovim, A. Butcher, A. Esterman, and K. McLaughlin presented the Diagnostic Classification System for Voice Disorders (DCSVD). It corresponds to a “syndromal” classification system that results from clinical and

laryngoscopic examinations that integrates terminologies, definitions and symptoms. The authors defend that this classification is a "comprehensive conceptual framework for diagnosis and reflects the inter-relationship between the physiological, the behavioral and the psychosocial factors rather than one isolated set of parameters presumed to be etiologically significant" (Baker, Ben-Tovim, Butcher, Esterman, & McLaughlin, 2007).

In this classification, voice disorders were classified as organic or as functional voice disorders.

Organic voice disorders (OVDs) refers to aphonia or dysphonia due to mass lesions, structural changes in the vocal folds, or interruption of neurological innervations (Baker et al., 2007). The onset of the vocal symptoms can be sudden or gradual and treatment requires medical or surgical intervention often in articulation with speech therapy. The psychosocial factors may arise as a result of the voice disorder rather than as a predisposing element. Organic voice disorders have been divided into five categories: mass lesion or tissue changes; laryngeal trauma; neurological lower motor neuron; neurological; and neurological upper motor neurons with dysarthrophonia. In organic voice disorders the vocal symptoms are consistent with the neurologic lesion and/or with a lesion on the vocal folds (Baker, 2016).

In functional voice disorders (FVDs), if an organic pathology arises it will not be enought to account for the nature and for the severity of the voice disorder (Baker, 2016). Therefore, the functional term broadly refers to a non-organic group (Baker et al., 2007). These situations arise in response to negative emotions following stressful life events and difficulties with predisposing personality traits that may influence the way of coping with certain difficulties (Baker, 2008).

Functional voice disorders are categorized into two subgroups: psychogenic voice disorders (PVD) and muscle tension voice disorders (MTVDs).

A psychogenic voice disorder (PVD) is a result of a disturbed psychological process in the absence of structural or neurological pathology sufficient to count for dysphonia.

Muscle tension voice disorders (MTVDs) are characterized by excessive, atypical or abnormal laryngeal tension, reflecting disturbed psychological processes that can lead to chronic patterns of misuse and abuse of the laryngeal musculature. This means that the voice shows gradual changes as a result of psychiatric disorders. With the course of time, those inadequate vocal behaviors can lead to the development of secondary changes in the vocal folds.

The association between psychological elements and vocal behavior patterns led the authors to subdivide muscle tension voice disorders (MTVDs) into two types: primary (type 1) where the anatomy of the vocal folds is normal (without primary or secondary pathology) but presenting a gap between them (incomplete vocal fold closure), the muscle tension can be palpable (extrinsic laryngeal musculature), and secondary (type 2) with inefficient phonatory pattern that leads to the development of benign vocal fold lesions as vocal nodules and polyps.

The Diagnostic Classification System for Voice Disorders proposed by Baker et al. (2007) provides a diagnostic tool that clarifies the terminologies that at the time were not explicit in the literature. This classification also enhances the relationships between psychological and vocal behavior elements. These conditions led to the adoption of this classification system in the present study.

# 4. Functional Voice Disorders

Functional Voice Disorders (FVDs) affect individuals of all ages (Baker, 2016), has a female predominance (3:1), and are more frequent between the third and fifth decades of life (Morente & Izquierdo, 2009).

The high prevalence in women, according to Butcher (1995, as cited in Seifert & Kollbrunner, 2006), is due to the fact that female patients have some common characteristics such as above average responsibilities, and difficulties in interpersonal relationships, in assertiveness and in emotional expression. These patients experience negative feelings or points of views that induce anxiety and musculoskeletal tension which are responsible for the inhibition of vocal production.

Regardless of the role of psychological factors in the etiopathogenesis of functional voice disorders, it is assumed that there are primary and/or secondary gains.

Primary gains reflect the decrease in anxiety and tension and avoidance of conflict due to the impairment on vocal quality (Rammage et al., 1987). This means that the vocal symptom is accepted by the patient as being less painful than the stressful life event or the interpersonal conflict that was in its origin. Therefore, the vocal symptom will play a protective role by preventing the patient from confronting with his/her own emotional difficulties (Sudhir, Chandra, Shivashankar, & Yamini, 2009).

Secondary gains are the benefits that the patient gets from the outside including compensations of various natures. The focus on the vocal symptom will strengthen its maintenance (Baker, 2002; White, Deary, & Wilson, 1997) and simultaneously there is a decrease in the attention that the patient gives to the feelings that he/she considers unacceptable (Freidl, Friedrich, Egger, & Fitzek, 1993; House & Andrews, 1987).

All these factors interact, leading to the maintainance and/or perpetuation of the vocal symptoms.

Functional voice disorders are not defined by a single vocal pattern (Behlau et al., 2015). There are changes in vocal quality as weak voice, strained sound, hoarseness, whispering phonation, breathy vocal and lack of vocal efficiency (Behlau et al., 2015; Willinger et al., 2005). Elhendi, Pérez, Rodríguez and Caballero (2005) also pointed out for changes in pitch and for increased thoracic effort during conversation. Strained patterns of phonation associated with excessive laryngeal musculoskeletal activity but also with tension that arises in response to high vocal demands are linked to the onset of functional

voice disorders (Baker, 2016). The patient may also refer to sensations as laryngeal irritation, vocal fatigue or even pain during prolonged phonation.

Based on the diagnostic classification proposed by Baker et al. (2007) functional voice disorders are classified as psychogenic voice disorders (PVD) or muscle tension voice disorders (MTVDs) with a primary or secondary presentation.

## 4.1 - Psychogenic Voice Disorders

Psychogenic voice disorders (PVD) exist in the absence of structural, anatomic laryngeal pathology (Baker et al., 2007) and/or neurologic alterations (Martins, Tavares, Ranalli, Branco, & Pessin, 2014).

Over the years, psychogenic voice disorders have received many diagnostic labels: non-organic, functional, dysfunctional, muscular tension dysphonia or aphonia, hysterical dysphonia or aphonia, conversion reaction, and psychosomatic. Dietrich, Abbot, Gartner-Schmidt and Rosen (2008) preferred the term “psychogenic” as it clearly indicates that the primary process has a psychological origin. Aronson also used the designation of “psychogenic voice disorder” as it points to the existence of one or more psychological disorders such as mood (depression and/or anxiety disorders), conversion disorder, and/or personality disorders.

The term psychogenic has historical use, dating back to the period of Ancient Greece. At that time, psychogenic voice disorder had a high female predominance which lead to the physicians to believed that the stress experienced by these women led to the uterus being displaced to the throat causing foreign-body sensation, making swallowing difficult and blocking the airflow requiered for phonation (Baker et al., 2002). This phenomenon was called “globus phenomenon” or “hysteria” (a Greek expression for uterus) (Baker, 2017).

Sigmund Freud made a major contribution to the definition of what is now recognized as psychogenic voice disorders. As a psychoanalyst, Freud presented the concept of “conversion disorder” to represent the psychological processes whereby repressed or uncounscious energy associated with unbearable ideas related to sexual or aggressive instincts were converted into physical symptoms (Baker, 2017). The conversion process would block the normal function of the sensory motor pathway with the unconscious purpose of allowing the patient to deny or avoid the emotional conflict that would be intolerable to face at that moment (Baker, 2017). In 1905, Freud had published

"Dora: an analysis of a case of hysteria", a well known clinical case report that illustrates his theoretical model. Dora was one of Freud's patients who presented aphonia and was diagnosed with hysteria. During the psychotherapy, the unresolved sexual conflict that was experienced in her early life was identified as the predisposing factor for the loss of her voice (House & Andrews, 1987). According to the Psychoanalytic Theory, thoughts and emotions undergo a process of repression being symbolically represented by a symptom that represents the patient's conflict at a conscious level (Baker et al., 2002). As is known, many authors do not agree with this model. Baker (2017) stated that regardless of whether this conceptualization contributed correctly or incorrectly to the perpetuation of a set of myths about individuals with functional health conditions, including those with voice disorders, it has played an important role in sensitizing both physicians and psychiatrists to actively manage many functional health conditions.

Behavioral Theories also defended the presence of psychological processes underlying the conversion reactions. According to these Theories, the vocal symptom would emerge as a response to anxiety associated with conflict, delaying the resolution of the conflict.

Cognitive-Behavioral Theories consider psychogenic voice disorder as cognitive behavioral conversion whose main purpose would be for the patient to avoid the consequences of the negative feelings (Butcher et al., 2007; Sudhir et al., 2009).

Andersson and Schalén (1998) best sum up the etiophatogenesis of psychogenic disorders by affirming, "there is a disturbance of the reciprocal interactions between emotional awareness, laryngeal perception, and central motor control of phonation".

**Diagnostic criteria**

For Wilson, Deary, Scott and Mackenzie (1995), a psychogenic voice disorder is a diagnosis of exclusion that may be confirmed only after specialized examination of the larynx, although the evaluation does not end at that precise moment. Morrison and Rammage (1994) reinforced this idea and value a formal psychological evaluation since the voice disturbance is not solved with vocal techniques (Rosen & Murry, 2000).

This voice disorder is strongly characterized by the existence of symptom incongruity as the patient can present severe dysphonia and normal glottic closure, with the larynx being capable of making an entirely or firmly vocal fold adduction (Figure 1) (Baker, 2016; Rammage et al., 1987). This is particularly visible in cough (Baker et al., 2002).

**FIGURE 1. - Adduction of the Vocal Folds in PVD.**
**Complete Adduction**

In general, females with psychogenic voice disorder were described as exhibitionists, presenting an excessive sensitivity to life events with an apprehensive affect and a high pattern of tension (Baker, 2017). In fact, the majority of the patients with psychogenic dysphonia had several previous contacts with health services due to other psychosomatic manifestations (Schalén, Andersson, & Eliasson, 1992).

These patients show continuous or extreme tiredness, tend to complain of insomnia and present a range of other functional medical symptoms, namely anxiety or phobias, mood disorders that range from melancholy to chronic depression, and even schizophrenic or psychotic processes (Baker, 2017).

## Current etiology

Some authors may have different interpretations for its pathogenetic mechanism but it is commonly agreed that a psychogenic voice disorder is triggered by emotional conflicts (Andersson & Schalén, 1998). Certain personality traits, the maladaptation to conflicts or to strong emotions or poor ability to cope with social stress (Andersson & Schalén, 1998) are frequently related predisposing factors. Butcher et al. (1987, as cited in Mathieson, 2001) had already identified some stressful situations such as family and interpersonal difficulties and also factors related to working conditions.

All these situations can lead to vocal abuse, conversion reaction, increase of anxiety, depression and/or interpersonal conflicts.

**Prevalence**

Clinical data, provided by voice clinics or ENT specialists, shows a considerably high percentage (40%) of patients presenting no identifiable organic laryngeal disease (Sama, Carding, Price, & Wilson, 2001).

Different authors have analyzed the prevalence of psychogenic voice disorders in women and found values between 85% and 90% (Elhendi et al. 2005; Sarriegui et al. 1996), with a female-male ratio of 8:1 (Baker, 2002). For Martins et al. (2014) this difference in gender is due to the progressive and significant contribution of women on both domestic and professional tasks and/or demands.

The age distribution in psychogenic voice disorders has two peaks, in adolescence and between the third and fourth decades of life (Elhendi et al. 2005; Sarriegui et al. 1996), the period with highest professional activity (Martins et al., 2014).

**Symptoms and signs**

The onset of a psychogenic voice disorder is always associated with the experience of one or more difficult life events (Butcher, 1995). Therefore, the course of the vocal symptom can also be very variable, ranging from days to weeks or even months.

The vocal symptoms often arise suddenly with episodes of normal voice varying between aphonia or dysphonia, or there is a loss in vocal production and over initiation and maintenance of phonation (Baker et al., 2007; Baker, 2016). The vocal symptoms are likely inconsistent and may be intermittent.

The voice may sound forced, breathy, weak or harsh. These changes depend on the emotional state of the speaker (Baker, 2016). Martins et al. (2014) alert that, fluctuations in vocal production are frequently observed in the first minutes of a medical examination.

The way the patient describes his/her vocal symptom has great clinical significance. It is common for the patient to make an exaggerated description compared to the severity of the vocal problem and there is a discrepancy between vocal symptoms and signs and clinical findings (Mathieson, 2001).

The patient's reaction to hearing own-recorded voice is not linear since it depends on psychological, social, family and/or professional factors. Some patients may express relief while others may immediately inhibit vocal production (Baker, 2016), inducing the production of a poorer vocal quality.

In addition to vocal changes, patients with a psychogenic voice disorder frequently describe vocal fatigue and vocal tract discomfort.

**Vocal profile**

Baker (2016) alerts to the fact that normal phonation can not be produced in a voluntary way but can arise unconsciously or during reflex activities (e.g., laugh and cough). The vocal folds close only at the very beginning of phonation and the laryngoscopy shows a complete glottal closure with audible sound for reflex activity (Hirose, 1983).

Patients with psychogenic voice disorders usually do not recognize those preserved sounds as normal vocal productions (Baker, 2016). This author added that the voice could vary during a conversation with shifts between "falsetto", "ventricular", "strangled" or "diplophonic".

There are visible changes or impairment in the respiratory control, vocal intensity, vocal range, vocal resonance, fundamental frequency, articulation, velocity and intonation of speech (Martins et al., 2014).

In adolescent and adult males, psychogenic voice disorders are characterized by mutational falsetto with high pitch, irregular breaks or breathy (Baker, 2016).

**Treatment**

The role of psychological factors is so crucial that the larynx can be perceived as an emotional organ (Andersson & Schalén, 1998). Psychological assessment is essential to determine the role and meaning of the vocal symptom in the patient's life history (Rammage et al., 1987).

Mathieson (2001) highlighted that, in an initial interview that does not include a mental health specialist, it may be difficult to detect the presence of severe mental illness. Patients with psychogenic voice disorders benefit from having multidimensional assessment (Rammage et al., 1987) and to contact a psychologist and/or a psychiatrist as soon as possible for psychological and psychopharmacological treatments (Rosen & Murry, 2000).

Psychological symptoms must be assessed through clinical history in conjunction with mental state examination and whenever possible with the application of standard psychological tests.

The assessment of primary and secondary gains allowed the identification of positive and negative prognostic factors for treatment outcomes. The positive prognostic factors are based on the resolution of the precipitating factor and on the confidence that the

patient has in his/her recovery. The negative prognostic factors include the duration of the vocal symptom and the negative experiences of previous treatments.

Baker (2016) stresses that during treatment it is important to keep in mind that the vocal symptom incongruity and reversibility are characteristics of psychogenic voice disorders. In fact a mental health specialist can achieve its reversibility through the management of psychosocial factors.

**Prognosis**

The prognosis of psychogenic voice disorders is good, especially if the treatment starts as soon as possible (Baker, 2016) with the integration of approaches of psychotherapy and speech therapy.

The psycotherapy will focus on the identification of psychological features that act as causal or maintenance factors, allowing the development of more effective strategies for the communication of difficulties and suffering.

## 4.2 - Muscle Tension Voice Disorders

In 1983, Morrison (as cited in Van Houtte, Van Lierde, & Claeys, 2011) introduced the term - Muscle tension dysphonia (MTD) - to describe patients with normal vocal fold morphology and neurologically intact larynx and with specific abnormal laryngeal postures, and presenting and a disturbed voice after extensive voice use (Jafari et al., 2017; Paltura & Yelken, 2016; Rosen & Murry, 2000). Roy (2003) believed that this label permitted to highlight the excessive, dysregulated, or imbalanced activity of the laryngeal musculature (intrinsic and extrinsic muscles) as a cause of dysphonia. Glottal insufficiency is usually seen in patients with a presumed overactivation and dysregulated laryngeal biomechanics and muscle tension patterns (Belafsky, Postma, Reulbach, Holland, & Koufman, 2002; Lowell, Kelley, Colton, Smith, & Portnoy, 2012).

Muscle tension voice disorders have various etiological factors (Altman, Atkinson, & Lazarus, 2005), such as poor vocal technique, great vocal demands (Morrison & Rammage, 1994), vocal misuse and abuse, and psychological and personality characteristics (Behlau et al., 2015). Dietrich and Abbot (2012) referred the evidence of significantly increased interpersonal stress associated with the onset of muscle tension voice disorders.

All these factors will increase vocal fold tension (Roy & Fergusson, 2001; Van Lierde, De Bolt, Dhaeseleer, Wuyts, & Claeys, 2010) and a new pattern of vocal production rise (Van Houtte et al., 2011).

**Diagnostic criteria**

As a multifactorial entity, the diagnosis of muscle tension voice disorders requires an anamnesis with data of history of vocal misuse or abuse, laryngoscopy, observation and palpation of the muscles around the larynx (Khoddami, Ansari, Izadi, & Moghadam, 2013) and evaluation of psychological and stressful life situations (Van Houtte et al., 2011).

In muscle tension voice disorders there are changes in the position (mostly higher position) and in the inclination angle of the larynx in the neck that immediately affects the intrinsic laryngeal musculature (vocal strain), leading to a disruption of vocal quality (Jafari et al., 2017; Khoddami, Ansari, Izadi, & Moghadam, 2013; Van Houtte et al., 2011). These changes occur once extrinsic and intrinsic laryngeal muscles are extremely sensitive to emotional stress (Aronson & Bless, 2009).

**Current etiology**

Anxiety and/or tension are associated with muscle tension voice disorders as both can perpetuate a high degree of persistent muscular tension on the neck, without exposure to the stressor element (Holmqvist, Santtila, Lindström, Sala, & Simberg, 2013).

There are exogenous and endogenous sources associated with the muscle tension. Exogenous sources include the professional situation (e.g., overwork, tense working conditions and/or professional worries), interpersonal difficulties and family responsibilities. Endogenous sources correspond to the personality traits that tend to induce tension (e.g., perfectionism, compulsive behaviors, overambitious drives, and/or lack of adaptability), as well as emotional self-regulation (e.g., uncontrolled outbursts of anger), and type of defense mechanisms.

In response to all these sources, a set of emotional and cognitive adjustments as well as physiological and psychological reactions should arise (Rosen & Sataloff, 1997).

**Prevalence**

Muscle tension dysphonia is a common functional dysphonia that affects nearly 10% to 40% of the patients at a voice clinic, with a higher prevalence in middle-aged women (Khoddami et. al, 2013).

**Symptoms and signs**

The onset is generally gradual, but in some cases it can start suddenly after acute trauma to the vocal folds leading to effortful phonation (Mathieson, 2001). The course of dysphonia is generally consistent but the voice quality depends on the vocal demands (Baker, 2016).

Green (2001) defined two patterns of communication in these patients. One is characterized by loud and rapid speech associated with vocal abuse and misuse while in the other, despite the considerable effort made by the patients to speak, the voice is not perceptible (Mathieson, 2001).

The laryngoscopy shows an excessive constriction of the epiglottic folds and a marked medial compression of the vocal folds (Baker, 2016).

Patients with muscle tension voice disorders often report hoarseness, aphonia or dysphonia, breathiness, excessively high pitch, sensations of a lump in the larynx and even pain in the laryngeal region and in the chest (Aronson, 1990, as cited in Andrews, 1995). The predominant findings from speech therapy evaluation are poor breath support, inappropriate pitch, visible cervical neck tension, inappropriate intensity, fast rate of speech, glottal fry, jaw tension, and hard glottal attacks (Johnson et al., 2010).

**Vocal profile**

The voice can be breathy, hoarse, rough, strained, harsh or strident (Paltura & Yelken, 2016). Baker (2016) affirmed that these patients have to make an effort to produce sustained vowels and then may complain of vocal fatigue, pain or discomfort.

In relation to vocal acoustic evaluation, the fundamental frequency can be within normal limits or present values that are too high or too low (Baker, 2016; Mathieson, 2001) with the formants (especially F2) being affected, mainly when combined with energy loss (Yanagihara, 1967, as cited in Mathieson, 2001).

**Treatment**

The treatment of muscle tension voice disorders requires the articulation between speech therapist and psychologist and/or psychiatrist. In most of the cases the first approach is speech therapy once it allows to break the vicious circle in the muscle tension, to promote a new vocal pattern and to prevent the development of organic lesions (Van Houtte et al., 2011). In fact, they can be reversible if there is an abandonment of previous vocal patterns (Baker, 2016). Psychological factors may act in the onset as well as in the

maintenance of this voice disorder, which explains why recovery is generally slow and requires psychological and/or psychiatric interventions.

**Prognosis**

The treatment of muscle tension voice disorders have good outcomes depending on the patient's overall health, vocal demands, work environment, performance conditions, lifestyle, and the identification of all the psychosocial issues that may be interfering with the vocal production (Baker, 2016).

### 4.2.1 - Primary Muscle Tension Voice Disorders

Primary muscle tension voice disorders (MTVD1) occur in the absence of organic vocal fold pathology with a sudden or gradual onset. They are associated with vocally high demands, inadequate vocal skills and psychosocial features (Mathieson et al., 2009; Van Houtte et al., 2011).

The most common characteristics are roughness, breathiness, and strainess with phonation breaks at glottal attacks (Gallena, 2007).

The laryngoscopy shows a wide gap (chink) upon closure, medial and anteroposterior compression of the glottis with reduced vocal fold amplitude (Figure 2) (Gallena, 2007).

**FIGURE 2. - Adduction of the Vocal Folds in MTVD1.**
**Incomplete Adduction**

### 4.2.2 - Secondary Muscle Tension Voice Disorders

Secondary muscle tension voice disorders (MTVD2) cover dysphonia with behavioral and organic etiologies. They are associated with inadequate vocal techniques and with excessive phonatory effort like screaming, excessive talking especially in a noisy environment, smoking, and also with medical conditions like respiratory tract infections, allergies, chronic cough and laryngopharyngeal reflux (Ho, Lee, & Jin, 2007; Hugh-Munier, Scherer, Lehmann, & Scherer, 1997; Mathieson et al., 2009). Hugh-Munier, Scherer, Lehmann, and Scherer (1997) further valued the presence of psychological factors as the emotional state and personality.

The organic condition results from the excessive effort in vocal production that leads to a trauma in the vocal folds, being developed vocal nodules, polyps or cysts (Figure 3) (Baker, 2016; Mathieson, 2001).

**FIGURE 3. - Adduction of the Vocal Folds in MTVD2.**
**Vocal Nodules and glottal Gap**

Vocal quality is affected by the effort made to maintain the normal pitch and volume in the presence of benign lesions. The voice sounds hoarse and breathy (Kandoğan & Özüer, 2007) since the lesion is located at the junction of the anterior and middle thirds of the vocal folds which corresponds to the area of maximal aerodynamic and muscular force during phonation (Hugh-Munier et al., 1997).

**Benign vocal fold lesions**

Vocal nodules and polyps are benign lesions, that compromise vocal production, resulting from a constant effort in vocal production that leads to the presence of a mass lesion that interferes with the closure of the vocal folds (Jiang, Zhang, MacCallum, Sprecher, & Zhou, 2009).

Vocal nodules are bilateral lesions located in the union of the middle and anterior thirds of the vocal folds.

Vocal polyps are usually unilateral vascular lesions located at the loose end of the vocal folds presenting different sizes, shapes and colors.

Treatment of these benign vocal lesions includes speech therapy, phonosurgery and psychological support when needed.

# 5. Psychiatric Disorders and Functional Voice Disorders

Specialists who work with patients with voice disorders should be aware of their high risk of developing mental disorders, primary or secondary to the vocal problem (Martinez & Cassol, 2015).

Whenever functional voice disorders are analyzed, co-morbidity with psychiatric disorders has always been referenced. In fact, the association between psychological features and functional voice disorders has been recognized and its complexity valued, giving rise to a growing research area.

## 5.1 - Affective and Anxiety Disorders

Patients with functional voice disorders frequently present symptoms of depression and anxiety that may act as a cause or a consequence of the voice disorder.

Willinger et al. (2005) evaluated the presence of affective and anxiety disorders in 61 patients with functional dysphonia. The authors found that 33% of these patients were diagnosed as having affective disorders and 20% with anxiety disorders. According to Rosen and Sataloff (1997) these psychiatric disorders interfere with the phonation process.

The incidence of depressive and anxiety symptoms in patients with functional voice disorders, as reported in the literature review, supported the need for the evaluation of affective and anxiety disorders as it provides information about the patient's mental state that is determinant for treatment planning. The classification criteria of the revised fourth edition of the Diagnostic and Statistical Manual of Mental Disorders ($4^{th}$ ed., text rev.; DSM-IV-TR; American Psychiatric Association, 2000) was used as the base of the present study.

## 5.2 - Personality and Personality Disorders

Personality defines a complex organization of interrelated traits (Newton-Nowes, Clark, & Chanen, 2015) that develop from birth to early adulthood.

The term "personality" derives from the Greek "persona" that originally represented the theatrical mask used by dramatic players. This concept has undergone changes. Firstly, the definition was restricted to the mask used by the actor giving focus to

the presentation. Later, it turned into a broader concept of representation including features in which the voice was included (Millon, 2016).

A great contribution was made by Millon, who in 1969 published a book named "Modern Psychopathology" where the most notable personality prototypes were organized into orderly schemes (Choca & Grossman, 2015).

For Millon, personality is a complex stable pattern of multiple psychological characteristics derived from genetics and experimental learnings. The author defines a hierarchical pattern of multiple dispositional styles and traits instead of a single aspect of functioning (Millon, 2016).

Personality represents the matrix of a person, with consistent patterns of feelings, thoughts and behaviors that will be revealed through sociability and interaction with the environment (Almeida, Fernandes, Azevedo, & Pinheiro, 2015). The cultural context plays an important role by influencing the individual's behavior. In fact, actions can be summarized, predictable and explained by personality traits (Almeida et al., 2015; Martens, 2010).

According to Millon, personality develops as a dynamic process based on the bipolarity of four principals: existence which ensures life preservation (pleasure *vs* pain); adaptation which comprises the adjustment strategies (passive *vs* active); replication and reproduction that defines the degree to which each one is targeted to the self or to the relationship with others (self *vs* other); abstraction with regard to how information is processed (thinking *vs* feeling) (Pilarska & Suchańska, 2015). The polarity balance of the personality dimensions explain their functioning and how personality disorders influence the way the individual thinks and feels about himself/herself, as well as how he/she is perceived by others (Furnham & Crump, 2005).

Under specific circumstances, personality traits may become inflexible, maladaptive and persistent, causing significant functional impairment or subjective distress (4th ed., text rev.; DSM-IV-TR; American Psychiatric Association, 2000). These changes lead to the development of a personality disorder.

The term "personality disorders" was formally defined in the 19th century.

Kurt Schneider (1923, as cited in Dahl & Andreoli, 1997) gave a major contribution by setting that extreme deviations of a trait were considered pathological if the individual or society was suffering because of its presence.

The study of personality disorders was found to be important in that it allowed many individuals to be seen as having a disorder, rather than being labeled as merely odd or eccentric.

Personality disorders are formed by a constellation of traits that systematically "support" one another being present in all domains of life (Strack & Millon, 2012). They exist in a continuum of severity, from normal personality traits (Ahmed, Green, Buckley, & McFarland, 2012) to different levels of maladaptive functioning that manifest in a wide range of psychopathologies (Fahy, 2012).

The Millon personality model and the Diagnostic and Statistical Manual of Mental Disorders of the American Psychiatric Association are strongly associated.

Millon's model of personality leads to a great change in the definition of personality disorders. In the third edition of the Diagnostic and Statistical Manual of Mental Disorders (3rd ed.; DSM-III; American Psychiatric Association, 1980), personality disorders were introduced in Axis II being qualitatively distinct from clinical syndromes (Henriques-Calado, Duarte-Silva, Keong, Sacoto, & Junqueira, 2013; Newton-Nowes et al., 2015). According to Choca and Grossman (2015) Millon is recognized as the inventor of the modern concept of personality.

Millon also defended the application of statistical criteria in the classification of mental disorders. These criteria set the normality for the behaviors that can be mostly found in a social group whereas, in contrast, the pathology or abnormality would be the uncommon behaviors in that same population (Millon, 2016). This perspective reinforces the common use of the Diagnostic and Statistical Manual of Mental Disorders in its different editions (Pilarska & Suchańska, 2015).

In 1977 the original Millon Clinical Multiaxial Inventory (MCMI) was published to assure the measurement of personality styles and view of psychopathology (Choca & Grossman, 2015). New editions of the Diagnostic and Statistical Manual of Mental Disorders and of the Millon Clinical Multiaxial Inventory have been published.

Personality prototypes were also presented in the Diagnostic and Statistical Manual of Mental Disorders: in the fourth edition (4th ed., DSM-IV; American Psychiatric Association, 1994) and in the fifth edition (5th ed.; DSM-5; American Psychiatric Association, 2013).

In the fourth edition of Diagnostic and Statistical Manual of Mental Disorders (4th ed., DSM-IV; American Psychiatric Association, 1994) personality disorder was defined as "an enduring pattern of inner experience and behavior, e.g. as a steady long-held pattern of beliefs and behaviors that deviates markedly from the socially acceptable level". These personality traits are presented as maladaptive, inflexible, pervasive, long lasting and culturally decontextualized (Gutiérrez et al., 2008). The personality disorders were grouped in three clusters: Cluster A includes schizoid, schizotypal and paranoid personality disorders; Cluster B enclose antisocial, borderline, histrionic and narcissistic personality disorders; while Cluster C covers avoidant, dependent and obsessive-compulsive personality disorders.

For the diagnosis of a personality disorder, the personality trait must impair the individual and others, be pervasive across a number of situations and persistent across lifespan. For Banerjee, Gibbon, and Huband (2009) they lead to behavior and emotion disturbances.

The authors agree that personality disorders will negatively affect the patients' perception, cognition, emotions and behavior, as well as the ability to function in the social context. In fact, these patients present deterioration in their functioning characterized by subjective suffering (Pilarska & Suchańska, 2015) and clinical significant distress or impairment in social and/or occupational functional areas.

Tyrer et al. (2015) stated that a pejorative connotation is often attributed to the term personality disorder; it is viewed as difficult to treat or even intractable. When patients' accept the disorder it improves their ability to manage their own lives (Newton-Nowes et al., 2015).

Personality disorders have high co-morbidity with other mental disorders. A strong association was found between Cluster B personality disorders and psychotic, affective and anxiety disorders, and between Cluster C and affective and anxiety disorders (Banerjee et al., 2009). In addition, personality disorders have a high co-morbidity with substance use disorders.

The personality model proposed in the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (5th ed.; DSM-5; American Psychiatric Association, 2013a) corresponds to a new approach for diagnosing personality disorders and is referred to as a "hybrid model" (Skodol, 2012, as cited in Widiger, 2015). In this edition, the level of personality functioning would "be evaluated on a continuous dimension of severity of self and interpersonal dysfunction to determine whether a diagnosis of PD was merited"

(Hopwood, Thomas, Markon, Wright, & Krueger, 2012). For this purpose, the trait-specific framework in Section III of the DSM-5 was introduced (Bornstein, Bianucci, Fishman, & Biars, 2014).

Porter and Risler (2014) systematized the eight primary changes to the diagnostic constructs of personality disorders in the DSM-5: removal of four personality disorders categories (e.g., paranoid, schizoid, histrionic, and dependent personality disorders); introduction of a dimensional conceptualization of personality disorders; insertion of a functional impairment severity rating scale; introduction of pathological personality trait descriptors; elimination of the strict temporal stability criterion; elimination of the Axis I exclusion, removal of the conduct disorder requirement for antisocial PD and introduction of the category PD-Trait Specified (PDTS).

Therefore, antisocial, avoidant, borderline, narcissistic, obsessive-compulsive and schizotypal personalities will be assessed according to five criteria: impairments in self and in the interpersonal functioning (Criterion A), a description based on a constellation of pathological personality traits (Criterion B), the stability across time and situations (Criterion C), the distinction between cultural or developmental normative personality features from clinical pathology (Criterion D), and medical or substance-related causes of personality problems (Criterion E) (Hopwood et al., 2012).

This means that a patient presenting a personality pathology that does not meet the criteria in at least one of the diagnostic categories would be classified with the PD-Trait Specified (PDTS) (Hopwood et al., 2012).

With the changes that were introduced in the DSM-5, the emphasis on personality functioning and trait-based criteria is expected to reduce the co-morbidity and to ensure accuracy in the diagnosis of personality disorders (American Psychiatry Association, 2013b).

In its fifth edition, the Diagnostic and Statistical Manual of Mental Disorders clearly distinguishes personality trait from personality functioning and from personality disorder, valuing the psychosocial impairment. In our study, the assessment of personality of patients with functional voice disorders respected the distinction between trait and personality disorder.

**Prevalence**

It is estimated that personality disorders affect nearly 15% of adults (Morcos & Morcos, 2016). The prevalence increases to 50% for psychiatric in and outpatients (Banerjee et al., 2009).

Despite being more frequent in men, in clinical settings the female gender reaches a higher prevalence, particularly the dependent and the histrionic personality disorders (Fahy, 2012).

**Assessment**

Banerjee et al. (2009) reinforce the importance of making a detailed diagnosis that reveals not only personality disorders and maladaptive traits but also the patient's strengths and protective factors. The identification of all these characteristics is important, as they can negatively affect the course of the illness and/or the treatment outcomes.

Standardized psychological instruments are commonly used for diagnosis. In the present study the Millon Clinical Multiaxial Inventory was applied because of "its theoretical anchoring, multiaxial format, tripartite construction and validation schema, use of base rate scores, and interpretive depth" (MILLON®, 2015).

**Treatment**

Psychological treatment is more effective when it is structured, intensive and long-term, and in association with pharmacological therapy when needed (Fahy, 2012).

## 5.3 - Personality and Functional Voice Disorders

Over the years the authors have been unanimous in describing patients with functional voice disorders as emotionally unstable.

The existence of a link between histrionic or hysterical personality traits and functional voice disorders was often reported (House & Andrews, 1987; Scott et al., 1997). Studies that were published in the period between 1962 and 1995 showed a decline in the frequency of this association. In subsequent researches, patients with functional voice disorders were more frequently diagnosed with psychiatric disorders such as psychosis, schizophrenia or personality disorders (Butcher, 1995; Mirza, Ruiz, Baum, & Staab, 2003; Roy et al., 1997; Willinger et al., 2005, as cited in Baker, Ben-Tovim, Butcher, Esterman, & Mclaughlin, 2013).

Distinct personality characteristics associated with this group of patients have been identified. Functional voice disordered patients (excluding patients with vocal nodules that were later classified with a secondary muscle tension voice disorder) were described as neurotic introverts (Roy & Bless, 2000), showing a propensity to worry or to be anxious. These patients also tend to feel victimized and resentful and consequently represent life as a stressful and disturbing experience (Roy & Bless, 2000). According to Mirza et al. (2003) and Baker et al. (2013) patients with functional voice disorders showed high interpersonal sensitivity, distrust and estrangements of others.

### 5.3.1 - Personality and Psychogenic Voice Disorders

It was common to various authors to describe patients with psychogenic voice disorders with a predisposing personality trait characterized by maladaptation to conflicts or to strong emotions (Andersson & Schalén, 1998). These patients showed inhibition in expressing thoughts and feelings that were felt by the self as unacceptable (e.g., anger), and were also reluctant to express strong feelings and also the feeling of powerlessness towards the hypothesis of change (Baker, 2002). House and Andrews in 1987 characterized those difficulties as the "conflict over speaking out" (Andersson & Schalén, 1998). Introversion and low assertiveness were also characteristics assigned to patients with psychogenic voice disorders (Baker, 2003).

### 5.3.2 - Personality and Primary Muscle Tension Voice Disorders

High neuroticism and low extraversion with body concern and anxiety (Roy & Bless, 2000) correspond to the personality characteristics that are used to describe patients with primary muscle tension voice disorders.

Alexithymic traits as the difficulty to identify and verbally express emotions and also to distinguish feelings from body sensations driven by emotional arousal (Gabriel, Untas, Layner, Koleck, & Luminet, 2016; Terock et al., 2015) were identified in patients with primary muscle tension voice disorders in percentage values of 36% (Kinz et al., 1988 as cited in Scott et al., 1997).

### 5.3.3 - Personality and Secondary Muscle Tension Voice Disorders

The association between secondary muscle tension voice disorders and personality exists (Abeida et al., 2013) but remains unclear. Recently, some authors have devoted

special attention to children with vocal nodules and have provided interesting cues for the understanding of this relationship. These children when compared to non-voice disordered children tend to present themselves as more aggressive and with greater difficulty in managing stressful situations (Ho et al., 2007).

Studies with adult population have been developed over the years, especially with patients with vocal nodules as control groups. These patients were described as neurotic, extroverted (Abeida et al., 2013; Roy & Bless, 2000), with high levels of fear and with a great tendency to worry (Ratajczak et al., 2008, as cited in Barakah et al., 2012). They also presented interpersonal problems that generate tension, anger or depression (Hugh-Munier et al., 1997), and exhibited marked aggressiveness and impulsivity (Abeida et al., 2013).

Excessive vocal misuse has been addressed as being associated with impulsiveness (Abeida et al., 2013) whereas anxiety and somatic complaints have been identify as associated with the presence of vocal nodules (Goldman et al., 1996, as cited in Barakah et al., 2012).

Likely in patients with vocal nodules, extroversive personality seems to play an important role in the etiopathogenesis of vocal polyps (Yano et al., 1982, as cited in Barakah et al., 2012).

## 5.4 - Affective Temperaments

Temperament can be defined as the individual's biases (Deguchi et al., 2016). As it represents a relatively stable individual characteristic, affective temperament can be evaluated years before the full clinical expression of psychiatric illnesses (Baldessarini et al., 2017).

Krapelin (1921, as cited in Ferreira, Vasconcelos, Neves, Laks, & Correa, 2013) described four basic affective dispositions - depressive, manic, cyclothymic and irritable, as subclinical forms of major affective psychosis.

Akiskal and Mallya formulated the modern concept of temperaments and described three original affective temperaments: depressive, cyclothymic, hyperthymic and irritable (Litaiem, Yousseff, Jabeur, Dhaoui, & Doss, 2013; Rötting, Rötting, Brieger, & Marnecos, 2007), to which later added the anxious temperament (Akiskal et al., 1998, as cited in Woodruff et al., 2011). This model recognizes the existence of a continuum from different types of healthy emotional reactivity to affective disturbances (Ardani et al., 2017).

The same authors proposed temperament traits as vulnerability markers to identify the risk of developing specific types of mood disorders (Ferreira et al., 2013). In fact, temperament was recognized as a precursor of minor and major mood disorders (Fındıklı et al., 2016), being also responsible for residual symptoms that tend to persist and not to remit (Dembińska-Krajewska & Rybabowski, 2014). Therefore, a dysregulation of temperament reflects a high predisposition of the individual for the development of affective disorders (Akiskal, 1996, as cited in Iliceto et al., 2011).

Affective temperament also plays an important role as a moderator factor for the individual's reaction to stressful life events (Elovainio et al., 2015).

For its assessment Akiskal et al. developed a standardized tool, the Temperament Evaluation of Memphis, Pisa, Paris, and San Diego (TEMPS).

The evaluation of affective temperament based on the model proposed by Akiskal et al., as far as we know, has not been performed on patients with three types of functional voice disorders. In the present study, the Portuguese version of TEMPS developed by Figueira et al. (2008) was used.

# 6. Functional Voice Disorders and Quality of Life

In functional voice disorders, the vocal quality is compromised at levels that can range from mild to severe. The impact of the vocal changes (e.g., dysphonia, aphonia as well as difficulty in maintaining voice, vocal fatigue, variations in the usual frequency, lack of volume and projection, loss of vocal efficiency and low resistance when speaking) depends on the psychological characteristics of the individual, social network, use of the voice and work conditions (Teixeira & Fernandes, 2015).

## 6.1 - Quality of Life in Functional Voice Disorders

The World Health Organization (WHO) defines health as a multidimensional concept incorporating physical, mental and social states of well-being (Hsiung, Pai & Wang, 2002).

The “International Classification of Functioning, Disability and Health” proposed by the WHO in 1980 considers three key concepts: impairment, disability and handicap. Impairment comprises the loss or abnormality of psychological, physiological or anatomical structure or function, while disability corresponds to the restriction that results from the impairment itself (Wheeler, Collins, & Sapienza, 2006). In this classification, handicap refers to the social, economic or environmental disadvantage resulting from impairment or disability (Hsiung et al., 2002; Rosen, Lee, Osborne, Zullo, & Murry, 2004).

In 1997, the WHO presented a revised version where the "impairment" concept was maintained but the terms "disability" and "handicap" were replaced by "activity limitations" and "participation restrictions", respectively. According to Awan, Roy, & Cohen (2014) “the revised framework no longer implies a linear relationship between impairment-level measures and levels of disablement”. This means that the psychosocial consequences of a voice disorder will be heavily influenced by the context (e.g., environmental) and personal factors (e.g., age, occupation, personality and coping style) (Lopes et al., 2017).

As pointed by Souza and Hanayama (2005) vocal impairment is present in daily activities affecting the personal, the social and the professional domains, in a degree that depends on the self’s integration and adaptation, on the social environment characteristics and on the quality of the interpersonal relationships.

Baker (2017) also reinforced this idea by stating that voice quality affects the interpersonal communication and community relationships, like the participation in social, cultural, sports and religious activities.

In a study developed by Misono et al. (2014), more than 50% of the patients with dysphonia missed work and more than 75% had prior history of dysphonia. It is likely that a patient with functional voice disorders may experience a decrease in professional productivity associated to loss of time from work (Schindler et al., 2013) with the risk of losing his/her job (Amir & Levin-Yundof, 2013). Thus, vocal impairment may interfere with the present and future professional career (Baker, 2017).

Baker (2017) pointed that vocal impairment or disability will have different characteristics throughout the course of human development, from childhood to the elderly. In childhood, a voice disorder is generally linked to development and behavioral problems, peer relationships, communication with teachers and classroom participation that can affect the child's self-esteem; in adolescence the impact is reflected in scholar and social isolation. In adults the relationships with family members and with work or community colleagues may be impaired. Voice disorders also affect elderly people with the effort, discomfort, anxiety and frustration leading to social isolation (Baker, 2017).

Besides age, there are other personal factors associated with disability namely gender, race, coping styles, fitness, lifestyle, habits, social background, education, and occupation (Baker, 2017). The impact that voice disorder has on the quality of life also depends on the knowledge that the individual has of his/her disease.

There is no direct link between the impact of a voice disorder and the severity perceived by others. However, the reaction of family members to the impaired voice can affect the way the patient perceives own disability (Wheeler et al., 2006).

According to Baker (2017), even knowing that functional voice disorders are not life-threatening (Schindler et al., 2013) many patients described their experience as being severe with psychosocial effects that are similar or even worse than those reported by patients with chronic diseases.

All these factors combined with the high co-morbidity of psychiatric disorders in functional voice disorders, justifies the interest in evaluating the perception that the patient has of the impact of the vocal impairment on the quality of life.

## 6.2 - Self-evaluation of Quality of Life related to Vocal Symptoms

In the late 90s, instruments were introduced to access the impairment of vocal symptoms through the patients' report (Franic, Bramlett, & Bothe, 2005). Over time, they have turn into standard instruments with widespread applications.

The self-questionnaires are used in clinical practice to quantify the impact of a vocal problem, to help with adherence to treatment, to determine the management planning and to evaluate the patient's response to different treatments.

Several validated instruments with many translations and cultural adaptations are now available and the most common are: Voice Handicap Index (VHI), Vocal Performance Questionnaire (VPQ), Voice Related Quality of Life (V-RQOL) (Behlau et al., 2017) and Voice Symptom Scale (VoiSS) (Slavych, Engelhoven, & Zraick, 2013). All these tests have in common the evaluation of physical (organic), functional (activity and participation) and socio-emotional domains.

# CHAPTER 3

## Research Questions and Goals

*Problem Definition*
*Research Goals*

# 1. Problem Definition

Regarding the specificity of the three types of functional voice disorders - psychogenic (PVD), primary muscle tension (MTVD1), and secondary muscle tension voice disorders (MTVD2), their relationship with psychological factors remains unclear despite clinical implications.

The aim of the present study was to identify the psychological features associated with functional voice disorders, providing a comprehensive perspective on the three presentations of functional voice disorders.

Research questions where defined based in three dimensions:

- Psychological: diagnosis of affective and anxiety disorders; evaluation of the severity of depression and anxiety symptoms; analysis of personality and personality disorders; evaluation of affective temperaments;
- Vocal acoustic evaluation;
- Self-evaluation of quality of life associated with the vocal problem.

The results of these assessments were always analyzed within and between the three groups of patients with functional voice disorders.

## 2. Research Goals

This Thesis led us to develop six studies that analyze different factors and their associations with the three groups of functional voice disorders.

1. Characterize patients with functional voice disorders in the sociodemographic, vocal and psychological dimensions.

**Study 1**

2. Analyze the incidence of affective and anxiety disorders and the severity of depression and anxiety symptoms.

**Study 2**

3. Identify the existence of a personality profile and the personality disorders acting as vulnerability factors for the development of functional voice disorders.

**Study 3**

4. Explore if there is an association between affective temperaments and the three presentations of functional voice disorders.

**Study 4**

5. Analyze and compare the vocal characteristics of patients with functional voice disorders.

**Study 5**

6. Assess the impact of functional voice disorders based on the self-evaluation of quality of life and evaluate if there are differences in the impairment associated to functional, physical and emotional domains. Develop of a psychological and/or acoustic model for the self-perceived evaluation of quality of life for each group of patients with functional voice disorders.

**Study 6**

# CHAPTER 4

## Methods

*Setting*
*Design and Procedure*
*Evaluation Protocol*
*Variables*
*Statistics*

# 1. Setting

The present study took place at the Department of Ear, Nose, Throat, Voice and Communication Disorders (ENT Department), Santa Maria University Hospital (HSM), Otolaryngology University Clinic, Faculty of Medicine of the University of Lisbon, Lisbon, Portugal.

The Ethics Committee of the Santa Maria University Hospital (HSM), Faculty of Medicine, University of Lisbon (FML) (29$^{th}$ March 2012) approved this project.

## 2. Design and Procedure

An exploratory, descriptive, and cross-sectional study with a purposive sampling was performed to answer to six goals. Patients with functional voice disorders attending the outpatient clinic of the ENT Department had been participated in this study in the period between 30th June of 2012 and 20th November of 2013.

The clinical data collected for diagnosis resulted from clinical history with personal and vocal data and laryngological examination procedures. The videolaryngoscopy with rigid endoscope or flexible nasofiberscope was used to evaluate and document the morphology and the biomechanical properties of the vocal folds (e.g., mobility, regularity and symmetry, and glottal closure) during sustained vowel production. The patients were asked to sustain the vowel /i/ for getting better visualization. These data provide information necessary to exclude organic or neurologic factors in patients with a disturbed voice.

During the evaluation the ENT specialist or resident was also attentive to reflex activities (non communicative voices) that are preserved in psychogenic voice disorders.

After collecting all clinical data, the Diagnostic Classification System for Voice Disorders (DCSVD) proposed by Baker et al. in 2007 was used as diagnostic criteria for functional voice disorders.

### 2.1 - Recruitment

Patients were recruited to participant by ENT specialists or residents and/or by speech therapists, some after the first appointment and others later, based on the diagnosis of a functional voice disorder.

### 2.2 - Procedure

The researcher explained to each participant the major goal of the study - interest in understanding the relationship between functional voice disorders and psychological features - as well as the procedures involved.

All participants were informed that their participation would be voluntary and that they could at any time to disassociate from the study without prejudice in their treatments.

Each patient signed the written informed consent form (Appendix B), after having heard, read and understood all the explanations. When the participant began the evaluation, to ensure anonymity and confidentialiality, the data collection notebook was identified with a numerical code.

The same evaluation protocol was applied to all patients that were assessed in five areas: ENT examination, chracterization of subjects (sociodemographic, vocal and psychological data) (Study 1); psychological evaluation (Studies 2, 3 and 4); vocal acoustic evaluation (Study 5); and self-evaluation of quality of life (Study 6).

Considering the goals, the evaluation started with the recording of the voice, which was followed by the clinical interview and to the responses to the battery of tests ending with videolaryngoscopy.

## 2.3 - Psychological Evaluation Report

After completing the evaluation protocol, the patient was informed of the possibility to schedule an appointment, within two weeks, to receive the results of the psychological evaluation. The confidentiality of data was always ensured.

The patient was also informed that whenever justified, references would be made for psychological and/or psychiatric outpatient clinics namely the ENT Department and the Department of Psychiatric at Santa Maria Hospital (HSM).

It should be noted that all patients expressed interest in knowing their results, which reflects their concern with their current emotional state and vocal quality.

In this second contact information was provided about the illness, treatment and prognosis. The researcher expressed also availability to clarify doubts.

## 2.4 - Inclusion and Exclusion Criteria

Due to the high incidence of functional voice disorders in women, the present study included only female patients. Two male patients were evaluated, with the first having been referenced one year after the beginning of the sample collection.

The inclusion criteria were: female patients (aged over 18 years) with functional voice disorders, all of them outpatients of the Department of Ear, Nose, Throat, Voice and Communication Disorders (HSM).

The exclusion criteria were: being under age (a minor), European Portuguese not their first language, illiteracy, inadequate hearing status, pregnancy, puerperium, breast-feeding, transsexuality, neurologic disease, history of current cancer disease, organ transplant history, and malignant lesion of the larynx and/or in other otolaryngological territories.

## 2.5 - Adherence to Participation

There was a high adherence of participation. Only nine patients did not agree to participate due to lack of time (three patients), absence to scheduled dial evaluation (two patients), and others (four patients) declined without knowing the objectives.

# 3. Evaluation Protocol

The protocol included vocal acoustic evaluation, psychological assessment, self-evaluation of quality of life and the diagnosis and classification of functional voice disorder.

## 3.1 - Vocal Acoustic Evaluation

The recording took place in the Audiology room of the ENT Department, a Faraday Cage. A digital recorder was used with a unidirectional headset microphone placed at a distance of 5 cm from the mouth.

The voice analysis included the recording of three sustained vowels (/i/, /a/, and /u/) produced at a comfortable level. Besides this, cough recording was also performed.

This procedure occurred before the clinical interview avoiding influences on voice production and consequently on vocal quality.

The vocal signals were analyzed with Praat software (version 5.3.17) in seven acoustic measures, namely fundamental frequency, jitter, shimmer, vocal intensity, harmonic-to-noise ratio (HNR), and the first and second formants.

A more detailed description of this procedure is provided in Study 5.

## 3.2 - Clinical Data

The patients answered to a semi-structured interview with open and closed questions (Appendix C).

The interview explored the patient's sociodemographic data (age, education, employment status, marital status, and hobbies); habits (tobacco and alcohol); past and present medical history (acute and chronic diseases; surgical procedures; regular medication; hearing complaints; breathing problems; allergies; swallowing problems); voice use patterns (at home and at work; external comments about the voice); vocal symptoms (onset; type; evolution; current and/or past history of voice therapy; family history of voice disorders); psycological data (current and/or past mental health treatments; family history of psychiatric disorders).

## 3.3 - Psychological Evaluation

A set of standardized tests, mostly psychological instruments were applied (clinical and self-assessment tests):

**Clinical assessment tests:** Mini International Neuropsychiatric Interview (MINI); Hamilton Depression Rating Scale (HAM-D); and Hamilton Anxiety Rating Scale (HARS) (Study 2).

**Self-assessment tests:** Millon Clinical Multiaxial Inventory (MCMI-II) (Study 3); Temperament Evaluation of Memphis, Pisa, Paris and San Diego - Auto questionnaire (TEMPS-A) (Study 4).

The battery of tests was applied respecting the sequence of instruments present on the data collection notebook (Appendix D). Patients completed them in their own time. In case of doubts the researcher could clarify the questions.

The Rating Scales for depression and anxiety (HAM-D and HARS) were filled in at the end of the interview, based on the researcher's overall perception of the patient.

## 3.4 - Evaluation of Quality of Life

The self-evaluation of quality of life was assessed through the Voice Handicap Index (VHI-30) (Study 6).

The description of the listed instruments will be developed in Chapter "Results", in the respective study.

## 3.5 - ENT Evaluation

Patients were observed and evaluated by an ENT specialist or resident who made a videoendoscopy with a rigid endoscope (Karl Storz; Germany) or with a fibronasoendoscope (Olympus; Japan), which permitted the recording of the vocal folds in digital format.

The vocal folds were captured in the abduction and adduction positions, allowing the evaluation of their anatomy and movements.

Two other ENT specialists analyzed the endoscopic findings separately. If disagreement arose, the images were re-analyzed.

The patients were classified and clustered into three groups according to the classification system that was previously described: 39 patients (47%) in PVD group, 16 patients (19%) in MTVD1 group (primary muscle tension voice disorders), and 28 patients (34%) in MTVD2 group (secondary muscle tension voice disorders).

# 4. Variables

In the present work, the variables were aggregated into four categories in order to characterize the three study groups. The variables were systematized accordingly: characterization of subjects (Tables 1, 2 and 3), psychological evaluation (Table 4), vocal acoustic evaluation (Table 5), and self-evaluation of quality of life (Table 6).

**TABLE 1**

**Operationalization of the Variables for the Characterization of Subjects** (Part I)

| | **Characterization of Subjects** |
|---|---|
| **Sociodemographic Characteristics** | **Age:** Years. |
| | **Education**: Incompleted basic education, 1st cycle, 2nd cycle, 3rd cycle, secondary education, higher education, academic degree or master's degree. |
| | **Employment Status:** Housewife, employed, sick leave, unemployed or retired. |
| | **Marital Status:** Single, married, divorced or widowed. |
| **Health Behaviors** | **Smoking status**: Non-smoker, current smoker or past smoker. |
| | **Alcohol Consumption patterns:** Without, daily or occasionally. |

**TABLE 2**
**Operationalization of the Variables for the Characterization of Subjects** (Part II)

| Characterization of Subjects | |
|---|---|
| **Vocal Data** | **Vocal Symptoms:** Hoarseness, aphonia, vocal fatigue an/or intensity changes.<br><br>**Onset of the Vocal Symptoms:** Type (progressive or sudden); date knowledge (no or yes); past vocal symptom (no or yes).<br><br>**Time since the Onset of Vocal Symptoms:** Less than 1 month, 1 to 3 months, 3 to 6 months, 6 to 12 months, 12 to 18 months, 18 to 24 months, 2 to 5 years, 5 to 10 years or more than 10 years.<br><br>**Comments made by Others about the Patients' Voice:** Without, speak loud, not understood or not heard.<br><br>**Family History of Voice Disorders:** Prevalence (without or with); etiology of the voice disorder (benign, malignancy, psychogenic, unknown); identification of the family members with voice disorders with reference to the etiology (Appendix E).<br><br>**Current History of Speech Therapy:** Without or with; current status (keeps, discharged or disengagement) (Appendix E), past (past history, previously same vocal symptoms); self-perception on future benefits (uncertainly, no or yes) (Appendix E).<br><br>**Vocal Behavior:** Not applied, talk much, talk less, strives voice, abuse of phone, and a combination of one or more; vocal behavior at home and at work (Appendix E). |

**TABLE 3**
**Operationalization of the Variables for the Characterization of Subjects** (Part III)

| Characterization of Subjects | |
|---|---|
| | **Current Mental Health Treatments:** Psychological, psychiatric or both. |
| | **Pharmacotherapy:** Without or with; Current psychotropic medication (no or yes); psychotropic medication (anxiolytic; antidepressant, anticonvulsivant, anxiolytic and antidepressant, anxiolytic and anticonvulsivant, antidepressant and anticonvulsivant; anxiolytic, antidepressant and antipsychotic. |
| | **Treatments in Mental Health Services:** Psychological or psychiatric treatments, or both treatments; self-perception on future benefits with mental health treatment (uncertainly, no or yes). |
| **Psychological Data** | **Family History of Psychiatric Disorders:** Prevalence (without or with). |
| | - **Psychiatric Disorders in the Family:** Frequency (n); number of family members (1,2,3 or 4) and etiology of psychiatric disorders (affective disorders, anxiety disorders, psychotic disorders, alcohol dependence, drug dependence, AHDH, epilepsy, dementia, anorexia nervosa, and co-morbidity) of direct family members; number of family members (1,2,3,4,5 or 7) and etiology of psychiatric disorders (affective disorders, anxiety disorders, alcohol dependence, drug dependence, AHDH, epilepsy, dementia, mental retardation, and co-morbidity) of other family members (Appendix E). |
| | - **Family History of Suicidal Behaviors:** Frequency (n) for suicide attempt; frequency (n) on suicides; identification of family members with suicide attempts (father, mother, uncle and cousin); identification of family members who committed suicide (mother, daughter, brother, uncle, grandfather) (Appendix E). |

**TABLE 4**
**Operationalization of the Variables resulting from the Psychological Evaluation**

| | Psychological Evaluation |
|---|---|
| **Psychological Tests** | **HAM-D:** Severity of symptoms of depression. |
| | **HARS:** Severity of symptoms of anxiety. |
| | **MINI:** Presence or absence of psychiatric disorders (current and past). |
| | **MCMI-II:** Presence or absence of personality traits and personality disorders, and clinical syndromes. |
| | **TEMPS-A:** Presence or absence of affective temperaments. |

**TABLE 5**
**Operationalization of the Variables resulting from the Vocal Acoustic Evaluation**

| Vocal Acoustic Evaluation | |
|---|---|
| **Vocal Acoustic Parameters** | Fundamental frequency (F0); jitter; shimmer; vocal intensity; harmonic-to-noise ratio (HNR); formants: $F_1$ and $F_2$. |

**TABLE 6**
**Operationalization of the Variables resulting from the Self-evaluation of Quality of Life**

| Self-evaluation of Quality of Life | |
|---|---|
| **Quality of Life in Voice Disorders** | **VHI-30:** Self-perception of voice handicap and disability (total score; scores for functional, physical, and emotional subscales). |

# 5. Statistics

A database was specifically built for the present study using SPSS Statistic v21.0 for Mac OS (IBM Corporation, Chicago, IL).

After introducing the collected data, some variables were reviewed in order to enable better visualization and to assist in their handling.

Descriptive statistics were used to characterize the three groups (PVD, MTVD1 and MTVD2): means, standard deviations (*SD*s), and minimum and maximum values for continuous variables, and frequencies, percentages and adjusted residuals for categorical variables.

Different statistical tests procedures were applied in the six studies according to their goals and the specificity of the variables under analysis.

All statistical tests were analyzed with a significance level set at 5%.

# CHAPTER 5

## Results

*Study 1*
**Characterization of Subjects**

*Study 2*
**Affective and Anxiety Disorders, Severity of Depression and Anxiety Symptoms**

*Study 3*
**Personality Profile**

*Study 4*
**Affective Temperaments**

*Study 5*
**Vocal Acoustic Evaluation**

*Study 6*
**Self-evaluation of Quality of Life**

# Characterization of Subjects

## Study 1

The semi-structured interview allowed the sociodemographic, vocal, and psychological characterization of the three groups based on a set of variables (1st Goal), being the most relevant information presented in this study. Additional data was included in the Appendix E.

### 1. Constitution of the Groups

A total of eighty-three (83) female patients with functional voice disorders, ages between 18 and 83 years and with a mean age of 52.51 years (standard deviation [*SD*] = 14.27) were eligible for inclusion and after ENT examination were classified and clustered in three groups (Figure 4).

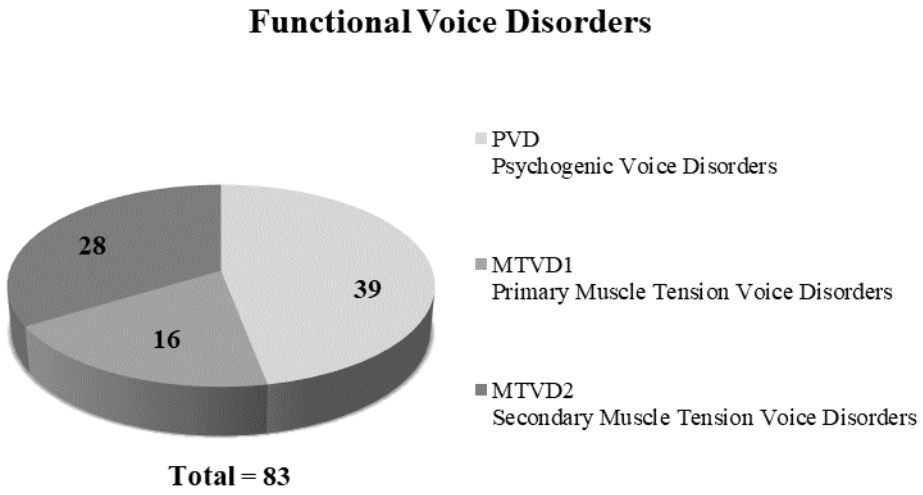


**FIGURE 4. - Patients with Functional Voice Disorders by Group.**

## 2. Sociodemographic Characteristics

### 2.1 - Gender

In the literature, women in comparison to men have a higher risk of having functional voice disorders. It is noteworthy that the first of two men was referenced for participation one year after the beginning of the sample collection.

This study had an exclusive participation of females (83 subjects).

### 2.2 - Age

Table 7 presents descriptive measures for age by Group.

Our patients had a mean age of 52.51 years, with ages ranging from 18 to 83 years. There were no large variations of mean ages by Group.

**TABLE 7**
**Age by Group:** Mean, Standard Deviation, Minimum and Maximum

| | Mean | *SD* | Minimum | Maximum |
|---|---|---|---|---|
| **PVD** | 55.1 | 11.97 | 28 | 79 |
| **MTVD1** | 48.6 | 17.50 | 18 | 71 |
| **MTVD2** | 51.2 | 15.04 | 21 | 83 |

*Abbreviations:* MTVD1, Primary Muscle Tension Voice Disorders; MTVD2, Secondary Muscle Tension Voice Disorders; PVD, Psychogenic Voice Disorders; *SD*, Standard Deviation.

For age, statistically significant differences between groups were not found ($F_{[2,80]} = 1.377$, $p = .258$).

### 2.3 - Education

For the analysis of these data as well as for other variables, it is necessary to consider the healthcare sector in which the recruitment of the sample occured. Our study was performed in a public hospital of the national health system, which confers different characteristics from a private hospital namely in the level of education.

Table 8 presents descriptive measures for education by Group.

Education was reported as years of formal schooling. The group of patients with secondary muscle tension voice disorders (MTVD2) had registered a slight higher mean

value compared to the other two groups (MTVD1 and PVD). Maximum educational level was found in secondary muscle tension voice disorders group (MTVD2) while minimum education level belongs to both groups of patients with muscle tension voice disorders (MTVD1 and MTVD2).

**TABLE 8**
**Education by Group:** Mean, Standard Deviation, Minimum and Maximum

| | Mean | *SD* | Minimum | Maximum |
|---|---|---|---|---|
| **PVD** | 8.6 | 4.29 | 4 | 17 |
| **MTVD1** | 9.5 | 5.16 | 3 | 17 |
| **MTVD2** | 10.8 | 4.32 | 3 | 19 |

*Abbreviations:* MTVD1, Primary Muscle Tension Voice Disorders; MTVD2, Secondary Muscle Tension Voice Disorders; PVD, Psychogenic Voice Disorders; *SD*, Standard Deviation.

For education, there were no statistically differences between the means of the groups ($F_{[2,80]} = 2.011$, $p = .141$).

### 2.4 - Employment Status

Profession was categorized into five categories: housewife, employed, sick leave, unemployed and retired (Table 9).

Nearly 60% of the patients had an active professional life while the others were retired (21.7%), unemployed (10.8%) or housewives (6.0%). The only group without unemployment rate was the primary muscle tension voice disorders group (MTVD1).

In the three groups the employed condition had stand out followed by the retired. The third most frequent status among patients with psychogenic and with secondary muscle tension voice disorders (PVD and MTVD2) was the unemployed. Housewife condition was more common among patients with secondary muscle tension voice disorders (MTVD2) followed closely by the two other groups (PVD and MTVD1). Sick leave patients were found in low percentages in both primary and secondary muscle tension voice disorders groups (MTVD1 and in MTVD2) and there was no sick leave patient with psychogenic voice disorders (PVD).

**TABLE 9**
**Employment Status by Group:** Frequency and Percentage

| | Housewife | Employed | Sick Leave | Unemployed | Retired |
|---|---|---|---|---|---|
| **PVD** | 2 (5.1%) | 20 (51.3%) | 0 (0.0%) | 6 (15.4%) | 11 (28.2%) |
| **MTVD1** | 1 (6.3%) | 11 (68.8%) | 1 (6.3%) | 0 (0.0%) | 3 (18.8%) |
| **MTVD2** | 2 (7.1%) | 18 (64.3%) | 1 (3.6%) | 3 (10.7%) | 4 (14.3%) |

*Abbreviations:* MTVD1, Primary Muscle Tension Voice Disorders; MTVD2, Secondary Muscle Tension Voice Disorders; PVD, Psychogenic Voice Disorders.

There was no statistical association between Group and employment status ($\chi^2 = 6.983$, $df = 8$, $p = .538$).

## 2.5 - Marital Status

Table 10 presents descriptive statistics for marital status by Group.

The married condition was the most frequent marital status among the three groups.

**TABLE 10**
**Marital Status by Group:** Frequency, Percentage and Adjusted Residual

| | | Single | Married | Divorced | Widowed |
|---|---|---|---|---|---|
| **PVD** | Frequency (%) | 2 (5.1%) | 24 (61.5%) | 10 (25.6%) | 3 (7.7%) |
| | Adjusted Residual | - 2.1 | -.2 | 2.0 | .2 |
| **MTVD1** | Frequency (%) | 6 (37.5%) | 10 (62.5%) | 0 (0.0%) | 0 (0.0%) |
| | Adjusted Residual | 3.2 | .0 | - 2.0 | - 1.2 |
| **MTVD2** | Frequency (%) | 3 (10.7%) | 18 (64.3%) | 4 (14.3%) | 3 (10.7%) |
| | Adjusted Residual | - .5 | .2 | -.4 | .9 |

*Abbreviations:* MTVD1, Primary Muscle Tension Voice Disorders; MTVD2, Secondary Muscle Tension Voice Disorders; PVD, Psychogenic Voice Disorders.

Chi-square test showed significant differences in association between Group and marital status ($\chi^2 = 15.424$, $df = 6$, $p = .017$).

In the group of patients with primary muscle tension voice disorders (MTVD1) there were more single patients than expected, and there were no divorced or widowed patients, whereas in the psychogenic voice disorders group (PVD) there were fewer single patients and more divorced patients than expected.

## 3. Health Behaviors

To identify voice-related life style habits, patients were asked if they had hobbies that involved voice use. The majority were chorists, with eight patients singing in choirs (religious or recreational) and two patients participated in amateur theater. These patients showed increased susceptibility to experience the impact of vocal changes in their hobbies but also socially and professionally.

Tobacco and alcohol interfere with voice quality and have a strong link with vocal diseases.

### 3.1 - Smoking Status

Table 11 presents descriptive statistics for smoking status by Group.

The group that showed the highest percentage for non-smokers was the psychogenic voice disorders group (PVD = 82.1%). Current smokers were more frequently found in the group of patients with secondary muscle tension voice disorders (MTVD2 = 25.0%).

Nearly a quarter of patients from primary and secondary voice disorders groups were past smokers (MTVD1 = 25.0% and MTVD2 = 28.6%).

**TABLE 11**
**Smoking Status by Group:** Frequency, Percentage and Adjusted Residual

| | | Non-smokers | Current smokers | Past smokers |
|---|---|---|---|---|
| **PVD** | Frequency (Percentage) | 32 (82.1%) | 1 (2.6%) | 6 (15.4%) |
| | Adjusted Residual | 2.5 | - 2.1 | - 1.3 |
| **MTVD1** | Frequency (Percentage) | 12 (75.0%) | 0 (0.0%) | 4 (25.0%) |
| | Adjusted Residual | .6 | - 1.5 | .4 |
| **MTVD2** | Frequency (Percentage) | 13 (46.4%) | 7 (25.0%) | 8 (28.6%) |
| | Adjusted Residual | - 3.1 | 3.4 | 1.1 |

*Abbreviations:* MTVD1, Primary Muscle Tension Voice Disorders; MTVD2, Secondary Muscle Tension Voice Disorders; PVD, Psychogenic Voice Disorders.

Statistically significant association between Group and smoking status was found ($\chi^2 = 14.957$, $df = 4$, $p = .005$).

The adjusted residuals showed that in the psychogenic voice disorders group (PVD) there were more non-smokers patients and less current smokers than expected while in the group of patients with secondary muscle tension voice disorders (MTVD2) there were less non-smokers patients and more current smokers than expected (Table 11).

### 3.2 - Alcohol Consumption Patterns

Table 12 presents descriptive measures for alcohol consumption patterns by group.

Most of the participants from the three groups had no alcohol consumption (without condition) (PVD = 46.2%, MTVD1 = 62.5% and MTVD2 = 53.6%) and the second highest frequency was occasionally consumption pattern (PVD = 43.6%, MTVD1 = 37.5% and MTVD2 = 39.3%). Patients with primary muscle tension voice disorders (MTVD1) had no daily consumption.

**TABLE 12**
**Alcohol Consumption Patterns by Group:** Frequency and Percentage

| | Without | Daily | Occasionally |
|---|---|---|---|
| **PVD** | 18 (46.2%) | 4 (10.2%) | 17 (43.6%) |
| **MTVD1** | 10 (62.5%) | 0 (0.0%) | 6 (37.5%) |
| **MTVD2** | 15 (53.6%) | 2 (7.1%) | 11 (39.3%) |

*Abbreviations:* MTVD1, Primary Muscle Tension Voice Disorders; MTVD2, Secondary Muscle Tension Voice Disorders; PVD, Psychogenic Voice Disorders.

Statistically significant association between Group and alcohol consumption patterns was not found ($\chi^2 = 2.394$, $df = 4$, $p = .664$).

Regarding alcohol consumption, without use pattern was the most frequent in the three groups, but when presented it occurred on an occasional basis.

# 4. Vocal Data

## 4.1 - Onset of the Vocal Symptoms

Table 13 presents the description made by Group regarding the type of the onset of the vocal symptoms, the knowledge of the date of the onset, and if they had experienced the same vocal symptom in the past.

Considering the type of the onset, both groups of patients with psychogenic and secondary muscle tension voice disorders (PVD and MTVD2) had experienced mostly a progressive course while patients from primary muscle tension voice disorders group (MTVD1) had reported more frequently a sudden start.

**TABLE 13**
**Onset of the Vocal Symptoms by Group:** Frequency and Percentage

| | Type of Onset | | Date of Onset | | Past Vocal Symptom | |
|---|---|---|---|---|---|---|
| | Progressive | Sudden | No | Yes | No | Yes |
| **PVD** | 21 (53.8%) | 18 (46.2%) | 16 (41.0%) | 23 (59.0%) | 28 (7.1%) | 11 (28.2%) |
| **MTVD1** | 7 (43.8%) | 9 (56.3%) | 8 (50.0%) | 8 (50.0%) | 9 (56.2%) | 7 (43.8%) |
| **MTVD2** | 18 (64.3%) | 10 (35.7%) | 16 (57.1%) | 12 (42.9%) | 22 (78.6%) | 6 (21.4%) |

*Abbreviations:* MTVD1, Primary Muscle Tension Voice Disorders; MTVD2, Secondary Muscle Tension Voice Disorders; PVD, Psychogenic Voice Disorders.

It is commonly reported that patients with psychogenic voice disorders (PVD) very often indicate the precise date of the beginning of the vocal symptom, which they often associate with a striking event expressed as: “It was 15 days ago, I was talking to a colleague and she suddenly said: you're running out of voice”; “A year ago after a conflict”; “Five years ago during the college internship”; “Ten years ago after talking to a person who told me: I'm only happy when I completely destroy you”. In fact patients with psychogenic voice disorders (PVD) had a better knowledge on the date of the onset of the vocal symptom compared to patients from the two other groups (MTVD1 and MTVD2) (Table 13), but there was no association between Group and the knowledge on the precise date of the onset ($\chi^2 = 1.722$, $df = 2$, $p = .423$).

As seen in Table 13, nearly half of the patients with primary muscle tension voice disorders (MTVD1) reported a previous experience of similar vocal symptoms in

percentages that were almost the double than those obtained by the two other groups (PVD and MTVD2). There was no association between Group and similar past vocal symptom experience ($\chi^2 = 2.486$, $df = 2$, $p = .288$).

## 4.2 - Vocal Symptoms

Table 14 presents the vocal symptoms experienced by the patients by Group.

Regarding the three groups, the most frequent vocal symptoms were vocal fatigue and intensity changes, and the vocal symptom that was less experienced was aphonia.

For patients with psychogenic voice disorders (PVD), the biggest complaint was vocal fatigue (≈ 97%) closely followed by intensity changes (≈ 92%) and hoarseness (≈ 90%).

The secondary muscle tension voice disorders group (MTVD2) was the group that reported greatest changes in vocal quality: hoarseness (100.0%), intensity changes (100.0%) and vocal fatigue (≈ 93%).

Concerning the group of patients with primary muscle tension voice disorders (MTVD1), vocal fatigue (≈ 88%) continues to be the most frequent as intensity changes (≈ 88%), while hoarseness had a percentage value close to 69%.

**TABLE 14**
**Vocal Symptoms by Group:** Frequency and Percentage

| | Hoarseness | Aphonia | Vocal fatigue | Intensity changes |
|---|---|---|---|---|
| **PVD** | 35 (89.7%) | 18 (46.2%) | 38 (97.4%) | 36 (92.3%) |
| **MTVD1** | 11 (68.8%) | 8 (50.0%) | 14 (87.5%) | 14 (87.5%) |
| **MTVD2** | 28 (100.0%) | 10 (35.7%) | 26 (92.9%) | 28 (100.0%) |

*Abbreviations:* MTVD1, Primary Muscle Tension Voice Disorders; MTVD2, Secondary Muscle Tension Voice Disorders; PVD, Psychogenic Voice Disorders.

It was verified that the group with the highest frequency of vocal symptoms was the secondary muscle tension voice disorders group (MTVD2) followed by the psychogenic voice disorders group (PVD). However, patients with primary muscle tension voice disorders (MTVD1) also presented vocal fatigue, intensity changes, hoarseness and even aphonia although in comparatively lower percentages.

With Chi-square test procedure, statistically differences in association between Group and vocal symptoms were found for hoarseness ($\chi^2 = 10.311$, $df = 2$, $p = .006$).

Table 15 presents descriptive statistics for hoarseness by Group.

All patients with secondary muscle tension voice disorders (MTVD2) had complained about hoarseness while nearly 70% of the patients with primary muscle tension voice disorders (MTVD1) had the same complained.

**TABLE 15**
**Hoarseness by Group:** Frequency, Percentage and Adjusted Residual

| | | **Hoarseness** |
|---|---|---|
| **PVD** | Frequency (Percentage) | 35 (89.7%) |
| | Adjusted Residual | - .2 |
| **MTVD1** | Frequency (Percentage) | 11 (68.8%) |
| | Adjusted Residual | - 2.9 |
| **MTVD2** | Frequency (Percentage) | 28 (100.0%) |
| | Adjusted Residual | 2.3 |

*Abbreviations:* MTVD1, Primary Muscle Tension Voice Disorders; MTVD2, Secondary Muscle Tension Voice Disorders; PVD, Psychogenic Voice Disorders.

The analysis of adjusted residual indicates that in the primary muscle tension voice disorders group (MTVD1) there were fewer patients who complain of hoarseness than expected while patients with secondary muscle tension voice disorders (MTVD2) reported more complains of hoarseness than expected.

## 4.3 - Time Since the Onset of the Vocal Symptoms

Figure 5 represents the time since the onset of at least one vocal symptom. The definition of periods of time was made based on the patient's report.

In the group of patients with psychogenic voice disorders (PVD) vocal symptoms were more frequently found between two to five years (23.1%) and for three to six months (17.9%).

Patients with primary muscle tension voice disorders (MTVD1) were more often distributed in two time periods, the first was between twelve and eighteen months (31.3%) and the other from one to three months (25.0%).

In the secondary muscle tension voice disorders group (MTVD2), vocal symptoms had frequently arise between two to five years (39.3%) and for more than ten years (17.9%).

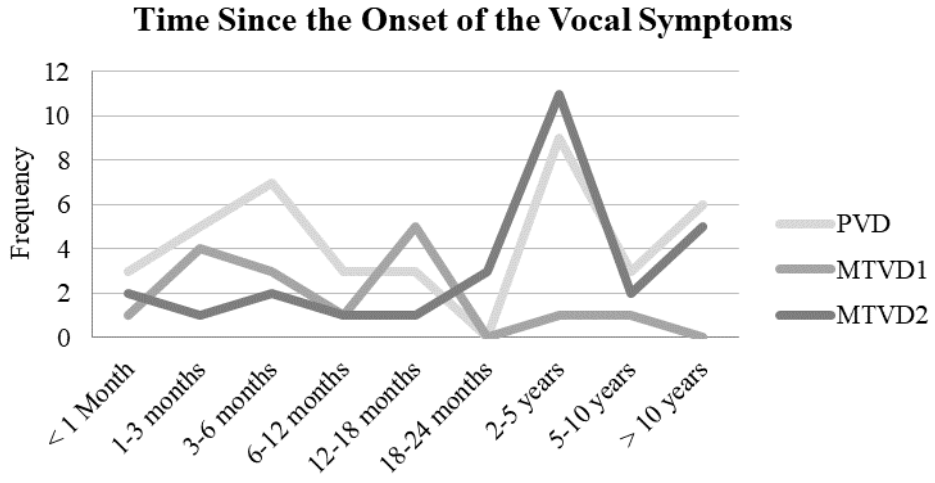


**FIGURE 5. - Time since the Onset of the Vocal Symptom by Group.**
*Abbreviations:* MTVD1, Primary Muscle Tension Voice Disorders; MTVD2, Secondary Muscle Tension Voice Disorders; PVD, Psychogenic Voice Disorders

There was a statistically significance in association between Group and the time since the onset of vocal symptoms ($\chi^2 = 27.011$, $df = 16$, $p = .041$).

Patients with secondary muscle tension voice disorders (MTVD2) presented long symptomatic periods and patients with primary muscle tension voice disorders (MTVD1) had a shorter symptom evolution.

## 4.4 - Comments made by others about the Patient's Voice

Patients from the outpatient clinic of the ENT Department frequently reported that others made comments about their voices. The most common comments were: "speaks loud", "not understood" and "not heard". It was asked to our patients to identify the one that was most frequently addressed.

Table 16 presents descriptive statistics of the comments that others make about the voice of the patient by Group.

**TABLE 16**
**Comments made by Others about the Patient's Voice by Group:** Frequency, Percentage and Adjusted Residual

| | | Without | Speaks loud | Not Understood | Not Heard |
|---|---|---|---|---|---|
| **PVD** | Frequency | 15 | 7 | 3 | 8 |
| | Percentage | 45.5% | 21.2% | 9.1% | 24.2% |
| | Adjusted Residual | - 1.8 | .1 | .7 | 1.9 |
| **MTVD1** | Frequency | 4 | 5 | 2 | 2 |
| | Percentage | 30.8% | 38.5% | 15.4% | 15.4% |
| | Adjusted Residual | - 2.1 | 1.7 | 1.3 | .0 |
| **MTVD2** | Frequency | 22 | 3 | 0 | 1 |
| | Percentage | 84.6% | 11.5% | 0.0% | 3.8% |
| | Adjusted Residual | 3.6 | -1.5 | - 1.7 | - 2.0 |

*Abbreviations:* MTVD1, Primary Muscle Tension Voice Disorders; MTVD2, Secondary Muscle Tension Voice Disorders; PVD, Psychogenic Voice Disorders.

There was a statistically significance in association between Group and the comments on patients' voice done by others ($\chi^2 = 16.163$, $df = 6$, $p = .013$).

The analysis of adjusted residual revealed that in primary muscle tension voice disorders group (MTVD1) there were less patients without comments about their voices than expected while patients with secondary muscle tension voice disorders (MTVD2) reported more comments about their voices than expected. In this group there were also less patients with the comment "not heard" than expected (Table 16).

## 4.5 - Current History of Speech Therapy

Table 17 presents the current history of speech therapy in the last six months by Group.

During this period of time, patients from the three groups were attending speech therapy sessions (PVD = 43.6%, MTVD1 = 50.0% and MTVD2 = 57.1%).

**TABLE 17**
**Current History of Speech Therapy by Group:** Frequency and Percentage

| | Without | With |
|---|---|---|
| **PVD** | 17 (43.6%) | 22 (56.4%) |
| **MTVD1** | 8 (50.0%) | 8 (50.0%) |
| **MTVD2** | 16 (57.1%) | 12 (42.9%) |

*Abbreviations:* MTVD1, Primary Muscle Tension Voice Disorders; MTVD2, Secondary Muscle Tension Voice Disorders; PVD, Psychogenic Voice Disorders.

There was no association between Group and current history of speech therapy ($\chi^2 = .239$, $df = 2$, $p = .887$).

Table 18 presents the current status on speech therapy by Group.

In the last six months, patients from the three groups received guidance by a speech therapy (PVD = 56.4%, MTVD1 = 50.0% and MTVD2 = 42.9%).

During this period, almost 19% of patients with primary muscle tension voice disorders (MTVD1) had ended their treatments with a speech therapist and patients from this group also disrupted more frequently their treatment (MTVD1 = 6.3%).

Patients with secondary muscle tension voice disorders (MTVD2) did not present treatment dropout.

**TABLE 18**
**Current Status on Speech Therapy by Group:** Frequency and Percentage

| | Keeps | Discharged | Disengagement |
|---|---|---|---|
| **PVD** | 17 (44.7%) | 3 (7.9%) | 1 (2.6%) |
| **MTVD1** | 5 (31.3%) | 3 (18.8%) | 1 (6.3%) |
| **MTVD2** | 14 (50.0%) | 2 (7.1%) | 0 (0.0%) |

*Abbreviations:* MTVD1, Primary Muscle Tension Voice Disorders; MTVD2, Secondary Muscle Tension Voice Disorders; PVD, Psychogenic Voice Disorders.

There was no association between Group and the characteristics and current status on speech therapy ($\chi^2 = 4.139$, $df = 6$, $p = .658$).

## 4.6 - Family History of Voice Disorders

The data regarding the prevalence and etiology of voice disorders in the patients' families was based only on their reports. All information was purely informative because it

had no medical confirmation. These data indicated the perception and some knowledge that each participant had of the existence or not of a voice disorder in his/her family.

### 4.6.1 - Prevalence

The prevalence of family history of voice disorders in the three groups was nearly one quarter. The group of patients with secondary muscle tension voice disorders (MTVD2 = 21.4%) had more family members with voice disorders compared to the other groups although the incidence in the primary muscle tension voice disorders group was not so comparatively low (MTVD1 = 18.8%).

**TABLE 19**
**Prevalence of Family History of Voice Disorders by Group:** Frequency and Percentage

| | Without | With |
|---|---|---|
| **PVD** | 35 (89.7%) | 4 (10.3%) |
| **MTVD1** | 13 (81.2%) | 3 (18.8%) |
| **MTVD2** | 22 (78.6%) | 6 (21.4%) |

*Abbreviations*: MTVD1, Primary Muscle Tension Voice Disorders; MTVD2, Secondary Muscle Tension Voice Disorders; PVD, Psychogenic Voice Disorders.

There was no association between the prevalence of family history of voice disorders and Group ($\chi^2$ = 1.683, *df* = 2, *p* = .431). Before this result it was decided to present in the Appendix E the frequency of the diagnoses of voice disorder as well as the identification of the respective family member by Group.

## 5. Psychological Data

### 5.1 - Current Mental Health Treatments

Table 20 presents descriptive measures for current mental health treatments (psychological, psychiatric or both) by Group.

Considering the total sample, 24.1% were patients from the outpatient clinics of mental health services.

Regarding the three groups, 43.8% of patients from primary muscle tension voice disorders group (MTVD1), 25.0% of patients from secondary muscle tension voice

disorders (MTVD2) group and 15.4% of patients from psychogenic voice disorders group (PVD) were current on mental health treatment.

Psychological treatment alone was more frequently among patients with secondary muscle tension voice disorders (MTVD2 = 7.1%), psychiatric treatment alone was more common in patients with primary muscle tension voice disorders (MTVD1 = 31.3%), and both treatments were found in the three groups (PVD = 5.1%, MTVD1 = 6.3% and MTVD2 = 7.1%).

**TABLE 20**
**Mental Health Treatments by Group:** Frequency and Percentage

| | Psychological | Psychiatric | Both |
|---|---|---|---|
| **PVD** | 1 (2.6%) | 3 (7.7%) | 2 (5.1%) |
| **MTVD1** | 1 (6.3%) | 5 (31.3%) | 1 (6.3%) |
| **MTVD2** | 2 (7.1%) | 3 (10.7%) | 2 (7.1%) |

*Abbreviations:* MTVD1, Primary Muscle Tension Voice Disorders; MTVD2, Secondary Muscle Tension Voice Disorders; PVD, Psychogenic Voice Disorders.

There was no association between the type of mental health treatments and Group ($\chi^2 = 7.068$, $df = 6$, $p = .315$).

## 5.2 - Psychopharmacology

### 5.2.1 - Pharmacotherapy

Table 21 represents the percentage of patients under pharmacotherapy by Group. Percentage values were very similar among the three groups.

Patients with primary muscle tension voice disorders (MTVD1) had a higher frequency on psychiatric treatment and also had the highest use of psychoactive drugs.

Patients with secondary muscle tension voice disorders (MTVD2) were equally distributed in the two categories.

**TABLE 21**
**Pharmacotherapy by Group:** Frequency and Percentage

| | Without | With |
|---|---|---|
| **PVD** | 22 (56.4%) | 17 (43.6%) |
| **MTVD1** | 7 (43.8%) | 9 (56.3%) |
| **MTVD2** | 14 (50.0%) | 14 (50.0%) |

*Abbreviations*: MTVD1, Primary Muscle Tension Voice Disorders; MTVD2, Secondary Muscle Tension Voice Disorders; PVD, Psychogenic Voice Disorders.

There was no statistically association between Group and pharmacotherapy ($\chi^2 = .784$, $df = 2$, $p = .676$).

### 5.2.2 - Psychotropic Medication

Table 22 presents descriptive measures for patients under pharmacotherapy by Group. Patients could have a prescription with one or more family groups of psychopharmacs such as antidepressants, anxiolytics, anticonvulsivants and antipsychotics.

Antidepressant combined with anxiolytics was the most frequent prescription among the three groups (PVD = 38.9%, MTVD1 = 22.2% and MTVD2 = 21.4%).

Antidepressants as a single drug prescription had similar percentages in the three groups, values that round 20%. The same was found for anxiolytics with a slightly higher percentage value (≈ 30%).

There was no statistically association between Group and pharmacotherapy ($\chi^2 = 8.237$, $df = 14$, $p = .877$).

**TABLE 22**

**Psychotropic Medication by Group:** Frequency and Percentage

| | Anxiolytic | Antidepressant | Anticonvulsivant | Anxiolytic Antidepressant | Antidepressant Anticonvulsant | Anxiolytic Anticonvulsant | Anxiolytic Antidepressant Antipsychotic |
|---|---|---|---|---|---|---|---|
| **PVD** | 5 (27.8%) | 3 (16.7%) | 1 (5.6%) | 7 (38.9%) | 1 (5.6%) | 0 (0.0%) | 1 (5.6%) |
| **MTVD1** | 3 (33.3%) | 2 (22.2%) | 0 (0.0%) | 2 (22.2%) | 1 (11.1%) | 1 (11.1%) | 0 (0.0%) |
| **MTVD2** | 5 (35.7%) | 3 (21.4%) | 1 (7.1%) | 3 (21.4%) | 2 (14.3%) | 0 (0.0%) | 0 (0.0%) |
| **TOTAL** | 13 (31.7%) | 8 (19.5%) | 2 (4.9%) | 12 (29.3%) | 4 (9.8%) | 1 (2.4%) | 1 (2.4%) |

*Abbreviations:* MTVD1, Primary Muscle Tension Voice Disorders; MTVD2, Secondary Muscle Tension Voice Disorders; PVD, Psychogenic Voice Disorders.

## 5.3 - Family History of Psychiatric Disorders

The data regarding the family history of psychiatric disorders was based only on the patients' reports thus there was no medical confirmation as in the family history of voice disorders.

Mental health results from a dynamic equilibrium from the interaction of the individual with his/her many environments. The organic and genetic characteristics as well as the personal and family history play an important role in those interactions. This justifies the special attention that was given to the family history of psychiatric disorders.

All information given by the patient although for informational purposes had clinical interest to the extend that corresponds to the representation of the diagnoses of mental illness in the patient's families by Group.

### 5.3.1 - Prevalence

Table 23 presents descriptive measures for the prevalence of family history of psychiatric disorders by Group.

The three groups reported a considerable high percentage of family history of psychiatric disorders (PVD = 71.8%, MTVD1 = 68.7% and MTVD2 = 67.9%).

**TABLE 23**
**Prevalence of Family History of Psychiatric Disorders by Group:** Frequency and Percentage

| | Without | With |
|---|---|---|
| **PVD** | 11 (28.2%) | 17 (71.8%) |
| **MTVD1** | 5 (31.3%) | 11 (68.7%) |
| **MTVD2** | 9 (32.1%) | 19 (67.9%) |

*Abbreviations*: MTVD1, Primary Muscle Tension Voice Disorders; MTVD2, Secondary Muscle Tension Voice Disorders; PVD, Psychogenic Voice Disorders.

There was no statistically association between the prevalence of family history of psychiatric disorders and Group ($\chi^2$ = .132, $df$ = 2, $p$ = .936).

In the analysis of family history of psychiatric disorders, family members were divided into direct and others. For these two groups of relatives, information regarding incidence, etiology and suicidal behaviors (suicide attempts and suicides) was collected and presented in Appendix E.

For a better characterization of the psychological profile of these patients and the impact that psychological features may have on functional voice disorders, it was preferred to approach these data in a global perspective in chapter "General Discussion and Conclusions".

# Affective and Anxiety Disorders, Severity of Depression and Anxiety Symptoms

**Study 2**

## 1. Introduction

Patients with functional voice disorders (FVDs) have been described as having interpersonal sensitivity or estrangement and distrust of others (Baker et al., 2007; Lauriello, Cozza, & Rossi, 2003; Mirza et al., 2003) and as being very reactive to stressful life events (Baker, 2008). Whenever FVDs are analyzed, reference to psychiatric illness always arises. All these factors may interfere with the etiopathogenesis of FVDs, such as worsening the vocal condition or delaying the patient's vocal recovery.

The review of the studies that focused on the evaluation of patients with functional voice disorders raised some methodological issues: small sample sizes (Aronson, Peterson, & Litin, 1966; House & Andrews, 1987; Roy et al., 1997), a study group consisting of both genders, a non-homogeneous number of participants being compared with a vocally healthy control group (Aronson et al., 1966; Dietrich et al., 2008; Gerritsma, 1991; Roy et al., 1997), and whenever the goal was to analyze the frequency of psychological variables in samples with voice disorders, too often these studies resorted to the use of a semi-structured interview and self-report psychological standardized tests (Baker et al., 2012; Barakah et al., 2012; Dietrich et al., 2008; Gerritsma et al., 1991; Misono et al., 2014; Roy et al., 1997; Smits et al., 2012).

In addition to these methodological issues, the choice of nomenclature raised the question about the real meaning of these labels as they only provide information about the presence of psychological variables in the etiopathogenesis of FVDs. More recently, terms as depression, anxiety, and personality disorders have become commonly used in literature when referring to FVDs patients either at a syndromatic or nosological level according to the DSM-IV and to the International Statistical Classification of Diseases and Related Health Problems criteria (ICD-10).

Willinger et al. (2005) assessed the severity of depressive symptoms of 61 patients with functional dysphonia, and they concluded that 33% of the patients showed clinically significant depressive symptoms, with a percentage far superior to that obtained by the healthy control group. The authors also used a standardized psychiatric interview that allowed them to diagnose 33% of FVDs patients with mood disorders and 20% with

anxiety disorders, based on the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) criteria for Axis I (Willinger et al., 2005).

Kotby et al. (2003) evaluated the severity of anxiety symptoms in a comparative study with 100 patients diagnosed with non-organic voice disorders and 50 normal individuals (control group). Elements of both genders were present in both groups. For the sum of mild, moderate, and severe categories of anxiety severity, subjects with non-organic voice disorders scored 43% and individuals of the control group reached a value of 6%.

The main purpose of this study was to investigate and compare the incidence of affective and anxiety disorders and to analyze and compare the severity of depression and anxiety symptoms between the three groups of patients with functional voice disorders (2nd Goal).

## 2. Procedure

The battery of psychological tests included the following standardized tests: Mini International Neuropsychiatric Interview, Hamilton Depression Rating Scale and Hamilton Anxiety Rating Scale.

The *Mini International Neuropsychiatric Interview* (MINI; v.5.0.0) is a brief standardized diagnostic interview in clinical and research practices (Øhre, Saltnes, von Tezchner, & Falkum, 2014). It was developed in 1990 by two psychiatrists, David V. Sheehan (United States) and Yves Lecrubier (France), for the diagnosis of psychiatric disorders described in the DSM-IV and in the ICD-10 (Amorim, 2000). The MINI's structure is based on the criteria of the DSM-III-R and IV (Sheehan et al., 1998) and was designed to explore the Axis I of DSM-IV. This interview is organized in independent diagnostic modules that confer a high level of sensitivity. Each diagnostic section has two to four screening questions (Øhre et al., 2014) with a dichotomous codification (yes or no), and it encompasses algorithms to establish or exclude a diagnosis (Amorim et al., 1998).

The MINI allows us to make the following diagnoses: major depression disorder (current or recurrent), major depression with melancholic features (current), dysthymia (current), suicidality (current), manic episode (current or past), hypomanic episode (current or past), panic disorder (current or lifetime), agoraphobia (current), social phobia

(current), obsessive-compulsive disorder (current), posttraumatic stress disorder (current), alcohol dependence (past 12 months), alcohol abuse (past 12 months), substance dependence (non-alcohol in the past 12 months), substance abuse (non-alcohol in the past 12 months), psychotic disorder (lifetime or current), mood disorder with psychotic features (lifetime or current), anorexia nervosa (current), bulimia (current), generalized anxiety disorder (current), and antisocial personality disorder (lifetime; optional application) (Guterres, Levy, & Amorim, 1999).

For this analysis, we used only the diagnoses of depression and anxiety according to the DSM-IV and ICD-10 criteria. When reference is made to lifetime psychotic disorder, the data report the presence of delusions and hallucinations that were scored as bizarre in MINI.

The *Hamilton Depression Rating Scale* (HAM-D) is a semi-structured, clinician-rated interview that was developed by Max Hamilton in 1960, and is the most used tool to assess depression severity worldwide. The original scale contains 17 items, which are classified in categories according to the increase of intensity. Each item can be scored on a 5-point (absent, mild, moderate, severe or incapacitating) or 3-point scale (absent, slight or trivial, clearly present) (Cusin, Yang, & Yeung, 2009). The level of severity is reached by adding the scores of the following categories: depressed mood, suicide, work and loss of interest, retardation, agitation, gastro-intestinal symptoms, general somatic symptoms, hypochondriasis, insight, and weight loss (Hamilton, 1960). The sum of scores is classified into normal or remission (0-7), mild depression (8-13), moderate depression (14-18), severe depression (19-22), and very severe depression (≥ 23). This means that the higher the score, the more severe are the symptoms of depression (0-54) (Carneiro, Fernandes, & Moreno, 2015). The psychometric properties point to an excellent validation and adequate internal consistency of different versions (range from .48 to .92) (Cusin et al., 2009), and the inter-rater reliability of the scales is consistent and exceeds .85 (Carneiro et al., 2015). In this study, the internal consistency coefficient of the HAM-D was good, with a Cronbach's α of .82.

The *Hamilton Anxiety Rating Scale* (HARS) is a rating scale that was developed by Max Hamilton in 1959 to assess and quantify the symptom severity of (Bruss, Gruenberg, Goldstein, & Barber, 1994): somatic anxiety (physical complaints related to anxiety, such as insomnia, somatic muscular, somatic sensory, cardiovascular symptoms,

respiratory symptoms, gastrointestinal symptoms, genitourinary symptoms, and autonomic symptoms) and psychic anxiety (mental agitation and psychological distress like anxious mood, tension, fears, and depressed mood) (Shear et al., 2001; Hamilton, 1959). It consists of 14 items categorized according to a series of symptoms (psychological and somatic anxiety) that can be classified into a 0 to 5-point scale, varying from not present (score of 0) to severe (score of 4). The total score ranges from 0 to 56 and is reached by the sum of scores of each item. There are cutoff scores that indicate anxiety categories: normal (0-13), mild (14-17), moderate (18-24), and severe (25-30) (Hamilton, 1959). The HARS is also a well-validated tool with acceptable levels of inter-rater reliability and is easy for the clinician to apply (Hamilton, 1959). In this study, the internal consistency coefficient of the HARS was good, with Cronbach's α of .87.

## 3. Statistical Analysis

Data was analyzed with SPSS Statistic v21.0 for Mac OS (IBM Corporation, Chicago, IL). Descriptive statistics measures were used to characterize the three groups: means, standard deviations (*SD*s), minimum and maximum values for continuous variables, and frequencies, percentages and adjusted residuals for categorical variables.

The One-way analysis of variance (ANOVA) was applied to compare the severity of the groups' depression (HAM-D) and anxiety (HARS) symptoms, while Tukey's HSD test procedure was used for multiple comparisons between groups. The Chi-Squared Test of Association evaluated the existence of associations between groups and psychiatric diagnoses (MINI).

The correlation between the HAM-D and the HARS was assessed with Pearson's Linear Correlation Coefficient.

The significance level was set at 5%.

## 4. Results

Table 24 presents the cross tabulations, Group versus affective disorders (MINI), with two diagnoses presenting significant associations, e.g., current major depression ($\chi^2$ = 5.999, *df* = 2, *p* = .050) and current mood disorder with psychotic symptoms ($\chi^2$ = 6.202, *df* = 2, *p* = .045). The group of patients with primary muscle tension voice

disorders (MTVD1) reached a higher percentage compared with the other two groups, and in the secondary muscle tension voice disorders group (MTVD2) the analysis of adjusted residual indicated that there were fewer patients with current major depression in this group than expected. In current mood disorder with psychotic symptoms, the group of patients with primary muscle tension voice disorders (MTVD1) reached the highest percentage, yet in the group of secondary muscle tension voice disorders (MTVD2) fewer patients than expected had this diagnosis.

**TABLE 24**
**Affective Disorders in MINI by Group** (statistical significant)

| | **Affective Disorders** | No | Yes |
|---|---|---|---|
| | **Current Major Depression** | | |
| **PVD** | Frequency (Percentage)<br>Adjusted Residual | 22 (56.4)<br>-.9 | 17 (43.6)<br>.9 |
| **MTVD1** | Frequency (Percentage)<br>Adjusted Residual | 7 (43.8)<br>-1.6 | 9 (56.2)<br>1.6 |
| **MTVD2** | Frequency (Percentage)<br>Adjusted Residual | 22 (78.6)<br>2.3 | 6 (21.4)<br>-2.3 |
| | **Current Mood Disorder with Psychotic Symptoms** | | |
| **PVD** | Frequency (Percentage)<br>Adjusted Residual | 29 (74.4)<br>-.8 | 10 (25.6)<br>.8 |
| **MTVD1** | Frequency (Percentage)<br>Adjusted Residual | 10 (62.5)<br>-1.7 | 6 (37.5)<br>1.7 |
| **MTVD2** | Frequency (Percentage)<br>Adjusted Residual | 26 (92.9)<br>2.3 | 2 (7.1)<br>-2.3 |

*Abbreviations:* MINI, Mini International Neuropsychiatric Interview; MTVD1, Primary Muscle Tension Voice Disorders; MTVD2, Secondary Muscle Tension Voice Disorders; PVD, Psychogenic Voice Disorders.

Tables 25 presents the cross tabulations, Group versus anxiety disorders (MINI), with emphasis on the three diagnoses where statistically significant associations were found for lifetime panic disorder ($\chi^2$ = 9.474, *df* = 2, *p* = .009), current generalized anxiety ($\chi^2$ = 6.451, *df* = 2, *p* = .040), and current panic disorder with agoraphobia ($\chi^2$ = 8.619, *df* = 2, *p* = .013). Almost 28% of the patients had lifetime panic disorder, and the examination of adjusted residues showed that the psychogenic voice disorders group (PVD) had a lower percentage of patients with this diagnoses than expected, whereas in the MTVD1 group more patients received this diagnoses than expected. Half of the sample was diagnosed with current generalized anxiety, and the analysis of adjusted

residual revealed that in the secondary muscle tension voice disorders group (MTVD2) there were fewer patients than expected with this diagnosis. Only 4.8% of the subjects were diagnosed with current panic disorder with agoraphobia, and through the analysis of the adjusted residual it was noted that in the primary muscle tension voice disorders group (MTVD1) there were more patients with this diagnosis than expected.

**TABLE 25**
**Anxiety Disorders in MINI by Group** (statistical significant)

| | **Anxiety Disorders** | No | Yes |
|---|---|---|---|
| | **Lifetime Panic Disorder** | | |
| **PVD** | Frequency (Percentage)<br>Adjusted Residual | 33 (84.6)<br>2.4 | 6 (15.4)<br>-2.4 |
| **MTVD1** | Frequency (Percentage)<br>Adjusted Residual | 7 (43.8)<br>-2.8 | 9 (56.2)<br>2.8 |
| **MTVD2** | Frequency (Percentage)<br>Adjusted Residual | 20 (71.4)<br>-.1 | 8 (28.6)<br>.1 |
| | **Current Generalized Anxiety** | | |
| **PVD** | Frequency (Percentage)<br>Adjusted Residual | 17 (43.6)<br>-1.0 | 22 (56.4)<br>1.0 |
| **MTVD1** | Frequency (Percentage)<br>Adjusted Residual | 5 (31.2)<br>-1.6 | 11 (68.8)<br>1.6 |
| **MTVD2** | Frequency (Percentage<br>Adjusted Residual | 19 (67.9)<br>2.4 | 9 (32.1)<br>-2.4 |
| | **Current Panic Disorder with Agoraphobia** | | |
| **PVD** | Frequency (Percentage)<br>Adjusted Residual | 38 (97.4)<br>.9 | 1 (2.6)<br>-.9 |
| **MTVD1** | Frequency (Percentage)<br>Adjusted Residual | 13 (81.2)<br>-2.9 | 3 (18.8)<br>2.9 |
| **MTVD2** | Frequency (Percentage)<br>Adjusted Residual | 28 (100.0)<br>1.5 | 0 (0.0)<br>-1.5 |

*Abbreviations:* MINI, Mini International Neuropsychiatric Interview; MTVD1, Primary Muscle Tension Voice Disorders; MTVD2, Secondary Muscle Tension Voice Disorders; PVD, Psychogenic Voice Disorders.

Table 26 presents the cross tabulations, Group versus lifetime psychotic disorder ($\chi^2 = 6.933$, $df = 2$, $p = .031$). About 37% of the total of the sample were diagnosed as having symptoms related to lifetime psychotic disorder, and the analysis of adjusted residuals revealed that there were fewer patients in the secondary muscle tension voice disorders group (MTVD2) with this diagnosis than expected.

**TABLE 26**
**Lifetime Psychotic Disorder Symptoms in MINI by Group** (statistical significant)

| | Lifetime Psychotic Disorder Symptoms | No | Yes |
|---|---|---|---|
| **PVD** | Frequency (Percentage) | 21 (53.8) | 18 (46.2) |
| | Adjusted Residual | -1.6 | 1.6 |
| **MTVD1** | Frequency (Percentage) | 8 (50.0) | 8 (50.0) |
| | Adjusted Residual | -1.2 | 1.2 |
| **MTVD2** | Frequency (Percentage) | 23 (82.1) | 5 (17.9) |
| | Adjusted Residual | 2.6 | -2.6 |

*Abbreviations:* MINI, Mini International Neuropsychiatric Interview; MTVD1, Primary Muscle Tension Voice Disorders; MTVD2, Secondary Muscle Tension Voice Disorders; PVD, Psychogenic Voice Disorders.

The MINI also showed significant statistical associations between Group and suicidality ($\chi^2 = 6.384$, $df = 2$, $p = .041$).

The suicide risk was more prevalent among patients with psychogenic voice disorders (PVD), either at the level of incidence or severity (Figure 6).

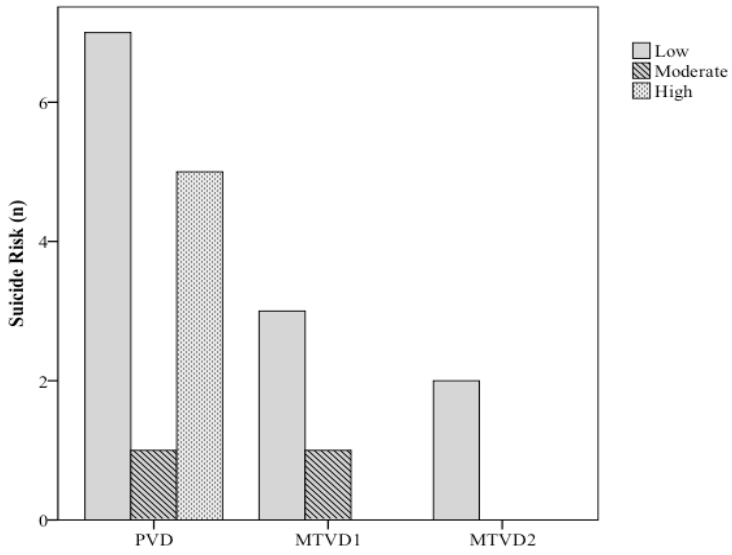


**FIGURE 6. - Frequency on the Suicide Risk categories by Group.**

*Abbreviations:* MINI, Mini International Neuropsychiatric Interview; MTVD1, Primary Muscle Tension Voice Disorders; MTVD2, Secondary Muscle Tension Voice Disorders; PVD, Psychogenic Voice Disorders.

Table 27 presents the descriptive measures for the HAM-D by Group. The MTVD1 group had a higher mean than the other two groups and was also the group with greater minimum and maximum values. Taking into account the classification of

depression severity proposed by the author of the test, the mean value obtained by the group of patients with primary muscle tension voice disorders (MTVD1) corresponded to moderate depression, whereas both psychogenic and secondary muscle tension voice disorders groups (PVD and MTVD2) received the classification of mild depression.

**TABLE 27**
**HAM-D by Group:** Frequency, Mean, Standard Deviation, Minimum and Maximum

| | Mean | *SD* | Minimum | Maximum |
|---|---|---|---|---|
| **PVD** | 10.2 | 6.10 | 0 | 22 |
| **MTVD1** | 14.1 | 5.27 | 4 | 24 |
| **MTVD2** | 8.0 | 4.33 | 0 | 14 |

*Abbreviations:* HAM-D, Hamilton Depression Rating Scale; MTVD1, Primary Muscle Tension Voice Disorders; MTVD2, Secondary Muscle Tension Voice Disorders; PVD, Psychogenic Voice Disorders; *SD*, Standard Deviation.

Significant statistical differences between the means of the groups were found ($F_{[2,80]} = 6.469$, $p = .002$, $\eta p^2 = .139$, medium effect). Post-hoc analysis using Tukey's HSD test procedure revealed differences between psychogenic and primary muscle tension voice disorders groups (PVD and MTVD1) ($p = .040$), and between primary and secondary muscle tension voice disorders groups (MTVD1 and MTVD2) ($p = .002$) (Figure 7).

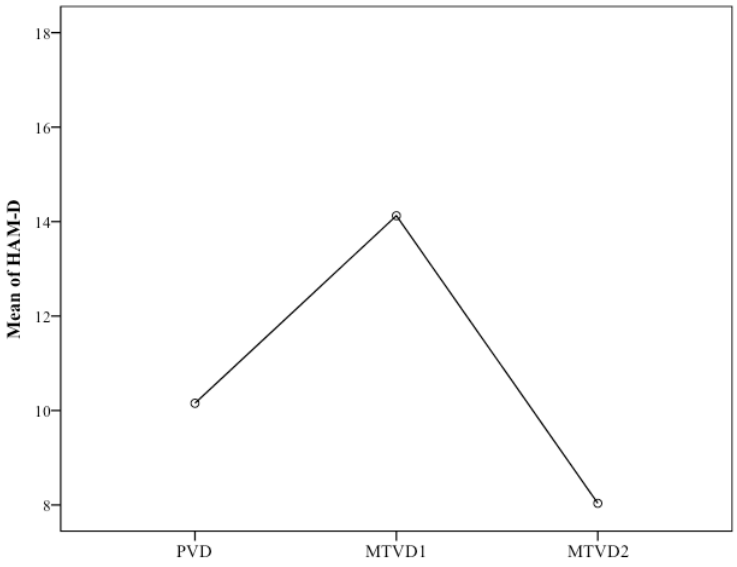


**FIGURE 7. - Means of HAM-D by Group.**

*Abbreviations:* HAM-D, Hamilton Depression Rating Scale; MTVD1, Primary Muscle Tension Voice Disorders; MTVD2, Secondary Muscle Tension Voice Disorders; PVD, Psychogenic Voice Disorders.

Table 28 presents the descriptive statistics for the HARS by Group. The primary muscle tension voice disorders group (MTVD1) had a higher mean compared with the means of the two other groups. The minimum values were the same in the groups of patients with psychogenic and secondary muscle tension voice disorders (PVD and MTVD2) and slightly higher in the primary muscle tension voice disorders group (MTVD1), yet maximum value was reached among patients with psychogenic voice disorders (PVD). According to the classification of the severity level of anxiety proposed by the author of the HARS, the mean value obtained by the group of patients with primary muscle tension voice disorders (MTVD1) was classified as mild anxiety, whereas both groups of psychogenic and secondary muscle tension voice disorders (PVD and MTVD2) received the classification "normal range."

**TABLE 28**
**HARS by Group:** Frequency, Mean, Standard Deviation, Minimum and Maximum

| | **Mean** | ***SD*** | **Minimum** | **Maximum** |
|---|---|---|---|---|
| **PVD** | 11.6 | 6.36 | 1 | 29 |
| **MTVD1** | 16.3 | 4.79 | 7 | 21 |
| **MTVD2** | 9.6 | 4.20 | 1 | 18 |

*Abbreviations:* HARS, Hamilton Anxiety Rating Scale; MTVD1, Primary MuscleTension Voice Disorders; MTVD2, Secondary Muscle Tension Voice Disorders; PVD, Psychogenic Voice Disorders; *SD*, Standard Deviation.

Statistically significant differences in means between groups were found using one-way ANOVA ($F_{[2,80]} = 7.752$, $p = .001$, $\eta p^2 = .162$, medium effect). The differences between psychogenic and primary muscle tension voice disorders groups (PVD and MTVD1) ($p = .013$) and between primary and secondary muscle tension voice disorders groups (MTVD1 and MTVD2) ($p = .001$) were reported by Tukey's HSD test (Figure 8).

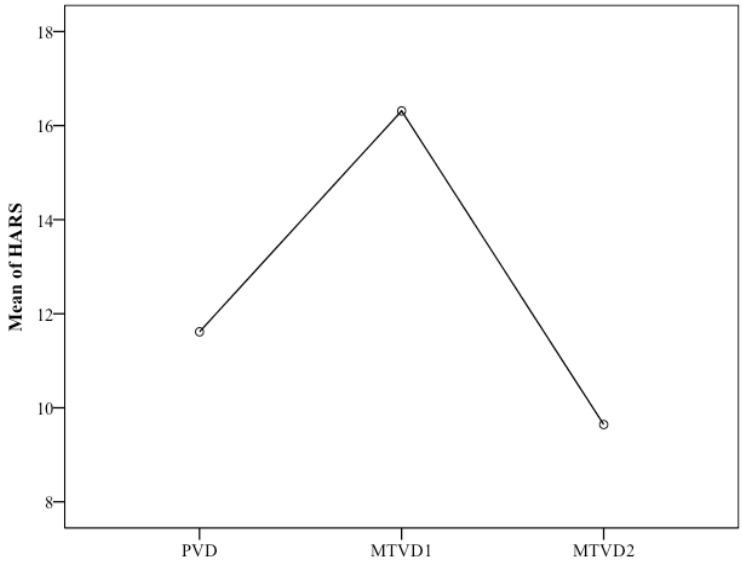


**FIGURE 8. - Means of HARS by Group.**

*Abbreviations:* HARS, Hamilton Anxiety Rating Scale; MTVD1, Primary Muscle Tension Voice Disorders; MTVD2, Secondary Muscle Tension Voice Disorders; PVD, Psychogenic Voice Disorders.

To evaluate the relation between the HAM-D and the HARS, Pearson's correlation coefficient was applied and a strong linear correlation ($r$ = .877, $p$ < 0.001) was found. This means that patients with high depression serevity levels also had high anxiety.

All patients were screened with the MINI, which permitted psychiatric diagnoses. The Chi-square test of association was used to verify the existence of associations between group and psychiatric diagnoses. There were statistically significant associations between Group and five diagnoses that were classified in the two major diagnostic categories (affective and anxiety disorders), in lifetime psychotic disorder and in suicidiality.

## 5. Discussion

The present study was developed to to analyze the severity of depression and anxiety symptoms and to characterize the incidence of affective and anxiety disorders in three different groups of patients with functional voice disorders (FVDs). In literature, patients with FVDs were defined as a single study group that was subsequently compared with healthy control groups.

The MINI enabled us to observe the existence of differences in association between groups and specific diagnoses of affective and anxiety disorders and in the lifetime psychotic disorder category, with the group of patients with primary muscle tension voice disorders (MTVD1) reaching higher percentages in all.

We found a strong association between the risk of suicide and bellowing to the psychogenic voice disorders group (PVD).

Freeman et al. (2017) had developed a European cross-national study to examine gender differences in suicide intent. The authors found that the significant risk factors identified for female gender for suicide intent were mental illness, especially major depression that was responsible to underlie more than half of all female suicides (Freeman et al., 2017). In fact, according to Soeiro (2006) suicide has been considered as the most severe symptom from depressive and melancholic states.

Patients with psychogenic voice disorders (PVD) had a prevalence of 43.6% of current major depression. Data for Portuguese women in the study of Freeman et al. (2017) was in line with our results.

Frazão, Santos and Sampaio (2014) alerted that individuals at risk of suicide were more likely to have a history of family affective disorders (depression or bipolar disorder) and/or a family history of suicide. In our study information on family history of suicidal behaviours (suicidal attempts and suicides) was also collected. In the group of patients with psychogenic voice disorders (PVD) there was one suicide attempt made by a mother and two suicides, a mother and a daughter. Comparing with the other two groups, although there were no significant differences, in the PVD group the element with suicidal behaviors corresponded to direct family members, which puts them at greater risk.

The assessment of suicidal risk should be done carefully. The methodology proposed by Sampaio (2002, as cited in Santos & Lima das Neves, 2014) allows the collection of information on the characteristics of suicidal behavior when effected; precipitating factors; individual's current problems; mental health evaluation; personal and family history, and family system; support network; somatic diseases; assessment of internal resources; necessary in solving problems; and evaluation of good and poor prognosis factors that are associated with psychiatric diseases and with adherence to therapy.

Regardless of the differences in risk of suicide observed between groups, this outcome deserves due prominence in future research and in the clinical context.

In addition, despite the MINI not contemplating a diagnostic category for psychoses, it provided information about lifetime psychotic disorder symptoms, where significant differences between groups were presented. According to Baker (2008) there are virtually no reported cases of patients with FVDs suffering from psychotic disorders, yet in the primary muscle tension and psychogenic voice disorders groups (MTVD1 and PVD) about half of the participants presented lifetime psychotic symptoms. Future studies should consider the incidence of psychotic disorders in patients with functional voice disorders (FVDs).

In the group of patients with primary muscle tension voice disorders (MTVD1), a significant high prevalence of affective and anxiety disorders was identified.

References to studies comparing the incidence of depression and anxiety in different types of functional voice disorders (FVDs) were not found.

Furthermore, self-report instruments are often used in researches to evaluate symptoms of depression and anxiety (Baker et al., 2012; Barakah et al., 2012; Dietrich et al., 2008; Misono et al., 2004; Smits et al., 2012) making it impossible to compare the reporting date of the perception of patients for symptoms with the results derived by clinical standardized scales that reflect the evaluation made by the mental health specialist.

A comparison could be made between our findings and the results of the study developed by Willinger et al. (2005). In fact, in both researches, the same assessment test for the evaluation of depression severity (HAM-D) was administered.

In the Willinger et al. (2005) study the patients with functional dysphonia achieved a mean value of 13.3 in the HAM-D thus receiving the classification of mild depression, in our study the mean for the total sample was 14.1 corresponding to the classification of mild depression. When the means of the three groups were analyzed, it was verified that they presented distinct values. The statistical analysis showed that the mean of the primary muscle tension voice disorders group (MTVD1) was significantly higher than the mean of the other groups. Whereas the mean value of the primary muscle tension voice disorders group (MTVD1) corresponded to moderate depression both the psychogenic and secondary muscle tension voice disorders groups (PVD and MTVD2) received the classification of mild depression, just like the study group in the Willinger's research (2005).

In our study, 34.9% of the total sample scored for the sum of mild, moderate and severe categories of the HARS a value similar to that obtained by 43% of the patients in

the study of Kotby et al. (2003), a sample with no organic voice disorders but including both genders. When our three groups were independently considered, percentages varied widely (MTVD1 = 75.0%, PVD = 38.5% and MTVD2 = 7.1%).

This means that the classification of different types of functional voice disorders (FVDs) had a great impact on the anxiety analysis as seen in the primary muscle tension voice disorders group (MTVD1) which stood out from the other two groups.

A correlation between the HAM-D and the HARS was a novelty in studies with patients with functional voice disorders, and it was very interesting as it allowed to verify the existence of a strong positive correlation between depression and anxiety in FVDs. According to a systematic review between the years 1994 and 2009 with patients with chronic diseases, high rates of anxiety and depression were associated to increasing mortality rates and with reduced quality of life (Gerontoukouet, Michaelidoy, Rekleiti, Saridi, & Souliotis, 2015; Yohannes, Willgoss, Baldwin, & Connolly, 2010).

To address this issue, the health system should promote early intervention in FVDs patients in order to prevent the development of affective and anxiety disorders or to avoid worsening their mental health state, and also to reduce or eliminate the vocal symptoms. Therefore, the intervention of a mental health professional in the clinical voice assessment team is vital in order to provide an additional dimension to the care and comfort of these patients (Rosen & Sataloff, 1997).

The cross-sectional design of the present study proved to be reliable for the evaluation of the incidence of affective and anxiety disorders, but it could not show causation between the psychological features and functional voice disorders (FVDs). Our findings emphasized the need for future longitudinal studies of affective and anxiety disorders as causes or consequences of FVDs, particularly taking into consideration the classification of the three types of FVDs. For each FVDs presentation, it would also be important to identify the risk factors associated with its development, to set a psychological profile, and to recognize either bad or good prognosis factors connected to the treatment of the voice disorder or the psycho-emotional state.

The application of hetero assessment standardized psychological tests was fundamental in this study for allowing the use of a common language based on the DSM criteria.

## 6. Conclusion

Our findings provided evidence for a strong link between affective and anxiety disorders and functional voice disorders (FVDs). These FVDs patients presented high levels of co-morbidity, proving the need for clinical voice assessment and mental health care.

The three groups (PVD, MTVD1, and MTVD2) received exactly the same approach, which allowed us to see that even though they belong to the same category of voice disorders, they do not present the same psychiatric diagnosis or the same degree of severity of depression and anxiety symptoms. As verified, whenever the severity of anxiety is explored, it should take into consideration the type of FVDs. This reinforced the need for a specific assessment for each FVDs presentation. This study demonstrated the need for the psychologist to be integrated into the multidisciplinary voice assessment team from the beginning so as to complement medical and speech therapist evaluations.

# Personality Profile

## Study 3

### 1. Introduction

Personality is an enduring pattern of inner experience and behaviors that are relatively stable over time and in different situations. According to Millon, personality is the equivalent of a well-organized biological system of structures and functions of the human body with systematic interconnection with the psychic system and its functionality (Davis, 1999).

Personality traits (PT) are not static dispositions. Their dimensionality points to the individual's behavior that varies over time (Hopwood, Zimmermann, Pincus, & Krueger, 2015).

In some situations, PT can become into personality disorders (PD), which are common conditions that place a significant burden on the individual's suffering and on the interpersonal relationships and that can lead to significant distress and impairment. Personality disorders are classified on the basis of worldwide criteria and it is accepted that they have a negative impact on cognition, affect and/or impulse control.

For over 60 years, Moses devoted himself to the study of the relationship between voice production, personality and emotional dynamics. There is unanimity in recognizing that Moses made a great contribution to this field of research leading to this relationship to be recognized and accepted. However, it is still considered that there is much to explore in this complex relationship. In fact, Almeida et al. (2015) affirmed that the etiology of voice disorder would be influenced by personality, especially when it is related to the vocal behavior of the speaker. The same authors further added that despite this "it is noteworthy that little is known of the relation between personality and voice".

For Baker (2017) vocally abusive behaviors will reflect a degree of psychological vulnerability that is associated with personality traits and coping strategies, specifically in FVDs. The author indicated that stressful life circumstances, personality traits or psychiatric co-morbidity might play a role on its onset and course.

Another reason that raised interest in exploring and analyzing the relationship between personality and/or personality disorders and functional voice disorders was the

consensual idea that patients with personality disorders can be complex to manage. This is more visible when there is co-morbidity with other mental health disorders as seen in our sample where patients with functional voice disorders had significant mental health problems, such as depression and anxiety in different severity levels.

All these factors lead us to develop this study with the aim of identifying a personality profile and personality disorders acting as vulnerability factors for the development of each of the three types of functional voice disorders (3rd Goal).

Millon´s theoretical model of personality was applied in this study' due to its clear conceptualization and to the existence of a specific assessment tool.

For Millon, there are personality prototypes respecting a continuous of trait characteristics that can be differentiated by a set of functional (behaviors, interpersonal conduct and cognitive style), and also structural attributes (self-image, object representations and mood-temperament) (Strack & Millon, 2012).

Personality prototypes can be classified in basic or severe being the differentiation between categories based on the evolutionary model where a clearly dividing line between normal and abnormal styles does not exist. This implies that normal personality evolves over time with the purpose of ensuring survival and adaptation, whereas abnormal personality emerges from things that have gone wrong (Strack, 2007).

The basic prototypes were described in normal and disordered forms (e.g., schizoid, avoidant, depressive, dependent, histrionic, narcissistic, antisocial, aggressive/sadistic, compulsive, passive-aggressive, self-defeating) while the severe styles of personality disorders (e.g., schizotypal, borderline, and paranoid) were described as exaggerations or distortions of the basic prototypes (Strack & Millon, 2012).

For over 40 years Millon's model of personality and the Millon Clinical Multiaxial Inventory, despite the different revised versions have been useful resources for the evaluation and understanding of personality disorders and clinical syndromes (Strack, 2007). Although the Millon Clinical Multiaxial Inventory does not reach the same degree of precision in the diagnosis of personality disorders as the structured interviews conducted by experienced clinicians, it is widely accept that it is more diagnostically accurate than clinical interviews and similar self-report measures of personality (Strack, 2007).

## 2. Procedure

In this study, the three groups were assessed with the self-report measure of personality developed by Millon, *Millon Clinical Multiaxial Inventory - II* (MCMI-II).

The first version of the "Millon Clinical Multiaxial Inventory (MCMI-I)" was published in 1977 and was anchored in Millon's theoretical model of personality (Craig, 1999a). This inventory allows the detection of personality disorders and a few major clinical syndromes (Craig, 1999b).

MCMI-II as clinical personality assessment instrument was subject to review, with the purpose of introducing personality disorders on a separate axis (Rossi et al., 2015). After the publication of DSM-III-R, a second version was released in 1987, the "Millon Clinical Multiaxial Inventory (MCMI-II)". This new version included three new validity scales (McCann, 1990) and two personality scales (sadistic and self-defeating) (Retzlaff, Lorr, Hyer, & Ofman, 1991), and some psychometric changes (Rossi & Derksen, 2015) such as the replacement of 45 items that together were intended to improve validity to increase the diagnostic power and also to update the test to fit diagnostic nomenclature (McCann, 1990). All these changes had improved the MCMI performance (McCann, 1990).

This self-psychological report test consists of 175 items with true or false responses with the results reflecting the diagnostic criteria used in the DSM for Axes I and II.

The main objective of the MCMI-II is to provide information to clinicians, namely psychologists and psychiatrists, necessary for treatment decision-making in individuals with emotional and interpersonal difficulties (Millon, Davis, & Millon, 1999 as cited in Dyer, 2005).

The structure of this test allows the measurement of 22 clinical scales (Millon, 1987; Rocha, Sousa, Alchieri, Sales, & Alenca, 2011) grouped and coded as:

- **Basic clinical personality patterns (Axis II):** schizoid (1), avoidant (2), dependent (3), histrionic (4), narcissistic (5), antisocial (6A), aggressive (sadistic) (6B), obsessive-compulsive (7), passive-aggressive (8A), and self-defeating (8B).

- **Severe or pathological personality disorder scales (Axis II):** schizotypal (S), borderline (C), and paranoid (P).

- **Moderate clinical syndrome scales (Axis I):** anxiety (A), somatoform (H), bipolar-manic (N), dysthymia (D), alcohol dependence (B), and drug dependence (T).

- **Severe clinical syndrome scales (Axis I):** thought disorder (SS), major depression (CC), and delusional disorder (PP).

It also has three items of **validity index**: disclosure (X), desirability (Y) and debasement (Z).

The best way to assess the MCMI-II, as a screening instrument, is scale by scale. Based on the idea that personality disorders and clinical syndromes were not normally distributed in the general population, Millon introduced "base rate scores" (BR). A conversion into a BR score was ensured since Millon believed that BR scores were more appropriate to use in the clinical settings (Miller, Goldberg, & Streiner, 1993).

Each scale can score into a diagnostic level: (BR ≥ 85 score) where the trait or disorder is a dominant clinical element, a category that may indicate the presence of the trait and/or the syndrome but below the diagnostic level (75 ≤ BR ≤ 84) (Gibertini & Brandenburg, 1986), and if the BR scored is under 74 it indicates a result that has no clinical relevance (Craig, 1999b).

The MCMI is therefore a psycho-diagnostic test where the raws are converted to base rate scores that were defined by the prevalence of disorders measured by the total of the scales (Gibertini & Brandenburg, 1986). This instrument is also sensitive to the current affective state, thus all scales (Axis II or Axis I) reflect the traits and states of the individual (Millon, 1992).

The internal consistency of the original scales for the basic clinical personality patterns ranged from .86 (schizoid and aggressive) to .93 (avoidant); for the severe personality disorder scales the values for the alpha Cronbach varied between .90 (paranoid) and .93 (schizotypal); for the moderate clinical syndromes scales the alpha Cronbach values were between .84 (bipolar-manic and alcohol dependence) and .94 (anxiety); and for the severe clinical syndromes scales the alpha values ranged from .81 (delusional) to .90 (major depression) (Millon, 1987).

In this study the internal consistency coefficient of MCMI-II was calculated for all scales: schizoid (α = of .70), avoidant (α = .85), dependent (α = .85), histrionic (α = .62), narcissistic (α = .71), antisocial (α = .64), aggressive (sadistic) (α = .64), obsessive-compulsive (α = .64), passive-aggressive (α = .82), self-defeating (α = .82), schizotypal (α = .84), borderline (α = .89), paranoid (α = .79), anxiety (α = .79), somatoform (α = .79), bipolar-manic (α = .75), dysthymia (α = .90), alcohol dependence (α = .78), and drug dependence (α = .80), thought disorder (α = .81), major depression

(α = .90), and delusional disorder (α = .74). By comparing the values of alpha Cronbach in this study with those achieved by the author of the test, ours were relatively lower. Nevertheless, they proved to be good indicators of internal consistency.

A recent survey on psychological test usage indicated that the MCMI is among the 25 most frequently used psychological tests in clinical practice and that it is ranked third, behind the MMPI and the Rorschach, in research studies on tests published until 2001 (Craig, 2001). This and the fact that its structure is directly linked to the Diagnostic and Statistical Manual of Mental Disorders were the main reasons why we chose the MCMI-II to be part of our battery of tests.

## 3. Statistical Analysis

Data was analyzed with SPSS Statistic v21.0 for Mac OS (IBM Corporation, Chicago, IL).

For an accurate evaluation of the personality role, the statistical procedure that was carried out was the Analysis of Covariance (ANCOVA). The inclusion of two covariates was made to mitigate the impact of the severity of depression and anxiety symptoms presented in each patient.

In this analysis, the independent variable was Group, both Hamilton Rating Scales corresponded to covariates with the following values HAMD = 10.20, HARS = 11.86, and the twenty-two scales of MCMI-II were the dependent variables.

Post-hoc comparisons of adjusted means were performed to detect in which groups there were significant differences in means.

The significance level was set at 5%.

## 4. Results

Considering the total sample, the most common personality traits were schizoid and avoidant (26.5%) narcissistic (25.3%) and histrionic (24.1%) while the most frequent personality diagnoses were obsessive-compulsive (63.9%), dependent (37.3%) and avoidant (19.3%).

Tables 29 and 30 present the results for the basic personality patterns by Group.

For the basic personality patterns the most common traits in the psychogenic voice disorders group (PVD) was schizoid (33.3%), histrionic in the primary muscle tension voice disorders (MTVD1 = 50.0%) and both narcissistic and obsessive-compulsive (25.0%) in the group of patients with secondary muscle tension voice disorders (MTVD2). The most frequent personality diagnosis in the basic category was obsessive-compulsive in the three groups (PVD = 71.8%, MTVD1 = 75.0% and MTVD2 = 46.4%).

**TABLE 29**

**Basic Clinic Personality Patterns in MCMI-II by Group:** Frequency and Percentage (Part I)

| | | Schizoid | | | Avoidant | | | Dependent | | | Histrionic | | | Narcissistic | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | No | PT | PD | No | PT | PD | No | PT | PD | No | PT | PD | No | PT | PD |
| **PVD** | Frequency | 20 | 13 | 6 | 21 | 9 | 9 | 16 | 6 | 17 | 29 | 9 | 1 | 27 | 9 | 3 |
| | Percentage | 51.3 | 33.3 | 15.4 | 53.8 | 23.1 | 23.1 | 41.0 | 15.4 | 43.6 | 74.4 | 23.1 | 2.6 | 69.2 | 23.1 | 7.7 |
| **MTVD1** | Frequency | 12 | 4 | 0 | 10 | 3 | 3 | 5 | 5 | 6 | 7 | 8 | 1 | 7 | 5 | 4 |
| | Percentage | 5.0 | 25.0 | 0.0 | 62.5 | 17.6 | 18.8 | 31.3 | 31.3 | 37.5 | 43.8 | 50.0 | 6.3 | 43.8 | 31.3 | 25.0 |
| **MTVD2** | Frequency | 21 | 5 | 2 | 19 | 35 | 4 | 15 | 5 | 8 | 24 | 3 | 1 | 19 | 7 | 2 |
| | Percentage | 5.0 | 17.9 | 7.1 | 67.9 | 17.9 | 14.3 | 53.6 | 17.9 | 28.6 | 85.7 | 10.7 | 3.6 | 67.9 | 25.0 | 7.1 |

*Abbreviations:* MCMI-II, Millon Clinical Multiaxial Inventory (II); MTVD1, Primary Muscle Tension Voice Disorders; MTVD2, Secondary Muscle Tension Voice Disorders; No, No clinical significance; PD, Diagnosis of personality disorder; PT, Presence of trait of personality; PVD, Psychogenic Voice Disorders.

**TABLE 30**
**Basic Clinic Personality Patterns in MCMI-II by Group:** Frequency and Percentage (Part II)

| | | Antisocial | | | Agressive | | | Obsessive-compulsive | | | Passive-agressive | | | Self-defeating | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | No | PT | PD | No | PT | PD | No | PT | PD | No | PT | PD | No | PT | PD |
| **PVD** | Frequency | 36 | 3 | 0 | 33 | 5 | 1 | 7 | 4 | 28 | 31 | 7 | 1 | 23 | 9 | 7 |
| | Percentage | 2.3 | 7.7 | 0.0 | 84.6 | 12.8 | 2.6 | 17.9 | 10.3 | 71.8 | 79.5 | 17.9 | 2.6 | 59.0 | 23.6 | 17.9 |
| **MTVD1** | Frequency | 14 | 1 | 1 | 11 | 4 | 1 | 3 | 1 | 12 | 13 | 1 | 2 | 8 | 5 | 3 |
| | Percentage | 7.5 | 6.3 | 6.3 | 68.8 | 25.0 | 6.3 | 18.8 | 6.3 | 75.0 | 81.3 | 6.3 | 12.5 | 50.0 | 31.3 | 18.8 |
| **MTVD2** | Frequency | 25 | 2 | 1 | 24 | 1 | 3 | 8 | 7 | 13 | 24 | 1 | 13 | 22 | 4 | 2 |
| | Percentage | 9.3 | 7.1 | 3.6 | 85.7 | 3.6 | 10.7 | 28.6 | 25.0 | 46.4 | 85.7 | 3.6 | 10.7 | 78.6 | 14.3 | 7.1 |

*Abbreviations:* MCMI-II, Millon Clinical Multiaxial Inventory (II); MTVD1, Primary Muscle Tension Voice Disorders; MTVD2, Secondary Muscle Tension Voice Disorders; No, No clinical significance; PD, Diagnosis of personality disorder; PT, Presence of trait of personality; PVD, Psychogenic Voice Disorders.

Table 31 presents the results for severe personality patterns by Group.

The most common trait in the three groups was paranoid (PVD = 12.8%, MTVD1 = 18.8% and MTVD2 = 17.9%). Whit regard to personality disorders, paranoid personality disorder was the most frequent personality disorder in the groups of patients with psychogenic (PVD = 10.3%) and primary muscle tension (MTVD1 = 12.5%) voice disorders. Patients with secondary muscle tension voice disorders (MTVD2) did not present any diagnosis of personality disorders. Schizotypal personality disorder was diagnosed only among patients with psychogenic voice disorders (PVD = 7.7%)

**TABLE 31**

**Severe Personality Patterns in MCMI-II by Group:** Frequency and Percentage

| | | Schizotypal | | | Borderline | | | Paranoid | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | No | PT | PD | No | PT | PD | No | PT | PD |
| **PVD** | Frequency | 32 | 4 | 3 | 34 | 2 | 3 | 30 | 5 | 4 |
| | Percentage | 82.1 | 10.3 | 7.7 | 87.2 | 5.1 | 7.7 | 76.9 | 12.8 | 10.3 |
| **MTVD1** | Frequency | 14 | 2 | 0 | 15 | 0 | 1 | 11 | 3 | 2 |
| | Percentage | 87.5 | 12.5 | 0.0 | 93.8 | 0.0 | 6.3 | 68.8 | 18.8 | 12.5 |
| **MTVD2** | Frequency | 27 | 1 | 0 | 27 | 1 | 0 | 23 | 5 | 0 |
| | Percentage | 96.4 | 3.6 | 0.0 | 96.4 | 3.6 | 0.0 | 82.1 | 17.9 | 0.0 |

*Abbreviations:* MCMI-II, Millon Clinical Multiaxial Inventory (II); MTVD1, Primary Muscle Tension Voice Disorders; MTVD2, Secondary Muscle Tension Voice Disorders; No, No clinical significance; PD, Diagnosis of personality disorder; PT, Presence of trait of personality; PVD, Psychogenic Voice Disorders.

Considering the basic and severe personality patterns, in the group of patients with psychogenic voice disorders (PVD) the two most common personality traits were paranoid (12.8%) and schizotypal (10.3%), while the most frequent diagnoses were paranoid (10.3%), schizotypal and borderline personality disorders both with an incidence of 7.7%.

Paranoid (18.8%) and schizotypal (12.5%) personality traits were frequent in patients with primary muscle tension voice disorders (MTVD1). In this group, paranoid was the most common personality disorder (MTVD1 = 12.5%) and no patients had a schizotypal personality disorder.

Patients with secondary muscle tension voice disorders (MTVD2) presented as more frequent paranoid traits (17.9%) and no patient had criteria for the diagnosis of a personality disorder.

When the severity of depression and anxiety symptoms were set as covariates, differences between means of the groups were found in four scales ($p$ = .035). Post-hoc analysis allowed verifying between which groups the differences were presented.

In the **Basic Clinical Personality Patterns** associated with the Axis II of DSM, the significant differences between groups' means were found in one of the ten scales: schizoid ($F_{[2,78]}$ = 3.529, $p$ = .034, $\eta^2$ = .155, $\varepsilon^2$ = .111, medium effect).

As seen in Table 32, the mean for schizoid in the psychogenic voice disorders group (PVD) was slightly higher than the means of the other two groups (MTVD1 and MTVD2), with the group of primary muscle tension voice disorders (MTVD1) scoring the lowest value of all.

**TABLE 32**
**Schizoid Personality in MCMI-II by Group** (statistical significant)

| | | Estimated Marginal Means |
|---|---|---|
| | **Basic Clinical Personality Patterns** | |
| **PVD** | **Schizoid** | 73.8 |
| **MTVD1** | | 62.8 |
| **MTVD2** | | 66.4 |

*Abbreviations:* MCMI-II, Millon Clinical Multiaxial Inventory (II); MTVD1, Primary Muscle Tension Voice Disorders; MTVD2, Secondary Muscle Tension Voice Disorders; PVD, Psychogenic Voice Disorders.

For schizoid personality, post-hoc analysis procedure revealed differences between psychogenic and primary muscle tension voice disorders (PVD and MTVD1) ($p$ = .024) (Figure 9).

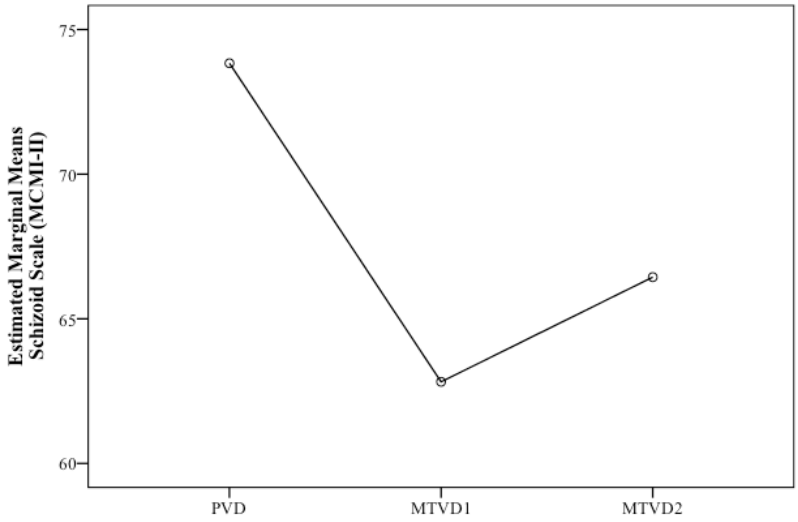


**FIGURE 9. Estimated marginal means for the Schizoid Personality by Group.**

*Abbreviations:* MCMI-II, Millon Clinical Multiaxial Inventory (II); MTVD1, Primary Muscle Tension Voice Disorders; MTVD2, Secondary Muscle Tension Voice Disorders; PVD, Psychogenic Voice Disorders.

In the **Severe or Pathological Personality Disorder Scales** from Axis II of DSM significant statistical differences between means were found in one of the three scales: schizotypal ($F_{[2,78]}$ = 4.150, $p$ = .019, $\eta^2$ = .335, $\varepsilon^2$ = .300, large effect).

The group of patients with psychogenic voice disorders (PVD) presented a higher mean compared to the means of the secondary and primary muscle tension voice disorders groups (MTVD2 and MTVD1), respectively (Table 33).

**TABLE 33**

**Schizotypal Personality in MCMI-II by Group** (statistical significant)

| | | Estimated Marginal Means |
|---|---|---|
| | **Severe Personality Disorder** | |
| **PVD** | **Schizotypal** | 64.8 |
| **MTVD1** | | 55.8 |
| **MTVD2** | | 57.5 |

*Abbreviations:* MCMI-II, Millon Clinical Multiaxial Inventory (II); MTVD1, MTVD1, Primary Muscle Tension Voice Disorders; MTVD2, Secondary Muscle Tension Voice Disorders; PVD, Psychogenic Voice Disorders.

Differences between groups were found with Post-hoc analysis between psychogenic and primary muscle tension voice disorders groups (PVD and MTVD1) ($p$ = .025), and between psychogenic and secondary muscle tension voice disorders groups (PVD and MTVD2) ($p$ = .023) (Figure 10).

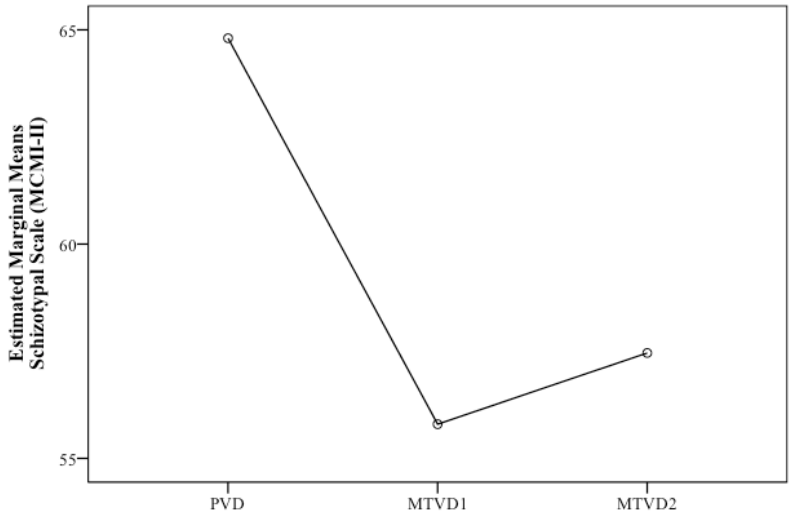


**FIGURE 10. - Estimated marginal means for the Schizotypal Personality by Group.**

*Abbreviations:* MCMI-II, Millon Clinical Multiaxial Inventory (II); MTVD1, Primary Muscle Tension Voice Disorders; MTVD2, Secondary Muscle Tension Voice Disorders; PVD, Psychogenic Voice Disorders.

From the six **Moderate Clinical Syndromes Scales** from Axis I of DSM statistically differences between means were found in one scale: dysthymia ($F_{[2,78]}$ = 3.204, $p$ = .046, $\eta^2$ = .579, $\varepsilon^2$ = .557, large effect).

In the dysthymia scale (Table 34), psychogenic voice disorders group (PVD) registered the highest mean being the means of primary and secondary muscle tension voice disorders groups (MTVD1 and MTVD2) similar.

**TABLE 34**
**Dysthymia Scale in the MCMI-II by Group** (statistical significant)

| | | Estimated Marginal Means |
|---|---|---|
| | **Moderate Clinical Syndrome Scales** | |
| **PVD** | | 56.1 |
| **MTVD1** | **Dysthymia** | 43.1 |
| **MTVD2** | | 43.6 |

*Abbreviations:* MCMI-II, Millon Clinical Multiaxial Inventory (II); MTVD1, MTVD1, Primary Muscle Tension Voice Disorders; MTVD2, Secondary Muscle Tension Voice Disorders; PVD, Psychogenic Voice Disorders.

Post-hoc analysis revealed differences between psychogenic and secondary muscle tension voice disorders groups (PVD and MTVD2) ($p$ = .031) (Figure 11).

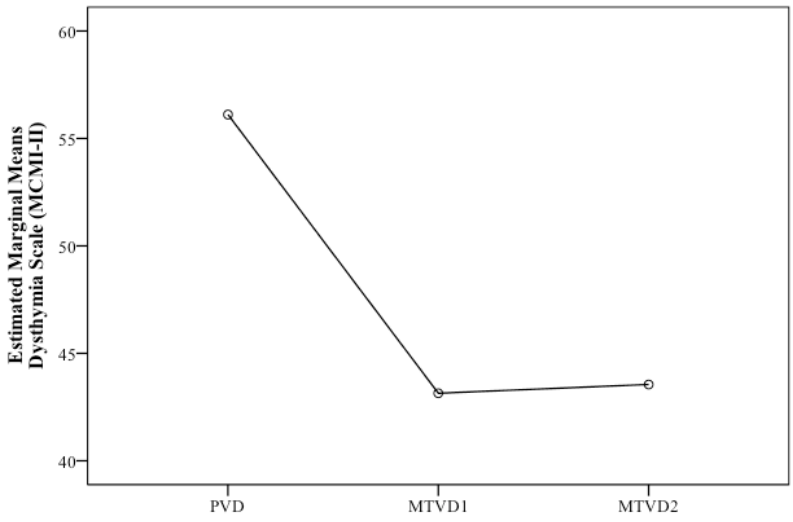


**FIGURE 11. - Estimated marginal means for Dysthymia Scale by Group.**

*Abbreviations:* MCMI-II, Millon Clinical Multiaxial Inventory (II); MTVD1, Primary Muscle Tension Voice Disorders; MTVD2, Secondary Muscle Tension Voice Disorders; PVD, Psychogenic Voice Disorders.

The statistical differences between means of groups in the category of **Severe Clinical Syndromes Scales** associated with Axis I of DSM, were found in one of the three scales: thought disorder ($F_{[2,78]}$ = 3.196, $p$ = .046, $\eta^2$ = .306, $\varepsilon^2$ = .271, large effect).

In Table 35, the mean of thought disorder in psychogenic voice disorders group (PVD) was considerable higher than the means of primary and secondary muscle tension voice disorders groups (MTVD1 and MTVD2) which reached the same value. Nevertheless, these two groups had different values of standard deviation (*SD* [MTVD1] = 3.74; *SD* [MTVD2] = 2.73).

**TABLE 35**
**Thought Disorder in MCMI-II by Group (**statistical significant)

| | | Estimated Marginal Means |
|---|---|---|
| | **Severe Clinical Syndrome Scales** | |
| **PVD** | | 60.8 |
| **MTVD1** | **Thought Disorder** | 53.0 |
| **MTVD2** | | 53.0 |

*Abbreviations:* MCMI-II, Millon Clinical Multiaxial Inventory (II); MTVD1, Primary Muscle Tension Voice Disorders; MTVD2, Secondary Muscle Tension Voice Disorders; PVD, Psychogenic Voice Disorders.

Differences between psychogenic and secondary muscle tension voice disorders groups (PVD and MTVD2) were found ($p$ = .030) (Figure 12).

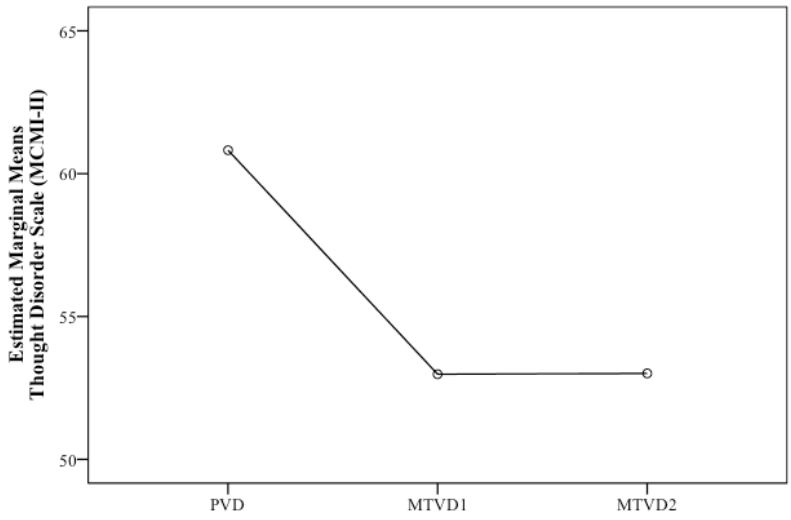


**FIGURE 12. - Estimated marginal means for Thought Disorder by Group.**

*Abbreviations:* MCMI-II, Millon Clinical Multiaxial Inventory (II); MTVD1, Primary Muscle Tension Voice Disorders; MTVD2, Secondary Muscle Tension Voice Disorders; PVD, Psychogenic Voice Disorders.

## 5. Discussion

The Millon Clinical Multiaxial Inventory (MCMI-II) has ensured the goal in the assessment of personality and personality disorders in patients with functional voice disorders (FVDs) having highlighted among these patients the presence of avoidant, narcissistic and histrionic traits, and compulsive, dependent and avoidant personality disorders.

When the severity levels of depressive and anxious symptoms were controlled the three groups of FVDs presented differences in the basic clinical personality patterns (e.g., schizoid) and in the severe personality disorders (e.g., schizotypal). Because of their similarities the analysis of these two personality disorders was carried out jointly. A description of the two personality disorders will be presented in order to provide a characterization of these patients.

In literature review, no references where found to the diagnosis of schizoid personality disorder in patients with functional voice. The same occured for the schizotypal personality disorder.

**Schizoid Personality Disorder**

In the basic clinical personality patterns, differences were found in one of the ten scales: schizoid personality disorder.

When comparing groups the differences were identified between psychogenic (PVD - PT = 33.3% and PD = 15.4%) and primary muscle tension voice disorders (MTVD1 - PT = 25.0% and PD = 0.0%) groups. Patients with psychogenic voice disorders (PVD) were more likely to present a schizoid personality trait than patients with primary muscle tension voice disorders (MTVD1).

The schizoid personality disorder was diagnosed only among patients with psychogenic voice disorders (PVD). To understand the relationship between schizoid and psychogenic voice disorders, we must bear in mind the characteristics of the schizoid individual.

Bleuler introduced the term schizoid in 1908 to describe subjects with characteristics that were similar to pre-psychotic personality or schizophrenic illness, such as suspicious, sensitive and in pursuit of vague purposes (Thylstrup & Hesse, 2009). Millon had described individuals with schizoid personality as being passive, distant, apathetic and indifferent, showing a lethargic behaviour with a lack of vitality which makes them to appear as being in a persistent state of low energy (Millon, 1998; Millon 2011, as cited in Strack & Millon, 2012).

The cognitive functioning of a schizoid individual is characterized by an impoverished cognitive style where loss of the course of thought might occur (Millon, 1998). Intellectualization is often used as a defense mechanism serving the purpose of revealing little about the self and its life.

Emotionally, these patients show a restricted experience and expression, low self-esteem, shame and self-hate (Fahy, 2012; Martens, 2010). Millon affirmed that schizoid patients present an intrinsic incapacity to experience the joyful and pleasurable aspects of life (Millon, 1998; Millon & Davis, 1996, as cited in Martens, 2010).

Their relations have been defined as ambivalent as they tend to establish interpersonal relationship characterized by a lack of positive affiliation that exposes them to the risk of being easily taken advantage of. According to Martens (2010) this relational pattern is justified by their experience of social and/or emotional rejection, negligence, and other traumatic experiences or conflicts. The same author goes further by stating that schizoid personality disorder overlaps with the negative symptoms of schizophrenia such as flat affect, lack of motivation and social withdrawal (Martens, 2010). On the other hand, they also share common traits with narcissistic (e.g., lack of empathy), and with antisocial personality disorders (e.g., withdraw) (Martens, 2010). This leads to these patients to show indifference or lack of interesting for the actions or feelings of others (Fahy, 2012; Millon, 1998; Strack & Millon, 2012).

The interest around the schizoid personality suffered a decline after the publication of the third edition of the Diagnostic and Statistical Manual of Mental Disorders (3rd ed.; DSM-III; American Psychiatric Association, 1980), in which schizoid personality was split up into three categories of personality disorders: schizotypal, avoidant, and schizoid (Hummelen, Pedersen, Wilberg, & Karterud, 2015). Later, in the revised fourth edition (4th ed., text rev.; DSM-IV-TR; American Psychiatric Association, 2000), the schizoid personality disorder was introduced under cluster A along with paranoid and schizotypal personality disorders.

On the other hand this decrease in interest was associated with the low prevalence of schizoid personality disorder in clinical samples. Hummelen et al. (2015) stated that this led the clinicians to question the useful function in keeping it as a separate diagnostic entity.

In epidemiological studies based on the revised third edition of the Diagnostic and Statistical Manual of Mental Disorders (3rd ed., text rev.; DSM-III-R; American Psychiatric Association, 1987) and on its fourth edition (4th ed., DSM-IV; American Psychiatric Association, 1994), the estimate prevalence in general population ranged from 0.0 to 3.1% (Hummelen et al., 2015). In clinical populations the prevalence was 2.2%, making it the least common personality disorder (Triebwasser, Chemerinski, Roussos, & Siever, 2012). Before these data, the hypothesis to exclude schizoid personality disorder

from the DSM was raised. However, in its fifth edition (5th ed.; DSM-5; American Psychiatric Association, 2013a) it remained in a separated diagnostic category (Hummelen et al., 2015).

The fact that patients with schizoid personality disorders are not particularly prone to seek treatment (Thylstrup & Hesse, 2009) contributed to that over the editions of DSM to be the least studied personality disorder (Hummelen et al., 2015). That is why Hummelen et al. (2015) suggested that further empirical studies be developed to confirm its clinical usefulness as a category.

The International Classification of Diseases in its tenth version (ICD-10), characterized schizoid personality disorder as "emotional coldness, detachment or reduced affection, withdrawal from affectional, social, and sexual contacts, preference for fantasy, solitary activities and introspection, limited capacity to express feelings and to experience pleasure, indifference to either praise or criticism and to social norms and conventions" (World Health Organization, 1992, as cited in Thylstrup & Hesse, 2009).

In 2006, the Psychodynamic Diagnostic Manual emphasized the emotional ambivalence of the schizoid unlike the two classification systems (ICD-10 and DSM-IV-TR) that highlights the emotionally detached features and inner life of the schizoid patients (Thylstrup & Hesse, 2009). This classification model assigns the same importance to the fear of closeness and the intense desire for intimacy, which is mediated by intrapsychic conflicts such as the fear of fusion or loss of the object, the paranoid and sexual anxieties that inhibit the development of an intimate relationship (Martens, 2010; Thylstrup & Hesse, 2009).

According to Kosson et al. (2008), schizoid personality has a rich history in psychiatry and psychoanalysis with several clinical descriptions that focus on the concern with inner life and a variety of interpersonal problems such as the difficulty in communication, suspicion and interpersonal sensitivity.

García et al. (2004) defined the schizoid inner world as a source of contradictions. This statement has a great impact when studing patients with psychogenic voice disorders (PVD). In the field of voice and voice disorder these patients also present contradictions. Patients with psychogenic voice disorders (PVD) despite having normal anatomy and physiology of the larynx, they simultaneously exhibit poor vocal quality. It is interesting to note that the diagnosis of schizoid personality disorder had a higher prevalence among these patients, compared to the other two presentations of FVDs.

**Schizotypal Personality Disorder**

In the severe personality disorders category, schizotypal personality was the only one of a total of three personality disorders where statistical differences were found. The psychogenic voice disorders group (PVD) presented significant differences when compared with the two other groups (MTVD1 and MTVD2).

With regard to schizotypal personality trait, patients with primary muscle tension voice disorders (MTVD1 - PT = 12.5%) reached a slightly higher percentage of incidence compared to patients with psychogenic voice disorders (PVD - PT = 10.3%). This trait was also presented in the group of patients with secondary muscle tension voice disorders but in a lower percentage (MTVD2 - PT = 3.6%).

Schizotypal personality disorder was diagnosed in 7.7% of patients with psychogenic voice disorders (PVD) whereas in the groups of primary and secondary muscle tension voice disorders (MTVD1 and MTVD2) this personality disorder was not present.

Regarding the schizotypal personality, the differences between groups were marked being more pronounced between psychogenic voice disorders (PVD) and secondary muscle tension voice disorders (MTVD2) groups. In fact, patients with psychogenic voice disorders (PVD) were the only ones to be diagnosed with schizotypal personality disorder while the schizotypal personality trait was more likely to be found among patients with primary muscle tension voice disorders (MTVD1).

Geng et al. (2013) described schizotypal personality as a disorder presenting cognitive or perceptual distortions, eccentric behavior and social and interpersonal deficits. The monotonous appearance lead to schizotypal individuals to be seen as apathetic, indolent and discouraged (Strack & Millon, 2012). These patients are also perceived as strangers, different or peculiar due to the eccentric behavior and to the cognitive dysfunctions (Davis, 1999; Rosell, Futterman, SMcMaster, & Siever, 2014). Additionaly, they also reveal an inappropriate or constricted affect, and suspiciousness or paranoid ideation (Rosell et al., 2014; Zhang et al., 2014; Ünver, Öner, & Yurtbasi, 2015).

Referential thinking, odd beliefs and unusual perceptual experiences may also occur in their lives (Rosell et al., 2014; Zhang et al., 2014). Chemerinski, Triebwasser, Roussos and Siever (2013), and Rosell et al. (2014) defended that idiosyncratic beliefs such as “magical thinking” or a conviction that the mind has the ability to change the physical world correspond to the thought disorders that can be found in this personality disorder.

The cognitive functioning of these patients has several impairments as in the episodic and working memory, inhibition, abstraction, sustained attention and context processing (McClure, Havey, Bowie, Iacoviello, & Siever, 2013; Ripoll et al., 2013).

In the interpersonal relationships, schizotypal patients present social deficits as in connecting with others and in forming close relationships (Rosell et al., 2014; Ünver et al., 2015). They ensure minimal personal attachments and obligations (Davis et al., 1999) due to their difficulty in face-to-face interactions (Strack & Millon, 2012). A lack of close friends or confidants other than first-degree relatives is frequent in these patients (Chemerinski et al., 2013).

It is important to explain that the emotional and relational difficulties are experienced with considerable discomfort (Ünver et al., 2015). Therefore, excessive social anxiety is common (Zhang et al., 2014) and it does not diminish with familiarity. For Rosell et al. (2014) it tends to be associated with paranoid fears.

In the third edition of the Diagnostic and Statistical Manual of Mental Disorders (3rd ed; DSM-III; American Psychiatric Association, 1980) schizotypal personality was classified as a personality disorder. The fourth and in its revised edition (4th ed.; DSM-IV; American Psychiatric Association, 1994; 4th ed., text rev.; DSM-IV-TR; American Psychiatric Association, 2000) defended that deficits in interpersonal functioning, odd beliefs and thinking, unusual appearance and behavior must be well documented for the diagnosis. These criteria remain in the fifth edition of the DSM (5th ed.; DSM-5; American Psychiatric Association, 2013a).

The lifetime prevalence of the schizotypal personality disorder in community studies of Norwegian and U.S. samples, ranged from 0.6 to 4.6%, respectively (Chemerinski et al., 2013; Rosell et al., 2014). Men reached slightly higher rates compared to women (Rosell et al., 2014). In clinical settings, schizotypal personality disorders are also very rare with incidence values of 1.9% (Chemerinski et al., 2013).

Contrary to what happened in the successive revisions of the DSM, in the tenth version of the International Classification of Diseases (ICD-10, 1993) the schizotypal personality disorder does not match a diagnostic category (Fahy, 2012).

Ünver et al. (2015) stated that by placing this personality disorder in Cluster A personality disorders, being part of the schizophrenia spectrum, underlined its phenomenologically and biologically relationship with schizophrenia (McClure et al., 2013). There are longitudinal studies suggesting that these patients do not develop schizophrenia (Shea et al., 2004, as cited in Chemerinski et al., 2013) and others that

support this relationship such as the research developed by Asarnow et al. (2005, as cited in Zhang et al., 2014) in which the authors concluded that 25% of the schizotypal individuals developed more severe schizophrenia disorders (Zhang et al., 2014).

The characteristics of the schizotypal personality and its role in the history of mental illness, makes it necessary to carry more prospective studies with these patients. Chemerinski et al. (2013) warned to the fact that from all personality disorders, schizotypal personality is the one that has the poorest quality of life in the community.

Due to the persistent maladaptive patterns and despite its phenomenological overlap with schizophrenia, the Diagnostic and Statistical Manual of Mental Disorders defend that schizotypal personality disorder should be seen as a distinct psychopathological entity.

As previously mentioned, there are few studies that analyze the relationship between personality and functional voice disorders. However, in theoretical reviews, patients with psychogenic (PVD) and with primary muscle tension voice disorders (MTVD1) are often described as being more introverted and behaviorally constrained while patients with vocal nodules (MTVD2) are more frequently assigned as extroverted. According to Roy et al. (2000), by assuming a continuum between introversion and extraversion, these two groups are positioned at opposite ends.

Later in 2003, Roy affirmed that personality traits like introversion and neuroticism (trait anxiety) lead to an expected laryngeal inhibitory response to certain environmental signals. Introversion is attached with schizoid and schizotypal personalities that in this study were more strongly associated with psychogenic voice disorders (PVD). Our results met the findings reported in the literature and gave more detailed information on the characteristics of FVDs patients based on worldwide criteria.

The Millon Clinical Multiaxial Inventory (MCMI-II) also allowed the evaluation of clinical syndromes from Axis I of the Diagnostic and Statistical Manual of Mental Disorders.

Out of a total of six moderate clinical syndrome scales, statistical differences in means were detected in dysthymia. Differences were found between the groups with psychogenic voice disorders (PVD) and secondary muscle tension voice disorders (MTVD2), with PVD patients to reach a comparatively higher mean (PVD = 56.1 and MTVD2 = 43.6). Our results pointed for the association between psychogenic voice disorders and dysthymia.

Dysthymia besides being evaluated by the MCMI-II was also evaluated with the Mini International Neuropsychiatric Interview (MINI) in Study 2. Data revealed that dysthymia was more frequent in patients with psychogenic voice disorders (PVD = 50.0%) compared to patients with secondary (MTVD2 = 33.3%) and with primary (MTVD1 = 16.7%) muscle tension voice disorders. These data reinforce our findings and stresses the need to characterize dysthymia.

Dysthimic patients are described as apathic, with feelings of guilt, pessimistic and discouraged. Millon (1998) described their difficulties in concentration, lack of interests and diminished efficacy. Despite the depressed mood with marked low self-esteem, patients with dysthimia can maintain their daily functioning (Craig, 2001).

Based on the Millon's conceptualization, suicidal ideation appears to be associated with dysthymia. In Study 2, our findings pointed for the association between psychogenic voice disorders (PVD), dysthymia and suicidal risk. From our clinical practice, often these patients do not directly report their suffering or their suicidal thoughts, which leads to these psychological aspects to be carefully managed.

In the severe clinical syndrome scales, significant statistical differences in means were found in thought disorders and between patients with psychogenic voice disorders group (PVD) and with secondary muscle tension voice disorders (MTVD2). Patients with psychogenic voice disorders (PVD) showed a comparatively higher mean (PVD = 60.8 and MTVD2 = 53.0), which indicated that this group has been more often affected by thought disorders.

Thought disorders generally encompass symptoms that range from confused, fragmented, and bizarre thinking to scattered hallucinations and unsystematized delusions where ideas of influence and intrusive thoughts may be present (Craig, 1999, 2001).

Haddy, Strack and Choca (2005) reported a strong association between traits of social introversion (schizoid, avoidant, schizotypal) and symptoms of thought disorder. Having verified the existence of differences between groups in the schizoid and schizotypal personality disorders, the differences in thought disorders were expected.

**General Discussion**

Self-report measures of personality were evaluated with the Millon Clinical Multiaxial Inventory (MCMI-II) in this study. MCMI-II corresponds to a diagnostic

instrument that has a multiaxial format and validation schema, and is systematically connected to a comprehensive clinical theory.

In this study, the means of the three validity indices were within normative values. These scales are very useful once they indicate if it is a valid or invalid report. They also give information on the patient's response style (disclosure scale - defensive or open in the assessment; desirability scale - self favorability; debasement scale - self unfavorability). All participants had a valid test and the means of the three groups for these scales were very similar. These results ensure a higher level of accuracy for the analysis and interpretation of the results of MCMI-II.

A substantial proportion of patients with functional voice disorders met the criteria for diagnosis from Axis-I and Axis-II of the Diagnostic and Statistical Manual of Mental Disorders.

Our results supported the link between certain personality traits and personality disorders with functional voice disorders. The diagnosis of schizoid, avoidant, narcissistic and histrionic traits, and compulsive, dependent, and avoidant personality disorders reached high incidences. Our findings suggested that there are personality disorders associated with functional vocal disorders and that those reflect the personality profile of patients with FVDs.

The three groups (PVD, MTVD1 and MTVD2) showed differences in the schizoid and schizotypal personality disorders when the depression and anxiety severity levels were statistically controlled.

Our data corroborate the idea defended by Roy et al. (2000, as cited in Baker, 2017) about the existence of typical "personological resumés" for different voice disorders groups. In fact, there are personality traits that act as vulnerability factors for the development of each of the three types of functional voice disorders.

Another relevant finding in this study pointed to the schizoid and schizotypal personalities as potential discriminators between the different types of FVDs. According to Baker (2017) very few individuals with functional voice disorders were formally diagnosed with psychoticism, schizophrenia, or personality disorders. In this study this was not verified since the incidence of each personality disorder in the total of sample was: schizoid (9.6%), schizotypal (3.6%), and paranoid (7.2%) (Cluster A); antisocial (2.4%), histrionic (3.6%), borderline (4.8%), and narcisistic (9.6%) (Cluster B); dependent (37.3%), avoidant (19.3%), and obsessive-compulsive (63.9%) (Cluster C).

Baker (2017) added that personality profiles of female patients with functional voice disorders reflected high levels of reactivity to stress and social anxiety. Schizotypal personality disorders are associated with social anxiety which supports the Baker' statement, with regard to patients with psychogenic voice disorders (PVD).

With regard to our results, it was found that histrionic personality was one of the three most common personalities. It is interesting to remember that for many years, functional voice disorders and psychogenic voice disorders in particularly were named as "hysterical aphonia or dysphonia".

We reinforce that this discussion is conditioned to the existence of few studies focusing on the assessment of personality in FVDs as by the different conceptualizations of personality (e.g., the use of the designation of hysteria and histrionic), and consequently in the applied methodology. Despite this it is noteworthy to make reference to three studies in which the results assigned the relation between hysteria and psychogenic voice disorders.

In 1966, Aronson et al. (as cited in Roy et al., 1997) studied 27 patients (24 females and 3 males) with psychogenic dysphonia or aphonia, using the Minnesota Multiphasic Personality Inventory (MMPI). The results showed that hysteria was observed in less than half of the patients, and that 30% exhibited a conversion disorder. Some years later, in 1975, Pfau also assessed patients with PVD (46 females and 8 males) with the same psychological instrument as Aronson et al., and found that 35% of female patients presented a neurosis, of which 20% were considered a hysterical reaction. However, more than half of the profiles were not interpretable (37%) or the values were classified as normal limits (28%) (Roy et al., 1997). After psychiatric evaluation and the application of the Life Event Inventorie in a study with 22 females with hyper and hypofunctional aphonia, Kinzl et al. (1988, as cited in Roy et al., 1997) found that hysterical personality was frequent but was not always present.

In these three studies there was a high prevalence of hysteria but it is crucial to clarify the taxonomy in the history of the classification of psychiatric disorders as it is highly accepted that hysteria was a common diagnosis in general medical literature.

Feintsein (2011) made a "Medline" search up to the year of 1968 and verified that the number of papers on hysteria was 4000 and after the introduction of the term "conversion disorder" it decrease to 352. Note that the former category of "hysteria" was reviewed, leading the fourth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV, 1994) to introduce the category of somatoform disorders. This entity

embraces six conditions such as somatization disorder, conversion disorder, undifferentiated somatoform disorder, pain disorder, hypochondriasis, and body dysmorphic disorder.

Gerritsma (1991, as cited in Roy et al., 1997) studied 75 females and 7 males with psychogenic dysphonia or aphonia. Only 4% met the DSM criteria for hysterical personality disorder. The author also found that 40% reached a low score in introversion and that 65% of the subjects presented social anxiety (Roy et al., 1997). Our results were in agreement with these findings once introversion and social anxiety correspond to characteristics associated with schizoid and to schizotypal personalities disorders, and hysteria was present but not at high incidence levels.

Roy et al. (1997) assessed and compared the psychological characteristics of two groups using the MMPI: 25 females with functional dysphonia, and 19 females without current and past voice disorders (control group). The authors found that nearly one third of the vocal patients displayed a profile within normal range. Differences between groups were found in hypochondriasis, depression, hysteria, paranoia, psychasthenia, schizophrenia, and social introversion. These results concurred with ours in respect to the prevalence of psychopathology, depression, hysteria and psychastenia defined as a general anxiety trait and social introversion as common characteristics of patients with functional voice disorders.

## 6. Conclusion

Functional voice disorders develop in association with many psychological factors that can act as predisposing, precipitating, exacerbating, or perpetuating influences. One of these factors is personality. Screening for personality traits and personality disorders among patients with functional voice disorders help all the professionals included in the multidisciplinary vocal assessment to better understand the course of the vocal disease.

In this study, it was taken a step forward in the approach of personality in FVDs with the evaluation of personality disorders based on strict criteria. The applied method allowed the identification of a personality profile of FVDs and led to the distinction of three types of functional voice disorders with regard to the diagnosis of schizoid and schizotypal personality disorders.

Although functional voice disorders can be seen globally as a group by sharing a personality profile, they should be approached according to the specificities of each presentation.

Schizoid patients are described as detachment from social relationships with a restricted range of expression and emotions while schizotypal patients present an acute discomfort associated with close relationships that is accompanied by behavior eccentricities. Reference to these relational characteristics gains more meaning when it comes to patients with functional voice disorders where voice reaches a wider dimension.

The vocal quality similar to some characteristics of personality keeps the closeness, distance or withdrawal of the relationship with others. Thus, it will be essential to identify and understand the role of vocal impairment in individuals described as feeling more safe and comfortable without intensive communication and bonds with others or even without any kind of social interaction. We admit that the impairment in vocal quality is connected with interpersonal functioning. Continue to explore and evaluate its dimensionality will be undoubtedly relevant and will have implications in the outcome of these patients.

The vocal symptom placed at the center of treatment brings together the difficulties in self-emotional expression and in relationships. In clinical voice assessment, the psychologist must sensitize the rest of the multidisciplinary team to the risk of these patients failing in communication and in social interaction, rather than to the indifference to social interactions that is also present and which at first glance seems to be prevalent. The psychological treatment can promote the reduction of relational distress playing a restorative role in relationships.

# Affective Temperaments

## Study 4

### 1. Introduction

The model of temperament proposed by Akiskal et al. advocate the existence of five affective temperaments: depressive (sensitivity to suffering), cyclothymic (rapid shifts in mood and energy), hyperthymic (over-energetic and over-confident traits), irritable (moody, choleric, and impulsive) and anxious (exaggerated tendency to be worry) (Ardani et al., 2017). For Rovai et al. (2013) affective temperaments influence the individual's lives in normal and pathological conditions.

It is recognized that premorbid temperament plays an important role in the development of affective disorders (Dembińska-Krajewska & Rybakowski, 2014). In literature there were also references to the relationships between temperaments and the mental state in non-clinical populations (depressive symptoms, and in mood and anxiety disorders) and also in mental problems as suicide risk (Deguchi et al., 2016).

In addition, affective temperaments need to be characterized in affective disorders but also in other psychiatric and medical illness. The existence of a dominant affective temperament will have a predominant role in the course and outcome of the disease. Dembińska-Krajewska and Rybakowski (2014) argued that the type of temperament as its intensity would have an impact on the quality of life, which may be constructive or destructive. For instances, Fındıklı et al. (2016) noted that irritable, depressive, and anxious temperaments were higher in epilepsy while cyclothymic temperament was frequently associated with hypertension. The same authors pointed to the lack of studies of affective temperament in patients with other medical conditions.

The purpose of this study was to explore whether there is an association between affective temperaments and each of the three presentations of functional voice disorders ($4^{th}$ Goal).

### 2. Procedure

The *Temperament Evaluation of Memphis, Pisa, Paris and San Diego - Auto questionnaire* (TEMPS-A) is a self-report test developed by Akiskal and collaborators in 2005 to assess five affective temperaments: depressive, cyclothymic, hyperthymic, irritable

and anxious; by answering to 110 items with yes or no responses (Figueira et al., 2008). This instrument was built based on the assessment interview of temperament that was previously developed by the same authors.

The factorial score for each of the five subscales is calculated by adding one point for the presence of each trait with the total value for each scale resulting from the sum of all "true" answers. Then, the values are standardized through Z-scores that define a degree for each temperament (Figueira et al., 2008) and that go to determine the dominant affective temperament (Ardani et al., 2017). The subscales of the TEMPS-A attempt to capture emotional, cognitive and psychomotor traits that might predispose a person to major mood disorders as well as the adaptative characteristics of the individual (Akiskal et al., 2005; Tei-Tominaga, Akiyama, & Sakai, 2012).

This instrument is used worldwide, having been translated in more than 32 languages (Bahrini, Damak, & Cheour, 2016), and has at least twelve cross-culturally valid versions (Ardani et al., 2017). The Portuguese version of TEMPS-A was developed by Figueira et al. in 2008 and has an internal consistency similar to other language versions: depressive ($\alpha$ = .67), cyclothymic ($\alpha$ = .79), hyperthymic ($\alpha$ = .78), irritable ($\alpha$ = .72), and anxious ($\alpha$ = .83). In this study, the internal consistency of each affective temperament was: depressive ($\alpha$ = .78), cyclothymic ($\alpha$ = .85), hyperthymic ($\alpha$ = .76), irritable ($\alpha$ = .75), and anxious ($\alpha$ = .87) (Figueira et al., 2008). In our sample, the Cronbach $\alpha$ values were generally higher than those of the Portuguese population validation with the exception of hyperthymic temperament that was slightly lower.

## 3. Statistical Analysis

Data was analyzed with SPSS Statistic v21.0 for Mac OS (IBM Corporation, Chicago, IL).

Descriptive statistics measures (frequency and percentage) were used to characterize the incidence of the five affective temperaments in each group.

The correlation between each temperament type by Group was assessed with Pearson's linear correlation coefficient.

For an accurate evaluation of affective temperaments, the Analysis of Covariance (ANCOVA) was performed. In this analysis, the independent variable was Group, both

Hamilton Rating Scales corresponds to covariates (HAMD = 10.20, HARS = 11.86), and the five affective temperaments evaluated with TEMPS-A were the dependent variables.

Post-hoc comparisons of adjusted means were used to detect in which groups there were significant differences in mean values.

The significance level was set at 5%.

## 4. Results

Depressive and anxious temperaments were common among our patients in percentages a little below 50%. Yet, the depressive temperament had a slightly higher prevalence compared to the anxious temperament (depressive = 55.4% and anxious = 50.6%). Hyperthymic and irritable temperaments were less frequent in patients with functional voice disorders (both had a percentage of 9.6%).

Table 36 presents frequency and percentage of the classification categories of the five affective temperaments (TEMPS-A) by Group.

Patients with psychogenic voice disorders (PVD) presented more frequently a depressive temperament (64.1%) with the classification moderate to be the most common (38.5%). The second usual affective temperament was the anxious temperament (51.3%) with considerable prevalence of moderate classification (slight = 12.8% and moderate = 38.5%).

Three thirds of the patients with primary muscle tension voice disorders (MTVD1) revealed an anxious temperament while 56.2% presented a depressive temperament. A moderate anxious temperament had twice the prevalence of the slight classification in this group of patients (slight = 25.0% and moderate = 50.0%). For the depressive temperament, the percentages for both slight and moderate were quite similar (slight = 31.2% and moderate = 25.0%) in the primary muscle tension voice disorders group (MTVD1).

In the secondary muscle tension voice disorders group (MTVD2), the incidence for depressive and anxious temperaments was 42.9% and 35.8%, respectively. If on the one hand, patients with depressive temperament were more frequently classified as presenting a slight condition (slight = 25.0% and moderate = 17.9%), on the other for anxious temperament the prevalence of sligh and moderate was the same (17.9%).

**TABLE 36**
**Frequency and Percentage of the Classification Categories of Affective Temperaments in TEMPS-A by Group**

| | | Depressive | | | Cyclothymic | | | Hyperthymic | | | Irritable | | | Anxious | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Std | Sl | Mt | Std | Sl | Mt | Std | Sl | Mt | Std | Sl | Mt | Std | Sl | Mt |
| **PVD** | Frequency | 14 | 10 | 15 | 27 | 8 | 4 | 26 | 3 | 0 | 36 | 1 | 2 | 19 | 5 | 15 |
| | Percentage | 35.9 | 25.6 | 38.5 | 69.2 | 20.5 | 10.3 | 92.3 | 7.7 | 0.0 | 92.3 | 2.6 | 5.1 | 48.7 | 12.8 | 38.5 |
| **MTVD1** | Frequency | 7 | 5 | 4 | 12 | 3 | 1 | 13 | 2 | 1 | 14 | 2 | 0 | 4 | 4 | 8 |
| | Percentage | 43.8 | 31.3 | 25.0 | 75.0 | 18.7 | 8.3 | 81.3 | 12.5 | 6.3 | 87.5 | 12.5 | 0.0 | 25.0 | 25.0 | 50.0 |
| **MTVD2** | Frequency | 16 | 7 | 5 | 24 | 3 | 1 | 26 | 2 | 0 | 25 | 2 | 1 | 18 | 5 | 5 |
| | Percentage | 57.1 | 25.0 | 17.9 | 85.7 | 10.7 | 3.6 | 92.9 | 7.1 | 0.0 | 89.3 | 7.1 | 3.6 | 64.2 | 17.9 | 17.9 |

*Abbreviations:* Mt, Moderate classification; MTVD1, Primary Muscle Tension Voice Disorders; MTVD2, Secondary Muscle Tension Voice Disorders; PVD, Psychogenic Voice Disorders; Sl, Slight classification; Std, Standard value; TEMPS-A, Temperament Evaluation of Memphis, Pisa, Paris and San Diego - Auto questionnaire.

To evaluate the relation between the five affective temperaments (TEMPS-A) by Group, Pearson's linear correlation coefficient was applied (Table 37).

**TABLE 37**
**Pearson's correlation for Affective Temperaments (TEMPS-A) by Group**

| | | Depressive | Cyclothymic | Hyperthymic | Irritable |
|---|---|---|---|---|---|
| **PVD** | Cyclothymic | .617*** | | .351* | |
| | Hyperthymic | | | | |
| | Irritable | .446** | .725*** | | |
| | Anxious | .727*** | .706*** | | .637*** |
| **MTVD1** | Cyclothymic | | | | .725** |
| | Hyperthymic | | | | |
| | Irritable | | | | |
| | Anxious | | | | |
| **MTVD2** | Cyclothymic | .419* | | | .508** |
| | Hyperthymic | -.483** | | | |
| | Irritable | | | | |
| | Anxious | .749*** | .468* | -.527** | |

*Abbreviations:* MTVD1, Primary Muscle Tension Voice Disorders; MTVD2, Secondary Muscle Tension Voice Disorders; PVD, Psychogenic Voice Disorders; * p-value < .05; ** p-value < .01; *** p-value < .001; TEMPS-A, Temperament Evaluation of Memphis, Pisa, Paris and San Diego - Auto questionnaire.

In the group of patients with psychogenic voice disorders (PVD), a strong positive linear correlation was found between depressive and anxious temperaments ($r = .727$, $p < .001$), cyclothymic and irritable temperaments ($r = .725$, $p < .001$), and between cyclothymic and anxious temperaments ($r = .706$, $p < .001$). A moderate positive linear correlation was detected between irritable and anxious temperaments ($r = .637$, $p < .001$), depressive and cyclothymic temperaments ($r = .617$, $p < .001$) and between hyperthymic and cyclothymic temperaments ($r = .351$, $p = .028$).

The group of patients with primary muscle tension voice disorders (MTVD1) revealed the existence of a single correlation, a strong positive linear correlation between cyclothymic and irritable ($r = .725$; $p = .001$).

In the secondary muscle tension voice disorders group (MTVD2) there was a strong positive linear correlation between depressive and anxious temperaments ($r = .749$; $p < .001$),

and a moderate negative linear correlation between anxious and hyperthymic temperaments ($r$ = -.527, $p$ < .01).

When the severity of depression and anxiety were statistically controled, significant differences in means between groups were found in one temperament: depressive ($F_{[2,78]}$ = 4.272, $p$ = .017, $\eta^2$ = .357, $\varepsilon^2$ = .324, large effect).

Table 38 presents the estimated marginal means for depressive temperament by Group.

In the psychogenic voice disorders group (PVD) the estimated marginal mean for depressive temperament was slightly higher than the means of the two other groups (MTVD1 and MTVD2).

**TABLE 38**
**Depressive Temperament in TEMPS-A by Group** (statistical significant)

| | | Estimated Marginal Means |
|---|---|---|
| | **Temperament** | |
| **PVD** | | 11.4 |
| **MTVD1** | **Depressive** | 8.7 |
| **MTVD2** | | 10.3 |

*Abbreviations:* MTVD1, Primary Muscle Tension Voice Disorders; MTVD2, Secondary Muscle Tension Voice Disorders; PVD, Psychogenic Voice Disorders; TEMPS-A, Temperament Evaluation of Memphis, Pisa, Paris and San Diego - Auto questionnaire.

Post-hoc analysis revealed differences between psychogenic and primary muscle tension voice disorders groups (PVD and MTVD1) ($p$ = .006), with depressive temperament to be dominant among patients with psychogenic voice disorders (PVD) (Figure 13).

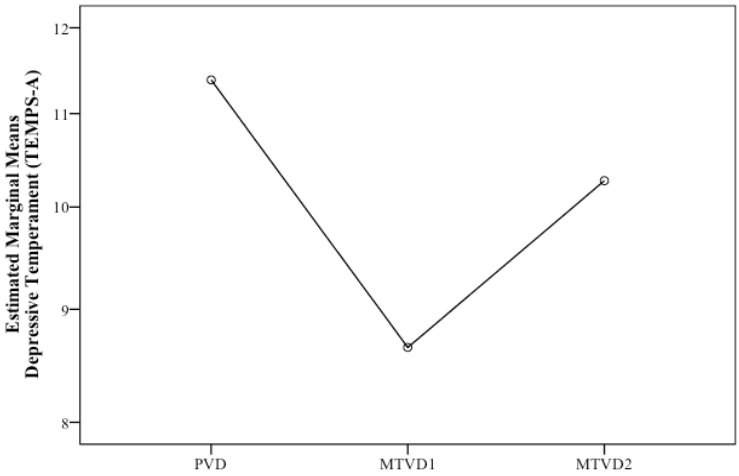


**FIGURE 13. - Estimated marginal means for the Depressive Temperament by Group.**

*Abbreviations*: MTVD1, Primary Muscle Tension Voice Disorders; MTVD2, Secondary Muscle Tension Voice Disorders; PVD, Psychogenic Voice Disorders; TEMPS-A, Temperament Evaluation of Memphis, Pisa, Paris and San Diego - Auto questionnaire.

## 5. Discussion

The inclusion of the Temperament Evaluation of Memphis, Pisa, Paris and San Diego - Auto questionnaire (TEMPS-A) in the evaluation protocol was justified by its wide application either in epidemiological and clinical studies of the general population as in patients with affective disorders and also in other medical diseases. This idea becomes clear when quoting Rovai et al. (2013): "affective temperaments have been reported to display an important pathoplastic action on a wide range of diseases, extending far beyond the field of affective illness. In particular, temperamental traits have been shown to influence not only psychiatric but also somatic diseases".

In the field of voice disorders there were very few reports on temperament. There are previously findings that notice a relationship between temperament type and voice disorders but generically. However, the theoretical conceptualization in which those researchers were based did not fit the theoretical model of temperament proposed by Akiskal as our study. According to our knowledge, this is the first study to screen for affective temperaments in patients with functional voice disorders classified according to a clinical and complex classification system (Baker et al., 2007), using the Temperament Evaluation of Memphis, Pisa, Paris and San Diego - Auto Questionnaire (TEMPS-A). In literature, only one publication evaluates a single group of patients with functional aphonia with TEMPS-A (Sinkiewicz et al., 2013).

Therefore, our findings will always be discussed based on: normative Portuguese data and in results from recognized studies that evaluated the relationship between affective temperaments and psychiatric disorders or others medical diseases.

In this study, the assessment of affective temperament with TEMPS-A proved to be effective. It was revealed that depressive and anxious temperaments were dominant among patients with functional voice disorders, in a degree that depended on the type of the FVDs. In literature, it was only found a reference to "anxious" as a temperamental characteristic of FVDs patients. Yet, studies where patients with different voice disorders were evaluated using a temperament scale were not found. Thus, our assessment went further by providing information on the type and degree of affective temperaments in each of the three groups of FVDs.

In the total sample, depressive and anxious temperaments were prevalent. These results represent a novelty in the characterization of patients with functional voice disorders and generically in the evaluation of temperament in patients with vocal pathology.

A person with depressive temperament shows a gloomy mood (Gois et al., 2012), shyness, a tendency to worry, and concentration problems. For Dembińska-Krajewska and Rybakowski (2014) depressive temperament is connected with a rigid thinking and self-accusation. It is also strongly associated with sensitivity to suffering (Woodruff et al., 2011). These characteristics may exacerbate the already existing low self-esteem and the concern with failure. Gois, Akiskal, Akiskal and Figueira (2012) warned of their imminent risk of developing feelings of inadequacy and failure.

For Woodruff et al. (2011) anxious temperament describes an exaggerated personality disposition toward worrying.

Depressive temperament was dominant in the psychogenic (PVD) and in the secondary muscle tension voice disorder (MTVD2) groups. Based on the Z-score classification, patients with psychogenic voice disorders (PVD) were more moderate depressives (Z-Scores above +2*SD*) whereas patients with secondary muscle tension voice disorders (MTVD2) were more frequently slight depressives (Z-Scores above +1*SD*). An increase in the depressive subscale was also found for the Portuguese population as reported by Figueira et al. (2008).

Patients with primary muscle tension voice disorders (MTVD1) had a higher incidence of anxious temperament with the moderate classification to be prevalent. These

patients also presented a moderate level of severity of the anxious symptoms and were more frequently diagnosed with anxiety disorders (Study 2).

In summary, our findings met the international trend by supporting an increase of depressive and anxious temperaments in female gender.

Clark et al. (1994, as cited in Gois et al., 2011) and Kendler et al. (1993, as cited in Gois et al., 2011) defended that neuroticism is a genetically-based temperament, sensitive to negative stimuli, and associated with a broad range of negative moods like sadness, depression, guilt, hostility and self-dissatisfaction. For Gois et al. (2011) these psychological features may act as vulnerability factors for depression and anxiety as well as predictors of their incidence and recurrence.

In Study 2, our results provided evidence for a strong link between affective and anxiety disorders and functional voice disorders. These data increase the importance of assessing affective temperaments in FVDs patients.

To deepen the knowledge of the relationship between affective temperaments and functional voice disorders, it was necessary to identify the correlations between the five affective temperaments per group of patients. When comparing the correlations between the five affective temperaments in each of the three groups of FVDs patients with those from the Portuguese validation (Figueira et al., 2008), very similar results were found. As the data derived from the validation of the TEMPS-A, the strongest correlation was found between depressive and anxious temperaments and was detected in the psychogenic voice disorders group (PVD) and in the secondary muscle tension voice disorders group (MTVD2). Our results were also in line with the findings for no correlation between hyperthymic and irritable temperaments. In the secondary muscle tension voice disorders (MTVD2) there was a mild negative correlation between depressive and hyperthymic temperaments as found in the Portuguese population. However, in this group a moderate negative correlation between hyperthymic and anxious temperaments was also identified. In the primary muscle tension voice disorders (MTVD1), a moderate correlation was detected between cyclothymic and irritable temperaments.

The findings from psychogenic voice disorders (PVD) and secondary muscle tension voice disorders (MTVD2) groups supported the characteristics found for the Portuguese population with higher positive correlation between depressive and anxious temperaments.

Since affective temperaments (depressive and anxious) were associated with functional voice disorders, it was important to evaluate if there were differences between

the means of the groups by controlling the effect of depression and anxiety severities. Differences between groups were found for depressive temperament, between psychogenic voice disorders (PVD) and primary muscle tension voice disorders (MTVD1). Comparatively to the primary muscle tension voice disorders (MTVD1), psychogenic voice disorders (PVD) had a higher mean. On the other hand, the MTVD2 group did not differ from other groups (PVD and MTVD1), which contributes to patients with psychogenic voice disorders to be more likely to present depressive temperament.

In the interpersonal relations, depressive individuals tend to be passive and dependable (Deguchi et al., 2016), very sensitive to criticism (Dembińska-Krajewska & Rybabowski, 2014) and to rejection (Gois et al., 2012). Subjects with depressive temperament are very attaching to the routine (Deguchi et al., 2016), yet they are permeable to letting others to decide on his/her behalf (Gois et al., 2012). It will be expected that these features will be enhanced in the presence of a dependent personality. In the group of patients with psychogenic voice disorders (PVD), 15.4% had a dependent trait while 43.6% presented a dependent personality disorder. The evaluation and characterization of the relationship between vocal impairment and dependent characteristics (depressive temperament and/or dependent personality trait or disorder) should be developed in future studies with patients with psychogenic voice disorders.

The vulnerability for depressive temperament verified in patients with psychogenic voice disorders may have other clinical implications.

The characteristics of depressive temperament increase the predisposition to major depression. This was corroborated by the findings of a study developed by Gois et al. (2012) with diabetic patients. The authors concluded that depressive temperament has an impact, not only on increasing the risk of patients with type 2 diabetes developing depression but also in influencing their self-care. Based on this assumption, in the group of patients with psychogenic voice disorder (PVD) depressive temperament may represent a subclinical manifestation of serious mood disorders that may compromise the vocal care.

In Study 2, nearly half of the patients with PVD presented a current major depression (43.6%) and the severity of depressive symptoms was evaluated as mild. These patients also had the highest risk of suicide (incidence and severity). Our data corroborate the notion defended by Karam et al. (2015) in which depressive temperament in patients with mental disorders represents a risk factor for suicide attempts. Therefore, it

is suggest that patients with psychogenic voice disorders (PVD) should receive a more detailed evaluation of suicidal behaviors.

Bahrini et al. (2016) developed a study to investigate the influence of affective temperaments on adherence to treatment. The authors found that the patients with depressive and irritable temperaments had a poor adherence to treatment and that patients with cyclothymic, irritable and anxious temperaments were more sensitive toward the negative side effects of psychotropic medication. When considering that 43.6% of the patients with psychogenic voice disorders (PVD), 56.3% of the patients with primary muscle tension voice disorders (MTVD1) and 50.0% of the patients with secondary muscle tension voice disorders (MTVD2) had prescriptions for psychotropic medication (more frequently anxiolytic, antidepressant or the combination of the two), we suggest that the results from Bahrini et al. should be taken into account in the assessment of patients with functional voice disorders. We agree with the authors as they suggest to provide more education concerning the need of medication for individuals with depressive temperament and to give more assistance and advices concerning psychotropic medication to anxious patients.

Pre-illness affective temperaments have an important role in the polarity direction and in the symptom profile, both in minor and major mood episodes (Fındıklı et al., 2016). The results from Study 2 had indicated the vulnerability of patients with FVDs to develop affective disorders. This has therapeutic implications depending on the type of functional voice disorder.

## 6. Conclusion

Özkan, Altinbas, Koç, Şen and Özisik (2016) defined affective temperament as a heritable phenomenon that describes the biological and genetic tendencies of the personality and provides the automatic emotional response to life events. Like personality, temperament refers to the basic nature of a person (Litaiem et al., 2013) and voice has the function of transmitting the emotions and temperament (Roy et al., 1997), revealing the individual's characteristics.

According to Deguchi et al. (2016) temperament establishes a person's baseline level of mood, reactivity and energy and is associated with mental problems, mental state, depressive symptoms, mood and anxiety disorders, and alcohol/substance abuse or

dependence. As affective temperaments may influence the vulnerability to psychopathology and may play a role in the development of somatic symptoms (Hyphantis et al., 2013), this relationship encourages the study of affective temperaments in patients with functional voice disorders.

Depressive temperament was more frequent in the psychogenic voice disorders (PVD) and in secondary muscle tension voice disorders (MTVD2) groups, in moderate and slight degrees, respectively. A moderate anxious temperament stood out among patients with primary muscle tension voice disorders (MTVD1).

Our findings reinforce the importance of classifying patients with functional voice disorders, with implications in treatment outcomes.

When the levels of depressive and anxious symptoms were controlled, statistical differences between the means of the groups were found for depressive temperament and between psychogenic voice disorders (PVD) and primary muscle tension voice disorders (MTVD1). It is accepted that depressive temperament may play an important role in the development and maintenance of medical diseases, and it is expected that the same will occur in psychogenic voice disorders (PVD).

The study of the correlations between the different types of affective temperament in each group showed that a positive strong correlation between depressive and anxious temperaments in patients with psychogenic voice disorders (PVD), as well as in the group of patients with secondary muscle tension voice disorders (MTVD2). The high correlation between depressive and anxious temperaments together with the incidence of affective and anxiety disorders, reinforces the screening of affective temperament in FVDs patients. It also contributed to the understanding of physiopathology, psychiatric co-morbidity and clinical manifestations in functional voice disorders.

The evaluation of affective temperaments will be important for the multidisciplinary vocal assessment once affective temperaments may influence the treatment course and outcomes.

This study offers an original approach to patients with functional voice disorders, a perspective that should be further developed.

# Vocal Acoustic Evaluation

## Study 5

### 1. Introduction

The voice results from the interaction of diffent systems in body and for Freitas, Pestana, Almeida, and Ferreira (2015) "the spoken voice involves, probably, the most elaborate system of human communication".

In vocal production, the will to communicate orally impels the brain to transmit nerve impulses to the respiratory system (Guimarães, 2004). Breathing will be responsible for the energy supply. The vibration of the vocal folds generates a sound that is amplified and modified by the resonance cavities (pharynx, mouth and nose), and by the articulation organs (tongue, lips, jaw and soft palate). The anatomical configuration of the vocal tract carries the specificity of the individual. It represents a kind of "voice signature" that allows others to remember and recognize the speaker's voice (Xu, Homae, Hashimoto, & Hagiwara, 2013). The physical attributes as well as the psychological characteristics are therefore revealed and identified based on the vocal characteristics.

The concept of vocal quality is difficult to define. According to Laver (1980, as cited in Waaramaa et al., 2008) voice quality corresponds to the "individual coloring of the speaker's voice", comprising the expected characteristics that stresses gender, age, and education status for that person. For Rockland, Teixeira, Silva and Lima (2010), voice quality is determined by the anatomical structures of the vocal tract, the use that each one makes of them, by the environment and also by the physical and emotional state of the speaker (Uchanski, 2005).

Over the years, the interest in voice and its disorders and the need for reliable techniques to quantify vocal disturbances increased (Yu, Quaknine, Revis, & Giovanni, 2001). The technological advances had improvement the vocal assessment with the development of signal recorders and software for its analysis.

Many authors state that there is no single method capable of assessing the voice and its deterioration (Freitas et al., 2015). The variation in voice quality is usually described by perceptual descriptions and means of acoustic measurements. In fact, in voice disorders there are perceptual signs of vocal changes such as hoarseness,

breathiness and roughness that require the identification of their acoustic correlations. Besides perceptual analysis, the acoustic analysis increased in clinical practice and provides quantitative measures of vocal function and vocal quality (Lopes et al., 2017).

Voice acoustic analysis corresponds to a non-invasive and objective method of vocal assessment that gives a set of acoustic measures in an easy, fast and affordable way (Sousa, Freitas, & Ferreira, 2011). Nemr et al. (2005) identified as advantages in its use "increase in diagnostic precision, identification and documentation of short and long-term treatment efficacy and possibility of providing visual feedback to the patient". The objective values provided by the acoustic method are necessary for the exchange of data between voice specialists and allow monitoring the course of treatments (Parsa & Jamieson, 2001).

Vocal acoustic measures are commonly used in many settings to define laryngeal characteristics, phonation, and perceptive and emotional impacts (Gobl & Chasaide, 2003). The most frequently analyzed are fundamental frequency, perturbation measures (jitter, shimmer and HNR), and the frequency of the first two formants.

Since patients with voice disorders can present relatively different values compared to healthy voices, Teixeira and Fernandes (2015) advocate the use of normative databases for a better analysis since they make it possible to distinguish between "normal" and pathological voices.

Data of mean F0 values for the normative Portuguese population, for sustained vowels /i/, /a/ and /u/, was provided by Guimarães and Abberton (2005) (named ($F0_{GA}$) (Table 40). Information on pathological voices also exists as a result of the studies of Carmona (2003) and Gouveia (2004) (named as $F0_C$ and $F0_G$, respectively) (Table 39).

**TABLE 39**
**Data for Portuguese Speakers for the Fundamental Frequency (F0 in Hz)**

Normative and pathological

| | **/i/** | **/a/** | **/u/** |
|---|---|---|---|
| **$F0_{GA}$** | 206 - 262 | 199 - 215 | 205 - 253 |
| **$F0_C$** | 184 - 234 | 174 - 228 | 188 - 239 |
| **$F0_G$** | 178 - 242 | 162 - 220 | 181 - 251 |

*Abbreviations:* F0, Fundamental frequency; $F0_C$, Data from the study of Carmona (2003); $F0_G$, Data from the study of Gouveia (2004); $F0_{GA}$, Data from the study of Guimarães & Abberton (2005); Hz, Hertz.

Delgado-Martins (1973) ($F1_{DM}$) and Escudero and Boersma (2009) ($F1_{EB}$) also contributed to normative data for mean F1 (Table 40).

**TABLE 40**
**Normative Data for Portuguese Speakers for the First Formant (F1 in Hz)**

| | /i/ | /a/ | /u/ |
|---|---|---|---|
| **$F1_{DM}$** | 294 | 626 | 315 |
| **$F1_{EB}$** | 313 | 781 | 335 |

*Abbreviations:* F1, First formant; $F1_{DM}$, Data from the study of Delgado-Martins (1973); $F1_{EB}$, Data from the study of Escudero and Boersma (2009); Hz, Hertz.

These data will be used in the analysis and discussion of our results to provide information on the vocal quality of patients in each group.

Although functional voice disorders correspond to common diagnoses in vocal assessment, many authors considered that the published acoustic studies are insufficient to characterize the voice quality of patients with FVDs. For Ruotsalainen, Sellman, Lic, Lehto and Yerbeek (2008) "the diagnosis of functional dysphonia does not, however, in itself reveal what aspects of vocal or speech production (pitch, loudness, intonation, phonation, breathing, resonance, or overall tension) need to be modified."

In literature, there are several references to the preservation of reflex activities such as cough and laugh in psychogenic voice disorders (PVD).

Cough is commonly defined as "a violent expulsion of air from the lungs with a characteristic sound" (Fontana & Widdicombe, 2007). It has two protective functions: prevent foreign material from entering the airway and expel foreign materials and secretions from the airway (Murty, Smith, & Lancaster, 1991). For Guimarães (2007), cough is the response of the mucosa to clear the respiratory tract. Fontana and Widdicombe (2007) considered cough as a complex phenomenon that integrates various definitions according to different approaches used by basic and clinical scientists.

Cough production involves three phases: the inspiratory phase with the air serving to lengthen the expiratory muscles, optimizing the length-tension relationship; the compressive phase with closure of the glottis to maintain lung volume and intrathoracic pressure with increased contraction of the expiratory muscles; and finally the expulsive phase with the opening of the glottis, great tightening of the vocal folds and elevation of

the larynx that releases a brief supramaximal expiratory flow (Chang, 2006; Fontana & Widdicombe, 2007; Guimarães, 2007; Murty et al., 1991).

The fact that voice can be approached in an objective way was essential to the design of this study. We aim to analyze and compare the vocal characteristics of patients with functional voice disorders (5th Goal). In addition to the analysis of the most common vocal acoustic parameters, the cough intensity was also evaluated.

## 2. Procedure

### Voice recordings

The record of vocal acoustic signal is a non-invasive procedure that allows to capture the vocal signal.

For the recording of the acoustic signal the technique that was used corresponded to the European and American directives and guidelines (Brockmann et al., 2008). The recording took place in the Audiology room (a Faraday Cage) of the ENT Department. The soundbooth, temperature and ambient noise were kept stable and constant in order to minimize the occurrence of possible changes in humidity or temperature that may affect the patient's comfort or the vocal performance (Leong et al., 2013). The same chair was used and the patients sat comfortably in it.

It was used for recording, a digital recorder, a Marantz PMD660 (Japan) and a unidirectional headset microphone (Beyerdynamic) placed lateral to the mouth with a constant mouth-to-microphone distance of 5 cm.

The vocal behaviors performed were the European Portuguese sustained vowels /i/, /a/, and /u/ which correspond to the extreme positions of the vowel phonetic system, and also cough. Patients were invited to make three trials consisting in the production of three steady state vowels at a comfortable pitch and stable loudness to prevent vocal efforts. Between trials, patients were asked to cough to cleat the throat.

The record of the vocal acoustic signal was always performed previous to the psychological evaluation to reduce interference effect of psychological features explored during the interview or along the content of the tests.

**Acoustic analysis**

The vocal signals were recorded in an uncompressed format - PCM.wav -, and were first targeted by Adobe Audition software (version 3.0). After digitization, for each vowel the onset and offset was edited and saved in .wav format. This was an important step since it allowed to exclude the voice variability associated to the onset and offset phases.

The most steady part of each vowel sample (1.0 second) was selected for the analyses with Praat software (version 5.3.17; Amsterdam, Boersma and Weenink). Each segment of speech consists in a steady state sustainable vowel.

The acoustic parameters considered to evaluation were fundamental frequency (F0), jitter, shimmer, intensity, harmonic-to-noise ratio (HNR), and first and second formants (F1 and F2). Most of the acoustic measures came out of the Praat Report, the automatic form which automatically calculates most of the mean values, with the exception of vocal intensity and formants values that where extracted through the "Get" function.

## 3. Statistical Analysis

Some of the acoustic outcomes were excluded from the analysis, as they did not show a stable acoustic signal. For this reason reference will be made to the number of patients that were analyzed for each variable in the three groups.

First, we present the descriptive measures (mean and standard deviation) for fundamental frequency (F0) for each vowel to enable the comparison with the normative reference values for the Portuguese population (normal and dysphonic).

One-way analysis of variance (ANOVA) was applied to compare the three groups for each vocal acoustic parameters evaluated with Praat software.

ANOVA assumptions of normality and homogeneity of variance were assessed using the Shapiro-Wilk test and the Levene test, respectively.

Tukey HSD procedure was used for multiple comparisons between groups to identify where differences between groups were verified for the first formant (F1) in sustain vowel /a/. In cases where there was no homoscedasticity according to the Levene test, the Welch version was used and, as a multiple comparison test, the Games-Howell test was applied (sustained vowel /i/ - F1; sustained vowel /u/ - F0 and F1; and cough intensity).

The significance level was set at 5%.

## 4. Results

Table 41 presents descriptive measures for the fundamental frequency (F0) of the three sustained vowels by group.

**TABLE 41**
**Fundamental Frequency (F0) by Group:** Mean and Standard Deviation
Vowels: /i/, /a/ and /u/

| | | Mean | *SD* |
|---|---|---|---|
| **/i/ F0** | PVD (37)** | 235.15 | 54.85 |
| | MTVD1 (13)*** | 238.57 | 104.10 |
| | MTVD2 (27)** | 206.04 | 48.74 |
| **/a/F0** | PVD (37)** | 220.78 | 72.59 |
| | MTVD1 (16) | 225.32 | 79.61 |
| | MTVD2 (27)* | 187.91 | 43.44 |
| **/u/ F0** | PVD (37)** | 250.52 | 71.93 |
| | MTVD1 (16) | 282.41 | 109.56 |
| | MTVD2 (28) | 209.09 | 51.82 |

*Abbreviations:* F0, Fundamental frequency; MTVD1, Primary Muscle Tension Voice Disorder; MTVD2, Secondary Muscle Tension Voice Disorder; PVD, Psychogenic Voice Disorder; *SD*, Standard Deviation; *, one excluded participant; **, two excluded participants; ***, three excluded participants.

Patients with primary muscle tension voice disorders (MTVD1) had a mean and standard deviation higher than the other groups (PVD and MTVD2) in the three sustained vowels. The group of patients with secondary muscle tension voice disorders (MTVD2) registered a mean value and standard deviation lower than those obtained by the other groups in the three sustained vowels.

Table 42 presents descriptive measures for statistically significant acoustic variable for the sustained vowel /i/ ($Welch'F_{[2,32.106]} = 4.924$, $p = .014$, $\hat{\omega}^2 = .09$).

**TABLE 42**
**First Formant (F1) for vowel /i/ by Group:** Mean and Standard Deviation

| | | Mean | *SD* |
|---|---|---|---|
| **F1** | PVD (39) | 340.05 | 113.40 |
| | MTVD1 (16) | 548.96 | 301.55 |
| | MTVD2 (28) | 317.85 | 51.16 |

*Abbreviations:* F1, First formant; MTVD1, Primary Muscle Tension Voice Disorders; MTVD2, Secondary Muscle Tension Voice Disorders; PVD, Psychogenic Voice Disorders; *SD*, Standard Deviation.

For mean F1 of the sustained vowel /i/, statistical differences were found between psychogenic voice disorders (PVD) and primary muscle tension voice disorders (MTVD1) ($p$ = .039), and between groups with primary and secondary muscle tension voice disorders (MTVD1 and MTVD2) ($p$ = .021).

Table 43 presents descriptive measures for statistically significant F1 for the sustained vowel /a/ ($F_{[2, 80]}$ = 3.439, $p$ = .037, $\hat{\omega}^2$ = .06).

In the sustained vowel /a/, the mean value of F1 in the primary muscle tension voice disorders group (MTVD1) was higher than the mean reached by the other two groups (PVD and MTVD2).

**TABLE 43**
**First Formant (F1) for vowel /a/ by Group**

| | | Mean | *SD* |
|---|---|---|---|
| **F1** | PVD (39) | 766.31 | 192.10 |
| | MTVD1 (16) | 853.35 | 149.51 |
| | MTVD2 (28) | 716.70 | 132.50 |

*Abbreviations:* F1, First formant; MTVD1, Primary Muscle Tension Voice Disorders; MTVD2, Secondary Muscle Tension Voice Disorders; PVD, Psychogenic Voice Disorders; *SD*, Standard Deviation.

Statistical differences were found between primary and secondary muscle tension voice disorders groups (MTVD1 and MTVD2) ($p$ = .028).

Table 44 presents descriptive measures for statistically significant acoustic variables for the sustained vowel /u/ namely F0 (*Welch'*$F_{[2,35.182]}$ = 5.513, $p$ = .008, $\hat{\omega}^2$ = .10) and F1 (*Welch'*$F_{[2,33.658]}$ = 6.887, $p$ = .003, $\hat{\omega}^2$ = .12).

Regarding the mean pitch (F0), the primary muscle tension voice disorders group (MTVD1) had register slightly higher values compared to the other two groups (PVD and MTVD2) with the means of patients with secondary muscle tension voice disorders (MTVD2) to be the lowest. Statistical differences were found between primary and secondary muscle tension voice disorders groups (MTVD1 and MTVD2) ($p$ = .007).

**TABLE 44**
**Statistical significant acoustic measures for vowel /u/ by Group**
**Fundamental Frequency (F0) and First Formant (F1):** Mean and Standard Deviation

| | | Mean | *SD* |
|---|---|---|---|
| **F0** | PVD (37)** | 250.52 | 71.93 |
| | MTVD1 (16) | 282.41 | 109.56 |
| | MTVD2 (28) | 209.09 | 51.82 |
| **F1** | PVD (39) | 408.66 | 128.23 |
| | MTVD1 (16) | 562.22 | 226.31 |
| | MTVD2 (28) | 362.47 | 69.39 |

*Abbreviations:* F0, Fundamental frequency; F1, First formant; MTVD1, Primary Muscle Tension Voice Disorders; MTVD2, Secondary Muscle Tension Voice Disorders; PVD, Psychogenic Voice Disorders; *SD*, Standard Deviation; **, two excluded participants.

For the F1 means, the values of the three groups were set in different hundreds (Table 44). Patients with primary muscle tension voice disorders (MTVD1) registered a higher mean especially when compared with the mean of the group with secondary muscle tension voice disorders (MTVD2). Statistical differences were found between psychogenic (PVD) and primary muscle tension (MTVD1) voice disorders groups ($p$ = .049), and between primary and secondary muscle tension voice disorders groups (MTVD1 and MTVD2) ($p$ = .009).

Table 45 presents descriptive measures for the statistically significant acoustic variable for cough: intensity ($Welch'F_{[2,39.247]}$ = 4.880, $p$ = .013, $\omega^2$ = .09).

The mean of primary muscle tension voice disorder group (MTVD1) was comparatively higher than the means of the two other groups (PVD and MTVD2).

**TABLE 45**
**Vocal intensity (dB) for Cough by Group:** Mean and Standard Deviation

| | | Mean | *SD* |
|---|---|---|---|
| **Intensity (dB)** | PVD (34)***** | 57.94 | 9.69 |
| | MTVD1 (16) | 66.17 | 9.75 |
| | MTVD2 (28) | 55.97 | 15.28 |

*Abbreviations:* dB, Decibels; MTVD1, Primary Muscle Tension Voice Disorders; MTVD2, Secondary Muscle Tension Voice Disorders; PVD, Psychogenic Voice Disorders; *SD*, Standard Deviation; *****, five excluded participants.

Statistical differences were found between psychogenic (PVD) and primary muscle tension (MTVD1) voice disorders groups ($p$ = .023) and between groups with primary and secondary muscle tension voice disorders (MTVD1 and MTVD2) ($p$ = .027).

## 5. Discussion

This study was designed to deepen the knowledge of the vocal characteristics of the three presentations of functional voice disorders (FVDs). With this purpose, the guidelines provided by Guimarães (2007) regarding the conditions and procedures for capturing, storing, editing and analyzing the sound signal were respected. The procedure took place in a Faraday Cage. The voice analysis equipment used for recording and storing the vocal signal were forefront technology, a digital recorder and a unidirectional headset microphone. In this way the vocal signal was captured and stored more safely and was better protected from the capturing of noise of external interferences.

Patients were invited to perform three trials of sustained vowels (/i/, /a/ and /u/) at a comfortable pitch and loudness and to cough. The vocal material was chosen by looking for the most stable portions, excluding the beginning and the end of each emission. The fact that there were three trials also contributed to eliminate possible recording errors.

The preference for the evaluation of three sustained vowels resulted from a set of factors. For Gerratt, Kreiman and Garrellek (2016) “they are relatively time invariant; free from influences of phonetic context and thereby unaffected by intonation, stress, or speaking rate; easy to elicit, produce, and analyze; more easily controlled; and less affected by the dialect of the speaker and/or listener than continuous speech is” (Gerratt et al., 2016). Titze (1995) defended that the steady-state characteristic of the sustained vowels represented the stationary process in vocal fold vibration.

From a wide variety of computerized voice assessment software available on the market, Praat was chosen. This acoustic software has great worldwide applicability in voice research. It proved to be useful in differentiating pathological from normal voices, and it is also an open source software and user friendly (Finger et al., 2009; Maryn & Weenink, 2015). The Praat has several functions of speech signal analysis providing a vast number of measurements (Grepl, Furst, & Pesak, 2007).

In this study the vocal performance of patients was evaluated by voice range profile measurements that were automatically extracted - Praat's voice report.

Already in 1995, Titze argued that the acoustic analysis performed on extremely disturbed voice signals was controversial. Later, Mitey and Hadjitodorov (2003) stated that the measure of fundamental frequency in the analysis of some pathological voices was unstable due to the presence of strong amplitude and fundamental frequency perturbation of voiced signal resulting from disturbed laryngeal function. The review of this data was important to ensure greater accuracy and reliability in our results.

Having as reference the overall perceptual voice quality, it was not surprising that some patients did not have a stable vocal signal for the evaluation of F0, which led us to exclude them from this analysis. This occurred more frequently in sustained vowel /i/ (2 x PVD, 3 x MTVD1 and 2 x MTVD2) than in sustained vowel /a/ (2 x PVD and 1 x MTVD2) or sustained vowel /u/ (2 x PVD). In cough intensity, the recording of five patients with psychogenic voice disorders (PVD) was not considered. For the analysis of the formants, all patients were included in the database as according to Camargo (1999) “the vocal tract would have formants, regardless of the occurrence of its excitation and during the production of some sounds”.

Felippe, Grillo and Grechi (2006) defended the existence of normative values for acoustic analysis. European Portuguese speakers are privileged because there are already normative databases, as a result of the work of Guimarães, Barros, Gama and Beirão (2003). The data that was defined by these authors takes into account the gender and the different vocal behaviors (e.g., sustained vowels, continuous speech by reading or talking, and singing). Guimarães (2007) considered that its application makes it possible to discriminate between normal and pathological voices, and Teixeira et al. (2013) argued that it allows professionals to identify or suggest the presence of vocal pathology. Normative data for two acoustic measures, namely fundamental frequency (F0) and first formant (F1) was used for the analysis of our results.

Fundamental frequency (F0) results from the vibration of the vocal folds per second of time and according to Silvestre (2009) reflects the "efficiency of the phonatory system, the laryngeal biomechanics and its interaction with aerodynamics". As fundamental frequency translates the state of the vocal folds (Morente et al., 2001), it is one of the most studied vocal measures. Guimarães (2005) stated that this acoustic parameter is influenced by gender and age, speech and vowel tasks, life habits and also by dysphonia.

Guimarães and Abberton (2005) presented the mean values for fundamental frequency for women, with ages ranging from 18 to 52 years, for sustained vowels /i/, /a/ and /u/ (Table 40).

When comparing the mean F0 values for /i/, all groups were within the normative reference values ($F0_{GA}$). Patients with secondary muscle tension voice disorders (MTVD2 ≈ 206 Hz) reached a mean value equal to the minimum reference value ($F0_{GA}$ = 206 Hz).

For sustained vowel /a/, the F0 means obtained by the patients with psychogenic and primary muscle tension voice disorders (PVD ≈ 221 Hz and MTVD1≈ 225 Hz) were slightly above the maximum reference value ($F0_{GA}$ = 215 Hz). For the same sustained vowel, patients with secondary muscle tension voice disorders (MTVD2 ≈ 188 Hz) registered a mean below the reference value (minimum value for $F0_{GA}$ = 206 Hz). For this vowel there was a great variability in the three groups compared to the normative values. A comparison between the F0 mean for the group of patients with secondary muscle tension voice disorders (MTVD2) and the reference values for patients with nodules showed that our group of patients had a mean of F0 ≈ 188 Hz, a value expected for this voice disorder ($F0_C$ = 201.30 ± 27.17 Hz and $F0_G$ = 90.9 ± 29.1 Hz). Note that these results become more meaningful when it is considered that vowel /a/ corresponds to the vocal stimulus that has less influence of the vocal tract in the glottal source (Lehto, Airas, Björkner, Sundberg, & Alku, 2007; Parsa & Jamieson, 2001).

Izadi and Salehi (2013) stated that an increase in fundamental frequency is frequently associated with vocal tension once the "increasing of the tension on the vocal folds will allow a shorter, thinner portion of the vocal folds to vibrate" (Dehqan et al., 2010). The groups with higher F0 means were the primary muscle tension and the psychogenic voice disorders (MTVD1 and PVD), respectively. In these two groups there was a higher prevalence of anxiety disorders based on the results of the Mini International Neuropsychiatric Interview (MINI) (Study 2).

Stress can be defined as a response to a perceived threat and is accompanied by specific emotions as fear, anxiety, and/or anger. Mendoza and Carballo (1998) refer that in a high stress situation, muscular activation occurs causing an increase in vocal fold musculature. For that reason, the same authors defended the fundamental frequency as a universal indicator of stress and cognitive workload. In fact, Wittels et al. (2002, as cited in Schneider et al., 2006) found that fundamental frequency is able to describe changes in the emotional state. Silvestre (2009) went further by saying that increased stress and/or anxiety lead to an increase in fundamental frequency. These contributions explain why the MTVD1 group had higher mean values of F0.

In addition, Knowles and Little (2016) described voices with low fundamental frequency as being considered more truthful and trustworthy than voices with higher mean fundamental frequency, for both genders. We admit that our findings for personality evaluation, made with the Millon Clinical Multiaxial Inventory (MCMI-II) supported this relationship (Study 3).

Differences between groups, for the schizotypal personality disorder, were found for psychogenic voice disorders (PVD) and primary and secondary muscle tension voice disorders (MTVD1 and MTVD2). Patients with schizotypal personality disorder present several deficits in interpersonal functioning (McClure et al., 2013), being suspicious and having constant doubts about the loyalty of others (Mayo Clinic, 2016), who in turn view them as strange, different or peculiar. This personality disorder was more frequently diagnosed among patients with psychogenic voice disorders (PVD). Although these patients did not have the highest values for fundamental frequency for the three sustained vowels of the three groups, they reached higher means of fundamental frequencies.

In this study, patients with secondary muscle tension voice disorders (MTVD2) had comparatively lower F0 means. Behlau, Madazio, Feijó and Pontes (2001) stated that a mass placed in vibration will produce a small number of cycles per second, causing a decrease in frequency. Our results were in agreement with literature.

With regard to sustained vowel /u/, the means F0 for the psychogenic and secondary muscle tension voice disorders groups (PVD ≈ 251 Hz and MTVD2 ≈ 209 Hz) were within the reference mean. The group of patients with primary muscle tension voice disorders (MTVD1 ≈ 282 Hz) scored a higher mean compared to the maximum value of the reference data ($F0_{GA}$ = 253 Hz). In fact, the group of patients with primary muscle tension voice disorders (MTVD1) tended to present higher F0 means for the three

sustained vowels, values that were also higher than those of the other two groups (PVD and MTVD2).

According to Behlau et al. (2001), the higher the tension the faster the cycles will be and consequently the fundamental frequency will increase. By opposition, patients with secondary muscle tension voice disorders (MTVD2) always registered lower mean F0 values compared to those of the other two groups (PVD and MTVD1). This was particularly noticeable in sustained vowel /a/, where the mean value for fundamental frequency was even below the reference mean. Izadi and Saheli (2013) affirmed that a decrease in fundamental frequency in patients with organic lesions is an important clinical finding. This was also expected, as patients with nodules or polyps will experience a decrease in fundamental frequency due to the presence of a mass (vocal fold lesion).

When comparing the F0 means for the three sustained vowels, of patients with secondary muscle tension voice disorders (MTVD2) with the reference data for dysphonic patients from the studies developed by Carmona (2003) and Gouveia (2004) studies, our results were in line with them.

The idea that women tend to decrease their fundamental frequency throughout life has always been present (Guimarães, 2005). However, the mean age of our sample (52.51 years) was closed to the maximum age of the individuals in the Guimarães and Abberton (18 to 52 years), Carmona (20 to 49 years), and Gouveia (2004) (18 to 50 years) studies.

We concluded that our findings for fundamental frequency were expected considering the referenced studies for European Portuguese speakers (normal and dysphonic).

**Voice perturbation parameters**

With regard to voice perturbation parameters differences in means between the three groups were not found. However, it is important to comment on our results.

The jitter represents the variability of the speech fundamental frequency from one cycle to the next (Rusz, Cmeijla, Ruzickova, & Ruzicka, 2011). Silva, Oliveira and Andrea (2009) stated that this parameter measure the estimation of irregularities in the vibration of the vocal folds.

In our sample, patients with psychogenic (PVD) and with secondary muscle tension voice disorders (MTVD2) had means of jitter for the three sustained vowels that were within the referenced values (0.5% < jitter < 1.0%) (Teixeira et al., 2013). For the

group of patients with primary muscle tension voice disorders the means of jitter for the three sustained vowels were slightly higher compared to the referenced values. According to Teixeira et al. (2013) higher values of jitter are a result of a lack of control of the vibration of the folds being associated with pathological voices that are perceived as roughness.

The shimmer corresponds to a short-term cycle-to-cycle amplitude perturbation in vocal fold vibration (Franca, 2002; Jiang et al., 2009; Petrovic-Lazic, Jovanovic, Kulic, Babac, & Jurisic, 2015). This acoustic perturbation measure indicates the presence of small and rapid variations in amplitude during phonation (Toran & Lal, 2010) that can be due to slightest differences of mass, tension, biochemical characteristics as well as to the neural control over the vocal folds (Lin, Chen, Chen, Wang, & Kuo, 2016; Toran & Lal, 2010).

The three groups had higher mean values for shimmer than the reference values for the three sustained vowels (shimmer > 3% corresponds to pathological voices in adults) (Guimarães, 2007). Both primary and secondary muscle tension voice disorders reached higher means in vowel /a/ while patients with primary muscle tension voice disorders had lower mean in vowel /i/. By comparing the means of the three groups, the MTVD1 group tend to reach higher values of shimmer.

These findings can be explained as a result of a poor and inconsistent contact between the vocal fold edges that increase the shimmer value (Petrović-Lazić et al., 2011). Teixeira et al. (2013) added that it might be related to the presence of noise emission and breathiness.

Another frequently used parameter is the harmonic-to-noise ratio (HNR), the average of the inharmonic energy to the harmonic spectral energy (Petrović-Lazić et al., 2011) that is expressed in decibels (dB). This noise measure is characterized by the relationship between the periodic and non-periodic components of the acoustic wave of a sustained vowel. The periodic component arises from the regular vibration of the vocal folds while the non-periodic component corresponds to the additional noise coming from the vocal folds and from the vocal tract (Felippe et al., 2006; Teixeira et al., 2013). The harmonic-to-noise ratio is used to estimate the level of noise in human voice by quantifying the amount of additive noise in the voice signal, including amplitude and

frequency variations, turbulence noise, sub harmonic components, and voice breaks (Franca, 2002).

The three vowels of the three groups (HNR ≈ 21 dB) had values of HNR superior than the reference value (pathological < 13.9 dB, Grinnblat, 2004, as cited in Guimarães, 2007), with the exception of the value for sustained vowel /a/ in the primary muscle tension voice disorders groups (e.g., HNR of MTVD1 = 13.47 dB). For Rusz et al. (2011) the existence of more signal noise addition captured by HNR measures can indicate incomplete vocal fold closure and incorrect vocal fold oscillations. This description corresponds to the results of the videolaryngoscopic exame.

For its analysis, it was also used the measures proposed by Praat. This program proposed a cut off value of 20 dB for vowels /a/ and /i/ and 40 dB for vowel /u/ (Elisei, 2012). Values below 20 dB were considered pathological. According to these data, the production of sustained vowel /a/ by the three groups was considered pathological.

Yet, unlike the jitter and shimmer, HNR is not a sensitive parameter since it does not allow differentiation between dysphonic and normal voice (Felippe et al., 2006).

With regard to perturbation measures, we did not find normative values only reference values and we also verified that there were no data related to specific vocal pathologies. It is expected that in future researches the analysis of perturbation measures will be developed in patients with functional voice disorders.

For vocal intensity, patients with primary muscle tension voice disorders (MTVD1) reached higher mean values in the three vowels compared to the patients from the two other groups, especially in the sustained vowel /a/. These results were congruent since the intensity varies with the increasing of tension in laryngeal tonus that generates higher glottic resistance and consequently greater intensity (Wertzner et al., 2005).

**Formants**

The first two formants are those that best reflect the structure of the vocal tract (Martinez, 2014).

In this study, differences between groups were found for the first formant in the three sustained vowels. For its analysis, we have to remember that the formants are strongly related to the length and configuration of the vocal tract has to be present. In fact, F1 varies strongly with tongue height (or jaw opening) reflecting the vertical

movement of the tongue while F2 depends more on the position of the tongue in the anteroposterior dimension (Dromey, Jang, & Hollis, 2013; Kent et al., 1993).

The vocal tract acts as a resonant cavity with the position of jaw, lips, and tongue affecting the parameters of the resonant cavity leading to different formant values (Molis & Leek, 2011).

Vowel perception depends on the first two or three lowest formants (Kieft et al., 2010), being the two first formants responsible for the phonetic identity of the vowel's sound (Magri, Cukier-Blaj, Karman, & Camargo, 2009). The target theory of vowel recognition determines that the vowel's formant pattern is sufficient for the identification of the vowel (Kent, 1993). The vowel height is negatively correlated with F1, which means that high vowels (e.g., vowels /i/ and /u/) have low F1 and low vowels (e.g., vowel /a/) have high F1 (Johnson, 2003).

For comparison purposes we used as reference the mean F1 data of the three vowels derived from two studies: the values for the Portuguese population descrived by Delgado-Martins (1973) ($F1_{DM}$) and the values for European Portuguese females from the Escudero and Boersma study (2009) ($F1_{EB}$) (Table 41).

Regarding F1 value of vowel /i/, all groups (PVD ≈ 340 Hz, MTVD1 ≈ 549 Hz and MTVD2 ≈ 318 Hz) obtained a higher mean than the reference values ($F1_{D}$ ≈ 294 Hz and $F1_{EB}$ = 313 Hz). Differences were found between psychogenic and primary muscle tension voice disorders groups (PVD and MTVD1), and between primary and secondary muscle tension voice disorders groups (MTVD1 and MTVD2).

In vowel /a/, the means of the three groups for F1 (PVD ≈ 766 Hz, MTVD1 ≈ 853 Hz and MTVD2 ≈ 717 Hz) were well above the European Portuguese reference value ($F1_{DM}$ ≈ 626 Hz). However, patients from psychogenic and secondary muscle tension voice disorders groups had a lower F1 mean than the reference value for European Portuguese females ($F1_{EB}$ = 781 Hz). Differences between groups were found between MTVD1 and MTVD2 groups. The MTVD1 group had a significantly higher F1 mean compared to the other groups and to the two reference values.

The mean values for F1 for vowel /u/ were slightly higher for psychogenic and secondary muscle tension voice disorders groups (PVD ≈ 409 Hz and MTVD2 ≈ 362 Hz) and higher for the group of patients with primary muscle tension voice disorders (MTVD1 ≈ 562 Hz), compared to the two reference values ($F1_{DM}$ ≈ 315 Hz and $F1_{EB}$ = 335 Hz). Differences were found between PVD and MTVD1 groups, and between MTVD1 and MTVD2 groups.

The analysis of the three sustained vowels, per group, for the first formant (F1) mean allowed us to identify the existence of a pattern:

- all mean F1 values were comparatively higher than the Portuguese data
- the highest mean F1 values were scored among patients with primary muscle tension voice disorders (MTVD1)
- the lowest mean F1 values were registered in the group of patients with secondary muscle tension voice disorders (MTVD2)

Formants correspond to a good correlate of articulatory posture (Camargo, 1999) and their frequencies depend on the maximum energy that is absorbed and irradiated (Magri et al., 2007). Magri et al. (2007) explains the relation between the length of the vocal tract and the frequency of the formants by stating that "the lengthening of the vocal tract would decrease the frequency of all formants and it decrease would increase the frequency of all formants".

The first formant (F1) has a direct relation with the cavities formed as a result of the opening height of the mandible, the displacement of the tongue in the vertical plane (lowering or elevation of the tongue) that varies with the height of the tongue and with laryngeal constriction (Gomes et al., 2016; Magri et al., 2007).

The group of patients with primary muscle tension voice disorders (MTVD1) had increased F1 values which are probably associated with the lowering of the tongue. This movement of the tongue results from the presence of laryngeal constriction adjustments, with elevated larynx and/or stretched lips due to muscular tension associated with anxiety. Roy et al. (2000) explained that in muscle tension dysphonia, the tension could also constrain the articulatory movements and the vocal tract dynamics.

In contrast, patients with secondary muscle tension voice disorders (MTVD2) registered a decrease of F1 values as a result of the elevation of the tongue, a lowered larynx and/or rounded lips. In secondary muscle tension voice disorders (MTVD2), the speakers need to compensate the effect of vocal fold tissue changes in vocal production, which according to Mathieson et al. (2009) leads to increased vocal loudness and to excessive vocal effort.

Titze and Talkin (1979, as cited in Camargo, 1999) proposed a model that explains muscular control of the larynx that they named as acoustic consequences of the

contraction of small groups of intrinsic larynx muscles during sustained vowel production.

In a study developed by Altman et al. (2005) with 150 patients diagnosed with muscle tension dysphonia, the authors found that 70% had “obvious cervical neck tension visible”.

Our results led us to admit the possible co-morbidity with temporomandibular dysfunction (TMD) as it “represents muscle tensions in head and neck that are directly transmitted through the muscular connections between jaw and hyoid bone to the larynx” (Moradi et al., 2014). Like most authors, Silva, Morriso and Cielo (2007) considered TMD as one of the most complex disorders of the body which produces changes in the mandibular movements that may damage not only speech articulation but also voice quality.

The prevalence of temporomandibular dysfunction has been estimated between 5% to 10%, with women having greater vulnerability (Moradi et al., 2014) as for the diagnosis of functional voice disorders. Barnard (1979, as cited in Silva et al., 2007) explained that the relationship between TMD and voice disorders must be a consequence of the difficulty in jaw movements.

As TMD is a multifactorial disorder, there are several causative factors such as the hypertension of oral areas (face and neck) that restrict the opening of the mouth and limit the mandibular movements during speech (Camacho et al., 2014; Moradi et al., 2014). Stress, gender, personality and anxiety are also identified as having a role in its etiology (Minghelli, Kiselova, & Pereira, 2011; Moradi et al., 2014). In fact, psychological, emotional, pathophysiological and behavioral factors are found to be associated to temporomandibular dysfunction (Schmidt, Pereira, & Wagner, 2015).

In addition to complaints of “headaches or neck pain, temporomandibular joint dysfunction described by the patient as “noises”, tinnitus or ear fullness, crepitation on opening or closing the mouth, opening limitation and difficulties in chewing, and in the speech” (Pereira, Brasolotto, Conti, & Berrenti-Felix, 2009), limitations during speech occur and may affect voice acoustics.

Rockland et al. (2010) stated that phonoarticulation changes are related to the reduction of the articulatory amplitude accompanied by compensatory mandibular movements. High severity symptoms of temporomandibular dysfunction are associated with greater jaw tension and less opening of the mouth (Moradi et al., 2014). According to Moradi et al. (2014) the temporomandibular joint dysfunction leads to vocal fatigue, a

decrease in voice range and sound displacement changes. Silva et al. (2007) added that the vocal quality of these patients is also affected revealing reduced loudness, increased noise and changes in resonance.

All these changes in vocal quality will negatively impact the quality of life. In a study conducted by Pereira et al. (2009), 33 women all suffering from TMD but subdivided into two groups, with or without dysphonia, answered the Voice-Related Quality of Life (V-RQOL). The authors found that changes in life quality were associated with the severity of temporomandibular dysfunction.

Once again it was verified that changes in vocal quality require a multidisciplinary approach, as they are multifactorial. The treatment of temporomandibular dysfunction includes medical, dental and physical specialist interventions. Wright and North (2009), and Schmidt et al. (2015) also recommended that these professionals work together with psychologist due to the impairment on quality of life.

Although in our sample no differences were found for F2, it is important to characterize our results.

The second formant (F2) is associated with front or back placement of the tongue (Molis & Leek, 2011). According to Silva (1996, as cited in Silva, 2014) F2 has high frequencies ranging between 1600 Hz and 2000 Hz.

In this study higher values were found as expected for vowel /i/ as a result of the forward movement of the tongue while the lowest vowels were registered by the three groups in vowel /u/ revealing the backward movement of the tongue.

**Cough**

One of the criteria for the diagnosis of psychogenic voice disorders (PVD) characterizes the nonphonatory movements of the vocal folds as most commonly normal. According to Mathieson (2001) these patients presented “normal vegetative behaviours such as coughing, throat clearing, yawning or laughing, but not when voice is being used for communication”.

During the ENT examination it is common to ask the patient to cough and clear the throat to test the phonatory mechanism in a nonthreatening way (Woo, 2010).

In this study voluntary cough, and not cough as a common symptom (acute or chronic) that affects a large proportion of general population (Kauffmann & Varraso, 2011), was also assessed. The cough and throat clearing seemed to be the laryngeal gestures which best fit our evaluation. Since the vocal performance included three trials, it was appropriate to ask patients to clear the throat between trials.

Chang (2006) characterized the sound of cough as the result of the "vibration of the large airways and laryngeal structures during turbulent flow in expiration, and is said to be individualised akin to individualised voice".

In 1991, Murty et al. affirmed that there were several "attemps to assess cough intensity objectively have been made by measuring air flow rates, noise an integrated surface abdominal muscle electrical activity".

For Guimarães (2007) vocal intensity can be related to the "subglottic pressure, the resistance of the vocal folds to that pressure and configuration of the vocal tract". The conceptualization of intensity associated with cough includes muscular activity, pressures in the abdomen, chest and infralaryngeal airways, airflow velocities, lung volume changes and sound (Fontana & Widdicombe, 2007).

Having evaluated the intensity (dB) of voluntary cough with the Praat, statistical differences between the means were identified between patients with primary and secondary muscle tension voice disorders (MTVD1 and MTVD2).

The primary muscle tension voice disorders group registered the highest mean value of intensity (MTVD1 ≈ 66 dB), while the lowest mean value was obtained by the group of patients with secondary muscle tension voice disorders (MTVD2 ≈ 56 dB). As there is a greater tension in patients with primary muscle tension voice disorders (MTVD1), these results were expected.

Psychogenic voice disorder group (PVD) did not differ from the other groups, based on the statistical report. This result renews and increases the neeed to assess objectively the characteristics of cough in patients with psychogenic voice disorders. It would also be of interest to have a database of individuals without laryngeal, pulmonary or neurological pathology with comparative purposes.

The cough was an additional element to our vocal assessment. Studies evaluating cough in patients with functional voice disorders should use complementary techniques such as electromyography (EMG), an evaluation procedure already applied in neuromuscular diseases such as stroke, Parkinson's disease and motoneurone disease (Fontana & Widdicombe, 2007).

## 6. Conclusion

In this study the researcher met the guidelines for the assessment of common dysphonias that were elaborated by the Committee on Phoniatrics of the European Laryngological Society (ELS) (Dejonckere et al., 2001) such as videolaryngoscopy, acoustic evaluation and subjective evaluation by the patients (Study 6).

The acoustic signal is the main source of biological data of vocal production, having therefore been studied in normal and pathological voices. As it is associated with perceptual phenomenon, it gives important information related to vocal quality. According to Kent et al. (2002) acoustic analysis is best suited for describing voices that have changes. Bough, Heuer, Sataloff, Hills and Cater (1996) justified the need for objective assessment and quantification of voice function in order to improve patient care.

With the aim of characterizing and differentiating the vocal acoustic characteristics of patients with different functional voice disorders, this procedure gave objective measurements of vocal function and provided physiological information on voice production.

Statistical differences between the means of the groups were found in acoustic measures as in the F0 mean of vowel /u/ and F1 means of the three sustained vowels, and also in cough intensity.

Patients with primary muscle tension voice disorders (MTVD1) had obtained higher F0 means for the three sustained vowels compared to the other two groups. Patients with secondary muscle tension voice disorders (MTVD2) reached the lowest means of fundamental frequency. The same pattern was also registered in F1.

The elevation of the mean values of F0 and F1 in the group of patients with primary muscle tension voice disorders (MTVD1) arise as a result of increased laryngeal muscle tension and anxiety in these patients. The low mean values reached by patients with secondary muscle tension voice disorders (MTVD2) were consequences of mass effect in vocal folds.

Our findings provided evidence for the relationship between voice quality, vocal tract shapes and anxiety disorders. This study gave us some important responses but "a direct link between jaw opening and acoustic voice outcomes remains to be clarified" (Mautner, 2016).

The analysis of the articulatory-acoustic relationships should be developed in future researches with patients with FVDs. The application of other instruments as the State-Trait Anxiety Inventory (STAI) and the Vocal Tract Discomfort Scale (VTD) can give additional inputs.

When comparing the results from the groups of patients with psychogenic (PVD) and with secondary muscle tension (MTVD2) voice disorders, surprisingly our findings did not support the difference between two important concepts, namely vocal quality and the physical state of the larynx (Koike et al. 1977, cited in Camargo, 1999). These two groups present greater anatomo physiological differences although from the statistical point of view they did not show differences in their vocal acoustic characteristics.

Since emotional state (specially anxiety) and some of the vocal acoustic parameters (F1) appeared to be strongly associated, we admit that vocal acoustic analysis studies in patients with functional voice disorders should improve the knowledge of this pathology.

# Self-evaluation of Quality of Life

## Study 6

### 1. Introduction

Voice disorders are “an array of self-reported symptoms and clinically observed signs” (Verdolini & Ramig, 2001, as cited in Wheeler, Collins, & Sapienza, 2006) which may produce a “devastating personal and vocational effects that ultimately impact a person’s quality of life” (Eadie & Baylor, 2006). The course of voice disorders is not linear, it may manifest as an isolate or recurrent episodes with the possibility of becoming a chronic condition.

For Zraick and Risner (2008) personality, life events, experiences, and adaptation processes are factors that may influence the self-reported of subjective well-being as well as the overall perception of quality of life associated with the presence of a vocal problem. This means that the impact of a voice disorder will vary greatly from person to person (Wheeler et al., 2006).

The Royal College of Speech and Language Therapists (2009) systematized the impact of voice disorders in various dimensions: impairment (e.g., phonation difficulties, vocal fatigue, altered voice quality and pain or discomfort when vocalizing); activity (e.g., diminution of a speaker's ability to communicate effectively, and in the reduction in speaking time and in communicative interactions); participation (e.g., effect on career, adverse effects on job performance, social isolation and limited participation) and well-being (e.g., frustration, anxiety, depression and self-esteem).

Voice as an inherent part of the human experience (Misono et al., 2014) depends strongly on the personal nature of the vocal process, on the individual psychosocial characteristics and on interpersonal relationships. For Childs et al. (2015) and also for Deary, Wilson, Carding, MacKenzie and Watson (2010), the self-perceived degree of disability associated with the vocal problem results from the vocal demands, expectations, and on a multitude of inner and relational factors that will shape the impact of the voice disorder.

Dehqan, Scherer, Yadegari and Dashti (2017a) presented the instruments of quality of life as “one way to assess the overall outcome of the physical, mental, and social well-being of a patient following a health-related problem”. For the assessment of quality of life in vocal pathology, the Voice Handicap Index allows patients to rate the

perception of the impact of their voice disorder has in the various fields of life (Tarazani, Khoddami, Jalaie, Moghadam, & Akbari, 2013).

Patients with functional voice disorders commonly present significantly poorer health, reflected in bodily pain, fatigue, general health perceptions and limitations due to physical, emotional and social problems (Ruotsalainen et al., 2008). In addition, Wenke et al. (2014) explained that the difficulty in performing daily tasks that require oral communication is a sign of poor quality of life.

Rzepakowska, Sielska-Badurek, Osuch-Wójcikiewicz and Niemczyk (2018) defended that the "complexities of the conditions for vocal production and the impact of voice quality on daily life are the reasons why voice assessment should be particularly accurate, detailed, and multidimensional". Thus, the knowledge of the level of self-perceived handicap experienced by the patient as a result of his/her disordered voice is an important element in the understanding of vocal disease, and also a therapeutic tool (Woisard, Bodin, Yardeni, & Puech, 2007).

It is accepted that the VHI-30 quantifies the psychosocial consequences of voice disorders (Lopes et al., 2017) and many of its items are related to the characteristics of the vocal sound (Schindler, Mozzanica, Vedrody, Maruzzi, & Ottaviani, 2009). Nonetheless, Dehqan et al. (2017b) pointed that "previous studies suggest that acoustic measures may not be predictive of the overall VHI-30 score, even if there are significant correlations between items of the VHI-30 and some voice parameters".

Using the Voice Handicap Index (VHI-30) we aimed to assess the impact of three types of functional voice disorders on the self-perception of quality of life. It was also our purpose to analyze if there were similarities or differences in evaluating the impairment that the functional, physical and emotional domains have on the daily life in patients of the three groups. Considering the incidence of psychiatric disorders, in this study a psychological and vocal acoustic model for the self-perceived evaluation of quality of life was developed for each group (6$^{th}$ Goal).

## 2. Procedure

The *Voice Handicap Index* (VHI-30) was introduced by Jacobson et al. in 1997 to quantify the patients' perception of handicap and disability due to vocal difficulties (Steen et al., 2008) and it is the first questionnaire to assess the impact of dysphonia on the patients' quality of life (Behlau et al., 2016). As an instrument that measures the psychosocial handicapping effects of voice disorders (Awan et al., 2014), it has a

widespread application, being sensitive for a wide variety of voice disorders (Ceballos, Carvallo, Araújo, & Reis, 2010). It proved to be good in assessing the biopsychosocial impact of vocal problems in daily life (Smits et al., 2012; Verdonck-de Leeuw et al., 2008).

The Voice Handicap Index has 30-items, equally distributed and grouped into three domains that represent the functional, emotional and physical aspects of voice, that are rated on a 5-point equal-appearing interval scale (none = 0, almost = 1, sometimes = 2, almost always = 3 and always = 4) (Jafari et al., 2017). The patient's answers indicate how frequently he/she has the same experience, generating a total value (VHI-T, varying between 0 to 120 points), as well as scores for each subscale (each ranging from 0 to 40 points). The higher the scores, the greater is the degree of perceived disability and handicap due to vocal difficulties. Additionally, the VHI-T can be classified as low or mild disability (≤ -30), moderate (31-60), severe (61-90), and very severe (91-120) (Rzepakowska et al., 2018).

The VHI-30 has been translated and validated in several languages having been applied in cross-national comparisons.

In 1998 Guimarães et al. developed an adapted version for the Portuguese population (Guimarães, 2007). This version of VHI-30 proved to be a good psychometrically instrument (Steen et al., 2008) with a Cronbach's alpha of .95 (total), .87 for physical, .88 for functional and .89 for emotional subscales (Verdonck-de Leeuw et al., 2008). In this study, the values of Cronbach's alpha revealed a very good internal consistency (total = .96, physical = .86, functional = .93 and emotional = .90).

The vocal database that was collected in "Vocal Acoustic Evaluation" (Study 5) was used in this study. The vocal material refers exclusively to the acoustic measures for the sustained vowel /a/ due to the fact that this vowel is the most frequently used in researches.

## 3. Statistical Analysis

All statistical analyses in the present study were completed with SPSS Statistic v21.0 for Mac OS (IBM Corporation, Chicago, IL).

Descriptive measures were used to characterize the scores of VHI-30 (total, functional, physical, and emotional) in three groups: means, standard deviations (*SD*s), minimum and maximum values.

A t-Student test for independent samples was applied to compare if there were mean differences in groups for the four scores of the VHI-30. Then, a t-Student test for paired samples was used to compare the mean scores of the three subscales in each group.

The Pearson's rank correlation test was performed to determine the strength of linear association between the variables of quality of life (total, functional, emotional and physical scores of VHI-30), the psychological features (based on the results of HAM-D, HARS, MCMI-II and TEMPS-A) and the vocal acoustic parameters for sustained vowel /a/ (F0, jitter, shimmer, HNR, vocal intensity).

A stepwise multiple linear regression model was executed to construct a statistical model representing the best combined variables to predict the significant of psychological and vocal acoustic measures in the overall VHI-30 score.

The significance level was set at 5% for all the analysis.

## 4. Results

To characterize the scores of VHI-30 by Group, Table 46 presents descriptive measures.

Compared to the other groups, the psychogenic voice disorders (PVD) group also reached the lowest mean value for VHI-30 total and for the physical and emotional subscales.

The mean values for all the scores of VHI-30 obtained by the patients with primary muscle tension voice disorders (MTVD1) were two times higher than those reached by the two other groups (PVD and MTVD2).

The means scores of patients with secondary muscle tension voice disorders (MTVD2) were located between the means of the other two groups (PVD and MTVD1) with the exception of the functional subscale in which this group had the lowest mean value.

Regarding the means of of the physical subscale of VHI-30 there was no great variability between the three groups, with patients with primary muscle tension voice disorders (MTVD1) to have a higher mean.

**TABLE 46**

**VHI-30 by Group:** Mean, Standard Deviation, Minimum and Maximum

| | | Total | Functional | Physical | Emotional |
|---|---|---|---|---|---|
| **PVD** | Mean | 38.79 | 11.62 | 17.05 | 10.59 |
| | *SD* | 29.38 | 11.02 | 10.10 | 11.14 |
| | Minimum | 0 | 0 | 0 | 0 |
| | Maximum | 110 | 40 | 38 | 40 |
| **MTVD1** | Mean | 56.19 | 18.63 | 22.13 | 15.44 |
| | *SD* | 23.91 | 10.90 | 7.20 | 8.63 |
| | Minimum | 14 | 0 | 8 | 2 |
| | Maximum | 89 | 39 | 34 | 29 |
| **MTVD2** | Mean | 42.04 | 11.32 | 19.93 | 10.79 |
| | *SD* | 24.74 | 10.33 | 7.40 | 8.65 |
| | Minimum | 5 | 0 | 4 | 1 |
| | Maximum | 97 | 37 | 37 | 28 |

*Abbreviations:* MTVD1, Primary Muscle Tension Voice Disorders; MTVD2, Secondary Muscle Tension Voice Disorders; PVD, Psychogenic Voice Disorders; *SD*, Standard Deviation; VHI-30, Voice Handicap Index.

The t-Student test was applied and mean differences between groups were found for the functional subscale, between PVD and MTVD1 groups ($t$ = -2.149, $df$ = 53, $p$ = .036), and between MTVD1 and MTVD2 groups ($t$ = -2.213, $df$ = 42, $p$ = .032). The group that presented the greatest impact of the functional domain was the primary muscle tension voice disorders (MTVD1).

Additionally, a t-Student test for paired samples was carried out to compare the mean scores of the three subscales. In the PVD group, statistical differences were found between functional and physical subscales ($t$ = 5.100, $df$ = 38, $p$ < .001), and between physical and emotional subscales ($t$ = 5.178, $df$ = 38, $p$ < .001). In the group of patients with primary muscle tension (MTVD1), statistical differences were found between physical and emotional subscales ($t$ = 3.750, $df$ = 15, $p$ = .002). In the secondary muscle tension voice disorders group (MTVD2), statistical differences were found between functional and physical subscales ($t$ = 6.681, $df$ = 27, $p$ < .001), and between physical and emotional subscales ($t$ = 8.429, $df$ = 27, $p$ < .001).

Statistical differences between the mean scores of functional and emotional subscales were not found in none of the groups.

The analysis for Pearson correlations between VHI-30 scores and the psychological variables pointed for different results between groups.

In the PVD group, a moderate positive linear correlation was found between HAM-D, depressive temperament and all the four scores of the VHI-30. In this group a moderate positive linear correlation was also found between HARS and VHI-30 scores, with the exception of the emotional subscale where there was a strong positive linear correlation ($r$ = .517, $p$ = .001). For the avoidant personality, a moderate positive linear correlation was detected in total ($r$ = .397, $p$ = .012), functional ($r$ = .402, $p$ = .011) and emotional ($r$ = .397, $p$ = .012) scores. Regarding the results of the anxious temperament there was a moderate positive linear correlation with functional ($r$ = .484, $p$ = .002) and physical ($r$ = .474, $p$ = .002) subscales and a strong positive linear correlation with total ($r$ = .540, $p$ < .001) and emotional ($r$ = .569, $p$ < .001) scores.

No significant correlations were identified between psychological variables and VHI-30 scores in the MTVD1 group.

A few significant correlations existed in the MTVD2 group as a moderate positive linear correlation between avoidant personality and functional domain ($r$ = .412, $p$ = .029), schizoid personality and total ($r$ = .404, $p$ = .033), functional ($r$ = .418, $p$ = .027) and emotional ($r$ = .411, $p$ < .030) scores and also between depressive temperament and the emotional aspect of voice ($r$ = .427, $p$ = .023). There was a strong positive linear correlation between depressive temperament and total score ($r$ = .476, $p$ = .010) and with the functional domain ($r$ = .541, $p$ = .003).

With regard to the Pearson significant correlation values between vocal acoustic measures and VHI-30 scores, there were differences between the three groups.

In the PVD group, both jitter and shimmer presented a moderate positive linear relationship with the four scores of VHI-30 while HNR showed a moderate negative linear relationship with total ($r$ = -.389, $p$ = .014), functional ($r$ = -.360, $p$ = .025) and physical ($r$ = -.433, $p$ = .006) scores.

In the MTVD1 group there was a strong positive linear correlation between jitter ($r$ = .711, $p$ = .002) and shimmer ($r$ = .558, $p$ = .031) with the functional domain, and also between jitter and total score ($r$ = .611, $p$ = .012) and a strong negative linear correlation between HNR and the functional subscale ($r$ = -.591, $p$ = .016) while a moderate negative correlation was detected between HNR and overall quality of life ($r$ = -.485, $p$ = .057).

No significant correlation was identified between acoustic variables and the VHI-30 among the group of patients with MTVD2.

With the purpose of constructing a valid predictive model of quality of life in FVDs patients, psychological and vocal acoustic variables were entered as independent variables into stepwise linear regression analyses to predict overall quality of life (VHI-30 total score as dependent variable).

Our results indicated the existence of psychological and/or vocal acoustic measures as predictors of the overall VHI score for each of the three groups: PVD ($F_{[2,36]} = 17.255$, $p < .001$), MTVD1 ($F_{[1,14]} = 8.338$, $p = .012$) and MTVD2 ($F_{[1,26]} = 7.618$, $p = .010$).

The coefficient of determination in the PVD group was $r^2_S = 0.489$, a value indicating that 48.9% of the variance in $R_{mean}$ was accounted for the QOL model. In fact, the overall self-perceived quality of life associated with the vocal problem was significant associated with anxious temperament ($b = 2.646$, $t = 4.717$, $p < .001$) together with shimmer ($b = 2.339$, $t = 3.739$, $p = .001$).

In the MTVD1 group, jitter ($b = 6.206$, $t = 2.888$, $p = .012$) was the only predictor included in the final model with this acoustic measure explaining 37.3% of the variance of the VHI-30 total score.

In the group of patients with MTVD2, depressive temperament was the unique predictor to enter in the final model but it only explained 22.7% of the variance of overall VHI-30 ($b = 3.427$, $t = 2.760$, $p = .010$).

## 5. Discussion

The Voice Handicap Index (VHI-30) assured that our goals were achieved in a sample with three types of patients with functional voice disorders (FVDs).

In this study, the three groups registered mean scores in VHI-30 total (PVD = 38.79, MTVD1 = 56.19 and MTVD2 = 42.04) that represented a moderate disadvantage and disability.

Van Gogh et al. (2007) using VHI-30 developed a study with three groups: a group of patients with voice problems after the treatment for early glottic cancer, another group with benign voice disorder and a third, a vocally healthy control group. The authors found that the vocal impairment in quality of life was similar for patients with voice problems after treatment for early glottic cancer and for patients with benign voice disorders (a form of functional voice disorders).

Our results as the Van Gogh et al. (2007) support the significant impairment that a functional voice disorder (FVDs) may have in the patient's daily life.

In this study, patients with primary muscle tension voice disorders (MTVD1) reported the worse quality of life followed by the patients with secondary muscle tension voice disorders (MTVD2). These findings were in line with the results of the study developed by Rosen and Murray in 2000. These authors assessed three groups of patients with the Voice Handicap Index (VHI-30): functional dysphonia, benign lesions, and unilateral paralysis of the vocal folds. They verified that the group with paralysis of the vocal fold had the highest score followed by patients with functional dysphonia, and finally by patients with benign vocal fold lesions whose scores were close to those seen in general population (Halawa, Perez, & António, 2011).

Regarding the classification of FVDs, Rosen and Murray also had a group of patients with primary muscle tension voice disorders named as functional dysphonia, and a group of patients with secondary muscle tension voice disorders designated by benign lesions of the vocal folds. In our study as well as in the study of the Rosen and Murray, patient with primary muscle tension voice disorders reported a worse voice-related quality of life compared to patients with secondary muscle tension voice disorders. This result leads to the need to reflect on the experience of patients with secondary muscle tension voice disorders. For a better understanding, two more studies will be considered.

Smits et al. (2012) compared two groups of female patients, one group with a vocal fold lesion and the other without a vocal fold lesion but with voice problems. Significant differences were not found between groups in the total score of the VHI-30 and also in the scores of the three subscales. The authors argued that a vocal fold lesion does not have a great impact on the patient's perception of voice handicap and psychosomatic well-being, being therefore considered as functional voice disturbances. Our groups of patients with psychogenic (PVD) and with secondary muscle tension (MTVD2) voice disorders did not presented differences yet both reached a moderate level of disadvantage.

In the same year, Schindler et al. (2012) developed a study to evaluate the impact of speech therapy in a group of sixteen patients with benign vocal fold lesions. The Voice Handicap Index (VHI-30) was part of the assessment protocol before and after speech therapy intervention. Being a longitudinal study, it is important to refer that significant differences were found between the results of the two moments of evaluation, with data indicating an improvement in voice quality and in total, physical and emotional scores.

From this study, it is also of special interest the data of the evaluation moment prior to speech therapy and also the fact that the authors did not found differences between groups in the functional subscale when comparing the two moments of evaluation.

In our study, statistical differences in means were found only for the functional domain, between psychogenic (PVD) and primary muscle tension (MTVD1) voice disorders groups, and between primary (MTVD1) and secondary muscle tension voice disorders (MTVD2) groups. Patients with primary muscle tension voice disorders (MTVD1) presented the greatest impairment. Our findings reinforced the division of functional disorders in the three groups.

By comparing our patients with secondary muscle tension voice disorders (MTVD2) with patients with benign vocal fold lesions in the study of Schindler et al. (2012), our patients had twice the results in three scores of the Voice Handicap Index (VHI-30): total (42.04 > 25.3), functional (11.32 > 5.8) and emotional (10.79 > 4.6). The same was not verified for the physical subscale, since the secondary muscle tension voice disorders group (MTVD2) scored a comparatively slightly higher mean value (19.93 > 14.8).

The group of patients with secondary muscle tension voice disorders (MTVD2) revealed a significant impact of vocal impairment in quality of life. However, when this data and the results derived from the psychological evaluation were jointly analyzed, it did not seem surprising as there was an index of inner suffering in this group of patients although in lower levels compared to the other two groups. The psychological features may play the role of cause, consequence or both, being therefore capable of affecting one's perception of quality of life. This result leads us to emphasize that benign lesions of the vocal folds must be classified as functional voice disorders in order to highlight its behavioral and emotional components.

Seeking to identify the similarities and differences between the three groups based on the mean values reached in each of the subscales of the Voice Handicap Index (VHI-30), it is essential to make reference to the study of Guimarães and Abberton from 2004. The authors aimed to determine whether quantifiable differences existed in scores of the VHI-30 between Portuguese adult speakers with and without vocal complaints. Two groups were assessed, a dysphonic group with several diagnosis (functional disorders, nodules, polyps, cysts, granuloma, leukoplakia, chronic laryngitis, Reinke's edema, sulcus vocalis, vocal fold scar, and hemorrhage) and a control group of participants with minor structural or physiological abnormalities, described as presenting

a healthy larynx or a posterior glottal chink. The dysphonic group of patients reported a moderate self-rated of psychosocial vocal impact (VHI-30 total = 34.4) compared to the patients from the control group (VHI-30 total = 10.5), having shown high scores in the three domains, although with a more pronounced difference in the physical subscale. The authors also found significant differences in the scores of the subscales for all the speakers, with the exception of functional and emotional subscales in the dysphonic group.

In our study, functional and emotional subscales did not differ in the analysis of the three groups as those obtained by Guimarães and Abberton for the dysphonic group. These results can be justified by the fact that the functional domain describes the impact of the person's voice disorder on daily activities, while the emotional subscale illustrates the patients' affective responses (e.g., feeling) to the vocal problem (Jacobson et al., 1997). In our opinion the functional and emotional domains are probably interconnected in patients with functional voice disorders. As the literature reports, this is very likely due to their etiology. In addition, there are other factors that will possibly strengthen this relationship, such as the coping strategies used, the patterns of resilience and the degree of acceptance of the voice disorder.

Regarding the physical subscale, Guimarães and Abberton (2004) verified that the two groups scored high mean values, with the dysphonic group having a more marked result (17.4 > 5.2).

Of the three subscales, in this study the physical also stood out (PVD = 17.05, MTVD1 = 22.13 and MTVD2 = 19.93), with the means not having statistical differences. An increase in the physical subscale represents a strong impact of the physical component in both studies. We admit that these results depend on the construction of the Voice Handicap Index (VHI-30) where the physical subscale is made up of statements related to the self-perception of laryngeal discomfort and voice output characteristics (Jacobson et al., 1997).

The physical subscale clearly establishes the scope of the physical domain as it describes the vocal problem generically. On the other hand, studies with patients with functional voice disorders report a general trend for somatic concerns and complaints, in parallel with high levels of depression and anxiety (state and trait) and with introversion (Roy, 2003). These two conditions may also justify the elevation in the physical subscale of the VHI-30 in the three groups.

The Voice Handicap Index has the merit of being used all over the world. This instrument gives us the possibility of comparing results obtained by different researchers, allowing the development of knowledge in the field of vocal pathology. Considering the results of the first analysis, from a psychological perspective, their contribution was below our expectations. Thus, the multivariate analysis played an elucidative role in determining the impact of the psychological features and vocal acoustic measures on quality of life.

Similar to many authors who have already been referenced, more recently Dehqan et al. (2017b) argued that "voice disorders not only affect the quality of voice, its capabilities, and parameters, but also result in varying degrees of psychological and social limitations".

Based on the knowledge of the existence of several factors affecting the quality of life of patients with FVDs, this study was designed to gather information to characterize the relationship between self-perceived evaluation of quality of life (VHI-30 scores), specific psychological features (namely severity of depression and anxiety symptoms, personality traits, and affective temperaments) and vocal acoustic measures (F0, jitter, shimmer, HNR and vocal intensity).

The analysis of the correlations between psychological variables and quality of life revealed: no significant correlations in the MTVD1 group; the significant correlations in the PVD and in the MTVD2 groups ranged from moderate to strong; and correlations were more pronounced among patients with psychogenic voice disorders (PVD = 83.3%, MTVD1 = 0.0% and MTVD2 = 29.2%). Furthermore, the PVD group had a much higher number of significant correlations compared to the MTVD2 group (19 > 4) and these presented stronger associations (PVD - 16 moderate and 3 strong correlations; MTVD2 - 2 moderate and 2 strong correlations). In this study, the relationship between psychological variables and quality of life in patients with psychogenic voice disorders was reinforced, suggesting that in this specific type of functional vocal pathology the psychological features were strongly associated with the self-perception of vocal handicap and disability.

In 2017, Lopes et al. pointed to the existence of inconsistent results for the correlation between acoustic measures (namely jitter, shimmer and the harmonic-noise ratio) and voice handicap in patients with voice disorders. The same authors also "alerted that acoustic measures are not among the factors that predict voice handicap in a patient".

Significant correlations were found between vocal acoustic variables and QOL. The acoustic parameters that presented the most significant correlations were jitter, shimmer and HNR as these perturbation measures are known to be correlated with hoarseness (Bier, Watson, & McCann, 2014), a very common vocal symptom in our sample. According to Dehqhan et al. (2017b) the self-perceived functionality of voice was highly related with these three acoustic measures, a condition that the same authors justified as a result of "discomfort and an auditory sense of a voice problem increase as the instability and noise of the voice signal increase". This was more noticeable in PVD and MTVD1 groups, which could indicate that these patients may pay different attention to specific characteristics of their vocal quality and also to its consequences compared to the patients with secondary muscle tension voice disorders. Nevertheless, the association between overall quality of life (VHI-30 total score), psychological variables and vocal acoustic parameters should be explored in future researches.

Lastly, we aimed to identify a multidimensional model capable of predicting the overall VHI score for each of the three presentations of functional voice disorders. Different models were developed for each of the three groups of patients with functional voice disorders, varying between one to two predictors of quality of life.

The results suggested that anxious temperament together with shimmer was predictive of the overall VHI-30 score in the PVD group. Shimmer is a measure of phonation stability linked to an inconsistency in the vocal fold contact (Moreira et al., 2015) and it is an acoustic parameter that also corresponds to a relatively consistent variable that appears to be correlated with the degree of dysphonia (Correia, 2014). Exaggerated worries that are common in anxious temperament (László et al., 2016) combined with high values of shimmer would lead patients with psychogenic voice disorders to focus on the vocal perceptual characteristics resulting in worse self-evaluation of quality of life.

Jitter reflects the severity of vocal deviation (Lopes et al., 2017) and was the best predictor of overall self-perceived quality of life in patients with MTVD1. As this acoustic measure is a result of the irregularity in vocal fold vibration, jitter would be more likely to be a predictor of quality of life in patients with lesions in the vocal folds (MTVD2) rather than in primary muscle tension voice disorders (MTVD1). Additionally, the same authors reported a very good correlation between jitter and total score of VHI among MTVD2 patients. Note that from all the three groups, patients from the MTVD1

group had slightly higher means of jitter compared to those obtained by the patients of the two other groups and also to the referenced values (Study 5).

In the three groups, it was verified that alone or together with a psychological variable, there was a vocal acoustic variable playing the role of predictor of quality of life. Tarazani et al. (2013) assumed that the responses to the VHI would be related to the acoustic measures whenever vocal production does not have the expected structural and functional characteristics.

Already in 2006, Wheeler, Collins and Sapienza explained that many of the VHI-30 items are associated to the impact that dysphonia has on vocal loudness, variability and clarity. Therefore, jitter and shimmer will provide information regarding the behavior of the vocal folds (Bier et al., 2014). Accordingly, this suggests that with changes in vocal production, the patient's responses would depend on the acoustic measures.

In the PVD group, the vocal acoustic predictor was shimmer with a moderate positive linear correlation with the total value of VHI while in the MTVD1 group it was jitter the predictor and with a strong positive linear correlation. The predictor model for the MTVD1 group, in particular, was not consistent with those found by Schindler et al. (2009) to the extent that “it was found that the acoustic measures were not predictive of the overall VHI score, even if a correlation between items of the VHI and some voice parameters was discovered”. So far no author reported the relationship between vocal acoustic measures and psychological variables as predictors of overall quality of life.

Of the three groups of patients, there was no acoustic parameter playing the role of predictor of quality of life in the MTVD2 group. This finding could be explained by the fact that patients with secondary muscle tension voice disorders probably have more realistic expectations regarding their vocal quality because they are aware of the existence of a vocal fold lesion, shown to them during the ENT examination. From the psychological point of view, although depressive temperament may play an important role in the management of the disease, it's likely that these patients may have developed more adjusted coping strategies more suitable for the acceptance of their vocal quality at the time the evaluation was conducted. This hypothesis that we advanced is reinforced by the fact that this group was the one that sought professional help later (Study 1).

Merrill, Anderson and Sloan (2011) had defined anxiety and depression as causal factors, triggers, or maintaining factors of functional voice disorders. It is interesting to note that affective temperament alone (MTVD2) or combined with an acoustic measure

(PVD) while a subclinical manifestation of mood disorders, assumed a more prominent role in the self-evaluation of quality of life than the presence of depressed or anxious states (HAM-D and/or HARS). Affective temperament is defined “as an inherited part of personality and represents the biologically stable core of emotional reactivity” (Nemcsik et al., 2017). As it is a more persistent “trait-related manifestations and commonly the antecedents of minor and major mood disorders” (László et al., 2016), it is also probable that may be present before the functional voice disorders itself. These results reinforced the interest of the assessment of affective temperament in patients with FVDs, a finding that was also highlighted in the Study 4.

As a whole, the multivariate regression analysis indicated that anxious and depressive temperaments but also some vocal perturbation parameters as shimmer and jitter (alone or together) may affect the perceived quality of life in patients with functional voice disorders. Our findings also provided evidence that these patients should receive differentiated treatments according to their classification of functional voice disorders.

## 6. Conclusion

The assessment of the self-evaluation of handicap and disability associated to a vocal problem allows understanding voice disorders and how they can affect daily life. It represents a modern view of health and quality of life.

Our findings revealed a moderate impact of functional voice disorders (FVDs), with the physical subscale having reached higher scores in the three groups of patients with FVDs, pointing out that the impairment of the vocal function is more associated with physical symptoms and complaints.

Differences in means were found for the functional subscale and between psychogenic voice disorders (PVD) and primary muscle tension voice disorders (MTVD1) groups, and between primary (MTVD1) and secondary muscle tension voice disorders (MTVD2) groups. These results emphasize the role of the functional domain in the self-evaluation of quality of life of patients with FVDs.

We believe that our findings lead to a future research area, with continuous assessment of similarities and differences between patients with psychogenic voice disorders (PVD) and patients with secondary muscle tension voice disorders (MTVD2).

These are two functional voice disorders with marked anatomic-functional differences, but which do not differ when evaluating their impacts on overall quality of life.

The emotional impact of FVDs was present but the result seems to overlap with the functional component. Nonetheless, both domains should be valued and taken into account for the diagnosis, treatment and prevention of functional voice disorders.

Our study also provided a clue to clarifying the meaningful predictors of self-evaluation of quality of life in patients with functional voice disorders. It was suggested that the perceived functionality of voice depended on the affective temperament and/or vocal acoustic measurements.

Despite many past studies reported "considerable variation in their findings pointing for no significant or weak significant correlations between the VHI and acoustic voice measures" (Awan, Roy, & Cohen, 2014), our results showed the existence of significant correlations between vocal acoustic measures and quality of life in varying degrees between moderate and strong depending on the type of functional voice disorders.

The evidence for associations between emotional problems and voice disorders that were identified in this study remain consistent with previous research. However, the psychological variables that presented significant correlation values with quality of life, namely affective temperaments (depressive and anxious temperaments), have been little studied.

The analysis that has been developed in this study was the first to our knowledge to explore the impact of vocal acoustic and affective temperament on quality of life of patients with functional voice disorders.

Globally, our findings shed light for future studies where the multidisciplinary assessment should be the main approach used to identify the impact that FVDs have on the patient's life either from an overall perspective or in the functional, physical and emotional domains, as well as to clarify the association between self-perceived quality of life, psychological features and vocal acoustic parameters. It is expected that this line of research will have clinical implications in multidimensional voice assessment protocols in patients with different types of functional voice disorders.

# CHAPTER 6

## General Discussion and Conclusions

# 1. Introduction

Voice is the individual human sound. It is an innate neurophysiological function, since it develops simultaneously with the organic development of the individual (Mota et al., 2010). Voice is also our primary means of expression inscribed in the relational context.

It is through voice that emotions, thoughts, ideas, motivations, projects as well as the emotional state and personality characteristics are revealed. The listener captures the voice and learns more about the speaker. Its complexity offers us many possibilities in communication and in relationships. Johnson et al. (2010) defended that "voice speaks the mind; its timbre speaks the heart" and for Bickel (2008) "you are your instrument".

Besides being an emotional valve and the reflex of personality, voice can reveal the physical condition as well as the laryngeal state (Colton & Casper, 1996).

The larynx operates in tune with other parts of vocal apparatus being responsible for the main source of sound in vocal production.

Vocal production requires the balance and coordination of three fundamental mechanisms: breathing (air supply from the lungs as a source of energy), phonation (vibration of the vocal folds) and resonance (structures of amplification). These mechanisms work together in harmony to produce voice. Apart from them, vocal sound depends also on multiple systems such as body posture, body and laryngeal muscles, emotional state and personality.

Voice results from anatomical, physiological, behavioral and/or psychological features and in some situations voice ceases to be the result of a natural process leading to vocal pathology.

## Classification of Voice Disorders

The classification of voice disorders has evolved greatly over time. Morente and Izquierdo in 2009 defended that there was no standardized nomenclature and classification of voice disorders due to the subjective component of voice and the

presence of multiple pathological processes in the same individual requiring the intervention of different professionals.

No single voice assessment measure can provide all the information needed to understand the vocal production and/or voice disorders. According to Lopes et al., (2016) the main criteria to include the patient in a diagnostic group results from laryngeal examination. Other authors valued the vocal acoustic analysis, self-assessment on quality of life, and psychological assessment. Yet, the majority approaches have not yet combines all these data.

Voice disorders are traditionally classified as organic or functional (non-organic).

Organic voice disorders (OVDs) result from several processes such as mass lesions, structural changes to the vocal folds or neurologic lesion. They are not related to vocal use but have direct consequence on vocal quality (Mota, Barbosa, & Nudelmann, 2010).

Functional voice disorders (FVDs) are associated with the voice use, abuse and/or misuse. There is a strong evidence of the co-morbidity with psychiatric disorders such as affective and anxiety disorders and/or personality disorders. In FVDs, psychological maladaptations and disturbances can act in an isolated way or concomitantly with the incorrect vocal behavior (Mota et al., 2010).

This study resulted from the clinical experience of the researcher as a psychologist in the ENT Department. Having worked for eight years with patients with voice disorders, the challenge was constant as well as the need to acquire theoretical and practical knowledge from areas that converge and complement each other in the vocal field.

Over the years the researcher was confronted with similarities, differences, specificities and some particularities of patients with functional voice disorders that led to the development of a set of reflections that were the basis of this Thesis.

ENT specialists and speech therapists shared their experiences in treating patients with functional voice disorders knowing that the psychological assessment was needed for some of these patients. The high incidence of functional voice disorders reported in literature increased the interest in studding these patients.

In 2007, Baker et al. proposed the Diagnostic Classification System for Voice Disorders (DCSVD), a model that distinguishes the three presentations of functional voice disorders based on laryngeal findings and on psychological and behavior factors: psychogenic (PVD), primary muscle tension (MTVD1), and secondary muscle tension voice disorders (MTVD2).

The aim of this study was to deepen the knowledge of functional voice disorders and to provide a comprehensive perspective on the relationship between its classification and psychological features.

ENT specialists, residents and speech therapists assumed the recruitment process of patients from the outpatient clinic.

The diagnosis of functional voice disorders was made through ENT examination and the patients were grouped based on the classification system adopted.

In total, 83 female patients with functional voice disorders had participated in this study. There were 39 patients with psychogenic voice disorders (PVD), 16 patients with primary muscle tension voice disorders (MTVD1), and 28 patients with secondary muscle tension voice disorders (MTVD2).

The size and constitution of the sample was a result of the characteristics of the ENT Department of a University Hospital, located in Lisbon and recognized by its differentiation in vocal care.

To better characterize the prevalence of functional voice disorders, it was decided to undertake a retrospective analysis based on two sources of information: the surgical list of patients undergoing laryngeal microsurgery and female patients evaluated for the first time by speech therapists. Both data refer to the same period in which our sample was collected (sixteen months).

In the registry book of the ENT surgical activity it was documented 151 microlaryngeal surgeries during that period of time: 58 patients (38.4% of the total microlaryngeal surgeries) with vocal fold polyps (MTVD2) having an equal gender distribution (29 patients). In microlaryngeal surgeries performed due to tumor pathology (with confirmed diagnosis) as well as other cases due to suspicion of tumor disease (biopsy), the distribution between the two genders was totally different (42 males and 7 females).

During the same period of time, 238 female patients with voice disorders had their first speech therapy evaluation. Of these 9 (3.8%) had a psychogenic voice disorders (PVD), 79 (33.2%) presented a primary muscle tension voice disorders (MTVD1), 51

(21.4%) were diagnosed with secondary muscle tension voice disorders (MTVD2), and 99 (41.6%) with other pathologies (vocal fold paralysis and Reinke's edema).

Note that surgical patients, patients screened by speech therapist and patients included in this study may overlap.

The analysis of these numbers merits reflection because we did not found any study in which the distribution of patients was analyzed based on different approaches as microlaryngeal surgery, speech therapy and psychological evaluation.

Functional voice disorders had a high prevalence in the total of the voice disorders that were diagnosed and treated in the ENT Department. It is with great interest that we await for further studies that are needed to clarify the incidence of functional voice disorders within the laryngeal pathology. But from the aforementioned numbers, it is clear that a multidisciplinary assessment requires the psychologist as a full time member of the voice team.

In the literature, the relationship between the psychological characteristics and functional voice disorders has gradually received more attention. The instruments used in the published studies were self-assessment tests and there was no formal clinical evaluation done by a psychologist.

In this study, the semi-structured interview and the evaluation with psychological standardized tests allowed the collection and analysis of mental health data as psychiatric diagnoses, severity of depressive and anxiety symptoms, personality disorders and affective temperaments. The evaluation protocol also included vocal acoustic analysis and the self-evaluation of quality of life associated with the vocal problem.

The variables were categorized into different dimensions: characterization of subjects (sociodemographic characteristics, health behaviors and vocal and psychological data); psychological evaluation (standardized psychological instruments: clinical and self-assessment tests), vocal acoustic evaluation (vocal acoustic parameters), and self-evaluation of quality of life.

The tests applied were chosen based on their structure, fundamentals, and if they ensures effectiveness in achieving our goals. Instruments in which we had clinical experience were used, with the exception of TEMPS-A.

The use of several instruments allowed the collection of a greater number of elements that were needed to compare groups and provide a better approach on functional voice disorders.

To present the major conclusions of our study the results were organized into five categories (characterization of subjects, vocal data, psychological data, vocal acoustic evaluation and self-evaluation of quality of life) followed by final conclusions.

## 2. Characterization of Subjects

Data gathering allowed the characterization of our sample from a sociodemographic perspective.

**Gender**

Our sample was constituted by 83 female patients with functional voice disorders. Their changes in voice quality were sufficiently meaningful for them to seek an ENT evaluation.

Looking at the literature it turns out that the exclusive participation of women in voice disorders studies has become frequent in the last decade. For instance, Smits et al. (2012) assessed the voice quality, voice handicap and psychosomatic well-being in 82 female outpatients with voice problems, and Baker et al. (2013) evaluated the psychosocial factors in 73 female patients with functional voice disorders.

For some authors, anatomy and vocal physiology (Baker et al., 2013; Roy et al., 2005), the hormone-mediated effects (Demmink-Geertman & Dejonckere, 2002) with sex steroid hormonal variation to affect voice production (Lã et al., 2012) are factors associated to the increase of vulnerability of women to the development of voice disorders. In addition, according to Smits et al. (2012) women also react differently to voice problems than men.

**Age**

The reference to the age of patients with functional pathology is relatively recent in researches. In fact, it was only at the beginning of this century that studies began to make reference to the ages of patients with functional voice disorders.

Dietrich et al. (2008) studied the frequency of perceived stress, anxiety and depression in patients with voice disorders (primary muscle tension voice disorder, vocal fold lesion, paradoxical vocal fold movement disorder, and glottal insufficiency) in a sample of 160 patients with a mean age of 50.6 years, with ages from 18 to 90 years. Later, Baker et al. (2013) carried out a study to explore the psychosocial factors contributing to the development of functional voice disorders (mean age of 47.2, ranging from 23 to 73 years), having for comparison purposes two other groups, one with organic

voice disorders (mean of 48.4 years, ranging from 22 to 77 years) and the other a non-voice-disordered control group (mean of 46.6 years, ranging from 20 to 76 years).

Our patients had a mean age of 52.51 years, with ages ranging from 18 to 83 years, values that were similar to the ages of the aforementioned studies.

The mean age correspond to a decade that represents an important stage in woman's life, experiencing changes in the biological, familiar, social and professional dimensions. All these factors may interfere with their emotional and physical states.

**Education**

It is accepted that the level of education influences different health and mortality through lifestyle, health related behavior, social relationships or occupation. According to Chiu, Hayward and Saito (2016) it is expected that people with higher levels of education live longer and have more years of life in healthy conditions than those with lower education.

The group of patients with psychogenic (PVD) and with primary muscle tension (MTVD1) voice disorders had the 3rd cycle while patients with secondary muscle tension voice disorders (MTVD2) were set at secondary level.

Our patients revealed a lower school investment than the females in the study developed by Baker et al. (2013), where in both groups, healthy control and patients with functional voice disorder, women had a tertiary education

With regard to mental illness, data from the "1º Estudo Epidemiológico Nacional de Saúde Mental" (Caldas-de-Almeida & Xavier, 2013) had pointed out that individuals with a lower level of education show a statistically significant lower risk for affective and anxiety disorders. This was not verified in our sample where the prevalence of psychiatric disorders was marked. According to Frasquilho et al. (2016) economic recessions had negative associations with mental health, leading to the increase of mental health problems namely psychological distress. The same authors alerted for the correlation between periods of recession and the higher prevalence of common mental disorders, substance disorders, and even suicidal behavior.

We have to admit that the financial crisis of 2007/2008 may have had repercussions in the period of time in which our evaluation took place. However, it will be important to develop more researches in which the education level of patients with functional voice disorders should be analyzed in relation to psychiatric disorders.

**Employment status**

We verified the existence of a variety of professions which were not voice professional, but there were individuals who were professional voice users like teachers, educators and educational assistants, trader (business owners and shopkeepers), administrative officials, public relations and call center assistants.

There are studies that refer to profession but only when voice professionals are evaluated (e.g., singers). Baker (2017) explains this fact with the idea that patients with voice disorders are seen as individuals of a certain age and sex, with a possibly given occupation who live in a social and contextual vacuum. These reinforce the need to characterize these patients from a sociodemographic perspective.

The voice is essential for effective communication and for the viability of work, with currently about one-third of the professions having the voice as a basic working tool (Mota et al., 2010). Przysiezny and Przysiezny (2015) defined professional voice as the oral communication used by individuals who depend on it for a full occupational activity.

The WHO has already recognized that dysphonia may be related to work. In 2009, in Brazil the "Comitê Brasileiro Multidisciplinar de Voz Ocupacional" was formed integrating representatives of several associations like Associação Brasileira de Otorrinolaringologia e Cirurgia Cérvico Facial (ABORL-CCF), Academia Brasileira de Laringologia e Voz (ABLV), Associação Nacional de Medicina do Trabalho (ANAMT), and Sociedade Brasileira de Fonoaudiologia (SBFa). Toghether they aimed to create projects and proposals with legislative criteria that emphasize the importance of early diagnosis and the promotion of proper treatment of voice-related problems in the workplace (Associação Brasileira de Otorrinolaringologia e Cirurgia Cérvico Facial, 2009). There are many recognized risk factors recognized by current legislation that can be found in several jobs where the voice is used in the performance of the profession.

Silva (2013) expects the diagnoses of laryngeal diseases to be included in the list of occupational diseases. For the same author, a legislative change will have a major impact on "dimensioning of the problem, for redirection of the National public health policies and, finally for better support for expert decisions" (Silva, 2013).

Absenteeism or prolonged absences from work are conditions that frequently come associated to work-related voice disorders (Przysiezny & Przysiezny, 2015).

A functional voice disorder in individuals who use the voice as a main working tool can have an impact on their livelihood as well as on their sense of professionalism and professional identity (Johnson et al., 2010).

We believe that in the future the psychological impact of voice disorders will be also considered in the evaluation of these cases.

Profession (past and present) must be included as data as it is an indicator of job functions, daily vocal demands, as well as the employment setting (e.g., noisy, dusty, air circulation, per work shift, and teamwork or individual work) and all these elements have an impact on voice quality.

**Marital status**

Our findings suggested a prevalence of married condition (63%). The result was similar to what was found by Baker (2017), where 54% to 76% of patients with functional voice disorders were in a formal conjugal relationship.

Data from Censos 2011, the year prior to the beginning of sample collection, indicates that 60.3% of females with age of 52 years (value that corresponds to the mean age of our sample), and living in the great Lisbon area (geodemographic area where the HSM is located) were married (Instituto Nacional de Estatística, 2012). These data were identical to ours.

The assessment on marital status provides information on social context (Lapierre, 2009) but is incomplete because it does not give information about the quality of the relationship. In our sample the married condition was common. This data must be considered because women seem to be more reactive to family-related stress (Caputo & Simon, 2013), presenting more physiological responses to marital conflict or disagreement than men (Gallo, Matthews, Trouxe, & Kuller, 2003).

According to Gallo et al. (2003) the marital relationship corresponds to the primary source of support for many adults. The same authors pointed out that general findings related to marital status and health are less consistent in the female gender than in men due to the fact that women show high sensitivity to the negative aspects of the relationship. Therefore, besides marital condition, the degree of marital satisfaction and cohabitation should also be evaluated in studies with patients with voice disorders.

**Health behaviors**

Data on lifestyle and health behaviors should be collected as tobacco and alcohol abuse, separately, have an adverse effect on voice and together they represent risk factors of voice disorders, namely chronic laryngitis, premalignant condition and malignant tumors.

In the literature there were no references to tobacco and alcohol consumption associated with functional voice disorders. Yet, differences in association between groups were found for one of these two variables: tobacco.

The highest percentages for non-smokers were found in the psychogenic voice disorders group (PVD = 82.1%) while the group of patients with secondary muscle tension voice disorders (MTVD2) scored higher for past smokers (28.6%) and also for current smokers (25.0%).

Nunes and Narigão (2014) reported that in the female gender, tobacco consumption has been lower than in males. The same authors indicate smoking in females as the seventh cause of loss of healthy life years, following diet, hypertension, obesity, sedentary lifestyle, glucose intolerance and alcohol use. Data from the "Programa Nacional para a prevenção e controlo do tabagismo" reports that in females, the mortality rate attributable to tobacco consumption per 100 000 people recorded a decrease in all age groups (from the age of 30 years), with the exception of the age group of 80 years or older (Nunes & Narigão, 2014).

**Conclusions and reflexions**

Our results provided information on the care and attention that these patients give to general health and to the voice in particular.

Knowledge of sociodemographic characteristics of our patients was important to the extent that it allowed us to frame the patient in many contexts and to identify the vulnerability factors for the development of functional voice disorders.

Psychologists, psychiatrists, ENT specialists, speech therapists, and primary care physician should be sensitized for the associations between functional voice disorders and the sociodemographic characteristics found in this study.

In the future, when performing epidemiological studies it will be possible to define the sociodemographic profile of these patients with implication for treatment planning and for the prevention of these vocal disabilities in the community.

## 3. Vocal Data

Patients with functional voice disorders may experience several vocal symptoms. The most reported were vocal fatigue and intensity changes, both with percentage values nearly 94%. Vocal fatigue is a common complaint among patients with voice disorders (Stemple, Stanley, & Lee, 1995), often being present togheter with other vocal symptoms (Eustace, Stemple, & Lee, 1996) a condition supported by our results. Aphonia was the least frequent vocal symptom (≈ 43%).

Patients also referred having had the same vocal symptom in the past, a more frequent experience in patients with primary muscle tension voice disorders (MTVD1 = 43.8%).

An increase in the number of vocal complaints is what most strongly determines the search for specialized care and is more significant to the patient than the deviation in voice quality itself (Lopes et al., 2016).

The variability and severity of the vocal symptoms, and the complaints requires them to be integrated in the patient's life history because these presented many difficulties in the use of voice. Humans often seek reasons for their condition before symptoms and signs of illness. Some patients with psychogenic voice disorders (PVD) located the beginning of the vocal symptom but seem to be unaware of their own psychological life stress at that moment. When analyzing these statements it was found that references to interpersonal relationships were common. These patients focused on the date of the onset of the vocal symptoms, a date that marks their lives, and the previous and subsequent periods to the experience of vocal, intra and interpersonal difficulties.

Besides the identification of the vocal symptom, it will be fundamental to make more specific queries to document the characteristics of the vocal symptoms and complaints such as the type of onset and their nature, and also the history of the vocal problem (time and severity). These set of factors associated with individual features contribute to great variability in its expression, regardless of the type of functional voice disorder.

The onset of the vocal symptom may be progressive or sudden. No variability on the type of onset was observed between groups.

Patients frequently report that others make remarks about their voices. Thus it is important to identify the nature and content of the oral observations made by others. In our sample, differences in association between groups indicated that patients with secondary muscle tension voice disorders (MTVD2 = 15.4%) received far fewer comments on their voices than patients in the other two groups (PVD = 54.5% and MTVD1 = 69.2%). It is interesting to note that patients with secondary muscle tension voice disorders were the patients whose vocal symptom had a longer evolution. This leads us to think that the people around them or have become accustomed to the new vocal register even with poor quality or have already failed to comment due to lack of proactivity revealed by these patients in seeking for specialized help which have been the result of several factors that must be identified.

In the group of psychogenic voice disorders (PVD) patients were more often addressed as “not heard”, while patients from the two other groups (MTVD1 and MTVD2) heard more “speaks loud”. It should be noted that the comments made convey the lack of control in vocal production. The impact of the comments, especially when made by significant others, may compromise the way the patient begins to hear his/her voice as well as the possibility of developing vocal behaviors as vocal inhibition due to embarrassment, shame or fear.

By comparing the time since the onset of the vocal complaints which corresponds to the progression of the vocal symptom, it was verified that patients (MTVD1) sought more quickly for early-specialized help, not letting the vocal symptom progress by lowering the cumulative effect of vocal use and misuse (Van Houtte et al., 2010), which reflects their concern with vocal health.

Regarding the total of patients included in our study nearly one half had prior speech therapy (last six months), revealing different levels of adherence to treatment. Patients with primary muscle tension voice disorders (MTVD1) had been characterized for having more dropouts and also for finishing the full course of vocal therapy while patients with secondary muscle tension voice disorders (MTVD2) had the greats compliance.

When analyzing the family history of voice disorders in the groups, it was verified that patients with secondary muscle tension voice disorders (MTVD2) had the highest

incidence (PVD = 10.3%, MTVD1 = 18.8% and MTVD2 = 21.4%). In total sample, there were thirteen family members with voice disorders (eight males and five females).

In the families of patients with secondary muscle tension voice disorders (MTVD2) there were six members with voice disorders: benign (a father and a son), malignance (two uncles) and with unknown etiology (a mother and a brother).

In the psychogenic voice disorders group (PVD) the psychogenic vocal etiology reached a higher number of cases (a mother and a daughter) compared to the other diagnoses in this group and also compared to the prevalence in the two other groups. In the families of these patients were also identified a malignant pathology (a father) and a voice disorder of unknown cause (a grand father).

Regarding the family members of patients from the primary muscle tension voice disorders group (MTVD1), it was reported a case of benign pathology (a son), another with psychogenic etiology (a mother) and other with unknown etiology (a mother).

# 4. Psychological Data

Historically the previous assignments of functional voice disorders had a pejorative charge namely "psychophonasthenia*",* *"*phononeurosis*",* "hysterical aphonia or dysphonia", and "medically unexplained" (Baker, 2002, 2008). The latest classification proposals point to the relationship between voice disorders and the psychological component in an aetiological perspective, preventing that the patient feels that his/her voice disorder is devalued or intractable.

The association of voice disorders with mental health problems is confirmed and is more complex than simple mechanical failure (Nerrière, Vercambre, Gilbert, & Kovess-Masféty, 2009). In 1996, Woodson already said "the volume of psychological problems could be sufficient to justify the inclusion of a psychiatrist or psychologist on the staff of voice clinic".

**Affective and Anxiety Disorders**

In this study, the diagnosis of the affective and anxiety disorders met the criteria outlined in the Diagnostic and Statistical Manual of Mental Disorders.

In 2014, Baker et al. mentioned that in muscle tension voice disorders the dysregulated vocal behaviors were prevalent over the psychological factors. In patients with psychogenic voice disorders (PVD), the psychological factors appear as more significant.

Our findings showed that patients with primary muscle tension voice disorders (MTVD1), when compared to patients from the two other groups, were more often associated with affective disorders namely with current major depression and current mood with psychotic symptoms and also with anxiety disorders such as lifetime panic disorder, current generalized anxiety and current panic disorder with agoraphobia.

The same was not verified for lifetime panic disorder once patients with psychogenic voice disorders (PVD) received more often this diagnosis.

In all psychiatric diagnoses where there were differences in association between groups, the secondary muscle tension voice disorder group (MTVD2) registered comparatively lower frequencies (e.g., current major depression and current generalized anxiety) or considerably lower frequencies (e.g., current mood disorder with psychotic symptoms).

As already mentioned by Hammen (2003) patients with primary muscle tension voice disorders (MTVD1) revealed greater vulnerability to develop symptoms of depression and anxiety in the presence of a stressor due to maladaptive interpersonal skills and cognitive representations of the self and others in relationships.

In this study, patients with primary muscle tension voice disorders (MTVD1) had higher severity levels of symptoms of depression (moderate) and anxiety (mild) compared to the patients from the two other groups (PVD and MTVD2) who presented mild depression symptoms and anxiety symptoms with "normal range" classification.

The suicide risk was more prevalent among patients with psychogenic voice disorders (PVD) either at the level of incidence and/or severity. Patients with psychogenic voice disorders (PVD) had a prevalence of 43.6% of current major depression and also had family history of suicidal behaviors in direct family members. Both conditions are identified as suicidal risk factors, which lead to the need to be especially attentive with regard to suicidal bevariors in the assessment of these patients.

**Personality and Personality Disorders**

Voice, personality and voice disorders are connected.

Personality is responsible for the increased of laryngeal tension leading to the impairment of voice quality across laryngeal inhibition and activation (Roy, 2003). Barakah et al. (2012) reinforced this relationship by stating that individuals that can not access their own voice can experience a 'loss of self', which only returns when the voice is restored.

In this study the evaluation of personality may reinforce the differences found between groups, but it does not neglect their common traits as schizoid and avoidant (26.5%), narcissistic (25.3%), and histrionic (24.1%); and personality disorders as compulsive (63.9%), dependent (37.3%), and avoidant (19.3%).

Patients with psychogenic voice disorders (PVD) were more frequently diagnosed with schizoid or schizotypal personality disorders compared to patients from the two other groups. Both have in common a lack of motivation, indifference, and a restricted emotional expression that leads and reinforce the social and interpersonal deficits.

These findings met the characterization of patients with functional voice disorders as a group. Roy (2003) characterized these patients as inhibited, stress reactive, socially anxious and non-assertive.

Personality and personality disorders have impact in the treatment outcome. There are maladaptive traits that hinder treatment efficacy as others that may favor its course (Widiger & Anderson, 2003). In fact, personality disorders can explain why some patients have failed to respond to the vocal treatment (surgery or speech therapy) when the role of the psychological component was not valued.

**Affective Temperaments**

Affective temperaments have a biological basis that can change over the person's life as a response to environmental factors and personal experiences. They provide important cues on the individual's abilities, motivations and defense mechanisms, being highly capable of predicting how the individual will respond to the environment.

The clinical features of mood disorders are influenced by affective temperaments in their cognitive and emotional functions.

We are not aware of any studies on the evaluation of affective temperaments in patients with three types of functional voice disorders. In our work its assessment was justified on the basis of theoretical grounds. Affective temperament is often studied in association with affective disorders as pointed by Lolich, Vázquez, Zapata, Akiskal and Akiskal (2015). As seen previously, patients with functional voice disorders are described as vulnerable to their development. There is also evidence for some personality dimensions to overlap with affective temperaments. Lastly, affective temperaments and some somatic pathologies related to life style and behavioral patterns are correlated (Rovai et al., 2013).

Once functional voice disorders are linked to affective and personality disorders it would be expect that they can be included into the category of the somatic diseases associated with behavioral conditions.

Considering the prevalence of affective disorders in our sample the evaluation of affective temperament was pertinent. Patients with psychogenic voice disorders (PVD) showed high vulnerability for depressive temperament in this study. Stably depressed mood, introversion, low energy level and hypersomnia are associated to depressive temperament (Rovai et al., 2013). Depressive patients are also characterized as quiet and

passive individuals with low self-esteem, rigid thinking and with great permeability to others. This contributes to the development of interpersonal relationships in which they assume passive and dependent roles.

A functional voice disorder in association with these psychological characteristics may contribute to the vocal symptom to emphasize the preexisting communication barrier.

The evaluation of affective temperaments was also relevant for the development of a psychological and acoustic model of the self-perceived evaluation of quality of life for each group of patients with functional voice disorders, as it played the role of predictor of overall quality of life in the group of patients with psychogenic voice disorders (PVD - anxious temperament combined with shimmer) and in the secondary muscle tension voice disorders group (MTVD2 - depressive temperament).

**Conclusions and reflexions**

The method applied met our goals. First, we observed a large number of functional voice disordered patients with psychiatric co-morbidity. Diagnoses of relevant psychiatric disorders (affective, anxiety and personality disorders) were made with considerable incidence, especially in the group of patients with primary muscle tension voice disorders (MTVD1).

It was possible to verify the existence of a personality profile in functional voice disorders as well as to identify the specificities of each of the three types of presentation.

The relation between psychological aspects, vocal symptom and functional voice disorders still raise the question: which are the boundaries between the roles of cause and consequence of psychological features in functional voice disorders?

It was our intention to focus on the evaluation of the mental health state of FVDs patients. Many psychological features were identified and some have been quantified (e.g., severity levels of depression and anxiety symptoms; overall self-evaluation of quality of life and the impact in physical, functional and emotional domains). We did not seek for causal relations but this area opens new perspectives in the understanding of functional voice disorders.

It was also found that about a quarter of the sample (24.1%) were receiving mental health treatments for reasons other than the vocal problem. Patients with primary muscle tension voice disorders (MTVD1) had the highest percentage of mental health

treatments (43.8%). In this group, the psychiatric treatment was the most common (31.3%) and 56.3% had psychotropic medication (33.3% anxiolytic, 22.2% of antidepressant and also the combination of anxiolytic and antidepressant).

The prescription of anxiolytics was also frequent in patients with secondary muscle tension voice disorders (35.7%) while patients with psychogenic voice disorders were more frequently treated with anxiolytic combined with antidepressant (38.9%).

Before the evaluation the researcher did not have any information about the mental state of the patient nor information on mental health treatments. It was only during the interview that these data were collected.

Considering the mental health state (in particular the lack of energy and motivation) and current treatments for psychiatric illness it would be expected that most of these patients had not participated in this study. By participating, they showed interest in being assessed through a formal psychological evaluation while others probably wanted to have a mental health specialist exploring the underlying cause of their vocal problems. However, if we consider the public and the self-stigmas of psychiatric illness and treatments, this would not be likely to happen.

Ahmedani (2011) affirmed that stigma is the co-occurrence of several components including labeling, stereotyping, separation, status loss, and discrimination. The same author added that they are embedded in the social framework to create inferiority.

Inferiority, despite being a concept no yet mentioned, from our clinical experience with patients with functional voice disorders tends to be present in their lives. These patients often report that they feel diminished compared to others when performing basic tasks such as placing an order in a shop or restaurant or when requesting information.

Under stigmatized conditions, Rusch, Kanter and Angelone (2008) warned that patients intentionally tend to hide their conditions, thereby decreasing the likelihood of seeking treatment.

The stigma associated with voice disorders should overlap with the stigma attached to mental illness. This was noticeable in adherence to participation in this study after having explained that our goal was to understand the relationship between functional voice disorders and psychological aspects. By agreeing to participate these patients seem to have emphasized the importance they attach to the vocal symptoms and complaints. That was already the reason for seeking support and guidance from ENT specialists and speech therapists at the ENT Department.

This leads us to question the reasons that will have contributed to this level of participation: Did these patients sought for medical validation of the impact that voice quality has on quality of life? Did it represent an insistent request for help?

We think that all these reasons, alone or together, reinforce the adherence in participation.

In the preface of their book "The Management of voice disorders", Morrison and Rammage (1994) expressed the desire that their writings would reach not only ENT specialists and speech therapists but also psychiatrists by stating "it should help the psychiatrist appreciate the ways in which muscle misuse lead to dysphonia". In 1996, Woodson defended that psychiatric input can be more acceptable to the patient if it is presented as a fairly routine component of voice evaluation.

Our results lead us to agree with these statements. In the presence of a functional voice disorder, it is required that psychological and/or psychiatric evaluations should be managed within the vocal assessment protocol. After twenty years, there are still differences between reality and the clinical needs. This is due to the type and number of available resources and also to the structure and organization of a voice team that tended not to integrate but maintain collaboration with mental health specialists.

Morrison and Rammage (1994) summarize: "our clinic is the product of who we are, where we live, the politics of our health care system, where and how we were educated, the expectations of our clientele, and an assortment of personal biases". This notion is relevant and remains valid. Having worked in the multidisciplinary assessment of voice disorders, the researcher can assure that this model of intervention provided a holistic view, where the voice represented more than the vocal sound. By emphasizing this perspective, we defend person-specification and not problem-specification (Division of Clinical Psychology, 2011).

Voice and its disorder often end up representing the person leading to the neglect of the characteristics of the individual characteristics and personal suffering.

Of clinical experience with these patients, we signaled the need to consider the existence of primary and secondary gains. It is extremely common that primary gains promote the reduction of anxiety and tension levels and the avoidance of conflict while secondary gains translate the benefits that the patient gets for having a vocal symptom. These can hinder the treatment process contributing to the perpetuation of the vocal symptoms.

Those gains should be identified also because they help to clarify the role that the vocal symptom has in the patient's life. They also explain the difficulty in improving vocal quality and even resistance to treatment. In these situations, we recommend that the results from the self-evaluation of quality of life be manage in the psychotherapy. Those scores are expected to represent a significant impairment. The confrontation of these results togheter with the interpretation of the gains will help to unblock the defense mechanisms and reduce the resistance to the treatment.

It is also for this reason that the use of instruments that evaluate the self-perceived quality of life related to the vocal problem are recommended as a standard procedure in vocal assessment.

The three groups of patients also reported a considerable high percentage of family history of psychiatric disorders (PVD = 71.8%, MTVD1 = 68.7% and MTVD2 = 67.9%). Considering the total sample, the most common diagnoses were affective and anxiety disorders which reinforce the vulnerability of these patients to their development.

With regard to referral made for mental health treatments it was verified that close to fifty percent of our patients met criteria for mental health services. There were signs and symptoms of mental processes and human behavior that were affecting the patient's ability to function as previously in family, social and /or work contexts.

Treatment of mental disorders is crucial to restore affective, cognitive and social functioning and to reduce the psychological distress, having impact on vocal quality and in quality of life.

# 5. Vocal Acoustic Evaluation

Since anatomic, physiological, emotional, behavioral, organic, environmental and cultural aspects influence voice production, its assessment requires "the mapping of all of these aspects and establishment of the relationship among them" (Almeida & Behlau, 2017). This conceptualization is consistent with our evaluation protocol, which included sociodemographic evaluation (Study 1), psychological evaluation (Studies 2, 3 and 4), vocal acoustic evaluation (Study 5) and self-evaluation of quality of life (Study 6).

In this Thesis, we proceeded with the vocal acoustic evaluation of patients with functional voice disorders in order to analyze and compare their vocal characteristics.

The vocal acoustic analysis corresponds to a non-invasive procedure that provides quantitative data and has good applicability in both clinical and research settings (Eadie & Doyle, 2005). In this study, three sustained vowels (/i/, /a/ and /u/) were used as vocal tasks.

Sustained vowels allow the assessment of the voice source, vocal tract and the characteristics of the articulators, as they are relatively time-invariant. According to Parsa and Jamieson (2001) they also reduce the effect of the phonetic context and stress in vocal quality.

In this study, the norms and recommendations for voice recording and analysis were followed: soundbooth room (a Faraday Cage), digital recorder with unidirectional headset microphone, and software for vocal acoustic analysis.

Recordings were excluded whenever the signal did not guarantee the accuracy and reliability of some acoustic measures needed for the analysis (Eadie & Doyle, 2005).

Fundamental frequencies (F0) were analyzed and the values obtained for the three types of functional voice disorders were compared within groups and with normative values for normal and dysphonic Portuguese population. The group of patients with primary muscle tension voice disorders (MTVD1) tended to present higher F0 means for the three sustained vowels than patients from the two other groups (PVD and MTVD2).

Patients with one of the two presentations of muscle tension voice disorders presented opposite vocal registers. F0 means for the three sustained vowels were higher in patients with primary muscle tension voice disorders (MTVD1) while patients with

secondary muscle tension voice disorders (MTVD2) showed lower F0 means. Statistical differences were found only for means of fundamental frequency (F0) for vowel /u/ between primary and secondary muscle tension voice disorders groups (MTVD1 and MTVD2), with their respective values increase and decrease.

Woo (2010) argued that in muscle tension voice disorders there are vast configurational changes in the larynx that leads to unhealthy and inefficient phonation. Khoddami, Ansari and Jalaie (2015) reminded that muscle tension voice disorders are functional voice disorder in which there is an excessive tension in the laryngeal muscles. For Stepp, Sawin and Eadie (2012) muscle tension voice disorders were "conditions of abuse and/or misuse of the vocal mechanism due to excessive and/or 'imbalanced' muscular forces".

Anxiety disorders were prevalent in the group of patients with primary muscle tension voice disorders (MTVD1) and according to Scheneider et al. (2006) the changes in F0 may resulted from a pathological voice that may be a consequence of anxiety and personality factors.

In 2008, Laukka et al. developed a study with 71 patients diagnosed as having a social phobia, according to the DSM-IV criteria. Their voice was recorded during an anxiogenic public speaking task, both before and after treatment (SSRI, selective serotonin reuptake inhibitors, non-SSRI drugs or a placebo treatment). The monitoring of anxiety was made through the State-Trait Anxiety Inventory (STAI-S) while the responses to treatment were evaluated with the Clinical Global Impression Improvement (CGI-I). The authors found that anxiety had an effect on several of the measured voice cues. Of these, fundamental frequency (F0) stood out since "anxiety may increase the tautness of laryngeal and vocal fold muscles which increases the pitch of the voice".

Our study demonstrated the existence of association between the increased of fundamental frequency (F0), tension and anxiety, thus corroborating the statement "the emotional state that underlies the vocal expression" (Mendoza & Carballo, 1998). In fact, our data supported the role of fundamental frequency as a sign of emotional impact (Schneider et al., 2006).

Statistical differences between groups were also found for F1 means for the three sustained vowels. These results allowed the identification of a pattern associated with the first formant (F1) that depends on the "opening of the mandible, lowering of the tongue, vertical displacement of the tongue and laryngeal constriction" (Teles & Rosinha, 2008).

From a statistical point of view, patients with primary muscle tension voice disorders (MTVD1) were always distinguished from the other groups, having achieved the highest means of F1. We recall that in this group, patients were more frequently diagnosed with anxiety disorders and were evaluated by the researcher as presenting mild anxiety, whereas the two other groups were classified in the category "normal range" for the severity of anxiety symptoms (HARS) (Study 2).

According to Woo (2010), the extrinsic laryngeal muscle tension raises the larynx to a high position. The same author also added that this condition confers a decrease of mobility to the larynx during phonation due to tension in the jaw and tongue and also to the lack of oral articulation.

Another finding of clinical interest corresponded to the evaluation of cough intensity (dB). We found a higher intensity among patients with primary muscle tension voice disorders (MTVD1) and lower intensity in secondary muscle tension voice disorders group (MTVD2).

One of the diagnostic criteria for psychogenic voice disorders (PVD) is the preservation of the nonphonatory gestures, a characteristic that is not assigned to the two other groups. Based on this criterion, it was expected to find statistical differences in cough intensity between patients with psychogenic voice disorders (PVD) and patients from the other groups. However, cough intentity of the PVD group was similar to that obtained by the group of patients with secondary muscle tension voice disorders (MTVD2).

For Titze (1995) "the human voice has been shown to carry much information about the general health and well-being of an individual". Considering the vocal acoustic parameters it should be noted that most of them were associated to the vocal tract shapes and were dependent on autonomous regulation and/or personality factors or even on emotional state, especially anxiety.

This study reinforced the need to characterize the vocal profile of the different presentations of functional voice disorders. We expect further similar researches considering the degree of tension that varies as a function of the perceived stress namely current emotional state, defense mechanisms and coping strategies. Having this knowledge, we will have a better understanding of the impact of psychological features on vocal quality. All these facts have clinical implications in the establishment of the

treatment and in determining whether the initial focus is assigned to the vocal techniques or managing of the psychological aspects.

# 6. Self-evaluation of Quality of Life

In 1995, the World Health Organization (WHO) defined "quality of life as the individual's perception regarding his/her quality of life, within the cultural context and systems of values" (as cited in Spina, Maunsell, Sandalo, Gusmão, & Crespo, 2009).

With regard to voice disorders, Dietriech and Abbot (2012) pointed that "a person's dispositional vocal behavior must first become counterproductive or dysfunctional in social or professional contexts". Lopes et al. (2016) added that negative impact can be visible on the patient's quality of life by compromising social, emotional, and work-related situations reflecting the communicational difficulties experienced by patients due to their vocal problems. Already in 2009, Spina et al. drew attention to the need to provide special health-care and attention for the life quality of dysphonic patients, since it reflects the difficulties of the patient in day-to-day life.

In our sample, patients with functional voice disorders revealed a moderate handicap or disability associated to the vocal problem. These patients may feel disadvantaged and demoralizing in performing daily activities, in professional tasks, and even in hobbies. All these factors may affect the individual daily functioning in economic, mental, emotional, and social aspects (Holmqvist et al., 2013).

Our results lead to considered functional voice disorders (FVDs) as an entity that produces a great impact on communication and on socio-professional contexts, a finding that is consistent with literature.

In the Voice Handicap Index (VHI-30) our patients more often reported physical complaints. This could be due to the characteristics of the physical subscale that include statements that represent the self-perceptions of laryngeal discomfort and voice output, characteristics that at the time of the evaluation were the most visible.

Differences between the three groups were found for the functional subscale, and between the psychogenic (PVD) and the primary muscle tension (MTVD1) voice disorders groups, and also between the primary (MTVD1) and the secondary (MTVD2) muscle tension voice disorders groups. These findings indicated that although only

patients with functional voice disorders were evaluated, the perception that they had of the impact that the functional domain had on the quality of life was not the same. In fact, the impact of the functional vocal aspect in the groups of patients with psychogenic (PVD) and with secondary muscle tension (MTVD2) voice disorders did not differ despite of their anatomic and physiological differences.

Patients with functional voice disorders often describe a vast set of physical, functional and emotional impairments. For Baker (2017) there is no correlation between the degree of the impact of vocal impairment and the severity of the voice disorder. From this, it will be important to evaluate the meaning that the patient attributes to the vocal symptom and the impact that the vocal problem has on the different contexts of his/her life.

Our results showed that patients were exclusively sensitive to the impact their vocal changes had on overall quality of life, most likely due to affective temperament and/or vocal acoustic parameters. The predictors of quality of life differed depending on the classification of the FVDs: PVD - anxious temperament together with shimmer; MTVD1- jitter; MTVD2 - depressive temperament.

The findings of this study indicated that, to some extent, there are measurable relationships between specific affective temperaments (depressive or anxious), vocal perturbation measures and overall self-evaluation of quality of life in patients with functional voice disorders. In the clinical setting, the need for a multidisciplinary assessment becomes clear in order to gain a more in-depth knowledge of the interlinkages identified.

# 7. Final Conclusions

Voice disorders are multidimensional and for accurate diagnosis, planning and monitoring of treatment the integration of data from different specialties is required.

The progress of knowledge in this field is clearly visible through the analysis of papers published in peer-reviewed journals and even in book titles. Initially the titles were generalists and are currently reflecting the progress of sub-specialization as: *The management of voice* disorders (M. Morrison, & L. Rammage (Eds.), 1994), *Psychological aspects of voice disorders* (D. Rosen, & R. Sataloff (Eds.), 1997a), *Voice care in the medical setting* (D. L. Koschkee, & L. Rammage (Eds.), 1997), *The voice and its disorders* (L. Mathieson (Ed.), 2001), *Emotions in the human* voice (K. Izdebski (Ed.), 2008), and *Psychosocial perspectives on the management of voice disorders. Implications for clients. Options and strategies for clinicians* (J. Baker (Ed.), 2017).

The psychological component became increasingly prominent. First, it appeared as references in chapters, then specialized chapters were created, and now there are books devoted exclusively to the relationship between psychology and voice disorders.

Colton and Casper (1996) defined voice as a powerful instrument that not only conveys the message but adds something to its meaning. Already in 2004, Cardinale and Durieux made a statement that illustrates the major goal of the various professionals working in the voice field: "Bien dans ma voix, bien dans ma vie".

As far as we know, our study was the first to explore the psychological features on the three types of functional voice disorders (FVDs).

The eighty-three female patients who participated in this study were concerned about their voices having gone to the ENT Department of Ear, Nose, Throat, Voice and Communication Disorders (HSM) to be evaluated, to have a diagnosis and to receive therapeutic guidelines. These patients were proposed to participate in this study by their ENT specialists or residents and/or speech therapists, having been informed that would be evaluated the relationship between psychological features and functional voice disorders.

Adherence to participation (90.2%) was remarkable with full collaboration during the entire assessment protocol.

These patients also showed an interest in their mental health and in the results of the psychological evaluation. They were also shown to be receptive to the guidelines

provided by the researcher accepting specialized help and referral for psychiatric and/or psychological outpatients consultations when justified. Patients that were already accompanied in mental health services were encouraged to continue their therapeutic process.

The relationship between voice disorders and psychiatric symptoms or illnesses has been proven having positively influenced the treatment outcome.

Our results responded to some gaps in the understanding of functional voice disorders having reinforced the importance of the psychologist from the diagnosis to the treatment of these patients.

# CHAPTER 7

## Limitations and Future Research

## Limitations and Future Research

With the aim of evaluating the association between psychological features and the three types of functional voice disorders, an exploratory and descriptive study was developed.

The study occurred in the ENT Department (HSM) and had a single-time cross-sectional design thus no inferences regarding causality could be drawn. Longitudinal studies should be developed to deepen the understanding of the role of psychological features in functional voice disorders allowing early diagnosis, therapeutic planning and prevention.

Our sample was composed by eighty-three female patients with functional voice disorders. Given the number of variables that were studied, a larger sample will reinforce the results of this study.

All patients were evaluated according to the same protocol and methodology.

Reference should be made to ENT's own progress and the technological advances in the study and evaluation of voice disorders that allow "an increasingly detailed examination of both the pathology and function" (Young, Shama, Petty, Hoffman, & Dailey, 2017). Videolaryngoscopy, the technique followed in this study in many cases can be complemented by the videostroboscopy but "a physician with poor understanding of muscle tension dysphonia and psychogenic dysphonia would have a difficulty making a diagnosis of functional dysphonia based on a videostroboscopy alone" (Woo, 2010). Young et al. (2017) added that "stroboscope's inherent limitations may, in some cases, produce an inaccurate or incomplete understanding of vocal fold pathology or function".

New imaging techniques such as high-speed videoendoscopy, functional magnetic resonance imaging (fMRI) and the electromyography (EMG) will contribute to a better understanding of this pathology.

One of the major difficulties that we face in this work was the existence of different nomenclatures for the same voice disorder. On the other hand, some authors used the same name with different meanings. The designations were proposed and used by professionals with different types of training, namely ENT specialists and speech therapists who did not always work as a team. In fact, as pointed by different authors and

affirmed by Elisei et al. 2013, “the diversity in the nomenclature of etiological diagnoses made it virtually impossible to compare the data”.

After being diagnosed with a functional voice disorders, the patients were classified and grouped according to the Diagnostic Classification System for Voice Disorders (DCSVD) (Baker et al., 2007): psychogenic (PVD), primary (MTVD1) and secondary (MTVD2) muscle tension voice disorders. This classification system makes the description of signs and symptoms and considers the existence of physiological, behavioral and psicossocial factors in the etiopathogenesis of functional voice disorders.

This classification proved to be effective and useful in the analysis of a vast set of variables. Our findings agreed and reinforced the Baker’s classification. Functional voice disorders have gained great visibility, which will be reflected in the diagnosis and therapeutic strategies. It is expected that other contributions will validate and/or reinforce the importance of this classification system.

The researcher was responsible for all non-medical clinical procedures. In our study, the presence of a single evaluator contributed to reduce the risk of interviewer bias since the way the information was solicited, recorded, evaluated or interpreted depended on the characteristics of the same person. However, the collaboration with more researchers would allow the interrater reliability measure and would create more opportunities for discussion.

A set of reliable instruments with widespread applications in the scientific community was used to evaluate the various dimensions.

To identify the individual characteristic and group patterns, methods included a semi-structured interview which made it possible to collect information needed to make a clinical history and to characterize these patients from a sociodemographic perspective. The characterization of subjects was useful to understand the lifestyle of FVDs patients, to describe the vocal symptoms and to assess on the current and past psychological problems. It also made it possible to obtain information about previous therapeutic responses as well as to evaluate the family history of voice and psychiatric diseases.

Standardized procedures as clinical and self-assessment tests have been used.

The introduction of clinical assessment tests in the evaluation of patients with FVDs was a novelty. For scientific rigor the psychiatric diagnoses were made according to the Diagnostic and Statistical Manual of Mental Disorders.

With the same purpose we also performed vocal acoustic evaluation. The levels of tension contributed to frequency changes comparing with normative values in parameters such as fundamental frequency (F0) and between groups in the means of the first formant (F1). This underscores the need for further studies in vocal acoustic analysis in patients with functional voice disorders, before and after treatments. We consider that it will be useful to add to this assessment other techniques and instruments as the evaluation in realistic environments (e.g., work place), and also the evaluation of the orofacial motrocity and posture.

The interest dedicated to voice became noticeable leading to the creation of sub specialties in the areas of ENT and speech therapy. The psychology will surely follow the specialization and differentiation in the field of voice and its disorders. In the study of voice will be important to strengthen relations with voice scientists and speech-language pathologist among others.

With regard to quality of life, our data revealed a moderate impairment and disability reported by these patients having evidenced the individual, interpersonal and professional impacts. The Voice Handicap Index, the instrument used to evaluate the self-perception of quality of life, is validated for the Portuguese population. However, in addition to its many advantages we recognize that it also has limitations. To avoid the overlapping between functional and emotional domains, this instrument or others should improve the accuracy so that the responses given by the patients can be clearer. Given the characteristics of the functional voice disorders, the measure of the impact of the physical, functional and emotional areas should be better defined.

The relationships between the severity of voice disorder and the self-evaluation of quality of life must be characterized in order to analyze whether there is a correlation between these two factors. In association, it will be also of interest to assess the evaluation made by significant others regarding the quality of life of patients with functional voice disorders using instruments as the Voice Handicap Index-Partner (VHI-P). Informants provide meaningful information as they usually have the opportunity to observe the

individual engaging in many different behaviors (Ganellen, 2007). They also play a decisive role in rehabilitation as well as in the psychosocial adjustment of the patient (Zraick et al., 2007).

Almost half of the sample met the criteria for mental health treatments and 24.1% were current accompanied by a psychiatric, a psychologist or both. The majority of the patients who benefit from psychological intervention accepted to receive psychological support given by the researcher. Woo (2010) pointed that "patients with psychogenic dysphonia usually are receptive to therapy once a careful explanation of the non organic basis for their dysphonia has been explained". In our opinion, this notion may be applied in general to patients with functional vocal pathology.

The psychotherapeutic process raised other relevant study hypotheses as the identification of stressful life events, alexithymia, attachment style, relationship patterns, and the assessment of perceived social support.

Having past recordings available, the possibility of using videolaryngological techniques and to performe vocal acoustic evaluation, the reassessment of these patients would be of clinical interest. It would be important to compare the anatomy and the physiology of the vocal folds and of the whole larynx (e.g., to determine the appearance of new lesions or the evolution of pre-existing lesions), their function (e.g., mobility, adduction movement and levels of tension), and also the vocal acoustic measures. This longitudinal study will contribute to determine the course and evolution of each presentation of functional voice disorders.

In the reassessment of these patients it would also be an asset to evaluate the therapeutic benefits of the different interventions (speech therapy and/or psychological and/or psychiatric treatments).

The design of a multidisciplinary assessment protocol with worldwide application for patients with functional voice disorders and covering the specificities of the three types of FVDs is required.

The continuous multidisciplinary work will improve the scientific level and create new research hypothesis through the interchange of ideas, doubts, reflections and projects with great benefits for the patients.

# CHAPTER 8

## Clinical Implications

## Clinical Implications

In the assessment and treatment of functional voice disorders co-morbidity with psychiatric illness, affective, anxiety, personality disorders, and the perceived handicap and disability of quality of life associated to vocal problem must be considered.

Functional voice disorders can manifest in different forms (symptoms and severity). In most cases, FVDs have been studied and treated by medical management, surgical intervention, and/or behavioral (voice) therapy provided by speech therapists.

The multidisciplinary assessment of functional voice disorders is the key to success in the diagnosis and treatment.

The clinical history should gather information on the co-morbidity with medical illnesses like allergies, laryngeal reflux, nasal and oropharynx pathologies and lung disease, and also in the previous therapy and its clinical responses. In addition to clinical data, attention should be given to the identification of vocal needs in interpersonal relationships, job performance (past and current) and hobbies. It also should focus on the vocal changes, when and how they started and how they evolved. In fact, the clinical history provides information needed to recognize, understand and manage the bio-psychosocial dimensions on which the vocal symptom is based.

Self-evaluation of the impact of voice disorder has a great utility as “vocal disorder constitutes a severe emotional handicap” (Woodson, 1996).

Our findings contributed to the characterization of affective, anxiety and personality disorders, and affective temperaments in patients with functional voice disorders. Similarities and differences between the three types of FVDs named as psychogenic voice disorders (PVD), primary (MTVD1) and secondary (MTVD2) muscle tension voice disorders should be considered in the management of these patients.

The relationships between psychological features and functional voice disorders were reinforced, increasing awareness for functional voice disorders.

In the psychotherapy, patients have the opportunity to feel heard even with an impaired voice. Their voices present acoustic changes that mirror many other difficulties, problems and disturbances. The psychologist will attend and respond to the patient’s

needs and suffering, considering the interface between biological, psychological and sociocultural variables within individuals and in the multiple social contexts that are part of his/her live (American Psychiatric Association, 2014).

The psychologist should have an active role in prevention and early diagnosis of functional voice disorders. It is up to the psychologist to be attentive to individuals at risk of developing vocal problems and also to reinforce knowledge, attitudes and behaviors that promote emotional and physical well-being (American Psychiatric Association, 2014).

As it is a disease that depends on the psychological and behavioral components it is important to sensitize patients and also other professionals as general practitioners, occupational health and social workers.

Through continuous work with patients with functional voice disorders, in the clinical and in research settings, it is expected that mental health specialists working on their own or as part of a multidisciplinary team will become increasingly aware of the relationship between psychological features and functional voice disorders.

Voice is the most important communication tool, thus voice disorders will affect the individual's relationships. Patients and family members may benefit from psycho-education programs to provide better support, understanding and coping.

Considering the patients' work, in particular cases, the collaboration with the employer will be advantageous to define the best strategies to ensure continuity and integration at work (e.g., temporarily readaptation of functions). A similar condition to what happens with teachers who present voice disorders in which the ENT specialist requests the reduction of teaching hours, making the teacher available for other school activities.

With regard to the management and treatment of functional voice disorders in literature the reference to "voice team" was frequent. However, we found that it often corresponded to the collaboration of different specialists instead of representing an interdisciplinary and multidisciplinary teamwork.

To better optimize the resources of the different specialties, the multidisciplinary assessment team should work together in close proximidity benefitting from the sharing of experience and knowledge in vocal care. The implementation of a vocal therapeutic decision consultation as a standard procedure will ensure the opportunity to add new information, to make reformulations and follow-up that are necessary for the monitoring

of cases. Together, the voice team elements should develop an assessment protocol for diagnosis and provide the proper therapeutic strategies.

The multidisciplinary voice team will ensure a consistent approach needed to improve both vocal and life qualities.

The interest in voice and in voice disorders “is not a luxury medical care” (Morente et al., 2001) neither a trend. It rather reflects the importance of voice as a primary means of communication. At the same time the voice serves as a presentation card with the particularity of reflecting physical and emotional states.

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