Surgical Technique

Hybrid clear corneal micro-incision surgical technique for stage 5 retinopathy of prematurity

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A safe technique for entry incisions and closure in stage 5 retinopathy of prematurity (ROP) surgery is being described. Three 23G clear corneal incisions are made which allow for safe and snug entry of 25G calibrated infusion and 25G instruments for performing lensectomy, membrane removal and vitrectomy. At the end of surgery, air is injected and corneal entries are hydrated for sutureless closure. The technique was performed in 50 eyes of 36 children with stage 5 ROP. The hybrid technique ensured safe entry and exit with stable anterior chamber during surgery. None of the cases developed retinal breaks during surgical entry nor had any complications such as hypotony, flat anterior chamber, hyphaema or corneal edema in post operative period. Clear corneal entry using 23G incisions for 25G instrument access is a safe and effective technique for performing lensectomy and vitrectomy with sutureless closure in cases with stage 5 ROP.

Key words: Clear corneal surgical entry, hybrid surgery, stage 5 ROP, vitrectomy

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The classical surgical technique for Stage 5 ROP involves lensectomy, vitrectomy and membrane peeling (LVM) using a pars plana/plicata approach.[1] A major problem with the pars plana/plicata approach is the difficult instrument entry into the vitreous cavity as the retina is usually dragged up circumferentially and adherent anteriorly on all sides.

Surgery for advanced stage 4 ROP has now shifted to sutureless transconjunctival 25 gauge lens-sparing vitrectomy,[2] however, benefits of small gauge lensectomy and vitrectomy have been poorly described for stage 5 ROP.[3] We describe our modification using 25G entry via clear corneal approach for consistent and safe surgical entry in such cases. We reviewed 50 consecutive cases of stage 5 ROP that underwent hybrid clear corneal micro-incision lensectomy and vitrectomy at our center during a period of 15 months (January 2017 to March 2018). The records of these cases were analyzed for any possible intra-operative and early postoperative complications.

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A long flat clear corneal incision is made in the infero-temporal quadrant with a 23G Micro-vitreo-retinal (MVR) Blade [Fig. 1a and Video Clip 1]. A 25G machine connected infusion cannula is inserted and infusion is started (Constellation Vitrectomy System, Alcon, USA). The tubing is suitably fixed to the surgical drape to prevent undue movements. Two more clear corneal entries using the same 23G blade are made in the supero-temporal and supero-nasal quadrant for insertion of surgical instruments (25G light pipe and 25G vitreous cutter). Unlike incisions for cataract which are horizontal, these two incisions are vertically aligned such that posterior instrument maneuvers later do not lead to corneal folds limiting visibility.

Lensectomy is performed with the vitreous cutter using low cut rate (1000 cps), and high suction (400 mmHg) after creating an anterior capsular opening using the same 23G MVR blade. The 25G infusion cannula provides forced fluid infusion and maintains intraocular pressure (IOP) throughout the procedure, and further, the IOP may be temporarily raised instantly to stop bleeding if required. This is followed by the creation of a central posterior capsule nick by the MVR, raising the posterior capsule from the retrolental membrane, and removal till the periphery by the vitreous cutter.

Further, a linear or cruciate incision is made in the retrolental/anterior hyaloid membrane using the MVR blade to create an opening [Fig. 1b]. The opening is made after trans-illumination with endo-illuminator to localize a clear central area beneath with no apparent underlying retinal

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tissue/blood vessels to avoid retinal breaks/bleeding. Such clear areas are readily visible while operating upon open retinal funnel configurations or can be previously localized by ultrasonography. The opening is then enlarged using cross traction of the light pipe and cutter. Care is taken not to damage the retina posterior to the membrane. The rest of the steps for stage 5 ROP surgery are like usual techniques for funnel opening and posterior dissection [Fig. 1c and d]. An irrigating plano-concave contact lens (held by the assistant) is used for deep posterior dissection [Fig. 1e] and also helps improve visibility by neutralizing instrument induced corneal wrinkles, but it has a predisposition to engage and push out the irrigating cannula if care is not taken by the assistant. In cases of very small corneas, the placement of contact lens may become difficult, especially since the instruments are manipulated closely around it. The use of full irrigation flow in the contact lens helps to keep the contact lens a little above the cornea, allowing easier placement and manoeuvrability in such cases.

The instruments are removed with the infusion line at the end. The 23G corneal wounds are massaged and hydrated with a balanced salt solution, followed by air injection in the anterior chamber, ensuring sutureless closure [Fig. 1f]. Repeated instrument manipulation may sometimes alter the wound size and structure and it may not seal as easily after hydration; in such cases if wound leakage/hypotony is noted, more air is injected through any port to achieve anterior chamber stability and internal wound tamponade. 8/0 vicryl suture may also be placed which dissolves spontaneously later and does not require suture removal.

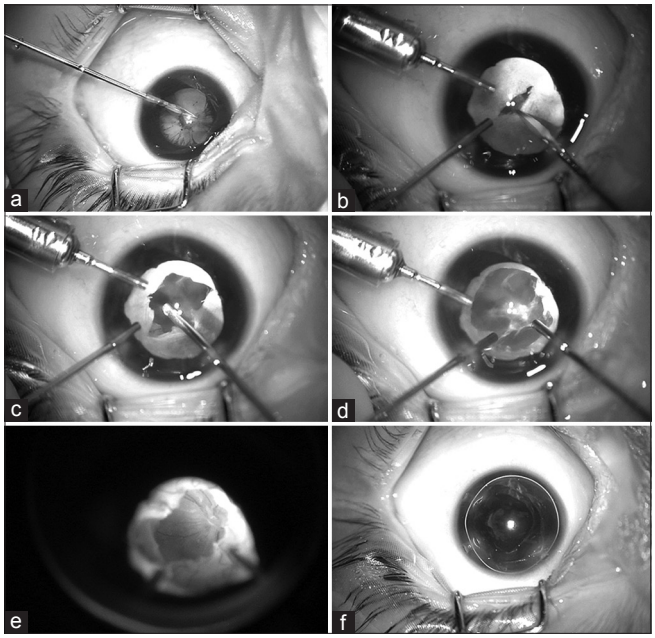

Figure 1: Intra-operative still images of the surgical management of stage 5 ROP. (a) A clear corneal peripheral 23G MVR entry is being made in the inferotemporal quadrant for the 25G infusion cannula. (b) Three clear corneal entry wounds are shown with snugly fit 25G instruments in the anterior chamber. Lensectomy has been performed. 23G MVR is being used to create an opening in the thick retrolental membrane. (c and d) The opening in the retrolental membrane is enlarged carefully with the vitrectomy cutter, which exposes the folded retinal tissue posteriorly for further dissection. (e) An irrigating plano-concave contact lens provides high magnification for deep posterior dissection and overcomes the corneal wrinkles. (f) The instruments have been removed and the corneal entry wounds have been hydrated. Air has been injected in to the anterior chamber to maintain its stability

We used this surgical technique for instrument entry successfully in 50 eyes of 36 babies with stage 5 ROP. The technique allowed safe sutureless surgical entry and exit with excellent IOP stabilization. None of our cases needed corneal wound suturing. None of the cases had surgical entry associated complications like retinal breaks/dialysis, significant corneal edema, Descemet membrane detachment, epithelial defect, wound leak at the end of surgery, post-operative wound leak and hypotony, flat anterior chamber, or hyphaema. However, the IOP was not measured on day 1 postoperatively and it is possible to miss mild hypotony.

Discussion

Stage 5 ROP poses a challenging surgical scenario. Previously the standard surgical technique for stage 5 ROP was described by Trese *et al*. that utilized a pars plicata approach with 20G MVR for creating sclerotomies.[1] With large-gauge vitrectomy, the surgical wounds are larger, the opening and closing times are prolonged, and the post-operative patient discomfort is greater when compared with the small-gauge vitrectomy.[4] Therefore the surgeons started favoring smaller 25-gauge transconjunctival sutureless vitrectomy for stage 5 ROP.[3] However, as the retina is pulled up from all sides, chances of damaging the retina are high with the pars-plicata approach, even with the smaller-gauge vitrectomy.

The anterior limbal based surgical approach may avoid the complications of pars-plicata sclerotomies, namely inadvertent retinal entry related injury and fibrovascular in-growth.[5] Unlike the sclerotomy incisions which disrupt the conjunctiva, the anterior approach may also preserve conjunctival integrity and safely allow a future glaucoma filtration surgery in these cases if needed. The use of limbal vitrectomy using trocar and cannula has been described in aphakic children by Kay *et al*.[6] and in adults,[7] however, none of the cases were stage 5 ROP babies that tend to have smaller corneal diameters, shallow anterior chambers, and highly elastic ocular coats. Kay *et al*. used 23G limbal trocar and cannula for surgery and advocated better fluidics and corneal rigidity with 23G systems.[6] However, we believe that the use of rigid 23G micro-cannulas at limbus may limit the instrument maneuverability, cause significant corneal distortions on deeper access and limit the use of contact lens due to limited space. It is known that the use of 25G instruments through the micro-canula as compared to direct entry through the sclerotomy wound has limited mobility due to a shorter fulcrum in the presence of trocar sleeve.[3]

The use of 25/27G instruments (smaller diameter) inserted through 23G cannula system (larger diameter) is a type of hybrid vitrectomy approach that allows efficient vitreous removal with the 23G cutter and finer dissection during membrane removal with 25/27G cutter.[8,9] This approach has been used for complex vitreo-retinal conditions such as diabetic tractional retinal detachments, retinopathy of prematurity and sutureless scleral fixation of intraocular lens.[9] Wu *et al*. had demonstrated the use of 23G instruments through 20G sclerotomy incisions without the presence of cannula system

for stage 4 ROP and found it to be efficient with benefits of both 20 and 23G vitrectomy systems.[10]

The use of hybrid limbal based vitrectomy for ROP is not previously reported in the literature. In our technique, all working ports are made in the clear cornea, thus, eliminating any chances of creating inadvertent retinal breaks. We prefer a 23G MVR blade (0.6 mm) that creates flat corneal openings which provide enough space for inserting 25G instruments and yet snug fit for adequate maintenance of the anterior chamber and proper infusion fixation. The corneal MVR allows a much sharper, flatter, self-sealing corneal entry compared to direct trocar cannula entries, which are a little difficult to insert in the cornea, as they are not designed for corneal entry and hence mostly need suturing as well. Corneal wrinkling may occur during instrument manipulation from corneal incisions (which may lead to poor surgical view); however, this is minimized significantly by proper incision orientation as well as use of contact lens which helps to provide an excellent view.

Conclusion

To conclude, in our experience, this technique provides an optimal way for safe surgical entry and exit for operating cases of stage 5 ROP and will enable new as well as experienced surgeons to safely initiate surgery in these complex cases.

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Conflicts of interest

There are no conflicts of interest.

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