Original Article

Visual Outcome after Deep Lamellar Keratoplasty in Keratoconus

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Purpose: To evaluate best corrected visual acuity and complications after deep lamellar kertoplasty in patients having keratoconus.

Materials and Methods: This was a descriptive case series study conducted at LRBT Eye hospital Lahore from October 2007 to August 2009. 67 eyes of 67 patients were selected from corneal unit of LRBT Eye Hospital. Deep lamellar keratoplasty was performed with pneumodissection. Visual acuity was checked preoperatively and postoperatively with Snellen chart at one month, three month and sixth month intervals. All complications were recorded and treated accordingly.

Results: In this study, 47 patients were male and 20 were female. Mean age was 21 years ranging from 12-43 years. Seven patients were excluded from the study due to descemet's membrane perforation. Pre-op BCVA ranged from 6/12-6/6 in 4, 6/24-6/18 in 20 and 6/60-6/36 in 36 eyes. Post-op BCVA was in range of 6/12 - 6/6 in 34, 6/24 - 6/18 in 19 and 6/60 - 6/36 in 7 eyes. In 3 eyes interface haze was noticed.

Conclusion: DLK can be considered as a suitable technique in patients with Keratoconus requiring corneal transplantation. The procedure produces good visual results with low rates of complications and minimal risk of graft rejection. As expertise has increased and procedures have become more technically refined, DLK should be considered in patients with a relatively preserved endothelial function.

Keratoconus (KC) is among the most common corneal stromal dystrophies causing a progressive, asymmetrical corneal ectasia. In western world it is one of the commonest indication for corneal grafting[1,2]. Keratoconus was first described by Nottingham in 1854 and later on widely reviewed by different authors[3,4].

Keratoconus is a frequently bilateral disease and usually becomes more marked at puberty. Presentation is typical with unilateral impairment of vision due to progressive myopia and astigmatism, which subsequently becomes irregular. The patient may report frequent changes in spectacle prescription or decreased tolerance to contact lens wear. Various systemic and ocular disorders are associated with the condition. Atopic or allergic conjunctivitis[5] are very common and injudicious use of topical steroids usually cause additional complications like posterior subcapsular cataract and glaucoma.

Traditionally, penetrating keratoplasty (PKP) has been the treatment of choice for corneal abnormalities. Penetrating keratoplasty is a relatively easy surgical procedure to perform. Improvements in surgical techniques, suturing materials, modern equipments and donor storage has resulted in better visual outcome[6]. The results show a good visual prognosis, and graft survival of 90% at 11 years are reported[7]. Despite these good survival rates, graft rejection episodes are common varying from 20% to 35% in the literature[8].

Deep lamellar keratoplasty (DLK) is a surgical technique in which the different corneal layers are

removed deep down to bare the descemet's membrane, thereby preserving healthy recipient endothelium. This procedure has several advantages over PKP. The recipient's endothelium is preserved so that normal donor endothelium is no longer necessary and the endothelial count remains relatively stable following the procedure[9,10]. Endothelial graft rejection episodes are minimized due to the conservation of healthy recipient endothelium, which in turn decreases the need for long-term immunosuppression. DLK becomes almost an extraocular procedure as there is no entry into the anterior chamber during the surgery. The resultant injury to the lens, iris and chamber angle structures are negligible so that there is no risk of developing secondary glaucoma.

In 1985, Archila was the first surgeon who used the air to help identify and tried separation of deep corneal stromal fibres from descemet's membrane[11] The technique was further refined by Price in 1989 and Chau et al in 1992[12,13] Interface haze remained a major drawback in the final visual outcome after performing DLK. This problem was overcome by doing deeper and smoother keratectomies, and techniques such as big bubble air injection, hydrodelamination, viscodissection or photoablation of the posterior stroma have been advocated to obtain a deep recipient stromal bed[14-17].

MATERIALS AND METHODS

This was a descriptive case series study conducted at LRBT eye hospital Lahore from October 2007 to August 2009.Patients were selected from the corneal unit of LRBT Free Eye and Cancer Hospital, Lahore. All patients fulfilling inclusion criteria were enrolled and an informed consent was taken.

INCLUSION CRITERIA:

- Age 10 – 45 years.
- Both genders (male and female)
- Keratoconus (moderate to severe), evaluated with the help of Alcon EyeMap (corneal topographer)
- Intolerance to hard contact lens irrespective of the level of visual acuity.

EXCLUSION CRITERIA:

- Active anterior segment disease
- Corneal endothelial involvement assessed with Specular Microscopy.
- Patients converted to PKP due to intra-operative complications i.e. micro-perforations.

Demographic data are shown in figure 1 and ocular associations are in table 1.

In our technique a partial thickness stromal trephination was done, which was followed by Paufique knife pocketing to have an easy access in the stromal bed. Air was then injected with 27G bent needle to facilitate stromal dissection to bare the descemet's membrane. A blunt stromal dissection was performed upto the deeper level to bare descemet's membrane strictly avoiding anterior chamber perforation. If at any stage a perforation occurred, the procedure was converted to penetrating keratoplasty and the patient was excluded from the study. A same sized cornea of both host and donor was used to minimize postoperative myopia. After preparing the host bed, donor button was cut in full thickness and endothelium was removed from donor button with the help of dry microsponges or fine forceps. The donor tissue was then anchored with 16 interrupted 10/0 nylon monofilament sutures and eye covered with sterile eye pad for 24 hours after applying a bandage contact lens. In most of the patients bandage contact lens was removed after 2 weeks of surgery.

Post-operative assessment was done on day 1, 1st month, 3rd month and 6th months. Best corrected visual acuity was checked with Snellen's chart. A detailed corneal and anterior segment examination was carried out and any complications were recorded and treated accordingly.

RESULTS

There were 67 eyes of 67 patients with KC (47 males, 20 females) with a mean age of 21 years (range, 12-43 years). All patients underwent surgery as they were intolerant of contact lenses, or BCVA was not fair enough to perform their routine life. Pre-operative BCVA data are presented in figure 2. In 36 eyes the BCVA was 6/60-6/36, in 20 eyes it was 6/24-6/18, and in 4 eyes visual acuity was ranging between 6/12-6/6. The follow-up period was 6 months. Post-operative BCVA data are presented in figure 3. In 34 eyes the post operative BCVA at 6th month follow up was in a range of 6/12-6/6, in 19 eyes it was 6/24-6/18 and in 7 eyes it was 6/60-6/36.

The intra and post-operative complications are presented in table 2. Seven patients were excluded from the study due to intraoperative perforations of descemet's membrane and anterior chamber entry. Two cases of double anterior chamber were noted

soon after the surgery, which were fully resolved within 1 month, without further intervention. Two patients developed infiltrates at suture site 6 weeks after operation, which resolved after 2-3 weeks without altering the treatment.

Table 1: Ocular associations

Atopic Conjunctivitis	06
Contralateral Hydrops	04
Post.Subcapsular Cataract	03
Nystagmus	03

Table 2: Complications both intra & post-operative

Descemet's Membrane perforation	7
Double AC	2
Interface haze	3
Suture site infiltrates	2
Blood trace at interface	1
Epithelial defects	1

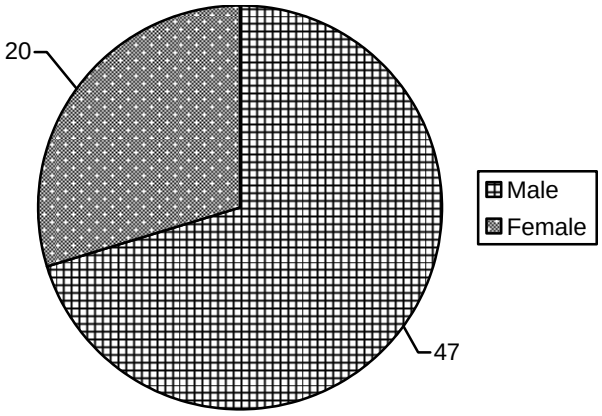

Fig. 1: Gender Distribution

One patient developed epithelial defects after removing bandage contact lens which were fully resolved after re-application of bandage contact lens and extensive lubrication in 1 to 2 week duration. In three cases we found interface haze which was

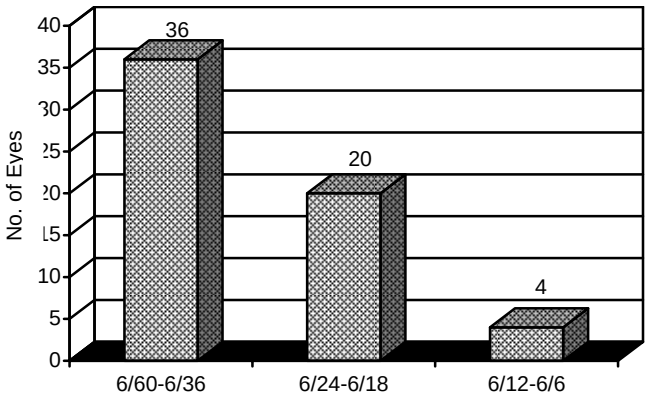

Fig. 2: Pre-operative best corrected visual acuity

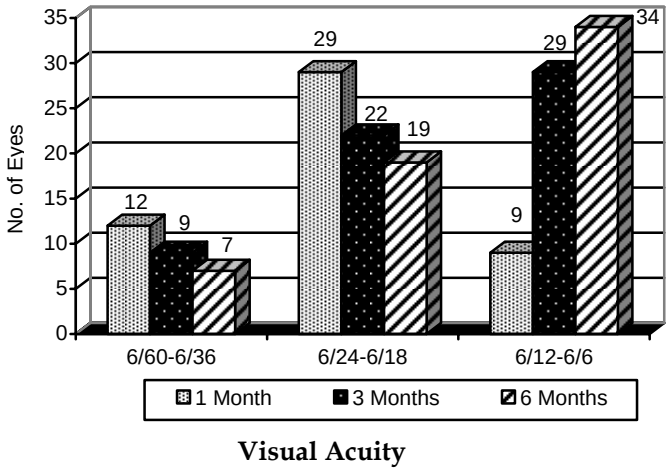

Fig. 3: Post-operative best corrected visual acuity

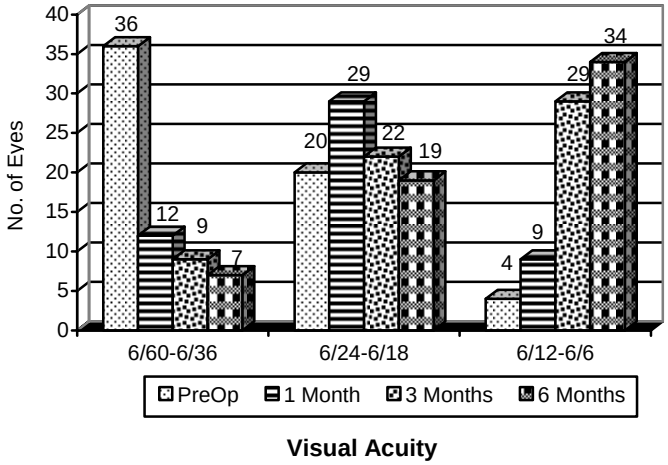

Fig. 4: Comparison – Pre and postoperative best corrected visual acuity

minimally reduced at the end of study and was a possible cause of decreased final visual outcome. In

one patient fresh blood was found in between donor and recipient corneal tissue which disappeared after 3 weeks by increasing the frequency of topical steroids leaving behind fine traces. The patient was having atopic conjunctivitis and this blood might have trickled from limbal blood vessels.

DISCUSSION

As early as the 1950s, Jose Barraquer and colleagues in Colombia applied new techniques of lamellar keratoplasty, dissecting the corneal stroma down to two-thirds of its thickness in both the donor and the recipient tissue[14]. The poor visual outcome related to the irregularity of the dissected bed and interface scarring in between the tissues made this procedure unfavorable among the corneal surgeons. Although exposure of Descemet's membrane in corneal dissection was performed in the 1970s, the term "deep lamellar keratoplasty," as it is used today, was not employed until 1984 by Eduardo Arenas Archila, MD, with the use of intrastromal air injection to facilitate host tissue removal[11]. Dissection at this natural cleavage plane, and subsequent removal of all the stromal tissue overlying the recipient Descemet's membrane and endothelium, was found to create a smooth recipient bed. To assist in the separation of the plane between stromal tissue and Descemet's membrane, techniques were developed to inflame the residual stromal tissue[18,19]. Following Archila's introduction of air, the technique was further developed and refined by Price, Rostron and Chau et al. Hydrodelamination is another method described in which balanced salt solution is injected into the plane[16]. Subsequently others successfully used viscoelastic injection to separate the two layers[17].

Melles et al. developed a method to monitor incision depth which involves filling the anterior chamber with air. The air bubble creates a mirror effect so that the distance between the blade tip and the bubble can be seen[20]. Anwar M, described a big bubble technique in which air is injected to detach the central Descemet's membrane from stroma[14]. In our study, we used the sterilised air to make a cleavage plane for stromal dissection. Pneumodissection technique gave a more uniform and smooth surface and resulted in a better apposition of host and donor button.

With regard to visual outcome, we have a highly satisfactory rate of vision ranging from 6/18-6/6 in 88.3 % of eyes at the end of six months follow up. These results are very similar to the study conducted by Nima Pakrou et al in which they achieved final vision of at least 6/12 in their patients. They also faced 2 descemet's membrane perforation and 1 double anterior chamber[21]. In another study conducted by Fogla and Prema, they also reported average BCVA of 6/9-6/6 at mean follow up of 5 months with 15.3% microperforeation of descemet's membrane[22].

In the largest comparative study of DLK versus PKP in KC, Watson et al[23]. report similar complication rates, visual and refractive outcomes in both procedures. The sutures in DLK patients were also removed earlier and the wounds stabilized sooner in their series. A quicker visual rehabilitation in patients undergoing DLK compared with PKP has also been noted. The avoidance of endothelial rejection suggests that DLK is a safe and effective alternative to PKP. This outcome also resembles the study of Javadi et al[24] who reported that DLK is an effective alternative surgical procedure for patients with keratoconus. Outcomes are comparable to penetrating keratoplsty in terms of refractive errors, BCVA, and contrast sensitivity.

Irregular astigmatism and myopia resulting from abnormal bulging of the conical cornea was overcome by using the same sized donor and host tissues.[25] In our study almost 85% of the cornea size was 7.75 mm. In the remaining eyes it was 7.50 mm for both donor and recipient.

There have been some concerns over the risk of interface opacity with DLK. This complication occurred in three (5%) of our patients. It has not been reported as a major complication with the newer DLK techniques[14,19] in which only recipient descemet's membrane and endothelium are retained with minimal disturbance of donor stromal lamellae. The complete removal of donor endothelium and Descemet's membrane is important as inflammatory reactions and potential scarring is minimised. Because the donor endothelium is separated from the anterior chamber by the host's deepest stroma, descemet's membrane and endothelium rejection cannot occur via the anterior chamber fluid.

Retaining the recipient's normal endothelium means that a donor cornea with normal endothelium is no longer required, and the resultant endothelial count remains relatively stable[26]. DLK has been shown to only minimally decrease endothelial cell counts with cell counts being maintained for a longer period. Shimazaki et al[27]. also demonstrated that in patients undergoing PKP as opposed to DLK, there was a

progressive decrease in endothelial cell density over 24 months. Rejection episodes are much reduced compared to PKP and long-term graft stability is improved, thereby reducing the need for long-term immunosuppressive therapy or extended follow-up. Still, DLK is a technically more difficult procedure which is demanding on both the skill and time of the surgeon. The technique used, and outcomes in our series appear to compare favourably to those previously described. There were seven cases (11.6%) of Descemet's membrane penetration, which is comparable with published data. Shimazaki et al[27], in their randomised trial of DLK in 26 eyes, had a membrane rupture rate of 7.6%. In their group of 25 KC patients undergoing DLK, Watson et al[23]. reported a Descemet's membrane perforation rate of 15%, using the Sugita and Kondo technique. A similar rate of 11.1% perforation with conversion to PKP was reported by Caprossi et al[28] using a method of air injection into the anterior chamber, followed by manual dissection.

One case of trickled blood in the interface was a new complication which is not reported before in the literature. The patient was having atopic conjunctivitis with deep pannus. Although blood disappeared after few weeks but a fine trace of interface haze left permanently which caused a relative decrease in visual outcome.

CONCLUSION

DLK can be considered a suitable technique in patients with Keratoconus requiring corneal transplantation. The procedure produces good visual results with low rates of complications and minimal risk of graft rejection. As expertise has increased and procedures have become more technically refined, DLK should be considered in patients with a relatively preserved endothelial function. Recent developments have rendered DLK the preferred procedure of corneal transplant for patients with a normal corneal endothelium. The main advantage is the ability to maintain an intact globe throughout the procedure, making the risk of intraocular complications negligible.

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