

POSTERIOR CAPSULOTOMY AND ANTERIOR VITRECTOMY FOR THE MANAGEMENT OF PAEDIATRIC CATARACTS.

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INTRODUCTION

Performing a cataract surgery in a very young child, leaving an intact posterior lens capsule behind, invariably results in rapid (within 2 years post-op) Visual Axis Opacification (VAO) and its amblyogenic effects. Moreover, the Anterior Vitreous Face (AVF), in close link to the posterior capsule being more "reactive" in infants & young children, acts as a scaffold for the proliferation of epithelial cells of the lens and also for metaplastic pigment epithelial cells, exudates & cells derived from the breakdown of the blood-aqueous barrier. The severe inflammatory response in smaller age-group children may lead to a fibrous membrane formation over an intact AVF, resulting in VAO. Therefore, removal of the central part of posterior capsule & the anterior vitreous is considered a routine step of the cataract surgery of younger children of today.

POSTERIOR CAPSULOTOMY

Applied anatomy & physiology of the posterior lens capsule :

- ◆ The posterior lens capsule is 3-5 times thinner than the anterior lens capsule, being about 4-9 micrometre in thickness, the central part being the thinnest.
- ◆ The mechanical strength of the posterior lens capsule (ultimate strain, load, elastic stiffness, stress and elastic modulus) have been found to decrease markedly with age. (Extensibility: by a factor of 2 during the lifespan, and forces required to break the posterior capsule by a factor of 5.)

The Surgical Steps :

- ◆ Aspiration of lens matter with 2-port automated irrigation-aspiration system,
- ◆ Inflation of the capsular bag and filling of the anterior

chamber with high viscosity substance like Sodium Hyaluronate.

- ◆ Initiation of the PPC and flap : 26-G Cystitome needle descends onto the capsule at a slant, engages the central capsule, lifts it up towards the surgeon, and at the same time initiates the puncture. A small flap is created by pushing the margin of the puncture inferiorly.
- ◆ High viscosity Sodium Hyaluronate is slowly injected through the puncture between the capsule and the vitreous face. (Forceful injection through the tear can extend it towards the periphery).
- ◆ Additional viscoelastic is placed over the posterior capsule surrounding the puncture. This flattens the central posterior capsule and reduces potential peripheral extension.
- ◆ The flap is then held with capsulorhexis forceps and posterior capsulorhexis accomplished.
- ◆ In case of a pre-existing PC defect, an attempt should be made to convert it into a primary PCC with an Utrata forceps under high-viscosity Sodium Hyaluronate.
- ◆ Some surgeons use dye (trypan blue) for better visualization of the capsule.

Architecture of the PC opening :

Size, Centricity and Shape :-

- ◆ An optimum sized (1-1.5 mm smaller than the IOL optic), centric, circular PC opening should be ideally desired by all.
- ◆ Optimization of the size of the PC opening is of utmost importance. It has to eliminate or delay the formation of VAO, and yet leave sufficient capsular support to achieve PC IOL implantation, either primary or

secondary (“in-the-bag” or in the ciliary sulcus). Very small central openings tend to spontaneously close & chances of synechiae increase.

- ◆ The size of the PCCC is also extremely important when attempting to capture the optic of the IOL. (Too small makes it difficult to capture and too large makes it difficult for the optic to remain captured).

Methods of creating the PC opening :

Capsulorhexis/Capsulotomy?

- ◆ The manual technique of Primary posterior capsulorhexis makes it possible to achieve an opening with a strong margin that facilitates safe anterior vitrectomy, prevents uncontrolled widening of the PC opening, provides good support of IOL over the PC & even allows optic capture if desired.
- ◆ Some surgeons prefer the use of a vitrector to cut an opening in the PC, instead of a PCCC, when vitrectomy is planned along with a posterior capsulotomy. The use of Radiofrequency diathermy for this purpose has been reported in the literature.

Surgical vs YAG Laser capsulotomy :

- ◆ Routinely used by most surgeons for a primary procedure, the re-opacification rate remains much lower in cases of surgical capsulotomy as it is possible in these cases to ‘treat’ the anterior vitreous face also.
- ◆ Though Nd-YAG Laser capsulotomy can be performed both as secondary and also as primary procedures (with lasers mounted vertically on operating microscopes), numerous studies have shown this to have a very high rate of reopacification. Also, sometimes, a transient rise of IOP has been described by some. The cost and non-availability of the instrument in children’s hospitals or paediatric ophthalmology offices may be additional barriers to the use of YAG laser.
- ◆ Most surgeons of the day, prefer to perform a primary surgical capsulotomy that will hopefully preclude the need for a secondary laser capsulotomy.
- ◆ A secondary surgical capsulotomy may be needed in case secondary cataracts regrow.

Timing of capsulotomy :primary/secondary :

- ◆ With the advent of higher quality vitrectomy machines & sharp, high-speed cutting hand-pieces, primary vitrectomy has become a very safe procedure with low post-op rates of occurrences of Retinal Detachment & CME.
- ◆ It is recommended at present to ‘treat’ the PC as a primary procedure in young children.

Timing of capsulotomy: before/after IOL implantation:

- ◆ Though visibility is poor capsulotomy after IOL implantation can achieve an easier and more stable IOL fixation & a wider PC opening.
- ◆ In cases of capsulotomy being done prior to IOL implantation, extension may hamper achieving successful “in-the-bag” fixation. Also IOL implantation is difficult if the eye is soft or non-vitrectomised. However, there is better visibility.
- ◆ The common practice is to perform IOL implantation after limbal vitrectomy in children >4yrs of age and IOL implantation before pars plana vitrectomy otherwise. However, in the presence of a large PC plaque, it is preferable to implant an IOL before posterior capsulotomy in children of any age.
- ◆ It is to be remembered in this context that, the radiofrequency bipolar unit is not easily manipulated beneath an IOL & is therefore usually performed on the PC, from an anterior approach, prior to IOL insertion.

Leaving behind an intact PC :

- ◆ Generally speaking, the PC may be left intact when the age of the child at the time of surgery is ≥ 8 yrs when he/she can be reasonably expected to co-operate for a secondary YAG laser capsulotomy at a later date.
- ◆ However, a primary posterior capsulotomy is to be performed at later date if YAG laser availability is in question, a PC anomaly (plaque / defect) is present or when the child is developmentally delayed or unco-operative for YAG laser capsulotomy.

ANTERIOR VITRECTOMY**Some important anatomical considerations :**

- ◆ The unique surgical anatomy of the infant eye require modification of standard vitreous surgery techniques.
- ◆ A major anatomic constraint is the relative size of the pars plana which is incompletely developed in the newborn (attaining a width of >3mm at 62wks post conception), so that the anterior retina lies just behind the pars plicata. Thus entry incisions for vitreo retinal surgeries in children are made through or anterior to the region of the pars plicata to avoid iatrogenic retinal breaks.
- ◆ Some studies have further shown that pars plana was 2.2 and 2.5 for nasal and temporal aspects at <6 mnths of age, 2.7 and 3 at 6–12 mnths, 3.0 & 3.1 at 1–2 yrs & 3.2 and 3.8 at 2–6 yrs of age.
- ◆ Also, it has been reported that a linear relationship exists between pars plana width and axial length of eye. In new borne the AL is 12mm. In cataractous eyes the AL may be even shorter and therefore the pars plana may be assumed to be shorter too.

Surgical technique :

- ◆ Considering the anatomy, the entry incisions are made ≤ 2 mm (depending upon the AL of the eye) posterior to the limbus in patients <1yr of age, 2.5mm posterior in children 1–4yrs old and 3mm posterior in children who are 4yrs of age or older.
- ◆ The aim is to remove the central anterior vitreous without attempting to remove all of the peripheral or posterior vitreous. Thus, for this limited vitrectomy, 2 ports are used.
- ◆ Separation of the irrigation from the cutting & aspiration reduces hydration of the vitreous.
- ◆ With an ocutome system (ATIOP), the reported desirable machine settings are a cut rate of 350 cuts/min, an aspiration flow rate of 20mL/min & a vacuum of 100 mmHg. Modern vitrectors have higher cutting rates & most now recommend that the vitreous be cut at a rate of at least 500 cuts/min.
- ◆ At the end of the procedure, an iris spatula may be

swiped from each port to rule out the possibility of vitreous strands entering the incisions.

- ◆ Some have reported passing a pre-placed 8-0 Vicryl suture across the sclerotomy site to facilitate closure after vitreous removal.

Some preferential practices :**Aids / Techniques for better visualization :-**

- ◆ Kenalog injection into the A/C provides a means for localizing & identifying vitreous gel, allowing thorough removal of the prolapsed vitreous & alerting surgeons to residual vitreous strand that might go unnoticed. It also allows surgeons to observe vitreous behavior so that they can avoid maneuvers that increase vitreous traction or prolapse.

Role of no-suture Vitrectomy :-

- ◆ Sutureless pars plana vitrectomy through self-sealing sclerotomies have been reported in literature & both advantages & disadvantages of the technique have been cited by many research work.
- ◆ Some have concluded that UBM showed no difference in the amount of visible incarceration between conventionally sutured versus sutureless sclerotomies.
- ◆ However, several complications reported with the sutureless technique include, wound leakage, extension, dehiscence, haemorrhage, vitreous &/or retinal incarceration, retinal tear, retinal dialysis. Moreover difficulty in passage of instruments have also been observed when tunnels are used & it has been argued that this technique requires conjunctival dissection which often needs suturing.
- ◆ Some researchers evaluating the safety & efficacy of this technique in children with thick pseudophakic membranes (undergoing secondary capsulotomy & vitrectomy), commented upon it to be a safe & effective approach which can be considered in selective cases.

Judging the end-point of vitrectomy :-

- ◆ This question has not been answered with considerable precision.

- ◆ Most surgeons advise a “generous” anterior vitrectomy without placing the vitrector so deep that visualization needs a posterior vitrectomy viewing attachment to the operating microscope.
- ◆ In general any vitreous that tracks forward past the plane of the posterior capsulotomy needs to be removed and sufficient vitreous is to be removed centrally so that the vitreous face cannot be used as a scaffold by the lens epithelial cells to create a VAO.

Does one need to perform an anterior vitrectomy whenever a posterior capsulotomy is being performed ?

- ◆ In general, this is an essential step for children upto 5 yrs of age as vitreous face opacification is likely to occur if anterior vitrectomy is not performed.
- ◆ In children between 5-8yrs of age, it is an optional step since chances are better that a posterior capsulotomy alone will result in a long-term clear visual axis. Nonetheless, if in such cases if vitreous face opacification occurs, a secondary pars plana anterior vitrectomy is performed.

Limbal vs pars plana approach for posterior capsulotomy & vitrectomy :-

- ◆ In the limbal approach, it is difficult to achieve adequate size of a PC opening (as IOL has not been implanted yet) & it is also more difficult to implant the IOL (especially in soft, vitrectomised eyes). Also, retinal traction may be increased if a residual vitreous strand remains attached to the anterior wound.
- ◆ The pars plana approach is free from all these disadvantages, though most anterior segment surgeons are often not very comfortable with it.
- ◆ The preference for the approach also depends upon factors like age at surgery, condition of PC, whether IOL implantation is intended or not et.
- ◆ The current strategy is to follow the limbal approach in children >4yrs of age & in all in whom IOL implantation has not been targeted. In younger children, the pars plana approach is preferred as it is

particularly difficult to implant the IOL in a soft vitrectomised eye (unless, the ciliary sulcus is the intended location for the IOL).

CONCLUSION :

To summarize, it can be said that primary surgical posterior capsulotomy & anterior vitrectomy is not only a vital & integral step in today’s management of paediatric cataract, but also, fact cannot be overstressed that the treatment of the posterior capsule & the anterior vitreous face determines the ultimate outcome of paediatric cataract surgery.

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