UNIVERSIDADE DE LISBOA

FACULDADE DE MEDICINA LISBOA

TRABALHO FINAL
MESTRADO INTEGRADO EM MEDICINA

Clínica Universitária de Oftalmologia

Pediatric Cataract: should the posterior capsulotomy and anterior vitrectomy be made through the limbal or pars plana via? A three study comparison.

Afonso Schönenberger de Oliveira Pimenta Braz

UNIVERSIDADE DE LISBOA

FACULDADE DE MEDICINA LISBOA

TRABALHO FINAL
MESTRADO INTEGRADO EM MEDICINA

Clínica Universitária de Oftalmologia

Pediatric Cataract: should the posterior capsulotomy and anterior vitrectomy be made through the limbal or pars plana via? A three study comparison.

Afonso Schönenberger de Oliveira Pimenta Braz

Orientado por:

Dra. Filipa Jorge Teixeira

MAIO'2019

Abstract: Introduction: In pediatric cataract surgery, primary posterior capsulotomy and anterior vitrectomy are common practice in the youngest children. Whether this should be done through the limbal or pars plana route, no strongly evidence-based conclusion has been taken. Methods: A summary of the current standards for pediatric cataract surgery was conducted. Additionally a literature review was performed using an electronic database search on PubMed (MEDLINE) and Cochrane Central Register of Controlled Trials (CENTRAL) from inception to March 2019, including all comparative studies of pars plana versus corneal approach for posterior capsulotomy and anterior vitrectomy. Results: Three comparative studies of both approaches were found. Both the limbal and pars plana achieved good results concerning visual acuity. However, the corneal limbus approach presented more intra and post-operative complications when compared to the pars plana route. In terms of technique, the limbal approach had the main advantage of a shorter learning curve, whereas through the pars plana more precise lensectomy, posterior capsulorrhexis and anterior vitrectomy can be achieved. Conclusion: Although no conclusion can be taken due to the high level of heterogeneity, it seems that the pars plana via offered better optimal technical execution, safer intraoperative handling and fewer postoperative complications.

Resumo: Introdução: Como conceito, Catarata define-se como uma opacidade da lente. Entre as idades pediátricas, particularmente nos mais jovens, essa opacidade provoca uma privação de estímulo que tem a capacidade de causar ambliopia irreversível. Aliada ao facto de que o olho pediátrico não corresponde morfologicamente ao olho adulto por ainda continuar seu crescimento e maturação, ainda existem vários desafios relativos às soluções cirúrgicas disponíveis e seus respectivos efeitos secundários. Tendo a grande maioria dos casos com catarata pediátrica nenhum tratamento médico possível, a opção cirúrgica é vista como a única maneira de restaurar o desenvolvimento biológico necessário para obter uma acuidade visual bilateral adequada. No entanto, ainda não estão claros todos os aspectos fundamentais da tomada de decisão na hora de escolher a abordagem cirúrgica correta. A lateralidade, a idade da criança, o tipo de catarata e a técnica cirúrgica devem ser consideradas em conjunto para alcançar o melhor resultado visual, nunca esquecendo as complicações pós-operatórias importantes e frequentes que podem comprometer o objetivo inicial. A cirurgia de catarata pediátrica está associada a várias complicações intra e pós-operatórias. Nos últimos anos, como resultado da melhoria da técnica cirúrgica e do management pós-operatório, a taxa de complicações diminuiu. Complicações associadas incluem: opacificação da cápsula posterior, glaucoma, complicações inflamatórias, hemorragia, edema corneano, má posição da lente intra-ocular (LIO), descolamento da retina, infecção, astigmatismo, myopic shift, ambliopia e estrabismo. A opacificação da cápsula posterior (PCO) é a complicação pós-operatória mais comum na idade pediátrica. Desenvolve-se devido à intensa resposta do olho jovem, criando uma resposta inflamatória que leva à formação de membranas fibrosas na superfície anterior do vítreo. Em crianças menores de 5 anos, praticamente ocorre em 100% dos pacientes sem capsulorrexia posterior e vitrectomia anterior. São por isso, hoje em dia, aplicadas globalmente como um procedimento padrão. Na cirurgia de catarata pediátrica, a capsulotomia posterior e a vitrectomia anterior são procedimentos standards nas idades mais jovens. No entanto, atualmente não existe evidência definitiva relativamente superioridade da técnica por via limbar ou pars plana. Métodos: Realizou-se um resumo teórico sobre o tema da cirurgia de catarata em idade pediátrica. Adicionalmente, foi realizada uma pesquisa da literatura utilizando pesquisa eletrónica na PubMed (MEDLINE) e Cochrane Central Register of Controlled Trials (CENTRAL) desde sempre até Março de 2019, incluindo todos os estudos comparativos da cirurgia de catarata pediátrica por via limbar vs pars plana. As palavras-chave para pesquisa incluíram "limbar", "transcorneal", "pars plana", "vitrectomia anterior", "capsulotomia posterior / capsulorrexia", "comparação de estudo", "catarata congénita", "catarata pediátrica", além de outras expressões relacionadas que foram utilizadas nesta pesquisa, com diferentes combinações, a fim de obter o máximo de artigos disponíveis. Os estudos

foram inicialmente selecionados pelo título e resumo e submetidos à avaliação de texto completo se elegíveis. Muitos artigos foram encontrados, todavia a maioria usou apenas uma técnica e tirou conclusões disso. Só foram possíveis reunir três estudos heterogéneos que abordaram a questão pretendida. Resultados: Foram encontrados 3 estudos comparativos: "Comparison between Limbal and Pars Plana Approaches Using Microincision Vitrectomy for Removal of Congenital Cataracts with Primary Intraocular Lens Implantation" - by Ahmadieh, H. et al; "Comparison of Transcorneal and Pars Plana Routes in Pediatric Cataract Surgery in Infants Using a 25-Gauge Vitrectomy System" - by Raina, U. et al; "Comparison between Limbal and Pars Plana Approaches Using Microincision Vitrectomy for Removal of Congenital Cataracts with Primary Intraocular Lens Implantation" - by Liu, X. et al. Tanto a via limbar quanto a pars plana alcançaram bons resultados quanto à acuidade visual. Em termos de acuidade visual, os dois estudos que usaram uma LIO primária, Ahmadieh, H. et al e Liu, X. et al chegaram à mesma conclusão, usando diferentes escalas de medida. Ambas as abordagens relatam boa melhoria da acuidade visual após a cirurgia e nenhuma delas, VCL e VPP, obteve superioridade mensurável da abordagem. Liu, X. et al não revelou diferença estatística directa entre a abordagem VCL e VPP. No estudo de Ahmadieh, H. et al, houve um sistema de classificação para os resultados VA pré e pós-operatórios, de acordo com os grupos, sendo que nenhuma diferença entre a abordagem limbal e pars plana foi encontrada. O estudo de Raina, U. et al não apresentou resultados em relação à acuidade visual pós-operatória. No entanto, é relatado que todos os pacientes em ambos os grupos tinham um eixo visual claro após 12 meses de acompanhamento. No entanto, a taxa de complicações cirúrgicas quando utilizada a via limbar corneano foi superior. Em termos de complicações intra-operatórias: Ahmadieh, H. et al relataram que a capsulotomia inadequada foi três vezes mais frequente com a abordagem limbal em comparação com a pars plana, embora não tenha encontrado uma diferença estatisticamente significativa. Houve também um caso de captura de íris no grupo VPP. Liu, X. et al revelaram uma diferença substancial entre a frequência de complicações intra-operatórias. Entre a aspiração da íris, o prolapso da íris, a lesão na íris e a existência de fragmentos do cristalino no vítreo, 42,5% dos pacientes do grupo VCL apresentaram pelo menos uma complicação em comparação aos 14,6% do grupo VPP. Por outro lado, em 2 dos 12 pacientes do grupo pars plana, relataram ruptura acidental da cápsula posterior antes da conclusão da aspiração da substância, enquanto nenhum foi relatado no grupo limbo. Raina, U. et al não relataram nenhuma complicação durante a operação cirúrgica. No entanto, no grupo VPP, 16,7% dos olhos sofreram acidentalmente ruptura. Em termos de complicações pós-operatórias: Em Liu, X. e cols., também mais pacientes do grupo VCL tiveram complicações pós-operatórias em comparação com a via pars plana (17,5% vs

7,3%). Os autores explicaram isso com a manipulação mais difícil do instrumento com o uso dessa via. A curta câmara anterior tornou a técnica desafiante, levando à falsa manipulação da íris durante a lensectomia e capsulotomia, ainda mais em olhos com pupilas menores. Ahmadieh, H. et al não relataram qualquer complicação como CME, glaucoma, rotura da retina ou luxação da LIO. No entanto, obtiveram um caso em cada grupo de formação de sinéquias posteriores. Raina, U. et al não tiveram complicações pós-operatórias em nenhum dos dois grupos. Em termos de técnica, a abordagem limbar tem a principal vantagem de uma curva de aprendizagem, mais curta, enquanto que através da pars plana é possível realizar uma lensectomia, capsulorréxis posterior e a vitrectomia anterior mais precisas. Conclusão: É sem dúvida verdade que, sem fortes evidências científicas, todas as decisões no mundo médico moderno não se sustentam apenas por si. Não obstante, o caminho para a evidência científica só pode ser feito passo a passo. O mesmo se aplica ao dilema da preferência entre as vias pars plana e limbar. Embora não seja possível chegar a uma conclusão definitiva, devido à grande heterogeneidade obtida nos estudos encontrados, com este trabalho é possível reconhecer alguma superioridade, apesar de limitada, da abordagem pars plana em relação à abordagem límbar de acordo com os resultados cirúrgicos e as avaliações cirúrgicas de especialistas, embora vários cirurgiões prefiram mais frequentemente a via anterior. As PCC e AV, fundamentais para o correto manuseamento de crianças mais novas, feitas através da via pars plana, parecem oferecer ótima execução técnica, manuseio intraoperatório mais seguro e menos complicações futuras. Para ser possível comprovar a conclusão deste trabalho, estudos prospetivos randomizados e metanálises posteriores devem ser realizados.

Key words: Pediatric Cataract Surgery, Posterior Capsulotomy, Anterior Vitrectomy, Limbal Approach, Pars Plana Approach.

Palavras Chave: Cirurgia de Catarata Pediátrica, Capsulotomia Posterior, Vitrectomia Anterior, Via Limbar, Via Pars Plana.

Index

Abbreviations

AC - Anterior Capsulorrhexis

ACCC - Anterior Continuous Curvilinear Capsulorrhexis

AL - Anterior Lensectomy

AVF - Anterior Vitreous Face

BCVA - Best-Corrected Visual Acuity

CC - Congenital Cataract

IA - Irrigation/Aspiration (technique)

IATS - The Infant Treatment Study

IOL - Intraocular Lens

LEC - Lens Epithelial Cell

Nd:YAG - Neodymium-Doped Yttrium Aluminium Garnet (laser)

PC - Posterior Capsule / Posterior Capsulotomy

PCO - Posterior Capsule Opacification

PFV - Persistent Fetal Vasculature

PMMA - Polymethyl-Methacrylate

PPC - Primary Posterior Capsulorrhexis

VAO - Visual Axis Opacification

VCL - Via Corneal Limbus

VPP - Via Pars Plana

I – Introduction

Cataract defines itself as an opacity within the lens. Among the pediatric ages, particularly in the younger ones, this stimulus deprivation has the capacity to cause irreversible amblyopia.[1] Allied to the fact that the pediatric eye does not correspond morphologically to the adult eye and that it still continues its growth and maturation, hard challenges still exist concerning the available surgical solutions and their respective secondary effects.

Classification and Etiology

Pediatric Cataracts can be classified as congenital, infantile or juvenile depending on the age at onset. Congenital cataracts are present at birth but may go unnoticed until an effect on the child's visual function is noticed or a white pupil reflex develops. Infantile cataracts develop in the first 2 years of life, and juvenile cataracts have an onset within the first decade of life.[2] Childhood cataract can also be classified according to the etiology in hereditary, metabolic, traumatic, iatrogenic, secondary (persistent fetal vasculature - PFV, uveitis, tumors, associated with chronic retinal detachment, steroid-induced, etc.) secondary to maternal infection during pregnancy, associated with ocular or systemic syndromes, an idiopathic [Table 1]. Furthermore, it often manifests with different patterns depending on its exact localization [Figure 1]. As with laterality, in bilateral cataracts an etiology can be found in around 50% of the cases, with the most common etiology in the USA and Europe being autosomal dominantly inherited cataracts. On the other side unilateral cataracts are most commonly due to PVF or trauma, and they are infrequently associated with systemic disorders.[2,3]

Epidemiology

Cataract, as the leading global cause of blindness, is widely known as a major ophthalmology concern, being included in the Vision 2020 Program, a global initiative that aims to eliminate avoidable blindness by the year 2020. However, congenital cataract has a low prevalence in almost every world region. By the European Union standards for rare diseases - prevalence of < 5/10.000, in many prospective and retrospective studies, congenital cataract can indeed belong to this particular group[4,5]. Some systematic reviews and meta-analyses were already made about the worldwide prevalence of congenital cataract and, for what one can analyze, it can be perceived as rare condition. Wu, X. *et al* reached a global prevalence of 4,24/10.000. They revealed Asia as the region with the highest prevalence - 7,43/10.000 - whereas Europe and Australia were on the other side of the coin - with 3,41/10.000 and 2,25/10.000, respectively. In what laterality concerns, bilateral congenital was present in 54,1% of the cases. Isolated congenital cataract, bilateral and unilateral cases without any existent comorbidity, was the most common clinical presentation in 62,3% of the cases. Regarding etiology, the idiopathic form was present in 62,2% of the times[6]. Sheeladevi, S. *et al* also obtained similar statistic values with a median prevalence of 1,03/10.000, reinforcing no difference in the laterality prevalence and adding that no difference in gender prevalence was achieved[7]. Both systematic reviews report sizable levels of heterogeneity and many regions didn't have collected data.

Visual Outcomes

There are some important influencing factors of visual outcomes, relevant to apply the right management in cases with better or worse prognosis factors. For starters, these include the age of onset of the cataracts - it is known that patients with 7 or more years of age tend to have excellent visual prognosis. The laterality is also quite significant because of its specific management indications. With prompt intervention, early-onset bilateral cases appear to have excellent visual prognosis, even in comparison with early-onset unilateral cases. The latter cases can however achieve good results with proper early surgery, optical correction and adequate patching therapy. This leads us to another determining factor: the correct age of intervention. Late interventions may not be result in an optimal solution because of the already wasted potential of vision acuity. The many possible associated ocular and systematic conditions have also been proven to worsen the visual prognosis, such as corneal opacities, glaucoma, retinal abnormalities, or nystagmus. Still, none of the possible surgical approaches will result in the wished visual outcome if the right optical and patching therapy, as previously reported, is not implemented[8].

Management

First of all, proper ophthalmological evaluation should be taken into place, including visual acuity. For this one, in older children optotypes are usually used in contrast with younger patients, where efforts to check the ability of each individual eye to fix and follow movement should be made. Pupillary reflexes, so that retinal and optic nerve pathology can be indirectly excluded through an absence of an afferent pupillary defect, and the anatomical components of the different eye as the cornea, iris or the morphology of the correspondent cataract are also checked. Slit-lamp examination is usual for this goal, whereas in younger patients hand-held slit-lamp might be needed. In terms of the posterior segment evaluation, indirect ophthalmoscopy is needed to rightfully access the retina as optic disc. When the cataract precludes this step, then B-scan ultrasound examination is mandatory. There is always a possibility for the existence of an extra-pathology that may alter the next correct procedure, as it would if some degree of retinal detachment is found. The complete initial evaluation will not be completed until some family members are also examined, whenever some genetic background is diagnosis relevant.

Laboratory work-up

Due to the plural etiology explicative of a pediatric cataract, a systemic investigation may be necessary when more symptoms and signs are present, especially in bilateral cases, since the majority of the unilateral ones manifest as isolated. This will allow the respective ophthalmologist to introduce possible non-surgical treatment options, sparing the child to unnecessary and worthless surgeries. At the newborn metabolic screening, some children with galactosemia may pass as false negative, being caught as children with failure to thrive, hepatomegaly or jaundice that afterwards should do some genetic testing. In this cases, early detection may prevent further cataract development and even reverse the process through adequate dietary measures[9]. In countries where rubella vaccination is not common practice, one should think in measuring its respective IgM titers. In boys that also manifest difficulties in weight gaining, hypotonia and feeding problems, screening for Lowe syndrome should be on the day-plan, starting with an urine amino acids assay. Genetic evaluation should always be put into place each time suggesting dysmorphic features are present.

Non-surgical treatment

Instead or before surgery, non-surgical treatment plays an important role. For instances, incomplete bilateral cataracts should only be removed after correct assessment of the young patient's visual behavior, including valorizing more density over size. It may be helpful the use of chronic dilatation of the pupils in these cases, especially if the cataract stands as central or if the child presents pupils in a miotic state. Chronic dilatation might need bifocals to balance the *de novo* created hyperopia. In cases of unilaterality or asymmetrically, part-time patching therapy of the normal/better eye may be beneficial to improve or maintain vision in the most affected eye.

Surgical Treatment

Having the great majority of Congenital Cataract no medical treatment[10], the surgical option is seen as the only way to restore the biological development necessary to achieve a proper bilateral visual acuity. However, it is still not clear all the fundamental aspects of decision making at the time of choosing the right surgical approach. Laterality, child's age, type of cataract and surgical technique all together must be considered to achieve the best visual outcome, never forgetting the important and frequent postoperative complications that can comprise the initial goal[11].

II – Pediatric Cataract Surgery -

State of the Art

Surgical Indications

Considering the high risk for amblyopia and lifetime-blindness, congenital cataract has indication to be operated when clinically important with the following characteristics: central axis opacity larger than 3mm, posterior opacity, opacities with no clear zones in between, when through direct ophthalmoscopy retinal details cannot be evaluated, concomitant with nystagmus or strabismus or when after 8 weeks of age central fixation is poorly achieved[12–14].

Surgical Timing

The exact timing to surgically intervene depends primarily whether a bilateral or unilateral case is in cause. Both present themselves with unequal latent and critical periods. During the latent period, vision deprivation does not reproduce irreversible vision loss in the deprived eye, whereas, whenever the critical period is reached, norm physiological vision capacity is almost impossible. Birch, E. *et al* achieved results that today still support clinical timing. For unilateral cataract cases, operation between 4 and 6 weeks of age seems to have the balance between best visual outcome and postoperative side-effects. For bilateral cases the surgical intervention should take place between 6 and 8 weeks of age, with the second eye being operated 1 week after[12,15,16].

Morphophysiological Considerations

Every clinician should take into account that the pediatric eye behaves itself as different morpho-physiological entity in comparison to a full grown and matured adult eye. The former presents itself normally with a more elastic capsule, lower rigidity of the sclera, higher mitotic level of the lens epithelial cells, and the myopic shift with ageing[14]. The still developing eye will be influenced by the cataract as well as by some possible surgical maneuvers and choices that will be discussed further. Concerning the pathophysiology of the cataract, the affected pediatric eye will, with a high probability, develop a myopic shift, especially if a nuclear cataract type is encountered[17]. This phenomenon consists of an increase of the dioptric power of the lens, leading to a mild to moderate degree of myopia. When it leads to important asymmetric lens-induced myopia, intolerable anisometropia may be in order. On the other hand, cataract surgery can itself be the cause for myopic shift, caused by axial elongation.

Biometry and IOL selection

Nowadays, when calculating the refractive power of the IOL to be used, the majority of the surgeons aim for hyperopia already thinking on the expected myopic shift[18] (Table 2[19]). Different formulas, that take into consideration input of axial length (AL) and keratometry (K) measurements, were already used to predict the most likely future refractive shift.

One of the most relevant studies in the latest years in Ophthalmology, the Infant Aphakia Treatment Study (IATS), concluded that the Holladay 1 and SRK/T formulae obtained the best results[20]. IATS was a multi-center, randomized, controlled clinical trial sponsored by the National Eye Institute that aimed to determine whether primary IOL implantation in infants younger than 7 months of age with a unilateral congenital cataract resulted in improved visual outcomes over contact lens correction of aphakia[21]. No difference in terms of visual acuity was achieved. However, there were significantly more adverse events and additional intraoperative procedures in the IOL group. Therefore, it was recommended leaving the eye aphakic and focusing the eye with a contact lens when operating on an infant with a unilateral cataract <7 months of age. The same study tried to show how different surgical factors could predispose to astigmatism. The factors encountered to be associated with a significant decrease in postoperative corneal astigmatism compared to IOL placement was aphakia (probably due to two unproven reasons: contact lens correction - by its probable lens shape ability - and smaller incisions). There was no statistical difference related with other surgical aspects like sutures placed, whether the wound was extended, or how the wound was closed[22].

Surgical aphakia has been dealt using spectacles, contact lens or IOL. The first two can make visual rehabilitation demanding, especially in developing countries. They give an additional burden for the parents, not only economically but also in what the emotional aspect of the child does respect. These represent also a challenge in younger children if one thinks about the compliance issues. When primarily implanted, IOL prevail in terms of providing an optic correction at all times, making caregivers less concerned. The use of the IOL is well established in children older than 2 years old[23]. For younger patients however, the implantation of an IOL is associated with higher rates of glaucoma, VAO, and a higher rate of consequent secondary procedures[24]. For these reasons, in unilateral as in bilateral cases, it is still not clear the exact indications for its use in these particular young group, particularly in those with microcornea and microphthalmos[23]. Many materials and types of IOL's have already been tried. Contemporary, the previously used PMMA IOL's were overthrown by the more recent hydrophobic acrylic lenses, with particular attention to the AcrySof type, due the better outcomes in postoperative complications[25]. Ursell, P. et al[26] obtained clear conclusions about the material choice (P<.0001): after two year of follow-up, AcrySof lenses were associated with less PCO (median 11.75%) than PMMA (43.65%) and silicone (33.50%) lenses. In terms of form the single-piece design is often indicated for in-the-bag implantation, whilst for sulcus implantation and optic capture the three piece is chosen[23].

Although there are no studies revealing the superiority of single-piece or three-piece IOL for in-the-bag implantation.

Anterior Capsulorrhexis and Lens Removal

In infants, cataract surgery should be performed using a closed eye system. A scleral tunnel, limbal, or clear corneal incision should be created superiorly to introduce the irrigation-aspiration hand-piece or a 20- or 23-gauge vitrector. A lateral incision should be created at the limbus for inserting an infusion cannula into the anterior chamber, in order to avoid pressure differences during the procedure.[2]

The first step after passing the cornea or the sclera (depending on the technique) is to execute an anterior capsulotomy/capsulorrhexis (AC). The thin, strong, and elastic anterior capsule of children requires a unique approach. There are two surgical techniques to perform the AC, the vitrectorhexis, preferred by some surgeons in younger patients, and the controlled anterior manual continuous curvilinear capsulorrhexis (ACCC). The notable elasticity of the pediatric capsule makes the ACCC a difficult technique to execute. The mean rate of inadvertent anterior lens capsular tears with ACCC or anterior vitrectorhexis is around 5.6% (vitrectorhexis 5.3%; ACCC 6.2%). In eyes operated for cataract at or before 72 months of age, the manual CCC technique was more likely to develop a tear (relative risk, 3.09) compared with eyes of older children (>72 months of age), where the vitrectorhexis technique was more likely to develop a tear (relative risk, 3.14), meaning that the mechanized vitrectorhexis was better for the youngest children, while manual ACCC worked better for the older ones[27].

The use of trypan blue has also became standardized since, Saini and colleagues[28] compared the clinical efficacy of trypan blue 0.1% in creating anterior ACCC during pediatric cataract surgery. In this prospective randomized study, the ACCC was performed with or without trypan blue. The authors reported 91.3% of the eyes had complete ACCC when dye was used compared to 73.5% when dye was not used.

Regarding the size of the capsulorrhexis it is of outmost importance that it should take in to account not only the eviction of capsular opacification and phimosis but also the maintenance of the IOL centration, or the need for following implantation of an IOL. It is recommended that it should be slightly smaller than the IOL optics, so around 4-5mm. Smaller capsulorrhexis diameter may lead severe capsular phimosis[12]. Leaving more capsule remnant at the conclusion of cataract surgery provides a more stable platform for a sulcus IOL implantation later, and it also increases the likelihood that secondary in-the-bag IOL placement can be accomplished.[2]

Following the capsulorrhexis, the hydrodissection can take place. It is a simple and inexpensive procedure that allows fast and easy removal of lens substance during pediatric cataract surgery. Multiple quadrant hydrodissection is an important component of the removal and washout of equatorial lens epithelial cells (LECs). Although it is contraindicated when there are concerns regarding the posterior capsule integrity, especially when a posterior lenticonus is suspected.[2]

Afterwards a lensectomy or lens aspiration takes place, and implies the full removal of the lens constitutes, leaving only the posterior capsular content and is therefore the chosen technique to insert IOL, with or without further manoeuvres[29]. On account of the soft pediatric lens nature, phacoemulsification is rarely used, favoring an anterior manual Irrigation/Aspiration (IA) technique or the use of a vitrector either through the limbal incision or the pars plana[12,13].

Posterior Capsulorrhexis and Anterior Vitrectomy

For what the most recent literature shows, leaving the posterior capsule intact in young children will lead almost always to PCO[30]. It results from the combination of the processes of proliferation, migration, and transdifferentiation of residual LECs on the lens capsule, after cataract surgery, and also due to the fact that the anterior vitreous face (AVF) is closely linked to the posterior lens capsule and is more “reactive” in infants and young children. The AVF can also serve as a scaffold, not only for LECs proliferation but also for metaplastic pigment epithelial cells, exudates, and cells that result from a break in the blood–aqueous barrier.[2,31]

Overall it is a well-accepted procedure and mandatory to prevent VAO and consequent amblyopia. Using currently available IOLs, visually significant PCO develops most commonly about 18 to 24 months after surgery if left intact. Therefore, the posterior capsule can be left unopened in older children if it is anticipated that the child will be cooperative for an Nd:YAG laser capsulotomy. Generally speaking, the posterior capsule can be left intact when children present for cataract surgery at age 8 years or older. A posterior capsulorrhexis (manual and vitrectorhexis) should be performed even for older children if Nd:YAG laser availability is in question, a posterior capsule anomaly (plaque, defect, etc.) is present, or the child is developmentally delayed or uncooperative for Nd:YAG laser capsulotomy.[10,30,13,32]

The timing during the surgery to execute the posterior capsulorrhexis has intrinsic relation with the surgical approach: before IOL implantation through a limbal course or after IOL implementation through VPP. Both approaches will be further discussed. Because of its ability to function as a scaffold for LECs, the anterior vitrectomy is also included in what is considered as a gold standard treatment for young congenital cataract because of its clear and beneficial clinical outcomes[33]. Normally the central part is removed, leaving the lateral and posterior parts of the vitreous. Nevertheless, vitrectomy should not be seen as a risk-free procedure. It implies great surgical skills and experience, as possible vitreous loss through the surgical wound, IOL dislocation into the vitreous cavity and it is also reported higher incidence of cystoid macular edema and retinal detachment[34].

Other techniques

There is a wide range of possible surgical techniques for the management of pediatric cataracts. Optic capture disclosed good surgical results by leading to a better centration of the IOL and because it allows an almost closure of the leaflets of the capsule[35]. Bag-in-lens made a better blocking of LEC migration, with both capsules fitting tightly around the peripheral groove surrounding the optic[36,37].

Complications

Pediatric cataract surgery is associated with several intra and post-operative complications. In the past years, as a result of improvement of the surgical technique and post-operative management the rate of complications has decreased. Associated complications include: posterior capsule opacification, glaucoma, inflammatory complications, bleeding, corneal edema, IOL malposition, retinal detachment, infection, astigmatism, myopic shift, amblyopia and strabismus[38].

Posterior capsule opacification (PCO) is the most common postoperative complication in the pediatric age. It develops due to the intense response by the young eye, creating an inflammatory response that leads to the formation of fibrous membranes on the vitreous anterior surface.[1,30] In children under 5 years, it virtually happens in 100% of the patients without posterior capsulorrhexis/AV. Therefore, nowadays it is globally applied as a standard procedure.

Glaucoma is also a quite common complication being reported in 15-45% of the cases. Younger age at the time of surgery is the most commonly reported risk factor. The IATS study revealed that a younger age (28 – 48 day vs 49 – 210 days) at surgery, lead to an increased risk of glaucoma (26% versus 9%, respectively at 4.8 years after surgery), and smaller corneal diameter (≤ 10 mm vs > 10 mm) showed increased risk for glaucoma as well. Age and corneal diameter were significantly positively correlated. Suggested etiological mechanisms include blockage of the angle from retained lens material, changes in the trabecular meshwork due to exposure to lens epithelial cells, chemical factors from the vitreous and an anterior segment dysgenesis, leading to both the cataract and maldevelopment of the angle[38].

After surgery, children tend do have a stronger inflammatory reaction than adults. Relevant postoperative inflammation can lead to some important complications that include secondary membranes that block vision and posterior synechiae, making a second surgery necessary in some cases. Intracameral preservative-free triamcinolone or dexamethasone decreases inflammation in children and is especially helpful for those undergoing IOL implantation. The former has routinely been administered subconjunctivally at the end of pediatric cases[38].

Retinal detachment is also reported as a serious complication that has a higher risk of occurrence in patients with higher myopia, traumatic cataracts, persistent fetal vasculature (PVF), and repeated surgeries. It is often seen as a late complication, occurring in many cases more than 10 years after the surgery. Some studies report a frequency between 3,2% and 7% during lifetime.[39,40] Therefore retinal examination is recommended early after pediatric cataract surgery.

The incidence of postoperative endophthalmitis in children is similar to that reported in adult surgery. The risk is low, with an incidence lower than 0,1%. On the other hand it carries an extremely relevant poor prognosis, with half of the patients having light perception vision or no light perception vision.[38]

Strabismus and nystagmus should also be mentioned, not only as common preexisting concomitant conditions, determining worse prognosis, but also as surgical consequences. Strabismus is more often associated after unilateral surgical management[41] and it is reported between 24% and 34% of the patiens[38,42]. Whereas nystagmus is believed to be more often associated with bilateral cataracts, and has been reported in 29-38% of the cases[43,44]. Esotropia is the most common form of strabismus associated with congenital cataract.

Bleeding, in its many forms (as simple subconjunctival hemorrhages, important intraocular hemorrhages or vitreous hemorrhages) may also result directly by surgical hand. Possible hyphema might be due to instrument manipulation, suturing or vessel syndromes like Swan. In patients with PFV, up to 10% of the affected may on the way of having a vitreous hemorrhage[38,42].

A tendency toward axial elongation and a myopic shift of refraction is well known. As explained before when implanting an IOL the selection of the IOL should take this fact into account.

Astigmatism in this age range plays a special role because of the amblyopia risk, derived from great scleral elasticity. However, children show a significant spontaneous reduction in astigmatism postoperatively, especially during the first 5 months of follow-up and less astigmatism seems to occur in children having surgery under 3 years[42]. Many aspects have been suggested to influence the degree of astigmatism and that was tried to be proven through the IATS, but the only factor that provoked higher astigmatism rate was the use of an IOL in comparison with aphakic patients[22].

Study Bullet-point

In terms of surgical technique, PPC and the AV can be done through two different approaches: via the corneal limbus (VCL) or via the pars plana (VPP). Whether the latter is better than the former, or vice-versa, it is still not well defined and many studies conclude that it should be used what suits best the corresponding surgeon[30,45]. To reach a better understanding of this matter, in this comparative study, the existing literature will be matched with a comparison of the only three available studies found that compare the outcomes of both techniques, creating a better basis for future prospective randomized trials concerning this subject, and consequently achieving stronger supported guidelines in the congenital cataract management.

III – Limbal vs Pars Plana

Current data regarding the two surgical approaches, limbal pars plana, and for the execution of the PPC and AV present satisfactory visual results and a low rate of major surgical complications (Figure 2).
Considering that both approaches are to be carried out after the lens removal and before the IOL insertion, every step until the PCC would be the same. As previously reported, the pars plana approach can be used after IOL implantation, aiming for a better IOL position[32]. Some authors advocate the pars plana use for aphakic cases, for smaller eyes or younger children[30]. Limbal posterior capsulorrhexis and anterior vitrectomy has also been used after IOL implantation, although it is hard to reach behind the IOL and may complicate positioning and stability of new IOL[46]. Both techniques need nevertheless one other entry port for irrigation purposes and in both cases a limbal port is used[30].
The Limbal approach seems to be very appealing. Not only because it was the first to be used, undoubtedly a major advantage in the spreading of practical usage, but also for its simpler technique and shorter learning curve, since the majority of the anterior segment surgeons already developed a habit. The Pars Plana approach is also widely used but has specific characteristics that one has to have in mind by the incision time. The pediatric eye is a growing eye. As a result of it the entry incision should be 2.0 mm posterior to the limbus in patients younger than 1 year, 2.5 mm posterior to the limbus in patients 1 to 4 years old, and in older children 3.0 mm posterior to the limbus[47], whereas the limbal entry is not influenced by the eye growth. It has been defended that using the pars plana approach, after IOL implantation, allows the surgeon to create a larger posterior capsulorrhexis in a more controlled way. The same authors also reported that it minimizes the rate of a vitreous wick[48].
Some experts already have a clear mind concerning their preferences[49], supported in their expertise and in the fact that is already possible to take some assumptions from what is reported in the current literature. With this thesis it is hoped to dissolve further this ophthalmological dilemma joining this works respective conclusions.
Both routes tend to have different rates of complications according to also different studies. Nevertheless, both seem to reach acceptable visual acuity results in a big number of papers. Recent previous studies using the limbal approach with primary IOL implantation reached a mean BCVA (logMAR) of 0.45 ± 0.38, with a rate of VAO around 19%, 3,51% of pupil decentration and no other case major complication[43]. Concerning the VPP, visual acuity evaluations were also appealing. Studies reported as much as 60% of the eyes getting a mean BCVA (logMAR) of 0,3 or better, rates of 9,2% in what VAO dues respect and no major complication such as glaucoma, IOL dislocation, subluxation or optic capture [48].
However, it seems arduous to reach a preference supported by plausible scientific-grounded reasons, for example with a systematic review, due to the lack of studies that aim to clarify this dilemma through proper comparison studies.

Three Studies Comparison

Method of Search

Using an electronic database search on PubMed (MEDLINE) and Cochrane Central Register of Controlled Trials (CENTRAL) from inception to March 2019, a literature review including all comparative studies of pars plana versus corneal approach for posterior capsulotomy and anterior vitrectomy. The keywords for research included "limbal", "transcorneal", "pars plana", "anterior vitrectomy", "posterior capsulotomy/ capsulorrhexis", "study comparison", "congenital cataract", "pediatric cataract", plus other related expressions, were used in this search, with different combinations in order to obtain the maximum of available articles. Studies were initially screened by the title and abstract and submitted to the full-text assessment if eligible. Many articles were reported using only one technique and making conclusions out of it. It was only possible to gather three heterogenous studies, in relation to one another, that addressed the pretended issue. In chronological order, they are:

- ✓ "Comparison between Limbal and Pars Plana Approaches Using Microincision Vitrectomy for Removal of Congenital Cataracts with Primary Intraocular Lens Implantation" - by **Ahmadieh, H. *et al*** [50];
- ✓ "Comparison of Transcorneal and Pars Plana Routes in Pediatric Cataract Surgery in Infants Using a 25-Gauge Vitrectomy System" - by **Raina, U. *et al*** [51];
- ✓ "Comparison between Limbal and Pars Plana Approaches Using Microincision Vitrectomy for Removal of Congenital Cataracts with Primary Intraocular Lens Implantation" - by **Liu, X. *et al*** [52].

Study Characterization

A summarized comparison between the three studies, regarding patient selection and study population is shown in table 3.

Ahmadieh, H. *and collegues*[50] conducted a randomized, controlled, double-masked clinical trial with 38 eyes, with equally numbered unilateral and bilateral cataract cases. In terms of age, the unilateral affected children included in this study had their youngest representative with 3 years, whereas the bilateral cases gathered started at 5 years of age. No child was older than 10 years old. For inclusions conditions concerning cataract surgery, the clinical cases accounted had to belong in at least one of the following predispositions: any lens opacity that caused VA ≤ 20/60, stereopsis disturbance and a deviation of the eyes. With regard to the exclusion points, it is mentioned the subsequent criteria: every case with traumatic cases with a history of surgery other than primary repair and cases with ocular hypotony were excluded, eyes with scleral laceration, vitreous prolapse into the anterior chamber, signs of endophthalmitis and intraocular foreign bodies, or cataract associated with ocular or systemic disease were excluded.

Raina, U. *et al* [51] conducted a prospective interventional study comparing the limbal and a 25-gauge transconjunctival sutureless vitrectomy approach for congenital cataracts. They included 24 eyes of 12 pediatric patients, 7 boys and 5 girls. Mean age was 7,5 months (3-12 months). Unfortunately, no further detailed inclusion and exclusion criteria were explained.

Liu, X. *et al* [52] published a retrospective study in 2016. They included 40 eyes from 26 patients in limbal group and 41 eyes from 30 patients, in the via pars plana group. Mean age was approximately 4 years (1,5-6 years). Inclusion criteria included all patients with congenital cataract who underwent cataract removal through a limbal or a pars plana incision using a 23-gauge vitrectomy system with primary IOL implantation. Clinical cases with traumatic, subluxated, or complicated cataracts and evidence of any ocular or systemic anomalies were excluded from the study.

Surgical Technique Applied

A summarized comparison between the three studies, regarding the surgical details is shown in Table 4. The detailed surgical steps for each article is present in Table 5 for **Ahmadieh, H. *et al*** [50], Table 6 for **Raina, U. *et al*** [51] and Table 7 for **Liu, X. *et al*** [52].
Ahmadieh, H. *et al* [50] performed the PPC and VA primarily and afterwards the IOL was implanted in the limbal approach and if the pars plana (23G) approach was used the IOL was implanted first and afterwards the PPC and AV.
The study by **Raina, U. *et al*** [51] operated, using a 25-gauge vitrectomy system for the posterior vitreorhexis and limited anterior vitrectomy, one eye of each patient by the anterior route and the other by the posterior route. All eyes were left aphakic.
Liu, X. *et al* [52] executed with both approaches the IOL implantation after the posterior capsulotomy and anterior vitrectomy (23G). An illustrative images of the surgical technique is demonstrated in Figure 3.

Gathered Outcomes

A summary of the surgical outcomes for each study is presented in Table 8.
The three studies presented different main outcomes. **Ahmadieh, H. *et al*** [50] measured visual acuity, estimated red reflex, postsurgical inflammatory reaction, corneal clarity, posterior synechiae, iris capture, IOL position, capsulorrhexis size, glaucoma, cystoid macular edema, retinal tear, and postoperative refraction.

Raina, U. *et al* [51] evaluated grading of conjunctival congestion, corneal edema, aqueous flare, and cells in the anterior chamber (all of them, after 1 week, with no clinical presence in neither of the patients), astigmatism and spherical equivalent. **Liu, X. *et al*** [52] measured visual acuity, postoperative refraction and complications including iris-trauma, lens-fragment in vitreous, tear of the posterior capsule, VAO, IOL pigmentation and others.

Visual acuity

In terms visual acuity, the two studies that used a primary IOL, **Ahmadieh, H. *et al*** [50] and **Liu, X. *et al*** [52] reached the same conclusion, using different measuring scales. Both approaches report good visual acuity improvement after surgery and neither of them obtained measurable superiority from the VCL and VPP approach. **Liu, X. *et al*** [52] disclosed no statically difference between the VCL and VPP approach (mean LogMAR BCVA was 0.32 vs 0.35 respectively, p=0.642). In the **Ahmadieh, H. *et al*** [50] study there was a classifying system for preoperative and postoperative VA results, according to groups: (1) light perception (LP)/hand movement (HM); (2) finger counting (CF); (3) 20/200 to 20/120; (4) 20/80 to 20/40; (5) 20/30 or better. Changes in visual acuity were evaluated with the difference determined by the degree of visual acuity improvement postoperatively, which was shown by a plus (+) sign. For example, a preoperative visual acuity of HM changing to postoperative acuity of CF was a +1 improvement and preoperative visual acuity of HM changing to postoperative acuity of 20/120 was a +2 improvement. Thus, the range of improvement was +1 to +4. As shown in Figure 4, most patients presented a +2 or +3 improvement in VA, with no statistically difference between the limbal and pars plana approach.

The study of **Raina, U. *et al*** [51] did not present the post-operative visual acuity. However it is reported that all patients in both groups had clear visual axis after 12 months of follow-up.

In the study of **Ahmadieh, H. *et al*** [50] the improvement of the red reflex was similar in both groups, without statistical difference. The other two studies did not analyze this variable.

Refractive error

In the study of **Raina, U. *et al*** [51], as an IOL was not inserted it was highly hyperopic. Whereas in the study of **Ahmadieh, H. *et al*** [50], VCL and VPP got similar mean spherical equivalents (-0,64 ±1.02 D vs -0,76±1.59 D, p>0,05). **Liu, X. *et al*** [52], using the mean refractive error, got the average of +0.71 D in the VCL group and -0.15 D in the VPP group.

Astigmatism

Regarding the astigmatism, in both studies of **Raina, U. *et al*** [51] (VCL:0.25 D vs VPP:0.17 D) and **Ahmadieh, H. *et al*** [50] (VCL:1,75 D vs VPP:1,75 D) there was no statistical difference.

Intra-op complications

Ahmadieh, H. *et al* [50] reported that inadequate capsulotomy was three times more frequent with the limbal approach compared to the pars plana, although it not met a statistically significant difference. There was also a case of iris capture in the VPP group.

Liu, X. *et al* [52] revealed a substantial difference between the frequency of intra-op complications. Between iris aspiration, iris prolapse, iris injury and the existence of lens fragments in vitreous, 42,5% of the patients in the VCL group had at least one complication in comparison with the 14,6% in the VPP group. On the other hand, in 2 of the 12 patients from the pars plana group, reported accidental rupture of the posterior capsule prior to completion of lens matter aspiration, whereas none was reported in the limbal group.

Raina, U. *et al* [51] did not report any complication during the surgical operation. However, in the VPP group, 16,7% of the eyes were accidentally ruptured.

Post-op inflammatory reaction

On the first day after surgery, **Raina, U. *et al*** [51] showed that in their study more corneal edema and anterior chamber reaction existed in the VCL group. However, this had no statistical significance and they resolved themselves by the first week. **Raina, U. *et al*** [51] results showed more conjunctival congestion on the first day after the cataract surgery. Notwithstanding there was no statistical significance and were self-resolved by the first week of follow-up.

Ahmadieh, H. *et al* [50] used fibrin formation to measure inflammatory reaction. Approximately the same number of eyes demonstrated these signs (VCL: 21% vs VPP: 26,3%) having no relevant statistical difference.

Liu, X. *et al* [52] just made reference to other scientific literature where an increased irritation of the iris was found resulting in elevated inflammatory reactions, whereas the pars plana route resulted in less postoperative inflammation.

Post-op complications

In **Liu, X. *et al*** [52]more patients of the VCL group also had postoperative complications in comparison with the pars plana route (17,5% vs 7,3%). The authors explained it with the harder instrument manipulation with this route use. The shallow anterior chamber made the technique challenging, leading to iris false manipulation during lensectomy and capsulotomy, even more in eyes with smaller pupils.

Ahmadieh, H. ***et al*** [50] did not report any complication such as CME, glaucoma, retinal tear or IOL dislocation. They did however get a case in each group of posterior synechiae formation.

Raina, U. ***et al*** [51] had no post-op complication in none of the two groups.

IV – Discussion

The three studies analyzed represent the only studies in the current literature that compared the limbal and the pars plana approach for pediatric cataract surgery. Although these studies present the same groups of comparison and the surgical steps are relatively similar, they are very heterogeneous in concerns of study methology, patient selection, exclusion criteria and study outcomes. This heterogeneity precludes a proper statistical comparison.

These three studies applied substantially contrasting steps in their clinical sequence. Firstly, the study design: **Liu, X. *et al***[52] is a retrospective study, **Ahmadieh, H. *et al*** [50] is a randomized, controlled, double-masked clinical trial and **Raina, U. *et al*** [51] is a prospective interventional study. The first has the disadvantage of being retrospective, weaker scientific evidence of the results. The second has the best scientific strength. On the other hand, it is by far the oldest study and since then plenty of scientific evidence has been produced. However, in terms of surgical technique, this did not seem to produce a disadvantage. The third, even though it presents itself as prospective, does not share the same primary outcome as the others: comparing both routes. It focuses more its attention on the results of the 25-gauge performance. **Raina, U. *et al*** [51] also did not mentioned the applied exclusion criteria.

Secondly, it goes without saying how crucial it is to gather same type populations to reach a better understanding about them. These selected studies used populations with a age gap as big as from children with less than 1 year of age, with **Raina, U. *et al*** [51], to the maximum of 10 years old with **Liu, X. *et al*** [52]. Since some of the included patients are classified as congenital, and others as pediatric, it exists undoubtedly some degree of dubiety concerning the rate of complications, visual acuity and technique to be applied.

Thirdly, distinct outcomes were aimed by the three studies. No proper statistical evaluation was able to be done since not all of the variables were measured by three studies, or even by the same scale. For instances, visual acuity was not objectified by **Raina, U. *et al*** [51], **Liu, X. *et al*** [52] used logMAR and **Ahmadieh, H. *et al*** [50], using Snellen, divided the patients by vision improvement. Other example is with refractive error. **Ahmadieh, H. *et al*** [50] and by **Raina, U. *et al*** [51], **Liu, X. *et al*** [52] reported their results the mean refractive error, but the former did not apply an IOL, whilst reported with the mean spherical equivalent. Astigmatism was not mentioned by **Liu, X. *et al*** [52]. And in what complications due respect, the three made mention and counted different ones. Also with the grading of the inflammatory response, **Raina, U. *et al*** [51] and **Ahmadieh, H. *et al*** [50] used variables that were not the same (flare, fibrin formation, etc.).

Additionally, regarding the surgical methodology **Raina, U. *et al*** [51] patients were left aphakic, whereas in the **Liu, X. *et al*** [52] IOL was implanted after PC and in the **Ahmadieh, H. *et al*** [50] in the VPP group IOL was implanted after PC and in the limbal group before the PC. Also, two different gauge sizes were also used, **Raina, U. *et al*** [51] used 25G, and the other two studies 23G.

Other relevant limitation is the short period of time that almost all of the patients were followed. **Ahmadieh, H. *et al*** [50] and **Raina, U. *et al*** [51] reported their last follow-up at 1 year after surgery. It is important to notice in the Infant Aphakia Treatment Study the rate of adverse effects and secondary procedures needed to be made after one year[24]. Even though the majority of postoperative effects takes place during the first year, current data tells us that significant part of them occur later (as VAO, glaucoma, strabismus or pupillary membrane)[42]. Because so, there is a wide gap of possible relevant data that makes difficult the correct assessment of postoperative complications with the use of both approaches. **Liu, X. *et al*** [52] did however have prolonged follow-up. For the VCL cases the last follow up reported was in average 31 months and for VPP 57 months.

Regarding the comparison of each approach and considering the studies own assessments, **Ahmadieh, H. *et al*** [50] concluded both the limbal and pars plana approaches achieved encouraging results and none of them surpassed the other, at least statistically. The overall outcome, divided for visual refraction, anatomic modification and intra and post complication ratio, was satisfying in either way for the authors. They also made reference for the need of a longer follow-up to evaluate important post-op complications such as glaucoma.

Raina, U. *et al* [51] considered that through the VPP allowed for a more controlled performance of the posterior capsulotomy, and it the optimal size was easier to achieve. Nevertheless, the authors mention that the VPP approach is a rather harder technique for the aspiration of cortical material on the side of the pars plana port. However, these authors also point out some advantages of the anterior route: greater maintenance of conjunctival and scleral integrity but also minimal risk of soft lens material dropping into the anterior chamber and further posterior segment complications. Even with all their clinical findings, they concluded that no route could surpass the other and therefore should be primarily based on the respective surgeon preference.

Liu, X. *et al* [52] reported that, through the pars plana route, more sufficient lensectomy and anterior vitrectomy was achieved; also allowed reduced surgical trauma, and better capacity to execute a precise capsulotomy. The VPP had a longer learning curve and that consequentially lead to induced trauma for the first optical corrections. Regarding the limbal approach these authors report that it led to more precise manipulations under direct vision and the anterior chamber maintenance was more stable. It also allows easier closure and water tightness of the incisions. The technique was said to be easier because of the simpler enlargement of the main limbal incision for primary IOL implantation too. In this study the authors made some precise recommendations. They recommend the use of the pars plana approach because of the more secure margin that it offers. The limbal approach should only be used in children older than 3 years, in consequence of their higher rate of complications before this age level.

Considering these studies results and what one can find in current literature, in my search it was much easier to find studies that have used the pars plana approach, especially in the most recent ones. A notable number of authors seem to prefer it over the limbal one to execute the posterior capsulotomy and anterior vitrectomy[48,53–55].

Concerning visual acuity, the outcomes in the VCL groups showed that what **Ahmadieh, H. *et al***[50] (having almost all patients better than 1 logMAR, contrasting to the values before the surgeries, with at least 31% of them between 0,6 and 0,3 logMAR) and **Liu, X. *et al*** [52] (mean logMAR of 0,32) achieved was almost as equal as what one can find in other studies, such as examples with a mean BCVA (logMAR) of 0,45 ± 0,38[43] or even with all the patients getting above 0,5 logMAR[45]. The same happened with the VPP groups. In the same two studies the results were quite similar with the ones through the limbal via. In literature about the VPP, one can find results of post-surgical mean BCVA logMAR such as 0,457 ± 0,110[54] or even with at least 60% of the patients with an visual improvement that got them e mean BCVA of 0,3 in the logMAR scale[48,53]. The same equality happened with our refractive error results.

Regarding the consequential complications, intra and postoperative, it is not possible to find consensual results of frequency in the literature.

Respecting VAO, only in **Liu, X. *et al*** [52] had one case with each via, leaving the other with no reported case. While such examples with no VAO case can also be found in studies with the VCL[45] and the VPP[53], considerable rates can be found in others, such as 19%[45] or higher[30] concerning the anterior route, and between 9,2%[48] and 20%[54]. This contrast in rates happens also with other intra and postoperative complications. Nevertheless, in absolute numbers between the three studies, the VCL achieved a notable greater number of intra-operative and post-operative complications (excluding PC mishandling), being this difference emphasized in. **Liu, X. *et al*** [52]. One should point out the apparent superior rate PC's tear with the pars plana via, even if **Ahmadieh, H. *et al***[50] reported more cases of inadequate PC size through the limbal via. This first point could be explained by the longer learning curve expected with this technique, if taking into account what these experts report from their surgical experience - more precise posterior capsulorrhexis and anterior vitrectomy is able to be done through the pars plana.

A list of each approach advantages was created in Table 9.

V - Conclusion

It is undoubtedly true that without strong scientific evidence, every single decision in this modern medical world does not stand only by its own. Notwithstanding, the path to scientific evidence can only be done step by step. The same is applied to the pars plana/limbal preference dilemma. Although no definitive conclusion is able to be drawn, with this work it is possible to recognize some limited superiority of the pars plana approach above the limbal approach according to the surgical results and expert's surgical assessments, although surgeons more often prefer the anterior route. PCC and AV, fundamental to the correct management of younger children, made through the pars plana route, seem to offer optimal technical execution, safer intraoperative handling and fewer future optical obstacles. To better prove this work's conclusion, prospective randomized trials and posterior meta-analyses should be undertaken.

VI – Bibliography

1. Lloyd IC, Ashworth J, Biswas S, Abadi R V. Advances in the management of congenital and infantile cataract. *Eye*. 2007;21(10):1301-1309.
2. Wilson ME, Trivedi RH, Pandey SK JW. Etiology and Morphology of Pediatric Cataracts. In: Wilson EM TR, ed. *Pediatric Cataract Surgery*. 2nd editio. Lippincott Williams & Wilkins; 2014:9.
3. American Academy of Ophthalmology. Pediatric Cataract - Europe. 2015.
4. Daien V, Le Pape A, Heve D, Villain M, Bremond Gignac D. Incidence and Characteristics of Congenital Cataract Surgery in France from 2010 to 2012: The EPISAFE Program. *Ophthalmic Res*. 2017;58(2):114-116.
5. Haargaard B, Wohlfahrt J, Fledelius HC, Rosenberg T, Melbye M. Incidence and cumulative risk of childhood cataract in a cohort of 2.6 million Danish children. *Investig Ophthalmol Vis Sci*. 2004.
6. Wu X, Long E, Lin H, Liu Y. Prevalence and epidemiological characteristics of congenital cataract: A systematic review and meta-analysis. *Sci Rep*. 2016;6(October 2015):1-10.
7. Sheeladevi S, Lawrenson JG, Fielder AR, Suttle CM. Global prevalence of childhood cataract: A systematic review. *Eye*. 2016;30(9):1160-1169.
8. Lambert SR, Lyons CJ. *Taylor & Hoyt's Pediatric Ophthalmology and Strabismus*.; 2017.
9. American Academy of Ophthalmology. Galactosemia. https://www.aao.org/bcscsnippetdetail.aspx?id=256624ba-52bc-4dd2-9d10-b97d5002d83d. Accessed April 3, 2019.
10. The Royal College of Ophthalmologists. Cataract Surgery Guidelines. 2010.
11. Lin AA, Buckley EG. Update on pediatric cataract surgery and intraocular lens implantation. *Curr Opin Ophthalmol*. 2010;21(1):55-59. doi:10.1097/ICU.0b013e32833383cb
12. Nischal KK, Medsinge A. Pediatric cataract: challenges and future directions. *Clin Ophthalmol*. 2015;9:77-90.
13. Pandey SK, Sharma V. CRSTEurope | Pediatric Cataract Management Guidelines.
14. Vasavada A, Nihalani B. Pediatric Cataract Surgery. *Curr Opin Ophthalmol*. 2006;17:54-61.
15. Birch E, Stager D. The Critical Period for Surgical Treatment of Dense Congenital Unilateral Cataract. *Invest Ophthalmol Vis Sci*. 1996;37(8):1532-1538.
16. Birch E, Cheng C, Stager Jr. D, Weakley Jr. D, Stager Sr. D. The Critical Period for Surgical Treatment of Dense Congenital Bilateral Cataracts. *J AAPOS*. 2009;13(1):67-71.
17. Iribarren R, Iribarren G. Prevalence of myopic shifts among patients seeking cataract surgery. *Medicina (B Aires)*. 2013;73(3):207-212.
18. Weakley DR, Lynn MJ, Dubois L, et al. Myopic Shift 5 Years after Intraocular Lens Implantation in the Infant Aphakia Treatment Study. *Ophthalmology*. 2017:1-6.
19. Triverdi RH, Wilson ME. Selecting Intraocular Lens Power in Children - American Academy of Ophthalmology. https://www.aao.org/eyenet/article/selecting-intraocular-lens-power-in-children. Published 2019. Accessed May 1, 2019.

20. Vanderveen DK, Trivedi RH, Nizam A, Lynn MJ, Lambert SR. Predictability of intraocular lens power calculation formulae in infantile eyes with unilateral congenital cataract: Results from the infant aphakia treatment study. *Am J Ophthalmol*. 2013;156(6):1252-1260.

21. Lambert SR, Buckley EG, Drews-Botsch C, et al. The Infant Aphakia Treatment Study. *Arch Ophthalmol*. 2010;128(1):21-27.

22. Wall PB, Msph JAL, Ms MJL, et al. The effects of surgical factors on postoperative astigmatism in patients enrolled in the Infant Aphakia Treatment Study (IATS). *J AAPOS*. 2014;18(5):441-445.

23. Vasavada AR, Vasavada V. Current Status of IOL implantation in pediatric eyes: an update. *Expert Rev Med Devices*. 2017;14(1):65-73.

24. Plager DA, Lynn MJ, Buckley EG, et al. Complications in the First 5 Years Following Cataract Surgery in Infants With and Without Intraocular Lens Implantation in the Infant Aphakia Treatment Study. *Am J Ophthalmol*. 2014;158:892-898.

25. Müllner-Eidenböck A, Amon M, Moser E, et al. Morphological and functional results of AcrySof intraocular lens implantation in children: Prospective randomized study of age-related surgical management. *J Cataract Refract Surg*. 2003;29(2):285-293.

26. Ursell PG, Spalton DJ, Pande M V., et al. Relationship between intraocular lens biomaterials and posterior capsule opacification. *J Cataract Refract Surg*. 1998.

27. Wilson ME Jr, Trivedi RH, Bartholomew LR et al. Comparison of anterior vitrectorhexis and continuous curvilinear capsulorhexis in pediatric cataract and intraocular lens implantation surgery: a 10-year analysis. *J AAPOS*. 2007;11:443–446.

28. Saini JS, Jain AK, Sukhija J et al. Anterior and posterior capsulorrhexis in pediatric cataract surgery with or without trypan blue dye. *J Cataract Refract Surg*. 2003;29:1733-1737.

29. Eckstein M, Vijayalakshmi P, Gilbert C, Foster A. Randomised clinical trial of lensectomy versus lens aspiration and primary capsulotomy for children with bilateral cataract in south India. *Br J Ophthalmol*. 1999;83(5):524-529.

30. Vasavada AR, Praveen MR, Tassignon MJ, et al. Posterior capsule management in congenital cataract surgery. *J Cataract Refract Surg*. 2011;37(1):173-193.

31. D'Antin JC, Barraquer RI, Tresserra F, Michael R. Prevention of posterior capsule opacification through intracapsular hydrogen peroxide or distilled water treatment in human donor tissue. *Sci Rep*. 2018;8(1):2-11.

32. Rastogi A, Mishra M, Goel Y. Comparative study of 25- versus 20-gauge pars plana capsulotomy and vitrectomy in pediatric cataract surgery. *Int Ophthalmol*. 2017.

33. Vasavada A, Desai J. Primary posterior capsulorhexis with and without anterior vitrectomy in congenital cataracts. *J Cataract Refract Surg*. 1997.

34. Jafarinasab MR, Rabbanikhah Z, Karimian F, Javadi MA. Lensectomy and PCIOL implantation with versus without posterior capsulotomy and anterior vitrectomy for pediatric cataracts. *J Ophthalmic Vis Res*. 2008;3(1):37-41.

35. Vasavada AR, Trivedi RH. Role of optic capture in congenital cataract and intraocular lens surgery in children. *J Cataract Refract Surg*. 2000;26(6):824-831.

36. Marie-Jose B.R. Tassignon, MD, PhD, Veva De Groot, MD, Gijs F.J.M. Vrensen P. Bag-in-the-lens implantation of intraocular lenses. *J Cataract Refract Surg*. 2002.
37. Groot V De, Leysen I, Neuhann T, Gobin L. One-year follow-up of bag-in-the-lens intraocular lens implantation in 60 eyes. *J Cataract Refract Surg*. 2006;32(October):1632-1637.
38. Whitman MC, Vanderveen DK. Complications of pediatric cataract surgery. *Semin Ophthalmol*. 2014;29(5-6):414-420.
39. Haargaard B, Andersen EW, Oudin A, et al. Risk of retinal detachment after pediatric cataract surgery. *Investig Ophthalmol Vis Sci*. 2014.
40. Rabiah PK, Du H, Hahn EA. Frequency and predictors of retinal detachment after pediatric cataract surgery without primary intraocular lens implantation. *J AAPOS*. 2005.
41. David R, Davelman J, Mechoulam H, Cohen E, Karshai I, Anteby I. Strabismus developing after unilateral and bilateral cataract surgery in children. *Eye*. 2016;30(9):1210-1214. http://dx.doi.org/10.1038/eye.2016.162.
42. Ma F, Wang Q, Wang L. Advances in the management of the surgical complications for congenital cataract. *Front Med*. 2012;6(4):360-365.
43. Ma F, Ren M, Wang L, Wang Q, Guo J. Visual outcomes of dense pediatric cataract surgery in eastern China. *PLoS One*. 2017;12(7):1-11.
44. Felius J, Busettini C, Lynn MJ, et al. Nystagmus and related fixation instabilities following extraction of unilateral infantile cataract in the Infant Aphakia Treatment Study (IATS). *Investig Ophthalmol Vis Sci*. 2014.
45. Vasavada AR, Trivedi RH, Singh R. Necessity of vitrectomy when optic capture is performed in children older than 5 years. *J Cataract Refract Surg*. 2001;3350(01).
46. Buckley EG, Klombers LA, Seaber JH, Scalise-Gordy A, Minzter R. Management of the posterior capsule during pediatric intraocular lens implantation. *Am J Ophthalmol*. 1993.
47. Aiello AL. Postnatal Development of the Ciliary Body and Pars Plana. *Arch Ophthalmol*. 2011;110(6):802.
48. Alexandrakis G, Peterseim MM, Wilson ME. Clinical outcomes of pars plana capsulotomy with anterior vitrectomy in pediatric cataract surgery. *J AAPOS*. 2002;6(3):163-167.
49. Triverdi R, Wilson Jr. E. Management of the Posterior Capsule in Pediatric Cataract Surgery - American Academy of Ophthalmology.
50. Ahmadieh H, Javadi MA, Mashyekhi A, Valaei N, Soheilian M. Primary capsulectomy , anterior vitrectomy , lensectomy , and posterior chamber lens implantation in children : Limbal versus pars plana. *J Cataract Refract Surg*. 1999;3350(99).
51. Raina UK, Bhambhwani V, Gupta A, Bhushan G, Seth A, Ghosh B. Comparison of Transcorneal and Pars Plana Routes in Pediatric Cataract Surgery in Infants Using a 25-Gauge Vitrectomy System. *J Pediatr Ophthalmol Strabismus*. 2016;53(2):105-112.
52. Liu X, Zheng T, Zhou X, et al. Comparison between Limbal and Pars Plana Approaches Using Microincision Vitrectomy for Removal of Congenital Cataracts with Primary Intraocular Lens Implantation. *J Ophthalmol*. 2016.
53. Huang Y, Xie L. Short-term outcomes of dry pars plana posterior capsulotomy and anterior vitrectomy in

paediatric cataract surgery using 25-gauge instruments. *Br J Ophthalmol*. 2010;94(8):1024-1027.

54. Li Q, Fu T, Li ZE, et al. Optical correction of aphakia following unilateral infantile cataract removal. *Acta Ophthalmol*. 2014;92(8):e657-e662.

55. Borisovsky G, Silberberg G, Wygnanski-Jaffe T, Spierer A. Results of congenital cataract surgery with and without intraocular lens implantation in infants and children. *Graefe's Arch Clin Exp Ophthalmol*. 2013;251(9):2205-2211.

VII – Annexes

Tables

Table 1 - Possible etiology behind pediatric cataract[8].

Pediatric Cataract - Etiology		
Idiopathic	**Radiation-induced**	**Drug-induced** Corticosteroids Chlorpromazine
Intrauterine infection Rubella Varicella Toxoplasmosis Herpes simplex	**Trauma** Accidental Laser photocoagulation Non-accidental	**Inherited** Autosomal dominant Autosomal recessive X linked
Uveitis or acquired infection Pars planitis Juvenile idiopathic arthritis Toxocara canis	**Ocular diseases** Microphthalmia Aniridia Retinitis pigmentosa Persistent fetal vasculature Retinopathy of prematurity Endophthalmitis	**Inherited with systemic abnormalities** Trisomy 13, 18, 21 Cri du chat syndrome Turner syndrome
Metabolic disorders Cerebrotendinous xanthomatosis Galactosemia Galactokinase deficiency Hypocalcemia Hypoglycemia Diabetes mellitus Mannosidosis Hyperferritinemia	**Skeletal disease** Smith–Lemli–Opitz syndrome Conradi syndrome Weill–Marchesani syndrome Stickler syndrome Syndactyly, polydactyly, or digital anomalies Bardet-Biedl syndrome Rubinstein-Taybi syndrome Cerebro-oculofacial skeletal syndrome	**Dermatological diseases** Crystalline cataract and umcombable hair Cockayne syndrome Rothmund-Rhomson syndrome Atopic dermatitis Incontinentia pigmenti Progeria Congenital icthyosis Ectodermal dysplasia Werner syndrome
Muscular disease Myotonic dystrophy	**Neurometabolic disease** Zellweger syndrome Meckel–Gruber syndrome Marinesco–Sjögren syndrome Infantile neuronal ceroid-lipofuscinosis	**Renal disease** Lowe syndrome Alport syndrome Hallermann-Streiff-François syndrome

Table 2 – Selecting Intraocular Lens Power in Children[19].

Age	Residual Refraction
< 1.9 months	+ 10 D
2.0–3.9 months	+ 9 D
4.0–5.9 months	+ 8 D
6.0–11.9 months	+ 7 D
1.0–1.9 years	+ 6 D
2.0–3.9 years	+ 5 D
4.0–4.9 years	+ 4 D
5.0–5.9 years	+ 3 D
6.0–6.9 years	+ 2 D
7.0–7.9 years	+ 1.5 D
8.0–9.9 years	+ 1 D
10.0–13.9 years	+ 0.5 D
> 14 years	Plano

Abbreviations: D - diopters.

Table 3 - Study characterization.

	Ahmadieh, H. et al	Raina, U.K. et al	Liu, X. et al
Type	Randomized, controlled, double-masked trial	Prospective interventional study	Retrospective study
Year of publication	1999	2016	2016
Locations	Labbafinejad Medical Center, Tehran, Iran.	Guru Nanek Eye Centre, New Delhi, India.	Eye and ENT Hospital of Fudan University, China.
Population	26 children - 38 eyes	12 children - 24 eyes	56 children - 81 eyes
VCL	19 eyes*	12 children - 12 eyes	26 children - 40 eyes
VPP	19 eyes*	12 children - 12 eyes	30 children - 41 eyes
Laterality included	Unilateral and Bilateral	Bilateral	Unilateral and Bilateral
Age Gap	3-10y unilateral cataracts 5-10y bilateral cataracts (MA = 6.3y.)	3 -12 months (MA = 7.5m.)	1.5 - 6 years (MA ≈ 4.08y.)
Gender Proportion (M:F)	12:19	7:5	30:26
Inclusion Criteria	Pediatric cataracts (VA ≤ 20/60, stereopsis disturbance, strabismus)	bilateral congenital cataracts with ≤ 1 y.	Congenital cataracts
Exclusion Criteria	Traumatic cataract, previous ocular surgery, ocular hypotony, vitreous prolapse into the anterior chamber, endophthalmitis, intraocular foreign bodies, or associated ocular/systemic disease.	Not mentioned.	Traumatic, subluxated, complicated cataracts and/or evidence of any ocular or systemic anomalies.

Abbreviations: CC - congenital cataract; IOL - intraocular lens; MA - median age; M:F- male/female; y.- year old; VA - visual acuity; VCL - via corneal limbus; VPP - via pars plana.
* Nr. of patients not specified.

Table 4 - Surgical details comparison.

Surgical details	Ahmadieh, H. et al	Raina, U.K. et al	Liu, X. et al
Gauge size	23	25	23
AC filling	Not specified.	Infusion cannula	Infusion cannula
Local and Size of the entry ports - VCL	One at 100º and then at 120º and 150º apart from the first - unknown	One infratemporal, 11º and 1º o'clock - unknown size	4º or 8º and 12º o'clock (VCL) - unknown size
Local and Size of the entry ports - VPP	One at 100º and then at 120º and 150º apart from the first - unknown	One supratemporal and one infratemporal - unknown size	4º or 8º, 10º and 12º o'clock (VPP) - unknown size
Lensectomy Material	Vitrector	Vitrector	Vitrector
Vitrectomy rate(R) and pressure(P)	Not specified.	R=600 to 1200cpm / P=450 to 600mmHg	R=600cpm (maximum) / P=400mmHg
AC and PC intruments	Needle and Vitrector	Vitrector	Vitrector
AC size	6.0mm	Not specified.	5.0 - 5.5mm
PC size	3.0 - 4.0mm	Not specified.	4.0 - 4.5mm
IOL implatation timing	VCL: After PC VPP: Before PC	Patients left aphakic	After PC
IOL type	One piece - Poly(methylmethacrylate)	Patients left aphakic	One piece - AcrySof
Location of IOL implatation	Capsular bag	Patients left aphakic	Capsular bag
Iridectomy	Yes	No	No
Closure of entries - VCL	10-0 nylon	If leaking one 10-0 nylon	Only the larger limbal incision: one/two 10-0 nylon
Closure of entries - VPP	7-0 vycril	If leaking sclerotomy 6-0 vicryl conjunctiva 8-0 vicryl	Not specified.

Abbreviations: IOL - intraocular lens; PC - posterior capsulotomy; VCL - via corneal limbus; VPP - via pars plana.

Table 5 – Surgical Steps in the by Ahmadieh, H. et al study.

Via Corneal Limbus	Via Pars Plana
A fornix-based peritomy was done and it was made a 100º mid limbal groove.	A fornix-based peritomy was done and it was made a 100º mid limbal groove.
Two stab incisions were created 120-150º apart.	Two stab incisions were created 120-150º apart.
An anterior capsulotomy was made with a needle and enlarged to 6.0 mm with the vitrectomy probe.	An anterior capsulotomy was made with a needle and enlarged to 6.0 mm with the vitrectomy probe.
Lens material was aspirated.	Lens material was aspirated.
Posterior capsulotomy was done with a gauge needle and then enlarged to 3.0 to 4.0 mm with the vitrectomy probe.	The limbal groove was performed, and after injection of a viscoelastic material, the IOL was implanted in the capsular bag.
An anterior vitrectomy was done through the posterior capsulotomy site. It was confirmed that no vitreous was present at the level of the pupillary area	The wound was temporarily closed with 3 separate 8-0 silk sutures.
A limbal groove was performed, and after injection of a viscoelastic material, the IOL was implanted in the capsular bag.	A sclerotomy was made 2.5 mm from the limbus in the superior quadrant.
Peripheral iridectomy and sutured wound closure.	The infusion cannula was placed in the anterior chamber and the vitrectomy probe in the anterior vitreous cavity.
	A 3.0 to 4.0 mm posterior capsulectomy was made and an anterior vitrectomy performed
	The sclerotomy site was closed. The temporary sutures were removed, a peripheral iridectomy was done, and the wound was closed with interrupted sutures.

Abbreviations: IOL - intraocular lens.

Table 6 - Surgical Steps in the Raina, U.K. et al study.

Via Corneal Limbus	Via Pars Plana
An infusion cannula was inserted through a limbal port inferotemporally to maintain the anterior chamber.	A superotemporal sclerotomy was placed 2 to 2.5 mm posterior to the limbus with a trocar without prior conjunctival dissection.
Two additional limbal side ports were then made at the 11- and 1-o'clock positions using the trocar included in the vitrectomy pack.	An angled incision was made in which the conjunctiva was laterally displaced with the aid of forceps and the eye was penetrated as tangentially as possible parallel to the limbus with the bevel up.
A stab incision in the anterior capsule of the lens was made with the same trocar.	A limbal side port was made inferotemporally with the trocar and an infusion cannula was inserted to maintain the anterior chamber.
The vitrectomy probe was inserted through the superotemporal limbal port.	After inserting the vitrectomy probe through the sclerotomy into the lens matter at the lens equator, the lens matter was aspirated.
An anterior capsulorrhexis followed by lens aspiration, posterior vitreorhexis, and limited anterior vitrectomy were performed. The cutter was alternated between the two limbal ports for complete soft lens matter removal.	A posterior vitreorhexis and limited anterior vitrectomy were then performed, followed by an anterior vitreorhexis.
The anterior chamber was checked for the presence of any vitreous strands with the help of an endoilluminator inserted through the side port.	As the vitrectomy probe was withdrawn, the sclerotomy site was compressed with a swab stick and checked for leakage indicated by the formation of a subconjunctival fluid bleb.
The infusion cannula was removed and the corneal wounds hydrated (sutured only if unstable).	The infusion cannula was removed and the corneal wound hydrated (sutured only if unstable).

Table 7 - Surgical Steps in the Liu, X. et al study.

Via Corneal Limbus	Via Pars Plana
Two limbal incisions at 4º or 8º and 12º o'clock. Insertion of the infusion through the 4 or 8 o'clock limbal incision to maintain the anterior chamber with balanced salt solution.	Two limbal incisions at 4º or 8º and 12º o'clock. Insertion of the infusion through the 4 or 8 o'clock limbal incision to maintain the anterior chamber with balanced salt solution.
The 23 gauge vitrectomy instrument was introduced through an incision at the 12 o'clock position.	A pars plana incision at 10 o'clock and a 23 gauge vitrectomy cutter with a microcannula was introduced. Sclerotomy site: 2.5mm posterior to the limbus in patients aged 1.5 to 3 years | 3.0mm in those aged 3 to 6 years
A central anterior capsulorrhexis of 5.0–5.5 mm diameter was created using the vitrector.	A central anterior capsulorrhexis of 5.0–5.5 mm diameter was created using the vitrector.
Lens material was removed.	Lens material was removed.
A posterior capsulorrhexis of 4.0–4.5mm diameter was created followed by a limited anterior vitrectomy.	A posterior capsulorrhexis of 4.0–4.5mm diameter was created followed by a limited anterior vitrectomy.
The 12 o'clock limbal incision was enlarged to 2.6 mm.	An 2.6mm limbal incision was made at the 12 o'clock position.
After the ophthalmic viscosurgical device, an IOL was implanted into the capsular bag.	After the ophthalmic viscosurgical device, an IOL was implanted into the capsular bag.
The limbal incision was sutured, and the corneal stroma at the limbal side port was hydrated with balanced salt solution after removal of the infusion cannula.	The limbal incision was sutured, and the corneal stroma at the limbal side port was hydrated with balanced salt solution after removal of the infusion cannula.

Abbreviations: intraocular lens.

Table 8 - Gathered outcomes of the three studies.

Outcomes	Ahmadieh, H. et al		Raina, U.K. et al		Liu, X. et al	
	VCL (n=19)	VPP (n=19)	VCL (n=12)	VPP (n=12)	VCL (n=40)	VPP (n=41)
Mean LogMAR BCVA	NR	NR	NR	NR	0.32 (0.00–1.30)	0.35 (0.00–1.30)
					p=0.642	
Mean refractive error (RE) / spherical equivalent (SE)	RE -0.64±1.02 D	RE -0.76±1.59 D	RE +15.50±2.28 D	RE +15.46±2.45 D	SE +0.71 D (-2.00 to +3.00)	SE -0.15 D (-2.00 to +2.75)
					p=0.001	
Mean astigmatism	1.75 D	1.75 D	0.25 D	0.17 D	NR	NR
			p=0.67			
Intra-OP complications^{o}	0%	5.3%	0%	0%	42.5%	19.5%
					p=0.032	
Inadequate PC handling	15.8%*	5.3%*	0%	16,7%**	5%**	14.6%**
					p=0.264	
Post-OP Inflammation	+	+	++	++	NR	NR
Post-OP Corneal Edema	0%	0%	33.33%	0,08%	NR	NR
			p=0.143			
Post-OP complications^{oo}	0.05%	0.05%	0%	0%	17.5%	7.3%
					p= 0.194	

(º) Intraoperative complications (excluding PC mishandling) of each study: Ahmadieh, H. et al - iris capture, iris mishandling and others not specified. Raina, U.K. et al - not specified. Liu, X. et al - iris aspiration, iris prolapse, iris injury, lens fragment in vitreous.
(*) Inadequate posterior capsulotomy size; (**)PC tear/rupture
(ǂ) Scale for nr. of eyes with inflammatory signs - until 1/3 of the eyes (+) / between 1/3 and 2/3 of the eyes (++) / more than 2/3 of the eyes (+++).
(ºº) Postoperative complications of each study: Ahmadieh, H. et al - CME, glaucoma, retinal tear, IOL dislocation, increased cup-to-disc ratio, posterior synechiae formation; Raina, U.K. et al - vitreous haemorrhage or choroidal, vitreous in the anterior chamber, retinal detachment and more not specified; Liu, X. et al - IOL pigmentation, VAO required surgery, Iris incarceration in incision required surgery to reposition the iris, IOL pupillary capture required surgery to reposition the IOL.
Abbreviations: CME - cystoid macular edema; IOL - intra-ocular lens; NR - not reported; OP - surgical operation; PC - posterior capsule; VA - visual acuity; VAO - visual axis opacification; VCL - via corneal limbus; VPP - via pars plana.

Table 9- Summary of the advantages of each surgical approach to pediatric cataract surgery (limbal vs. pars plana).

Limbal	Pars Plana
Ease and familiarity for anterior segment surgeon	More precise lensectomy, posterior capsulorrhexis and anterior vitrectomy
Shorter learning curve (more precise manipulation)	Reduced surgical trauma and intraoperative complications
Reduced number of incisions and easier closure	Reduced immediate postoperative inflammation
Greater maintenance of conjunctival and scleral integrity	Easier to perform in smaller eyes

Figures

Figure 1 - Known morphological forms of pediatric cataract.

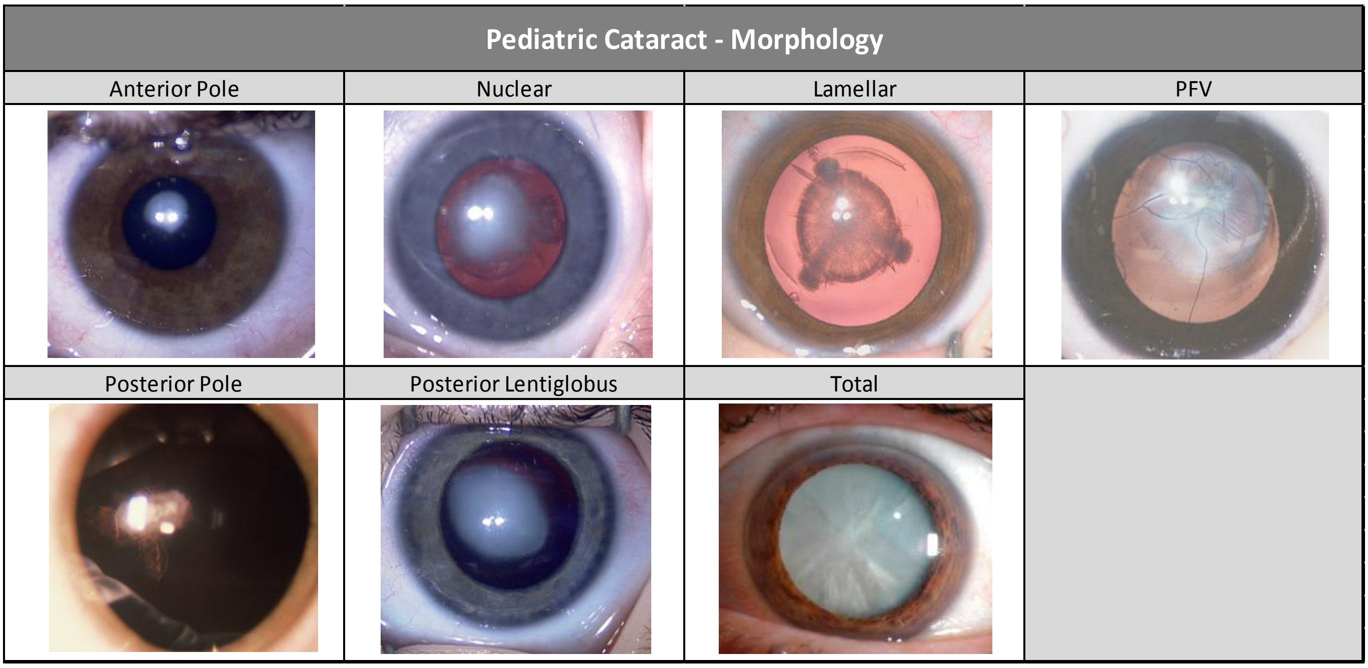


Figure 2 - The Limbal approach and Pars Plana approach respectively (in **Raina, U. *et al*** [51]).

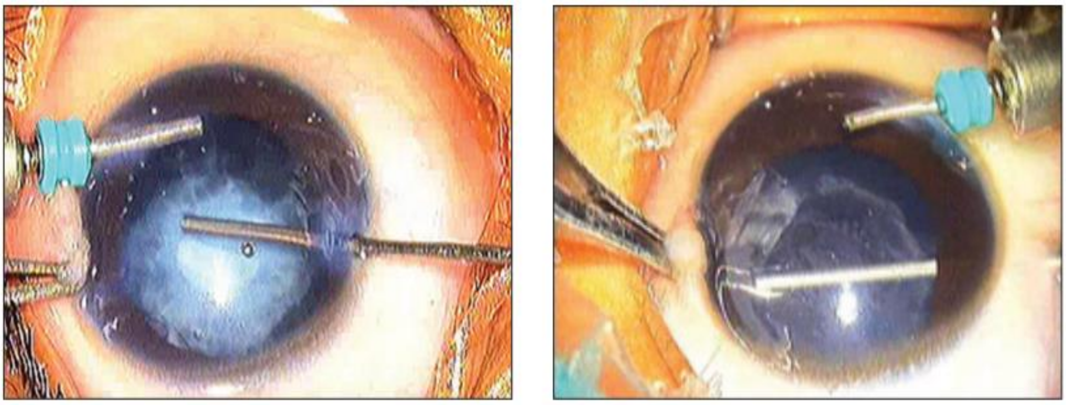


Figure 3 - Technique applied in the Pars Plana and Limbal approaches, by **Ahmadieh, H. *et al*** [50]

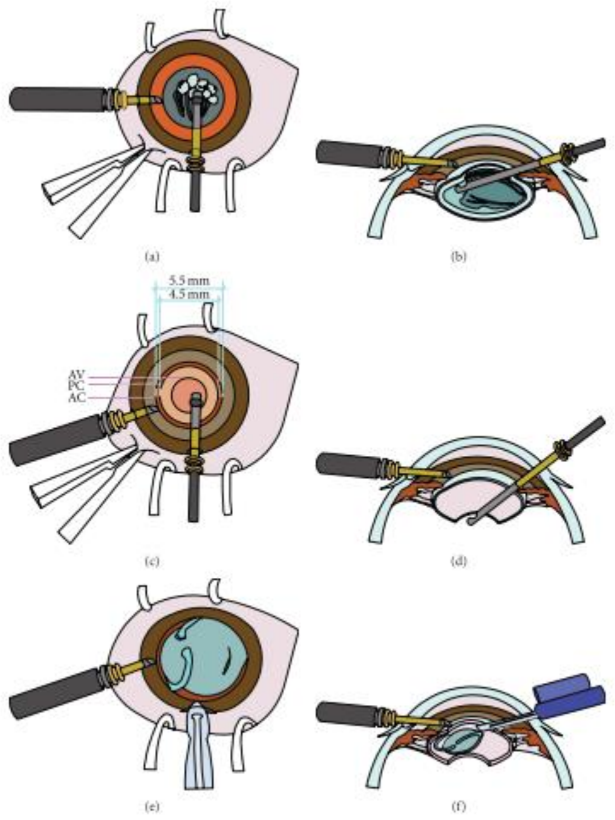
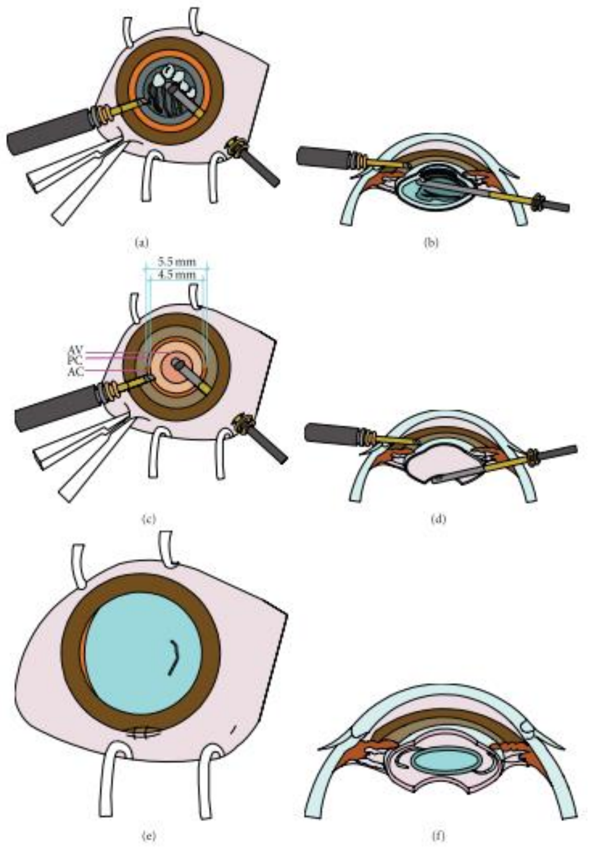
<table>
<tr><th>Limbal</th><th>Pars plana</th></tr>
<tr><td>
</td><td>
</td></tr>
</table>

Figure 4 - Visual acuity improvement in **Ahmadieh, H. *et al*** [50]**.**

Effect of technique on postoperative visual acuity, number (%).

	Improvement in Visual Acuity			
Technique	**+1**	**+2**	**+3**	**+4**
Limbal	1 (9.1)	3 (27.3)	6 (54.5)	1 (9.1)
Pars plana	0	6 (54.5)	4 (36.4)	1 (9.1)