Case series of deep anterior lamellar keratoplasty combined with phacoemulsification and intra-ocular lens implantation – a modified triple procedure

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Abstract

Background: *Patients presenting with corneal pathology and cataract present a surgical challenge to the operating surgeon. Some Ophthalmologists prefer to perform combined keratoplasty and cataract surgery simultaneously, while some prefer to perform sequentially.*

Purpose: *To describe performing deep anterior lamellar keratoplasty and phacoemulsification surgery on two patients with corneal opacity and cataract.*

Setting: *National Eye Hospital, Colombo*

Methodology: *We report two patients who underwent Deep Anterior Lamellar Keratoplasty (DALK) and cataract surgery.*

The first patient was a 66-year male patient. He had hand movement vision in both eyes. The right eye had diffuse corneal haze (corneal depositions) and a white mature cataract. The left eye also had corneal haze and a mature cataract. The fundi could not be visualized but the B scan showed an attached retina. The intra-ocular pressure of both eyes were normal.

The second patient was a 54-year female with right eye 6/60 due to diffuse corneal opacity (old interstitial keratitis) and mature cataract in the right eye. The left eye had a clear cornea and had IOL and the Best corrected visual acuity was 6/6. The fundus of the right eye was poorly visualized, but the B scan showed attached retina and the Intra-ocular pressure was normal.

Surgery was performed in the sequence of lamellar keratoplasty followed by phacoemulsification and Intraocular lens implantation and finally completion of corneal deep anterior lamellar keratoplasty with manual dissection. Both patients achieved good visual outcomes over 6 months post-operatively.

Conclusion: *Corneal pathology with cataracts can be operated on as a simultaneous surgery. However, pre-operative planning for surgical surprises and the suitable sequalae of surgical steps, with proper IOL power calculation leads to good visual outcomes.*

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Background

Patients with corneal scars or corneal ectatic disease presenting with visually significant cataracts pose a challenge to the Ophthalmologist. There are several surgical methods that have been described, such as the triple procedure (with penetrating keratoplasty, open sky extracapsular cataract extraction and intra-ocular lens implantation) and sequential surgery (penetrating keratoplasty followed by phaco-emulsification cataract surgery or endo-illumination assisted cataract surgery followed by penetrating keratoplasty)[1]. Since the advancement in the field of Deep anterior lamellar keratoplasty, many surgeons have also described triple procedures combining DALK and cataract surgery using different surgical techniques and steps for partial thickness corneal opacities or keratoconus in the presence of cataract.

Combining both cataract surgery and corneal surgery in one setting has advantages and disadvantages[1]. The biggest advantage lies in the fact that the patient will gain visual rehabilitation in a single setting. This will theoretically halve the risk of general anaesthesia, reduce theatre time and reduce the overall cost of management per patient. The disadvantage would lie mainly in the IOL power calculation without prior knowledge of the patients actual keratometry achieved post-operatively and the surgical difficulties that are associated with open sky cataract extraction.

In the following presentation, we discuss two patients who had visually significant anterior corneal scars and white mature cataracts who underwent triple procedures for visual rehabilitation in one setting.

History

Case 1

A 66-year male patient without history of trauma and no significant past medical history. On examination, he had hand movement vision in the right eye due to

diffuse corneal haze (corneal depositions) and a white mature cataract (Figure 1). The fundus could not be visualized but the retina was attached on the B scan. Intra-ocular pressure was 16 mmHg.

The left eye also had a corneal opacity with a mature cataract. The vision was hand movement on that eye as well. The B scan showed an attached retina while the Intra-ocular pressure was 14 mmHg.

The High Definition Corneal OCT showed the opacity was involving the anterior corneal stroma (around 70% depth) with sparing of the endothelium. The Specular microscopy showed a healthy endothelial count and number.

Case 2

The second patient was a 54-year female with right eye 6/60 Best corrected visual acuity. She had an old interstitial keratitis involving the cornea including the visual axis, extending to limbus peripherally. The scar had a few ghost vessels but no significant neovascularization (Figure 2). The anterior chamber details were hazy, but a mature cataract was faintly visible. B scan showed an attached retina. The right eye had an intra ocular pressure of 14 mmHg

The left eye had a best corrected visual acuity of 6/6 with normal anterior segment and posterior segment findings on examination. The IOP was 15 mmHg.

The HD corneal OCT taken at the cross section where the scar was deepest showed the homogenous scar extending across the full thickness of the cornea. The Specular microscopy showed a good number of healthy endothelial cells.

The surgeries were performed by the same Ophthalmologist, under general anaesthesia, at the National Eye Hospital, Colombo.

Surgical technique

Preoperative assessment

Because of diffuse corneal opacities, the exact details of the cataract were not clear, and preparations were made to meet unexpected intraoperative surprises such as poor pupil dilatation and subluxation.

Biometry

The patients' average preoperative keratometry readings, and the central keratometry readings of the operating eye were obtained from Placido-disc based topography. Axial length was obtained through emersion method. A suitable IOL power was then decided on by the operating surgeon.

Surgery

Surgery was performed under general anaesthesia.

The first step was to mark the corneal surface with a corneal marker (Figure 3A). Then, a partial trephination of the cornea of around 2/3rds the depth was performed with a vacuum trephine. An 8mm trephine was used for both patients.

Following the trephination, anterior lamellar keratoplasty of around 250 to 300 μm was carried out using a crescent knife (Figure 3B). Blurring due to the irregular dissected corneal surface was overcome by filling the corneal well with viscoelastic (Figure 3C).

The third step was to perform the cataract surgery. Once visualization was achieved, it was noted that both patients had well dilated pupils and no other significant difficulties for a routine phacoemulsification (Figure 3D). Since the cornea was marked where sutures for the PKP would be placed, the main incision was placed in-between two possible suture placements (Figure 3E).

Initial partial trephination had left adequate corneal thickness in the residual tissue to allow biomechanical strength to withstand the high intraocular pressure of phacoemulsification. The residual stroma contains the very strong Dua's layer which provides additional strength[2]. Routine, uncomplicated cataract surgeries and IOL implantations were performed (Figure 3E). At the end of phacoemulsification, the main ports were sutured with 10 o Nylon and the anterior chamber was sealed.

The last step was to complete the DALK. In these patients, manual dissection of the posterior lamellar was carried out (Figure 3F). And grafts sized 8.25 mm in diameter were used (Figure 3G).

Postoperative management

1% prednisolone acetate 6 hourly, an moxifloxacin six hourly and an ketorolac 8 hourly started. Prednisolone acetate was converted to fluorometholone at the end of 6 weeks and continued for one year till all sutures were removed.

Results

Both patients had 6/18 best corrected visual acuity at six months.

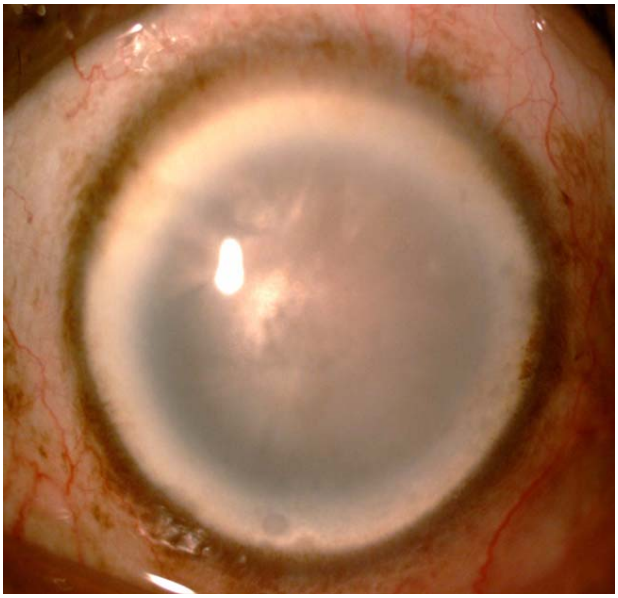


Figure 1.

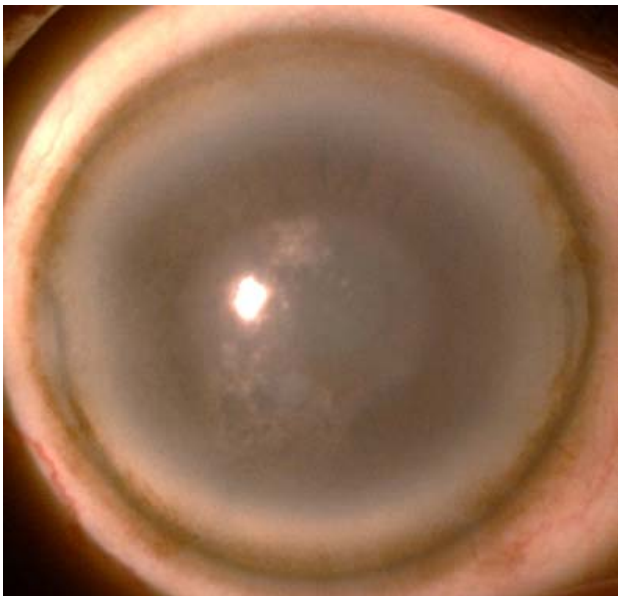


Figure 2.

Figure 3A.

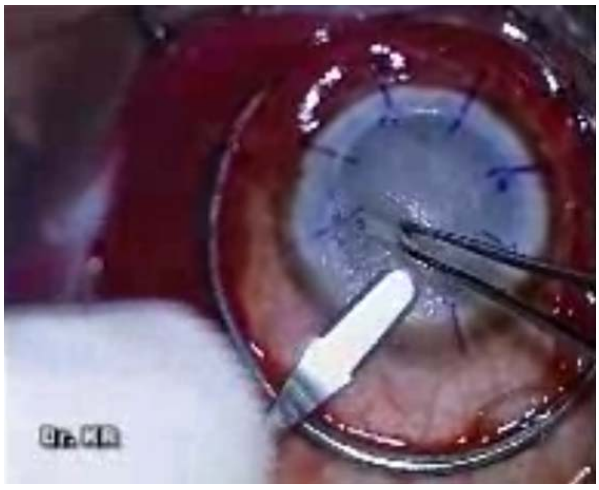


Figure 3B.

Figure 3C.

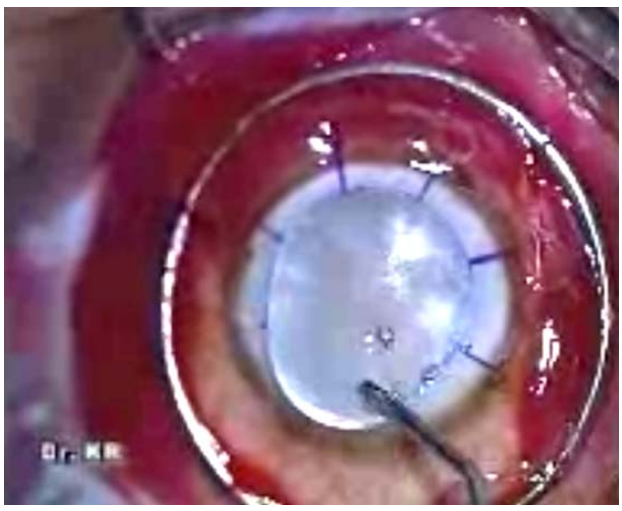


Figure 3D.

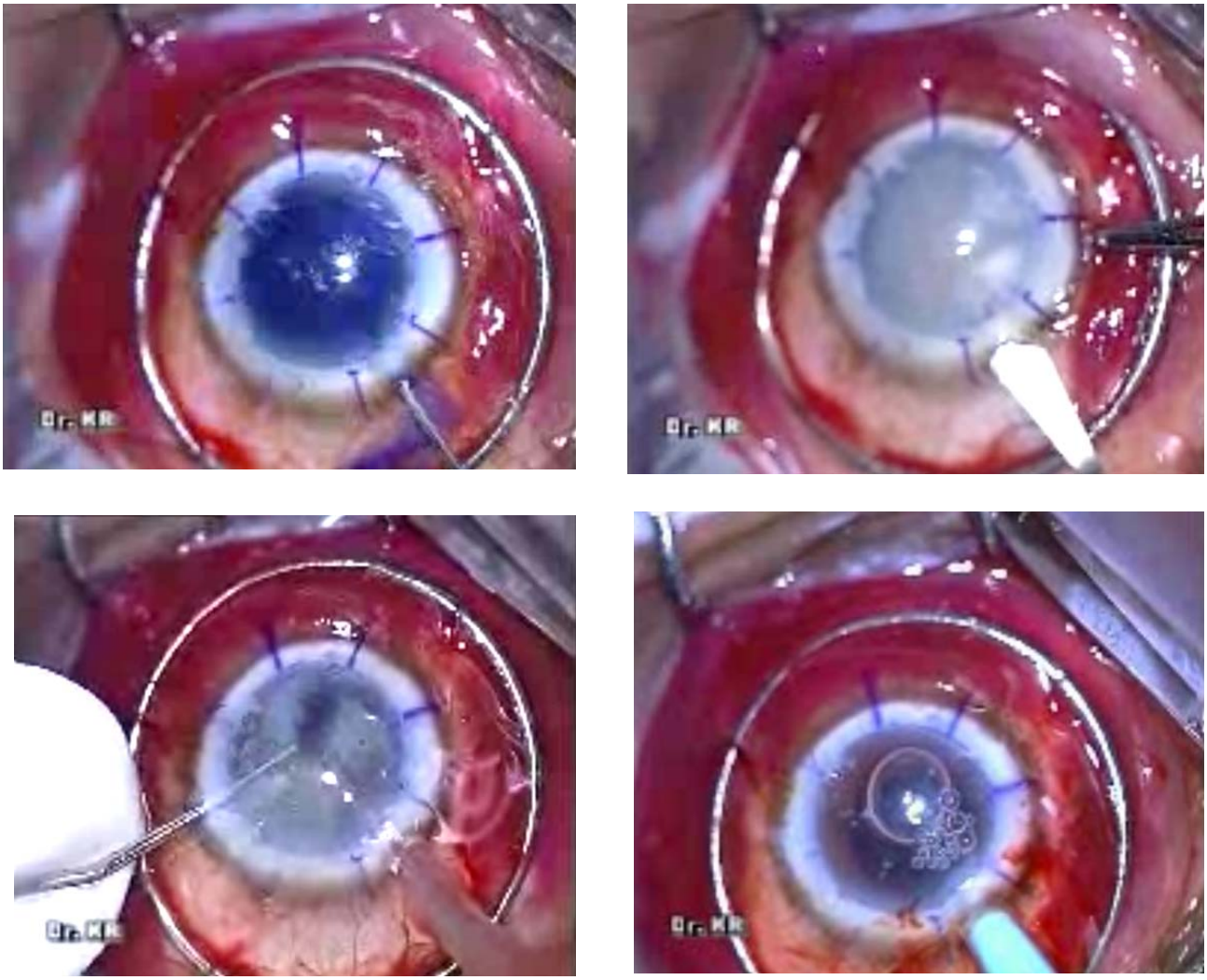


Figure 3E.

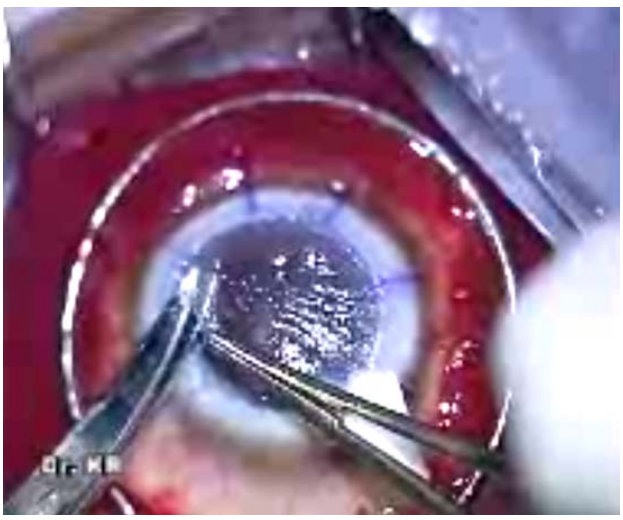


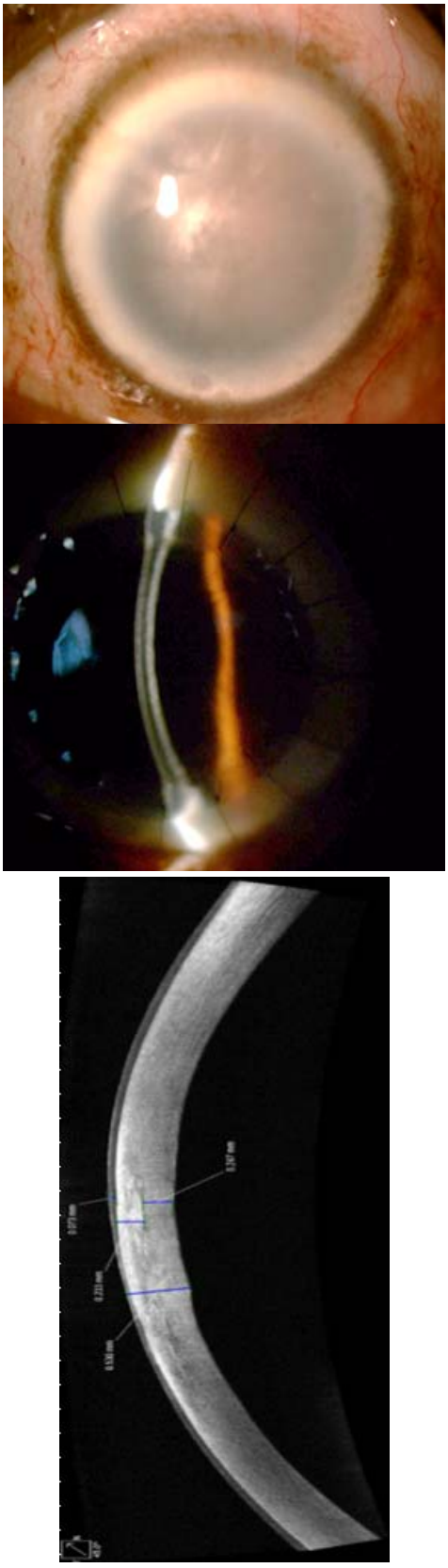
Figure 3F.

Figure 3G.

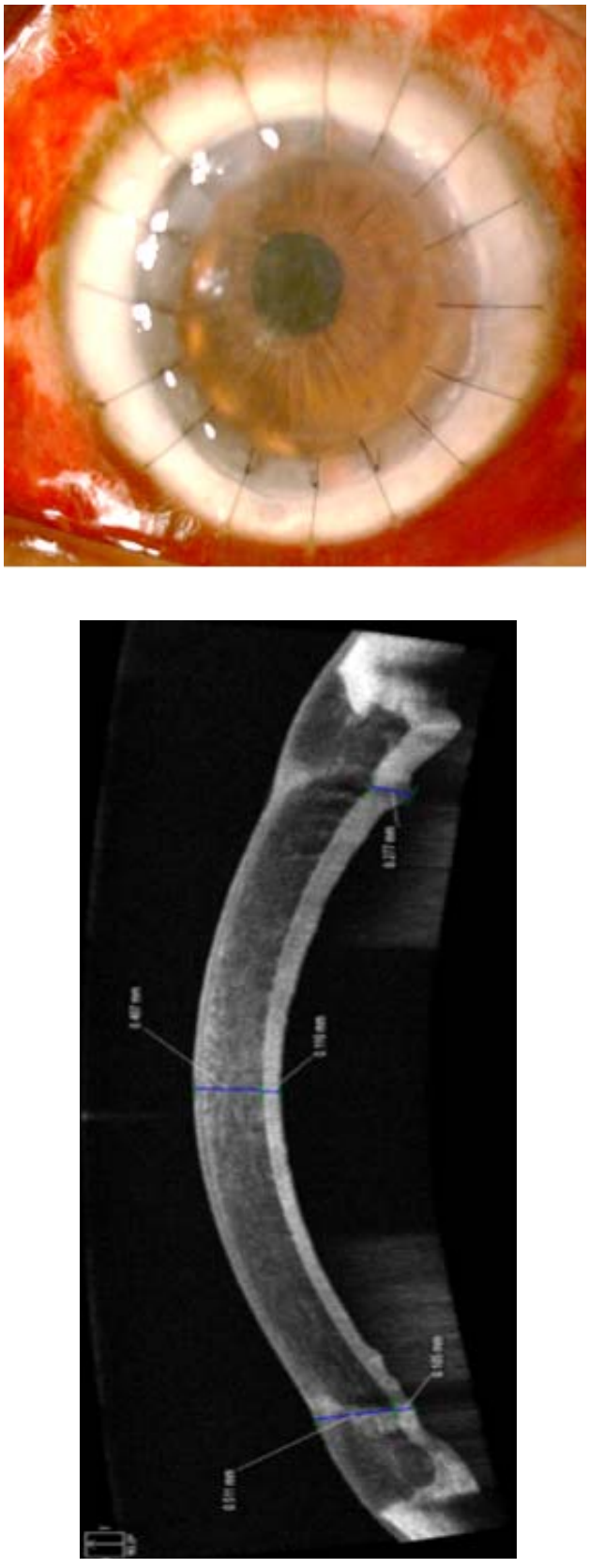
Figure 4. *Pre op and post-op comparison of the two patients.*

Case 1.

Preop

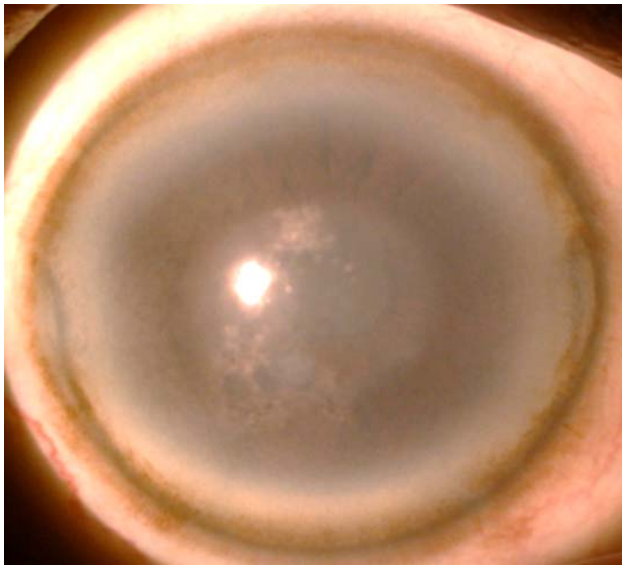


Postop

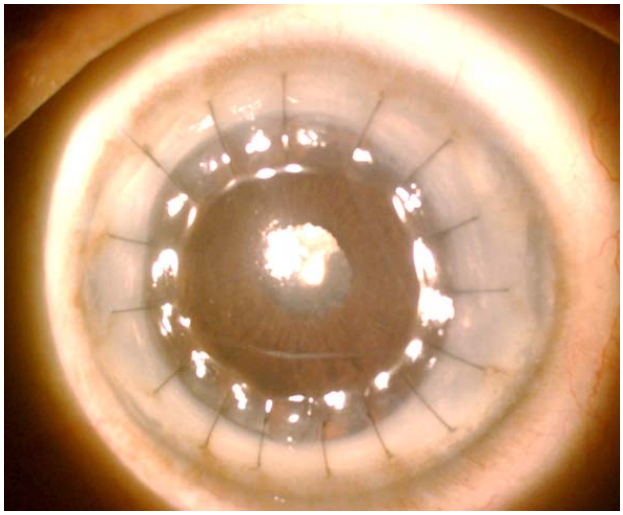


Case 2.

Preop



Postop



Discussion

The triple procedure has been employed for dual correction of corneal pathology and cataract surgery for decades. As mentioned before, the triple procedure can be performed as a PKP or a DALK. Which corneal surgery to perform depends on the depth and extent of the corneal pathology mainly. However, there are many advantages of performing a DALK over a PKP in a triple procedure[3].

In open sky cataract extraction, we face many challenges such as incomplete capsulorrhexis, incomplete cortical aspiration; unopposed posterior segment pressure leading to run off rhexis and posterior capsular rupture. Extended duration of the globe in the open sky position increases the risk of haemorrhages and expulsion which are the most dreaded clinical complications for any eye surgeon as well as the patient. Therefore, it is better to avoid open sky extra capsular cataract surgery in patients when possible. Performing DALK is therefore a better choice in patients with ectasia and anterior corneal scarring in view of optimal performance of the cataract surgery in an enclosed space as well as in view of it's benefits over PKP for the graft in the long run.

The biggest challenge in a triple procedure, whatever the corneal procedure is, determination of the IOL power. There have been many methods described but most of the studies have not compared statistically significant numbers of cases in order to determine the most effective. Some of the methods described are, using the preoperative keratometry from the affected eye or the fellow eye, multiple regression analysis with surgeon specific values, and individualized constants[14]. One study done by Katz and Fostre noted that the lowest postoperative refractive error was seen when the preoperative keratometry of the affected eye[5].

In our surgical experience, we can say that for penetrating keratoplasty and deep anterior lamellar keratoplasty done for optical purposes, the surgeon can manipulate the postoperative corneal shape with the size of host trephination, graft to host size difference, tightness and length of the sutures. Hence with prior experience of one's own surgeries, one can determine roughly what keratometry readings one can expect in the patient postoperatively. This knowledge would definitely guide the surgeon in deciding the IOL power for the triple procedure.

For our patients who had bilateral corneal pathology, we measured the axial length using emersion methods (as optical methods are difficult in these patients with high degree media opacities) and we obtained two biometry reports with the centre k reading and the average k reading. considering these biometry reports and the surgical experience in post-operative corneal contour changes, the IOL power was selected closest to near normality of the preoperative and expected post-operative anatomy.

When only a single eye was involved, we also obtained and compared the normal fellow eye's keratometry and based the IOL power mainly on that, provided that the two eyes had similar axial length

The next challenge is the sequence of steps. Triple procedure with DALK has been performed in multiple ways[6,7,8]. Some surgeons have performed the cataract surgery first and then the DALK[7]. This sequence is possible when the opacity is small and peripheral, or the surgery is for an ectatic cornea where there is adequate anterior chamber visualization[9]. Some surgeons have also described using endo-illumination in these kinds of situations to aid visualization[10]. We also believe that endo-illumination would be a very good method to perform cataract surgery in fairly opaque corneas and would allow two stage management where the cataract surgery is performed first. Performing the cataract surgery first is ideal as the graft survival in a secondary PKP will be much longer, and the surgery per say of a secondary DALK will be much more straight forward.

However, when endo-illumination is unavailable, visualization is poor, and the corneal opacity is central, like in our patient, removing the opacity first is the best approach.

Throughout the procedure, each step taken affects the subsequent one. Hence it is important to plan each step. When deciding on the trephine size, we did not go beyond 8 mm so that there was enough distant for limbal incisions in the cataract surgery. Good staining of the anterior capsule was performed to aid in visualization during rhexis. The corneal incisions of phacoemulsification were made short so that the DALK was not affected. Low settings on the machine were used during phacoemulsification to reduce pressure on the partially trephined cornea.

Conclusion

Performing triple procedure by combining DALK and phacoemulsification surgery for patients with corneal and lenticular dual pathology is beneficial in many ways. It is important to study assessment of IOL power further in these patients.

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