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To Study the Clinical Profile and Outcome of Neisseria Keratitis

Dr. Bhupesh

The Neisseria is a large genus of commensal bacteria that colonize the mucosal surfaces of many animals. Of the 11 species that colonize humans, only two are pathogens. N. meningitidis and N. gonorrhoeae often cause asymptomatic infections, a commensal-like behaviour. Neisseria Meningitidis is Gram negative cocci which remains intracellular and grows in enriched media like chocolate agar. Neisseria Meningitidis is seen only in humans. It is seen in 10-15% of healthy population as a nasolacrimal commensal.¹ It is transmitted from via respiratory route. Primary Ocular meningoccal infection is rare and Neisseria Keratitis² is even more rarely reported clinical condition. On extensive literature search we got only 2 case reports³,⁴ comprising of 3 patients. The reasons for assessing clinical profile of these cases are not having enough literature and very uncommon cause of microbial keratitis. Conjunctivitis in adults⁶ and neonates are reported in literature. There are reports for endophthalmitis⁵ caused by Neisseria Meningitidis also. In our knowledge this is the largest series of primary Neisseria Meningitidis Keratitis. We also assessed outcome of treatment and associated systemic and local conditions.

MATERIALS AND METHODS

We reviewed all medical records of culture proven Neisseria Keratitis cases who presented in cornea department from the year 2000 to 2011. We assessed clinical and microbiological properties of these cases. In clinical properties we analysed the mode of onset and presentation. We also looked for associated local and systemic risk factors. As per institute protocol all patients with microbial keratitis were sent for complete microbiological workup. This included smears like Grams, Geimsa and calcofluor-potassium hydroxide (KOH+CFW) mount. Inoculation directly onto 5% Sheep blood agar (BA), Chocolate agar (CA), Sabouraud Dextrose agar (SDA), Potato Dextrose agar (PDA), Brain heart infusion broth, Thioglycollate broth. Species were identified using Vitek II compact system, Antibiotic susceptibility testing was done by Kirby Bauer Disc Diffusion method.
RESULTS
We reviewed 28 medical records of proven Neisseria Keratitis. No particular age is predisposed but more commonly seen in extremes of age \(i.e.\) < 10 years of age and \(>60\) years of age. Males were more common than females (22:6). Most common duration of onset was within 1 week to 1 month. 32 percent of cases have presented as sterile persistent epithelial defect and 14\% of cases were diagnosed to have Herpes Simplex keratitis. 50\% cases presented as central round or oval ulcer with well defined heaped up margins. One case presented as infected shield ulcer and 3 cases as central corneal perforation

Associated risk factors were Vernal Keratoconjunctivitis, chemical injuries, status post corneal surgeries, spheroidal degenerations. Steroid use was the most common association (50\%). Associated systemic risk factors were also studied and 3 cases were found to be diabetic. Species have been identified in 12 cases. Most Common species was \(N.meningitidis\) – 9 cases. Others are \(N.mucosa, N.sicca, N.cinerea\).

Nearly 20\% organisms were resistant to quinolones. Out of 28, 24 cases responded to Ciprofloxacin and Fortified Cefazoline eye drops combination therapy in 1 to 2 weeks time. 3 patients needed tarsoraphy. One got evisceration and one needed penetrating Keratoplasty.

DISCUSSION
Neisseria keratitis is a rare cause of microbial keratitis. Clinical course of primary Neisseria keratitis appears to be slowly progressive. Clinical association with poor ocular surface can be a probable association. Although it was reported to be associated systemic infection but in our series no association could be pointed out. In our series it appears to be a chronic infection which in many cases can be secondary to poor ocular surface. Taking care of Ocular surface and the primary pathology is the most important way of management.

REFERENCES
Our Experience of Manual DSEK in 17 Cases with Retained ACIOL or Iris-Claw Lenses

Dr. Tuhin Chowdhury, Dr. Tuhin Chowdhury, Dr. Ayan Mohanta, Dr. Singhal Prashant Kumar

Descemet’s Stripping with Endothelial Keratoplasty (DSEK) has revolutionized the field of keratoplasty and is now considered to be the standard of care for treating endothelial dysfunction. It has several advantages over penetrating keratoplasty (PK) like faster visual recovery, less induced astigmatism, no suture related problems and greater resistance to trauma postoperatively. Pseudophakic corneal edema is one of the most common indications for DSEK but mostly reported in posterior chamber lenses. Nowadays, we come across many cases of corneal edema with bullous keratopathy with anterior chamber intraocular lens (ACIOL) or iris claw lenses and DSEK can be considered even in these cases. Classically, if the ACIOL is felt to be primarily responsible for endothelial decompensation, an IOL exchange should be considered either before or at the time of DSEK. However, in cases where ACIOL is not directly responsible for endothelial decompensation and patient had initial good vision in that eye following cataract surgery, it may be more desirable to leave the ACIOL undisturbed. The purpose of this study was to assess the outcome of manual DSEK in presence of an AC IOL (Kelman multiflex open-loop) or iris-claw lenses and to evaluate the maintenance of graft clarity with donor endothelial cell loss in 2 years after DSEK which was done for endothelial decompensation leading to pseudophakic bullous keratopathy (PBK).

MATERIALS AND METHODS

We did a retrospective, non-comparative interventional case study for 17 eyes who underwent manual DSEK with retained AC IOL or iris-claw lenses in our Cornea services at Disha Eye hospital, Barrackpore between December 2010 and February 2013. Pre-operative Snellen’s visual acuity of the patients ranged from CFCF- 3/60. Cases with central AC depth < 3 mm, vitreous in AC and secondary glaucoma were excluded from the study. All cases underwent pre-operative UBM to rule out any angle closure or peripheral anterior synechia. Pre-operative specular microscopy of the donor tissue was performed using KONAN KSS- EB10. Donor with endothelial cell density (ECD) >2800 cells/sq mm were used for DSEK. Follow-up ranged from 24 to 33 months. The donor ECD at 6, 12 and 24 months post-operatively were measured and compared with preoperative ECD eye-bank values.

Surgical Procedure

Donor preparation was carried out in a Barron Artificial Anterior Chamber
with the help of a blunt lamellar dissector after initial entry with crescent knife through a predetermined cut at peripheral cornea by a diamond knife. The lamellar dissection was carried upto the limbus all 360 degrees around. The corneoscleral rim was placed on a Teflon block and punched from the endothelial side by a hand held trephine and the donor lenticule was prepared. Donor lenticule should be relatively smaller in these cases as the graft edge should be free from IOL margin and in our series it ranged from 7.7- 8.5mm.

All surgeries were done under peribulbar anaesthesia. To get a firm air fill in AC with proper tamponade, we used self sealed scleral tunnel incision (5.5- 6.0mm) with corneal valve effect and the incisions should be bit larger to avoid more tissue manipulation during insertion of donor lenticule. 2 side port incisions were made at 2 and 10 o’clock position. Descemet’s membrane (DM) was stained by trypan blue and the AC was filled with 1% sodium hyaluronate. Central DM is scored by reversed sinskey hook and we shouldn’t go beyond 7mm. Tags of DM were removed by McPherson forceps and then AC was washed by Simcoe canula to remove any residual viscoelastics. AC was filled with BSS. Then the graft was folded in a taco configuration after putting a small amount of healon on central donor endothelium and then inserted by a long Kelman McPherson forceps.

In these eyes the AC is usually deep due to previous anterior vitrectomy and the graft may unfold very easily, otherwise, we have to unfold by injecting air. We usually fill the AC full with air and don’t go for any fluid air exchange. After proper centration of the graft we squeezed out any trapped fluid in graft host interface by gentle stroke with reversed sinskey hook and then inject steroid antibiotic in subconjunctival space and put a bandage contact lens. We asked the patient to lie down in supine position with face up for about an hour. We examine the patient after 90mins in Slit lamp and if the IOP is high then we remove some air in slit lamp in aseptic way which is usually not needed except one.
RESULTS
In the immediate post-operative period 3 eyes had donor dislocation which needed rebubbling with air, of which one graft ultimately got failed. Out of remaining 14 eyes, 13 eyes maintained good graft clarity and one eye had primary graft failure. No cases had pupillary block glaucoma in the immediate post operative period. No graft rejection was noted in any eyes in follow up periods. 9 eyes (52.94%) had BSCVA of 6/18 or more and 6 eyes (35.29%) had BSCVA 6/36 or more after 3 months of surgery. 2 patients with failed graft refused to undergo further surgery. The mean ECD at 6th month post-operative visit was 1952 cells/sq mm, at 12th month post-operative visit was 1705 cells/sq mm and at 24th month post-operative visit was 1543 cells/sq mm. There was no significant difference in cell loss in our small series compared with ECD loss in DSEK with presence of PC IOL.

DISCUSSION
Significant controversies are there regarding the proper management of PBK with corneal decompensation in presence of AC or iris claw IOL. The current consensus is to go for 2 staged procedure, where first stage is IOL exchange with scleral or posteriorly iris fixated IOL and then after one month endothelial keratoplasty. DSEK is potentially more traumatic for endothelial cell survival than PK but we feel that endothelial cell loss appears to plateau after 6 months. Earlier studies report that the presence of an ACIOL is a risk factor for graft rejection in PK. But in our series even after 2 years of follow-up no graft rejection was found. Another difficulty for DSEK in anterior pseudophakic cases is management of air bubble. In our cases as the IOLs were well centred with good central clearance, we didn’t face such problems, but still 3 eyes needed rebubbling. We usually don’t go for fluid air exchange but administer I/V mannitol 20% after 20 minutes of surgery if the patient has severe ocular...
pain and we examine the patient after 90 minutes in Slit lamp and if the IOP is high then we remove some air in slit lamp in aseptic way.

The surgical decision of retaining or exchanging the IOL while doing DSEK should be individualized in each case. This small series found that Manual DSEK in the presence of a properly centred AC IOL or iris-claw lenses can be a good option for old patients who are not willing for 2 staged procedures and for patients who had initial good vision following cataract surgery in that eye before the cornea got decompensated.

REFERENCES


Retrospective Analysis of Surgical outcome of Dual Head Pterygium Management, Our Surgical Experience

Dr. Chandra Shekar C.S., Dr. Shreesha Kumar K., Dr. Ramamurthy D., Dr. Chandrasekhar D., Dr. Srinivas V.K. Rao

Aim of this study is to Retrospective analysis of surgical outcome of double head pterygium our surgical experience

Design: Interventional, retrospective, single center study.

MATERIALS AND METHODS

55 eyes of 50 patients with double head pterygia were included of which 45 patients had unilateral and 5 bilateral presentation. 50 eyes had primary and 5 recurrent double head pterygia.
Surgical Procedure
A. 45 eyes underwent pterygium excision and split conjunctival autograft where the superior bulbar conjunctival graft is split into 2 parts and harvested
B. 4 eyes needed superior and inferior bulbar conjunctival graft and in these cases inferior bulbar conjunctiva was chosen because superior bulbar conjunctiva was not adequate
C. 3 eyes underwent epithelial sheet transplantation on one side and conjunctival autograft on the other. Epithelial sheet transplantation is a procedure where in the superficial epithelial layer of the pterygium is carefully separated and harvested
D. 3 eyes underwent stem cell transplant on one side and Conjunctival autograft on the other. In this procedure a thin block of peripheral corneal tissue (limbus) was included in the conjunctival graft.

RESULTS
It is a retrospective study from December 2006 -November 2012. Follow up 3–53 months average 14 months Male to female ratio 21:29. Age group ranged from 20-72 years. 5 patients lost follow up after 2 weeks post-op. Complications that were noted during the follow as below
A. Graft retraction was seen in 7 eyes,
B. Graft loss on one side in 3 eyes because of small sized graft
C. Recurrence of pterygium on the nasal side was seen in 1 eye and
D. Granuloma was noticed in 1 eye

Conclusion
Split conjunctival auto graft is an effective procedure in double head pterygia with encouraging results. Good results can be achieved with, superior and inferior bulbar conjunctival graft or epithelial sheet transplantation when superficial bulbar conjunctiva is not available or not sufficient
Outcomes of Accelerated Corneal Collagen Cross-Linking in Comparison with Conventional Cross-Linking

Dr. Ashwini, Dr. Sharon D’Souza, Dr. Himanshu Matalia, Dr. Rohit Shetty

Keratoconus is a bilateral, progressive, non-inflammatory, thinning disorder causing irregular corneal astigmatism of unknown cause. Biochemical alterations with increased expression of proteolytic enzymes and decreased concentrations of protease inhibitors, decreased stromal thickness, and modified configuration of collagen lamellae have been reported among the pathophysiologic mechanisms of keratoconus. While options like contact lenses, intracorneal ring implants and phakic intraocular lenses are available for visual rehabilitation in keratoconus, the only currently available approach to address the stromal imbalances in keratoconus and halt/delay the progression has been corneal collagen cross-linking with riboflavin (CXL).

The technique described by Seiler et al. (UV A exposure of 3mW/cm² for 30 minutes) has been the most widely used for corneal collagen cross-linking to date. The effectiveness and safety of this procedure has been well documented by various investigators.

A newer collagen cross-linking method introduced by Avedro Inc., (ACXL) reduces the UVA exposure time to 4 minutes by using higher UV power of 30mW/cm². The total energy maintained on the eye is 5.4J/cm² in the CXL procedure, whereas the total energy delivered to the eye is 7.2J/cm² in the ACXL procedure. This higher level of total energy in ACXL is required due to the lesser duration of riboflavin soak time requiring higher energy to get the same amount of cross-linking as CXL. This procedure reduces the overall treatment time to 24 minutes, as compared to 1 hour in CXL. The benefits of this procedure compared to CXL have not been reported. The purpose of our study is to evaluate the safety and effectiveness of ACXL compared to conventional CXL.

MATERIALS AND METHODS

It was a prospective non-randomized, interventional comparative case study, conducted at a tertiary eye care center. All patients with progressive keratoconus who presented to the institute consecutively were recruited. The institutional ethics committee approved the study. The methods applied in the study adhered to the tenets of the declaration of Helsinki for the use of human subjects in biomedical research. An informed consent was obtained and patients underwent corneal collagen cross-linking with riboflavin.

Patients with documented progression of keratoconus with a minimum
pachymetry at the thinnest point of 400µ as measured on Pentacam (Oculus, Wetzlar, Germany), with no central corneal scars and absence of herpetic eye disease, severe systemic illness and pregnancy were included in the study. The parameters considered to establish progression of keratoconus were defined as an increase in maximum K on Pentacam of >0.5 D, increase of corneal curvature in the cone area >1D, thinning of pachymetry >20µ and/or increase in refractive cylinder >1D over a period of 3 to 6 months. The study population was divided randomly into two groups – conventional collagen cross-linking (CXL) group and accelerated collagen cross-linking group (ACXL) group.

Surgery in both groups was performed under topical anesthesia using proparacaine hydrochloride 0.5%. After scraping the corneal epithelium in the central 9 mm mechanically, in the CXL group, riboflavin 0.1% (vitamin B2) with Dextran 20% drops (Mediocross, Andrec Corp.) was applied on the cornea every 3 minutes for a total soak time of 30 minutes, before UVA radiation. This was followed by UVA exposure of 3mW/cm2 for 30 minutes with simultaneous application of riboflavin every 5 minutes. In the ACXL group, after corneal epithelial scraping, Riboflavin 0.1% with Dextran 20% drops (Vibex, Avedro Inc.) was applied every 2 minutes for a total soak time of 20 minutes, followed by UVA radiation of 30mW/cm2 for 4 minutes. A single surgeon (RS) performed all surgeries. Post-operatively, soft bandage contact lens was applied on the cornea for 3 days and patients were treated with tapering doses of topical prednisolone acetate 1% eye drops for 3 weeks, topical antibiotics (moxifloxacin 4 times per day) for one week and topical lubricants (4 to 6 times a day) for 1 month.

Pre- and post-operative follow-up evaluations included best corrected visual acuity (BCVA), mean refractive cylinder and slit lamp examination. Pentacam was used for measuring flat and steep keratometry (K1 and K2 respectively) and pachymetry at the thinnest point on the cone. The amount of stromal haze induced by the procedure was evaluated and quantified by using densitometry on Pentacam. Patients in the ACXL group also underwent corneal endothelial evaluation using non-contact specular microscope (TOMEY, EM-3000, Nagoya, Japan). Data collected pre-operatively and post-operatively at 1, 3 and 6 months was analyzed. All patients with a minimum follow up of 6 months were included in the study. The primary outcome measures studied were the BCVA, manifest cylinder and K1 and K2 measured using Pentacam. The secondary outcome measures studied were corneal stromal haze and corneal pachymetry. The endothelial cell count was also studied only in the ACXL group.

All statistical analyses were done on MedCalc statistical software (version 12.4.0.0, Mariakerke, Belgium). All means were compared using parametric or non-parametric tests based on the normality of distribution. Repeated measure
analysis was performed to evaluate the changes in the outcome measures from baseline to final result. The repeated measure design allows the observer to look at change over time in a longitudinal study; it also helps to reduce the variance of estimates of treatment effects allowing statistical inference to be made with fewer subjects. Independent T-test assuming unequal variance was used to compare outcomes of CXL and ACXL. A p value of <0.05 was considered significant.

RESULTS
Of the 71 patients recruited for the study, 44 eyes (35 patients) underwent CXL, and 40 eyes (36 patients) underwent ACXL. The mean age of patients in the CXL group was 21.19 ± 6.57 years while it was 22.50±8.70 years in the ACXL group (p=0.42). All procedures were uneventful intra-operatively.

All baseline parameters were comparable in both groups (Table 1). All parameters were stable at the 6 month follow-up period in both groups (Tables 2 and 3), except for pachymetry (p=0.001) and densitometry (p=0.003) in the CXL group (Table 2). Pachymetry was noted to decrease post-operatively, which returned to pre-operative levels at 6 months in ACXL group. However, the pachymetry was lower in the CXL group at 6 months (Fig. 1). We noted a statistically significant increase in densitometry at 1 month post-operatively (p<0.0001 and p=0.04 in CXL and ACXL group, respectively), which returned to pre-operative levels by 6 months in the ACXL group but remained higher in the CXL group (Fig. 2). The degree of haze was similar in both groups at 1 and 3 months (p=0.20 and 0.12 respectively at 1 and 3 months). However, the haze in CXL group was sustained at 6 months compared to baseline and also in comparison with ACXL group.

When we analyzed the outcomes of the 2 procedures, all parameters except corneal densitometry were comparable at 6 months (Table 4). No changes were noted in the keratometry over 6 months (Fig. 3 and 4). Endothelial cell density and other parameters remained stable up to 6 months in the ACXL group (Table 5).

Two patients in the CXL group developed microbial keratitis in the 1st week post-operatively. They were managed with topical fortified antibiotics based on sensitivity reports from corneal scrapings; they were excluded from the statistical analysis.

DISCUSSION
Our study demonstrates the safety and effectiveness of ACXL in maintaining the visual, refractive and topographic stability of keratoconus up to 6 months. The most significant result noted in our study is the sustained corneal haze in the CXL group compared to the ACXL group.
Corneal haze increased in both groups at 1 month post-operatively and gradually decreased thereafter. At 6 months, in the ACXL group, the mean corneal haze was comparable to pre-operative values, but remained higher in the CXL group. A longer follow-up is required to determine the clinical significance of this difference in corneal haze between the procedures with respect to the effectiveness of cross-linking on the cornea. Touboul D et. al. observed anterior stromal changes like complete obliteration of keratocytes, increased tissue reflectivity, a honeycomb-like appearance and circular lacunae on confocal microscopy; all these were more in evidence after ACXL compared to CXL.\textsuperscript{9} As we did not perform a simultaneous confocal microscopy, we cannot correlate this change with the corneal haze noted post-operatively.

We noted a decrease in the corneal pachymetry after both procedures in the initial visits, with the thickness returning to baseline values at 6 months in the ACXL group, while remaining lower in the CXL group. Various authors have noted similar changes post CXL.\textsuperscript{10,11} This has been hypothesized to be due to various causes like epithelial remodeling, compression of collagen fibrils, stromal edema and keratocyte apoptosis.\textsuperscript{10-13} Greenstein et. al. noted a decrease in corneal pachymetry measured using Pentacam at 1 and 3 months post-operatively, and a gradual increase in pachymetry thereafter with a return to pre-operative levels by 1 year.\textsuperscript{10} This is similar to that noted in our study. The decrease in pachymetry in ACXL group was less than the CXL group, correlating with the lesser haze on densitometry seen in the ACXL group. This suggests that the decrease in pachymetry could be a ‘pseudo’ measurement on Scheimpflug imaging due to the stromal haze. Another evidence to support this theory is the findings by Caporossi et. al. where they noted a decrease in pachymetry on Orbscan II, but no changes at the same time on ultrasound pachymetry.\textsuperscript{7} They hypothesized that the falsely low reading might have been due to light scattering induced by the collagen cross-linking changes in the stroma. Thus, Scheimpflug imaging may not be the ideal way to measure corneal pachymetry in the early post operative period following collagen cross-linking, and ultrasound pachymetry may be a better tool for the same; a simultaneous ultrasound pachymetry measurement along with Pentacam in our study would have validated this. We did not notice any change in BCVA, mean refractive cylinder or keratometry in both the groups corresponding to the changes in corneal haze at any follow up interval. This suggests that corneal haze may not significantly affect the clinical outcomes in the early post-operative period.

The endothelial cell changes were analyzed only in the ACXL group, in order to assess the safety of the procedure related to the endothelium. Endothelial cell damage is a special concern in ACXL due to the increased power of UVA light delivered on the cornea compared to CXL. Specular microscopy was not
Figure Legends

**Fig. 1:** Change in pachymetry in conventional versus accelerated cross-linking group [mean (95% CI)] over 6 months

**Fig. 2:** Change in densitometry in conventional versus accelerated cross-linking group [mean (95% CI)] over 6 months

**Fig. 3:** Change in flat keratometry (A) and steep keratometry (B) in conventional versus accelerated cross-linking group [mean (95% CI)] over 6 months

performed in the CXL group, as the safety of CXL on the endothelium has been demonstrated previously by various investigators. The endothelial cell count and degree of pleomorphism and polymegathism remained stable throughout the 6 months follow up period, demonstrating the endothelial safety of ACXL in the early post-operative period. Both procedures had comparable BCVA, refraction and keratometry throughout the follow up period. No progression of keratoconus was noted in both groups. Thus, both CXL and ACXL appear to be equally efficacious in maintaining stability of vision and corneal curvature at least in the early post-operative period.

Two cases of microbial keratitis were noted in the CXL group. However, this is an incidental finding and is not independently related to the procedure itself. This is to say that one cannot draw conclusions from these findings and determine one procedure to be safer than the other.

ACXL is a potential new technique in the armamentarium of the corneal surgeon in treating progressive keratoconus. It provides a faster alternative to conventional CXL. Accelerated cross-linking protocols were originally
developed following one of the fundamental laws of photochemistry called the Bunsen-Roscoe Law of Reciprocity. This law states that photochemical biological effect is proportional to the total energy dose delivered regardless

### Table 1: Pre operative parameters in the CXL and ACXL groups

<table>
<thead>
<tr>
<th>Pre operative parameters</th>
<th>CXL [Mean (95%CI)]</th>
<th>ACXL [Mean (95%CI)]</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>BCVA</td>
<td>0.31 (0.25 to 0.38)</td>
<td>0.45 (0.26 to 0.65)</td>
<td>0.73</td>
</tr>
<tr>
<td>Manifest Cylinder</td>
<td>-3.88 (-4.44 to -3.33)</td>
<td>-2.77 (-3.60 to -1.95)</td>
<td>0.07</td>
</tr>
<tr>
<td>K1</td>
<td>48.15 (46.56 to 49.75)</td>
<td>46.04 (44.56 to 47.52)</td>
<td>0.06</td>
</tr>
<tr>
<td>K2</td>
<td>50.82 (49.37 to 52.26)</td>
<td>49.05 (46.69 to 51.42)</td>
<td>0.06</td>
</tr>
<tr>
<td>Pachymetry</td>
<td>451.90 (437.32 to 466.48)</td>
<td>454.67 (433.28 to 476.05)</td>
<td>0.21</td>
</tr>
<tr>
<td>Densitometry</td>
<td>22.00 (19.37 to 24.63)</td>
<td>24.54 (17.91 to 31.96)</td>
<td>0.07</td>
</tr>
</tbody>
</table>

BCVA: Best Corrected Visual Acuity; K1: Flat keratometry on Pentacam; K2: Steep keratometry on Pentacam; CXL: conventional corneal collagen cross linking with riboflavin; ACXL: accelerated corneal collagen cross linking with riboflavin.

### Table 2: Outcomes of CXL up to 6 months post surgery

<table>
<thead>
<tr>
<th>Mean CXL (95%CI)</th>
</tr>
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<tr>
<td>Pre Operative</td>
</tr>
<tr>
<td>6 Months Post Operative</td>
</tr>
<tr>
<td>p</td>
</tr>
<tr>
<td>---------------------------</td>
</tr>
<tr>
<td>BCVA</td>
</tr>
<tr>
<td>0.31 (0.25 to 0.38)</td>
</tr>
<tr>
<td>0.28 (0.25 to 0.38)</td>
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<td>0.20</td>
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<tr>
<td>Manifest Cylinder</td>
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<tr>
<td>-3.88 (-4.44 to -3.33)</td>
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<tr>
<td>-3.87 (-4.56 to -3.17)</td>
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<td>1.00</td>
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<td>K1</td>
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<td>48.15 (46.56 to 49.75)</td>
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<td>47.89 (46.37 to 49.41)</td>
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<td>1.00</td>
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<tr>
<td>K2</td>
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<td>50.82 (49.37 to 52.26)</td>
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<td>50.72 (49.23 to 52.21)</td>
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<tr>
<td>Pachymetry</td>
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<td>451.90 (437.32 to 466.48)</td>
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<td>434.70 (416.79 to 452.61)</td>
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<tr>
<td>Densitometry</td>
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<td>22.00 (19.37 to 24.63)</td>
</tr>
<tr>
<td>26.68 (23.38 to 29.98)</td>
</tr>
<tr>
<td>0.04</td>
</tr>
</tbody>
</table>

BCVA: Best Corrected Visual Acuity; K1: Flat keratometry on Pentacam; K2: Steep keratometry on Pentacam; CXL: conventional corneal collagen cross linking with riboflavin; ACXL: accelerated corneal collagen cross linking with riboflavin.

### Table 3: Outcomes of ACXL up to 6 months post surgery

<table>
<thead>
<tr>
<th>Mean ACXL (95%CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre Operative</td>
</tr>
<tr>
<td>6 Months Post Operative</td>
</tr>
<tr>
<td>p</td>
</tr>
<tr>
<td>---------------------------</td>
</tr>
<tr>
<td>BCVA</td>
</tr>
<tr>
<td>0.45 (0.26 to 0.65)</td>
</tr>
<tr>
<td>0.32 (0.22 to 0.42)</td>
</tr>
<tr>
<td>0.21</td>
</tr>
<tr>
<td>Manifest Cylinder</td>
</tr>
<tr>
<td>-2.77 (-3.60 to -1.95)</td>
</tr>
<tr>
<td>-3.15 (-4.24 to 2.05)</td>
</tr>
<tr>
<td>1.00</td>
</tr>
<tr>
<td>K1</td>
</tr>
<tr>
<td>46.04 (44.56 to 47.52)</td>
</tr>
<tr>
<td>45.91 (44.56 to 47.27)</td>
</tr>
<tr>
<td>1.00</td>
</tr>
<tr>
<td>K2</td>
</tr>
<tr>
<td>49.05 (46.69 to 51.42)</td>
</tr>
<tr>
<td>48.77 (46.28 to 51.25)</td>
</tr>
<tr>
<td>0.42</td>
</tr>
<tr>
<td>Pachymetry</td>
</tr>
<tr>
<td>454.67 (433.28 to 476.05)</td>
</tr>
<tr>
<td>446.59 (436.15 to 482.34)</td>
</tr>
<tr>
<td>1.00</td>
</tr>
<tr>
<td>Densitometry</td>
</tr>
<tr>
<td>24.54 (17.91 to 31.96)</td>
</tr>
<tr>
<td>22.85 (21.89 to 23.81)</td>
</tr>
<tr>
<td>1.00</td>
</tr>
</tbody>
</table>

BCVA: Best Corrected Visual Acuity; K1: Flat keratometry on Pentacam; K2: Steep keratometry on Pentacam; CXL: conventional corneal collagen cross linking with riboflavin; ACXL: accelerated corneal collagen cross linking with riboflavin.
of the applied irradiance and time. To deliver an equivalent energy dose, an accelerated protocol using 30 mW/cm² irradiance requires 3 minutes to achieve the same dose of 5.4 Joules/cm² obtained in 30 minutes of irradiation with 3 mW/cm² irradiance \[(0.030 \text{ w/cm²}) \times (180 \text{ seconds}) = 5.4\text{J/cm²}\].

The Bunsen-Roscoe reciprocity law holds if all other parameters are controlled. However in the case of corneal cross-linking, there are many other factors beyond the UVA dose that contribute to the total amount and distribution of cross-linking obtained. Factors related to the clinical procedure include the beam profile and illumination pattern of the UVA delivery device, the concentration and diffusion rate of the formulation of the riboflavin used, the length of the riboflavin presoak time, the viscosity of the riboflavin formulation, and the presence of additives that accelerate or inhibit the reaction, as well as presence and diffusion rate of oxygen in the target tissue.

Based on known factors, comsol models have been developed, and protocols are developed using this computer model through finite element analysis; riboflavin activation is then modeled as a function of tissue concentration and UVA dose. Based on both endothelial safety studies performed by David Sliney and theoretical modeling, which indicates that during the shorter irradiation time, the availability of riboflavin and oxygen is less due in part

<table>
<thead>
<tr>
<th>Table 4: comparison of the 6 months outcomes of CXL and ACXL</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mean CXL (95%CI)</strong></td>
</tr>
<tr>
<td>----------------------</td>
</tr>
<tr>
<td>BCVA</td>
</tr>
<tr>
<td>Manifest Cylinder</td>
</tr>
<tr>
<td>K1</td>
</tr>
<tr>
<td>K2</td>
</tr>
<tr>
<td>Pachymetry</td>
</tr>
<tr>
<td>Densitometry</td>
</tr>
</tbody>
</table>

**BCVA-Best Corrected Visual Acuity; K1-Flat keratometry on Pentacam; K2-Steep keratometry on Pentacam; CXL-conventional corneal collagen cross link with riboflavin; ACXL-accelerated corneal collagen cross linking with riboflavin.**

<table>
<thead>
<tr>
<th>Table 5: Endothelial cell changes on specular microscopy in ACXL group</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pre operative Mean (95% CI)</strong></td>
</tr>
<tr>
<td>-----------------------------</td>
</tr>
<tr>
<td>CD</td>
</tr>
<tr>
<td>CV</td>
</tr>
<tr>
<td>6A</td>
</tr>
</tbody>
</table>

**CD - Endothelial cell density/mm²; CV - Co-efficient of variation (degree of polymorphism of endothelial cells); 6A - Percentage of hexagonal cells (degree of pleomorphism of endothelial cells); ACXL - accelerated corneal collagen cross linking with riboflavin.**
to a shorter total induction time (pre-soak + irradiation) than the Dresden protocol, the company (Avedro) recommends that 7.2 J needs to be delivered at 30mW for 4 minutes. Regarding safety, the modeling demonstrates that with a shorter soak and this higher dose, riboflavin activation is highest in the anterior stroma, where cross-linking is desirable, and cross-linking at the level of the endothelium well within established safety thresholds.

No long term data on ACXL is available to date. The major concern in ACXL is regarding endothelial damage due to increased power of UVA radiation. However, we have demonstrated the safety of ACXL on the endothelium, at least in the initial post-operative months. Longer follow-ups are required to confirm the safety of ACXL on the endothelium.

The limitations of our study are it is a non-randomized study with a small sample size and short follow up. We have not analyzed the endothelial changes in the CXL procedure; however we believe that the safety of CXL procedure with respect to endothelial cell function has been proven beyond doubt. A comparison of ultrasound pachymetry with that of Pentacam would have validated the pachymetry changes better. While we did not have a control group in our study, we believe that it would be unethical not to treat an eye with progressive keratoconus given the proven effectiveness of cross-linking; hence, we compared the new alternative approach to the established conventional CXL.

We believe this is the first report on the safety and effectiveness of accelerated cross-linking in progressive keratoconus (ACXL). It appears to be a safe and faster alternative to CXL and it might in future be a feasible replacement to CXL. Randomized trials with a longer follow-up in other population cohorts are required for surgeons to extrapolate findings from this study.

**REFERENCES**


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**Phototherapeutic Keratectomy and Chelation for the Treatment of Band Shaped Keratopathy**

Dr. (Lt. Col.) Alok Sati, Dr. Mukesh Taneja, Dr. Murthy Somasheila I., Dr. Rathi Varsha Madanlal

Band shaped keratopathy (BSK) is characterized by the appearance of a band across the central cornea, formed by the precipitation of calcium salts on the corneal surface (directly under the epithelium). This form of corneal degeneration results from both ocular and systemic factors and is treated either with ethylenediaminetetraacetic acid (EDTA), superficial keratectomy or phototherapeutic keratectomy (PTK). Though literature is abundant in describing the effects of these treatment modalities on individual basis, however, we could not find the comparative analytical study between EDTA and PTK in the management of BSK. The current study compares EDTA and PTK as treatment modalities in BSK and to the best of our knowledge, no such comparative study has been described in literature.
MATERIALS AND METHODS

A retrospective analysis of clinical case records of 23 eyes of 23 patients with BSK was performed at a tertiary eye care center in South India, who underwent either removal of deposits either by EDTA or PTK between 1990 and 2012. Out of 23 eyes 9 eyes underwent removal of deposits with EDTA and 14 eyes underwent PTK. Preoperative evaluation included demographics, assessment of vision and corneal clarity, predisposing factors leading to BSK, ocular associations and indications of surgery. EDTA was performed by applying 0.05 mol of 1.5% neutral EDTA on corneal surface for 5-30 minutes followed by removal of calcium deposits with an ophthalmic surgical blade. PTK was performed by graded application of excimer laser on the central optical zone after debridement of epithelium. Corneal clarity was graded on a scale of 0 to 4, as given by Sharma N et. al., which is a modified version of post-refractive surgery corneal haze grading given by Gartry et. al. Postoperative assessment was done in terms of vision, corneal clarity, postoperative epithelial healing and recurrence. Descriptive statistics in term of mean and standard deviation were used to analyse the results.

RESULTS

<table>
<thead>
<tr>
<th>Preoperative characteristics</th>
<th>EDTA (n=9)</th>
<th>PTK (n=14)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>42±36(range,17 to 69 years)</td>
<td>35.12±44.58(range, 7 to 75 years)</td>
</tr>
<tr>
<td>Gender</td>
<td>M:F::1:1</td>
<td>M:F::5:1</td>
</tr>
<tr>
<td>UCVA (log MAR)</td>
<td>0.13±0.30</td>
<td>0.14±0.24</td>
</tr>
<tr>
<td>BCVA (log MAR)</td>
<td>0.19±0.44</td>
<td>0.19±0.34</td>
</tr>
<tr>
<td>Spherical equivalent</td>
<td>-0.12±1.33</td>
<td>+0.25±0.36</td>
</tr>
<tr>
<td>Corneal clarity score</td>
<td>0.77±1.66</td>
<td>1.71±1.40</td>
</tr>
</tbody>
</table>

Indications of surgery

- Vision: 8, 14
- Cosmesis: 0, 0
- Vision+cosmesis: 1, 0

Associations

- Dense amblyopia: 1, 0
- Lattice dystrophy: 1, 1
- BRVO: 1, 0
- Subluxated IOL: 1, 0
- Diabetic retinopathy: 0, 1
- Aphakia: 0, 1
Predisposing factors

- Idiopathic 4 9
- Chronic anterior uveitis secondary to unknown etiology 2 3
- Chronic anterior uveitis secondary to infection 1 1
- Chronic anterior uveitis secondary to trauma 2 1

Postoperative characteristics at 6 month

<table>
<thead>
<tr>
<th></th>
<th>EDTA (n=9)</th>
<th>PTK (n=14)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Preop</td>
<td>Postop</td>
</tr>
<tr>
<td>BCVA</td>
<td>0.19±0.44</td>
<td>0.01±0.06</td>
</tr>
<tr>
<td>Spherical equivalent</td>
<td>-0.12±1.33</td>
<td>0.59±3.34</td>
</tr>
<tr>
<td>Corneal clarity score</td>
<td>0.77±1.66</td>
<td>1.77±3.70</td>
</tr>
</tbody>
</table>

Other features postoperatively

<table>
<thead>
<tr>
<th></th>
<th>EDTA (n=9)</th>
<th>PTK (n=14)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Epithelial healing after surgery (days)</td>
<td>6.22±15.66</td>
<td>4.36±6.40</td>
</tr>
<tr>
<td>Total follow up period (months)</td>
<td>12± 28.20 (range, 1 to 36)</td>
<td>35.57±88.52 (range, 1 to 132)</td>
</tr>
<tr>
<td>Recurrence</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>• Site</td>
<td>Nasal</td>
<td>Central</td>
</tr>
<tr>
<td>• Average duration (months)</td>
<td>36 months</td>
<td>10 months</td>
</tr>
</tbody>
</table>

DISCUSSION

EDTA chelation: In our study, the most common indication of surgery was idiopathic where as Najjar DM et. al.² has described chronic corneal edema as the most common indication. This can be explained by difference in age at presentation. In our study, we have found no significant change in vision postoperatively in spite of significant improvement in cornea clarity score. This has been attributed to associated abnormalities like dense amblyopia, lattice dystrophy, BRVO and subluxated IOL. Najjar DM et. al.² have stated that 10 of 56 eyes (17.8%) had a recurrence at a mean time of 17.7 years (range, 1 month to 26 years) whereas we have found only one recurrence at 36 month after EDTA chelation.

PTK: Sharma N et. al.⁴ have stated 90% improvement in BCVA which was comparable with study by O'Brart et. al.⁴ However, we have not seen similar observations in our series. What we have observed is a nonsignificant change in BCVA. This could be attributed to varying indications in our series with associated comorbidities. We have found a significant improvement in cornea clarity score as compared to preoperative period. Sharma N et. al.⁴ have
observed a recurrence of two cases in her series. Both these eyes had silicone oil retained in the eye. Because the inciting factor was still there, the effect of PTK was to a great extent nullified. However, what incites recurrence in our patient is unknown.

In conclusion, both EDTA and PTK are the effective modalities to treat BSK. Their effectiveness should be judged based on corneal clarity score rather than on the basis of traditional method of judgment i.e. BCVA. This retrospective series shows a trend of similar rate of recurrence with both EDTA and PTK. However with such a small simple size, it is difficult to assess accurately. Moreover, we require a large sample size prospective study to finally conclude the results.

REFERENCES

In Vitro Efficacy of Riboflavin/UVA Combination Against Protozoal, Norcardia and Fungal Isolates

Dr. (Lt. Col.) Alok Sati, Dr. Prashant Garg, Dr. Pravin K Vaddavalli, Dr. Swapna Reddy

Antimicrobials against infective keratitis are associated with various issues including dosing frequency, compliance, cost, side effects and development of resistance. A search on, an alternative has found a potential antimicrobial combination in form of ultraviolet irradiation and riboflavin. This antimicrobial combination acts through oxygen free radicals, which interfere with cell membrane integrity. A scant literature exists regarding the dosage of riboflavin and the duration of ultraviolet exposure that would have an effect in eliminating or retarding the infectious process. The current project involves a series of invitro experiments highlighting the effect of the
above mentioned combination therapy in management of acanthamoeba, nocardia and fungi induced keratitis.

**MATERIALS AND METHODS**

A prospective in vitro study aimed at demonstrating the efficacy of UVA irradiation, riboflavin and a combination of both against acanthamoeba, nocardia and fungi at L V Prasad Eye Institute Hyderabad. A total of 15 isolates were included in the study, comprising of non-repetitive ocular isolates of Nocardia species (3), Fusarium species (3), Aspergillus flavus (3), Curvularia species (3), and Acanthamoeba (3). All the isolates were obtained from corneal scrapings of patients who had been investigated for microbial keratitis at our institute. A set of 4 culture plates was inoculated with each organism and the following protocol was followed for riboflavin or ultraviolet light (UVA) exposure.

Plate 1. Control (no riboflavin or UV)
Plate 2. Riboflavin only
Plate 3. UVA irradiation only (for 30 minutes)
Plate 4. UVA irradiation (for 30 minutes) + riboflavin.

All plates were read after incubating in the appropriate incubation conditions. The growth characteristics on the culture plate were interpreted as follows:

- Complete inhibition of growth at the site of exposure
- Significant inhibition (presence of few isolated colonies at the site of exposure)
- Minimal inhibition (confluent growth but visibly less than the unexposed part or the control plate)
- No inhibition at all

**RESULTS**

**Exposure to riboflavin alone**

3/3 Acanthamoeba, 12/12 fungal and 2/3 Nocardia isolates showed no inhibition of growth at all. 1 isolate of Nocardia showed significant inhibition of growth.

**Exposure to UV alone**

3/3 Nocardia, 12/12 fungal isolates and 3/3 Acanthamoeba showed no inhibition at all.

**Exposure to UVA + Riboflavin**

3/3 Nocardia showed significant inhibition of growth, whereas all the fungal and Acanthamoeba isolates tested showed no inhibition of growth at all.
DISCUSSION

The rationale of using UVA and riboflavin for infectious keratitis is based on the riboflavin-based pathogen reduction technology (PRT) used to treat blood products. The infectivity of pathogens is reduced by three combined mechanisms. First, the direct damage of nucleic acids of pathogens with the UVA irradiation source; secondly, damage of pathogen nucleic acids, proteins, and membranes by reactive oxygen species generated when riboflavin absorbs light and interacts with dissolved oxygen in solution. The third is the damage of pathogen nucleic acid by the interaction of riboflavin with nucleic acids.

Sauer A et. al. have found that riboflavin/UVA treatment was ineffective against A. fumigatus and Fusarium sp. Their observations were similar to what we observed in our study. In addition, we found that riboflavin/UVA was ineffective against Curvularia. The combination riboflavin/UVA effects could have another downside as the depth of penetration has been experimentally determined to be 300μm. This, along with the fact that penetration of the UVA is further impeded by an opaque cornea, could mean that this approach may have no impact on deep fungal infection in vivo.

Therapy for AK includes application of chemical compounds, such as biguanides and diamidines, hourly for months. Due to the aggressive, prolonged, and not uniformly successful treatment currently employed, alternative therapeutic procedures have been proposed for AK. Although the successful combination of UVA and riboflavin in therapy for AK has been described, our data demonstrates resistance of this protozoa strain to the photochemical process in our in vitro model. Our observations are in concordance with the in vitro model of Kashiwabuchi et. al.

Though, Amikacin is the drug of choice for nocardia keratitis and at present found to be quiet effective, however, our result shows promosing result in term of effectiveness of combination therapy. This gives a future scope of using it in nocardia keratitis. In conclusion, Riboflavin/UVA combination is effective against nocardia species, but ineffective on fungal and protozoal isolates.

REFERENCES

Descemet-Stripping Endothelial Keratoplasty (DSEK) with Insertion of Donor Button using Cystitome

Dr. Prateek Gujar

Descemet’s stripping endothelial keratoplasty (DSEK) can be considered as the most important breakthroughs in transplant surgery in the last 30 years. DSEK is purported to have several advantages over penetrating keratoplasty (PK). DSEK has generated successful outcomes in patients with corneal endothelial diseases, with more corneal surgeons preferring it over PK. Starting DSEK in initial cases can be quite challenging, particularly donor disc insertion and manipulation inside the anterior chamber. This should be done gently to protect the endothelial cells. Various techniques and inserters have been developed to facilitate non traumatic insertion of the graft. One of the disadvantages of DSEK is significantly higher endothelial cell loss in 1 to 2 years compared to PK. Some studies have reported 34% loss of endothelial cells in 6 months and 35% in 1 year. This loss of endothelial cells can be explained perhaps by learning curve of DSEK and mainly by factors related to the preparation and handling of the donor button.

We herein describe our experience of donor graft insertion using 27g needle cystitome to facilitate insertion in an easy and non-traumatic way.

MATERIALS AND METHODS

Prospective, interventional case series involving 37 eyes of 37 patients who underwent DSEK for endothelial dysfunction, at our centre. All patients signed the consent form for DSEK. All the cases were operated by a single surgeon. Exclusion criteria included eyes with active inflammation, silicone oil in vitreous cavity, and uncontrolled glaucoma.
Preoperative and postoperative evaluation included best corrected visual acuity (BCVA) using the Snellen chart, intraocular pressure (IOP), slit lamp bio microscopy and fundus evaluation. In patients with raised Intraocular pressure (IOP); IOP was successfully controlled using antiglaucoma medications before the surgery. B-scan ultrasound was done in cases of dense media haze. Density of donor corneal endothelial cells was also recorded. Postoperatively, anterior segment Optical coherence topography (AS-OCT) was performed after healing of epithelial defect. On the 6 month, 9 month, and 1 year postoperative visit specular microscopy was also done.

Preparation of the donor graft: The cornea donor was mounted on an artificial anterior chamber. In all cases manual dissection was performed. Initial incision extending to 1 quadrant was made at the limbus using a 350 microns guarded knife. Dissection was completed using pair of lamellar dissectors. After complete dissection, donor tissue was submerged in MK medium.

Surgical technique: All cases were performed under peribulbar anaesthesia except in patient with CHED who was operated under general anaesthesia. Temporal conjunctival peritomy was done and a temporal 6 mm corneoscleral tunnel was prepared. Two side port incisions were made at 12 and 6 0’ clock position. Cornea was marked with a trephine of 70% of horizontal corneal diameter. Anterior chamber (AC) was filled with dispersive viscoelastic and descemetorrhexis was performed using trephine mark as a guide. AC was washed thoroughly to remove all viscoelastic.

The scleral bed was coated with dispersive viscoelastic. Donor tissue was then transferred to teflon block and punched to desired diameter. Posterior part of donor tissue is then separated from anterior part, and placed over the scleral bed with endothelial side down. A 27g needle is bent at the tip to form a cystitome. The donor rim is engaged with the cystitome and gently pushed inside the AC. The upper lip of the tunnel is lifted with toothed forceps during insertion. The cystitome is then disengaged and taken out of the AC. Balanced salt solution (BSS) is gently pushed inside the AC and air is injected beneath the donor tissue. Scleral incision is then closed using 3 interrupted 10-0 nylon sutures. Donor tissue is then centered using reverse sinskey hook and a complete air fill is done. Side port incisions are then closed using single 10-0 nylon suture. The compression of the air was maintained for 10 minutes in all the cases except cases with ABK in which air fill was maintained for 60 minutes. Finally, BSS was injected and some air was removed to leave behind an air bubble that approached the size of the donor button.

In 3 cases of PBK, DSEK was combined with phacoemulsification and intraocular lens implant (IOL). In these cases phacoemulsification was done with scleral tunnel approach and DSEK was performed after IOL implant.
RESULTS
Out of 37 patients, 22 (59.45%) patients were male, 15 (40.54%) were female. Mean age was 57.52 years (range 10-70 years). Mean follow-up period was 9.16 months (range 6-16 months). Preoperative diagnosis included Fuch’s dystrophy (n=5, 13.51%), Pseudophakic bullous keratopathy (PBK, n=28, 75.67%), Congenital hereditary endothelial dystrophy (CHED, n=1, 2.70%), Iridocorneal endothelial syndrome (ICE, n=1, 2.70%), Aphakic bullous keratopathy (ABK, n=2, 5.4%).

Preoperatively all patients have BCVA of 6/60 or worse. The mean preoperative BCVA (Log Mar) was 1.19± 0.24. Postoperatively 67.56% (n=25) achieved a BCVA of 6/24 or better at last follow-up. The mean postoperative BCVA was 0.63± 0.37. There was a significant improvement in BCVA post-DSEK with p=0.02 (pair t test). The mean post-op astigmatism in Dioptres (D) was 1.6250 ±0.458. The mean postop spherical equivalent (SE) in non aphakic clear grafts was 2.12 D (n=34). Mean graft size was 8.01mm (range 7-8.5mm). Mean Preoperative endothelial cell density (ECD) in the donor cornea was 2558.67 ±301/sq. mm. The mean postoperative ECD in the clear grafts (n=35) at the last follow-up was 1797±223cells/sq.mm with a percentage endothelial cell loss of 29.76%.

The number of clear grafts at last follow-up was n=35 (94.59%). The mean central graft thickness at last follow-up was 135.62µ (range 91-157µ). Donor tissue dislocation was noted in 3 patients (8.1%) grafts. All the graft dislocations were noted on the first postoperative day and were managed with repositioning and rebubbling. While 2 grafts subsequently cleared after rebubbling, 1 graft had primary donor failure. 2(5.4%) patients (1 with ABK, 1 with CHED) had primary graft failure.

DISCUSSION
Various insertion techniques have been described to minimize the endothelial cell loss in DSEK. The mean endothelial cell loss reported at the end of 6 months after DSEK/DSAEK is 37%. Bahar et. al. reported endothelial cell loss significantly lower in the Busin guide-assisted DASEK group (25%) as compared to 34.3% loss in the Forceps-assisted DSAEK group. In our series the mean endothelial cell loss at last follow-up was 29.76%.

Dislocation of the graft remains the most important complication of DSEK, and it is typically evident within the initial week. Suh et. al. reported a dislocation rate of 23%. Lee et. al. reported a mean dislocation rate of 14.5% in DSEK/DSAEK. In our series 3 (8.1%) patients had graft dislocation. All the dislocations were evident on first postoperative day.

Primary graft failure in DSEK has been linked to poor surgical technique, with surgeon inexperience and related excessive iatrogenic intraoperative donor endothelial trauma as a main factor. The published studies showed rates from 0% to 29%, with an average primary graft failure rate of 5%. In our series 2 patients (5.4%) had primary graft failure. 1 patient had ABK and
1 patient had CHED as primary pathology. Studies show that DSEK induces a hyperopic refractive shift with an average induced hyperopia of 1.1D. In our series the mean SE in non aphakic eyes with clear grafts (n=34) was 2.12D. The mean post-operative astigmatism in our series was 1.625D. Preoperative astigmatism could not be assessed in most of the patients due to corneal surface irregularity. The average postoperative astigmatism reported after DSEK is 1.5 D, with surgically induced astigmatism ranging from 0.4 to 0.6 D, with a mean of 0.11 D of induced astigmatism.

**Conclusion**

To conclude insertion of donor graft with cystitome appears to be safe, easy to learn, and effective technique. It allows a hassle free insertion of the donor graft without the need to fold the graft. It is also more cost effective when compared to other insertion devices.

**REFERENCES**

X-Linked Megalocornea Associated with A Novel Chrdl1 Gene Mutation

Dr. Anthony J Aldave

X-linked megalocornea (MGC1; MIM 309300) is a rare anterior segment dysgenesis that is characterized by enlarged corneal diameters (>13 mm), corneal thinning and increased anterior chamber depth without other clinical features associated with congenital glaucoma. Although MGC1 was mapped to Xq12-q26 in 1991,2,3 the genetic basis was not reported until 2012.4 Using array comparative genomic hybridization (aCGH) to detect copy number variation in an affected individual, Webb and colleagues identified a 250 kb deletion on Xq23 that involved the Chordin-like 1 gene (CHRDLL1; MIM*300350) and segregated with the affected phenotype in the affected individual's family.4 We report an additional family with clinical features and inheritance pattern consistent with MGC1, associated with the novel p. (Pro56Leu*8) mutation in CHRDLL1.

An eleven-year-old boy with a history of impaired vision since age 4 was referred to one of the authors (S.J.I.) for evaluation. Corrected distance visual acuity (CDVA) was 20/25 OU and both corneas were clear but enlarged with horizontal corneal diameters measuring 15.0 mm OD and 14.5 mm OS. The intraocular pressures were within normal limits and optic nerve cupping was not observed in either eye. At age 15, he was referred to another of the authors (A.J.A.) for examination and DNA collection. CDVA measured 20/25 OD and 20/30 OS and slit lamp examination revealed bilaterally enlarged cornea diameters of 14.0 mm OU without abnormalities of clarity or contour. The anterior chambers were of increased depth, measuring 6.34 mm OD and 6.14 mm OS and the central corneal pachymetry was decreased at 463 microns OD and 461 microns OS. Corneal topographic imaging was unremarkable, with average keratometry values of 43.9 D OD and 44.0 D OS.

Examination of the proband’s three younger brothers revealed normal horizontal corneal diameters of approximately 12.5 mm in one and enlarged horizontal corneal diameters of 14.0 mm in two. While the central corneal pachymetry was slightly increased in the brother with normal corneal diameters (604 microns OU), it was decreased in the two affected brothers (466 microns OD and 459 microns OS in III-3; 482 microns OD and 514 microns OS in III-4). Corneal topographic imaging of the unaffected brother demonstrated average keratometry values of 41.83 D OD and 41.42 D OS, as compared to an average keratometry value of 45.65 OS (reliable corneal topographic imaging could not be obtained OD) in the proband’s 6-year-old brother. Corneal topographic imaging could not be performed in the proband’s 3-year-old brother. Examination of the proband’s mother was unremarkable.
Screening of each of the 12 exons of CHRDL1 was performed in the proband, his mother and each of his three siblings. A novel nucleotide deletion (c.167delC) was identified in exon 3 in the proband that is predicted to result in a frameshift mutation (p.(Pro56Leu*8)). This mutation was present in the hemizygous state in the proband’s two affected brothers and in the heterozygous state in the proband’s mother. The mutation was not identified in the proband’s unaffected brother or in 100 control X chromosomes.

We provide the initial confirmation of CHRDL1 mutations associated with MGC1 following the report by Webb and colleagues of a CHRDL1 mutation in seven families. We report a novel deletion in CHDRL1 (c.167delC; p. (Pro56Leu*8)) predicted to cause truncation of the protein product. To date, each of the eight families with MGC1 that has been screened has demonstrated a unique CHRDL1 mutation, including one of the two families in which linkage to CHRDL1 was demonstrated.

Therefore, there is no evidence for locus heterogeneity for MGC1 as there is for several other inherited disorders of the cornea, including posterior polymorphous corneal dystrophy (PPCD) and Meesmann corneal dystrophy. However, MGC1 is similar to PPCD in that each pathogenic mutation identified to date is predicted to result in premature termination or absence of protein production and is unique to the family in which it was identified. Based on this and the type and location of mutations identified to date, confirmation of a presumed clinical diagnosis of MGC1 may necessitate screening the entire coding region of CHDRL1 as well as splice sites and/or performing cytogenetic analysis for copy number variation.

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Trans-Epithelial Accelerated Corneal Collagen Cross-Linking (TEKXL): 6 Months follow up

Dr. Raghuraj S Hegde, Dr. Sharon D’Souza, Dr. Ashwini, Dr. Rohit Shetty

Keratoconus is a noninflammatory progressive ectatic disease of the cornea. Its incidence in western population is estimated to be approximately 1 in 2000. In most cases, keratoconus starts at puberty and progresses at a variable rate. The management of keratoconus with collagen cross linking (CXL) using ultraviolet (UV) irradiation and simultaneous topical riboflavin administration has been studied at length by several studies. Accelerated Collagen Crosslinking protocols (KXL) by Avedro™ have been found to as effective standard longer protocols used previously. Collagen cross linking conventionally requires deepithelialization before the administration of the photosensitizing agent and UV irradiation. This is because the corneal epithelium constitutes a barrier against penetration of molecules with a molar mass higher than 100 g/mol. Riboflavin is vitamin B2, a micromolecule with a molar mass of 376 g/mol that cannot penetrate the epithelium’s tight junctions. However, deepithelialization carries potential complications, such as corneal haze, ulceration, and infection. Trans-epithelial accelerated corneal KXL (TEKXL) is a new technique generating interest and has shown to be effective in improving BCVA and reducing the corneal curvature in patients with progressive keratoconus. This study aimed to assess the effectiveness and safety of TEKXL in reducing the progression of keratoconus and to evaluate the refractive changes induced by this treatment.

Purpose

To analyze outcomes of Trans-epithelial accelerated corneal collagen cross-linking with Riboflavin (TEKXL) (Avedro™ protocol) in Keratoconus corneas with low pachymetry.
MATERIALS AND METHODS

Twenty five eyes with Keratoconus (mean thinnest pachymetry- 410 ± 20µm) which underwent TEKXL were studied for best corrected visual acuity (BCVA), flat, steep and mean keratometry (K1, K2 and Km) on Pentacam, Densitometry (D) from Scheimpflug images and Deformation Amplitude(DA) from Corvis® ST for biomechanical stability preoperatively and on follow up at 1 week, 1 month, 3 months and 6 months. Epithelial profiling and specular microscopy was done preoperatively and at every follow-up and confocal microscopy 1 week preoperatively and on follow up at 3 and 6 months.

Formulations used

ParaCel™, a trans-epithelial riboflavin formulation from Avedro™, is a dextran-free, hypoosmolar formulation that contains permeability enhancing agents, including BAC, to allow for penetration through the epithelial barrier as described above. When eye drops containing BAC are used chronically, this cumulative dose may result in damage to the superficial corneal epithelial cells similar to that which occurs in dry eye syndrome. The effects of BAC are both duration and concentration dependent; therefore when considering the one-time application of ParaCel that occurs in trans-epithelial cross-linking, it is desirable to achieve a balance between permeability enhancement and epithelial preservation.

Vibex Xtra™ a 0.25% BAC-free riboflavin formulation is used to flush the ParaCel™ from the eye and is allowed to soak for the remainder of the induction period. Because the epithelium is left intact, the endothelial pumps are able to maintain normal stromal hydration, pulling fluid inward through the loosened epithelial junctions. This action, together with the increased (0.25%) riboflavin concentration found in ParaCel, permits ample riboflavin penetration to the corneal stroma in spite of the residual epithelial barrier.

Surgical Technique

Transepithelial CXL is similar to the conventional method but without removal of the epithelium. One drop of an anesthetic agent (proparacaine hydrochloride 0.5%) was instilled 10 minutes before draping. Immediately afterward, riboflavin solution (ParaCel™) was instilled every 90 seconds, for a total of 5 minutes. A BAC-free riboflavin formulation (such as VibeX Xtra 0.25% riboflavin solution) is used to flush the ParaCel™ from the eye and is allowed to soak for the remainder of the induction period, an additional five minutes. The eye was then exposed to ultraviolet A (UVA) with a UVA system (Avedro™) with a wavelength of 370 nm and an irradiance of 45 mW/cm2 for 2 minutes 40 seconds, corresponding to a total dose of radiation exposure of 7.2j/cm2 of the cornea. At the end of 2 minutes 40 seconds of irradiation, the
The cornea was washed thoroughly with a balanced salt solution. Postoperative treatment comprised moxifloxacin 0.5% eye-drops, lubricant eye-drops and tapering dose of steroid for 1 month.

**RESULTS**

Mean Best corrected visual acuity (BCVA) (pre-operative)- LogMAR 0.52; Mean pre-operative – flat keratometry (K1) was 50.80, steep keratometry (K2)- 55.48, mean keratometry Km- 53.05; Mean pre-operative Densitometry (D)- 23.62 ± 3.20. Mean pre-operative Deformation Amplitude (DA)- 1.34±0.14. On specular microscopy mean endothelial cell count (pre-operative) was 2134±40. On follow-up at 1 week and 1, 3 and 6 months K1, K2, Km, D, DA were measured. Mean post-operative K1- 50.87, 50.35, 50.45, 50.54. K2- 55.16, 54.85, 54.38, 54.60. Km- 53.04, 52.48, 52.56, 52.72. Mean postoperative Deformation amplitude (DA) was 1.25, 1.24, 1.31, 1.31. Mean post-operative Densitometry (D) was 23.8, 22.3, 21.36 and 21.30. At 6 months post treatment all parameters were stable (p> 0.05). Mean endothelial cell count at 6 months was stable at 2128±30. Mean BCVA improved to LogMAR 0.43 at the end of 6 months (p<0.05).

**Conclusions**

Trans-epithelial accelerated corneal collagen cross linking is a promising new procedure for stabilizing progressive keratoconus in corneas with low pachymetry not suitable for conventional cross-linking. The treated corneas at 6 months follow up displayed stability in all measured parameters (BCVA, keratometry deformation amplitude and endothelial cell count).

**DISCUSSION**

The goal of crosslinking treatment is to delay or halt the progression of keratoconus and to defer the need for a corneal transplantation. The technique was shown to arrest progression of keratoconus due to an increase in the biomechanical strength of the cornea in the anterior 200µ of the stroma. In the use of transepithelial riboflavin in adults, the effect of TEKXL has increased to nearly that of conventional cross linking as a result of the enhancer effect of EDTA and BAC, which increase the epithelial permeability of hydrophilic macromolecules. The risk for adverse events was lower with the epi-on technique than with the epithelium-off (epi-off) technique. In our study, in the patients undergoing TEKXL, the BCVA after 6 months improved marginally by 0.09 logMAR; this was not statistically significant (P>0.05) but there was no drop in BCVA in all eyes. There was a reduction in the average flat, steep and mean K reading in this series but it was not statistically significant (p> 0.05) but there was no increase of any K readings in all eyes indicating a degree of stabilization. The observed reduction in K values was probably the result of the increased biomechanical stability of the cornea after TEKXL. Biomechanical
stability was indicated by mean Deformation Amplitude (DA) and mean Densitometry values being stable (p> 0.05). Apoptosis was tracked by confocal microscopy which showed activated keratocytes at 3 months and apoptosed kerocytes at 6 months. This finding could correspond to the apoptosis that occurs after the treatment (2 to 3 months) and the repopulation that occurs thereafter (6 to 12 months). Wollensak et. al. found that this apoptotic cell death occurs after exposure to UVA light. Regarding the safety of TEKXL, no sight-threatening complications were encountered. In our study, there was no significant loss of corneal endothelium at the end of 6 months. Thus, TEKXL can play a key role in reducing the necessity for corneal transplantation in eyes with keratoconus. Furthermore, there is the added advantage of obviating the risks and complications associated with keratoplasty. In conclusion, TEKXL safely increased the stability of the cornea and may arrest or reverse the progression of keratoconus in patients with keratoconus with low pachymetry, at least in the short term. This method is technically simpler and less invasive than other therapies proposed for keratoconus. Further studies with more patients and a longer follow-up are needed to verify the stability of the induced effect.

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Cultured Oral Mucosal Epithelial Stem Cell Transplantation (COMET) in Cases of Bilateral LSCD

Dr. Gurjeet Singh, Dr. Himanshu Matalia

Total LSCD is a dysfunction or destruction of the entire limbal epithelial stem cell population, resulting in the progressive destruction of the corneal epithelium. It is characterized by conjunctivalisation, persistent epithelial defect, chronic inflammation, neovascularisation and corneal opacification. In bilateral LSCD various treatment procedures available are –keratolimbal allograft from cadaveric tissue, living HLA-matched donor, cultured live related limbal allograft and cultured oral mucosal epithelial transplantation (COMET).

Aim of this study is to study the clinical outcome of COMET in cases of bilateral total LSCD.

Study design: Observational case series.

MATERIALS AND METHODS

This study was conducted in Cornea Dept., Narayana Nethralaya, Bangalore from Jun 2010- July 2012. Patients gave written consent for the study approved by ethics committee. Inclusion criteria for total bilateral LSCD on Slit lamp exam for study were- 1) a complete disappearance of the palisades of Vogt girdle in the limbal area, 2) with persistent defects, recurrent ulcers, 3) neovascularisation, 4) conjunctivalisation. Exclusion criteria for study included 1) infectious eye disease, 2) h/o acute phase of ocular inflammation 3) h/o neoplastic disease, 4) glaucoma, 5) total symblepharon. Efficacy and outcome of procedure was identified as Primary outcome and Secondary outcome. In Primary outcome -Healed Epithelial defect, absence of conjunctivalization, decrease in corneal vascularization and in secondary outcome-improvement in presenting symptoms –photophobia, watering, central corneal clearing, improvement in visual acuity were taken as measures. Success was taken as when - all 3 criteria either improved or remained stable at mean follow up period. Failure was regarded if at least one criterion worsened or if one criterion that was subnormal at inclusion remained stable. Preparation of case was done taking care toward tooth decay t/t, abstinence from alchol /tobacco, regular tooth brushing and iodine gargles. A 3mm x 3 mm oral mucosal biopsy
(a) was taken and shredded in pieces and plated on amniotic membrane in Human Corneal Epithelium medium (b) and cultured at 37 deg for 2 weeks\(^3\) (c).

Growth of mucosal cell was monitored by daily observation of growth on inverted phase contrast microscope till formation of monolayer which usually takes 10-14 days. Then cultured oral mucosal cells are implanted at site of LSCD.

**RESULTS**

7 eyes of 4 patients, all males with median age 25 years (13-40 years) with mean follow up of 12 months with longest follow up to 24 months were included in this study. Epithelial defect improved in all 6/7 (86%) eyes. No conjunctivalisation was seen in 7/7 eyes at mean follow up period. In all cases, peripheral neovascularization to moderate degree manifested without markedly affecting visual function. Primary success outcome was 86%.

VA improved from average pre-op CF to post-op 20/300, with 1 eye to 20/25 for which PKP was done. All patient had improvement in there subjective symptoms like photophobia, watering. None of the eyes developed any serious ocular adverse effect.

**DISCUSSION**

Reconstruction with autologous COMET offers substantial clinical advantages over allogeneic transplantation for treating severe and bilateral diseases such as the Stevens–Johnson syndrome.\(^4\) It averts the risks of allogeneic immunorejection and immunosuppression which is required in procedures like keratolimbal allograft from cadaveric tissue and cultured live related
limbal allograft. In our study modest peripheral corneal neovascularization was observed within a few months after transplantation of the cell sheet and reached a stable state within six months, also reported in other studies.\(^4\,^5\) Transplanted buccal mucosal cell survive by vessel canalization. Higher success rate attained in our study can be pointed to 86% cases being chemical injury cases.

**Conclusion**

Cultivated autologous oral mucosal epithelial sheet transplantation constitutes a promising treatment in patients with severe and bilateral ocular surface disorders.

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5. Midterm results on ocular surface reconstruction using cultivated autologous oral mucosal epithelial transplantation—Tsutomu Inatomi.
Outcome of Simple Limbal Epithelial Transplant (SLET) for Limbal Stem Cell Deficiency (LSCD)

Dr. Vikas Mittal

The discovery of limbal location of corneal epithelial stem cells revolutionized the treatment and hence the prognosis of corneal blindness due to ocular surface burns. Sangwan et. al. recently proposed a novel technique of in-vivo expansion of limbal stem cells, Simple limbal epithelial transplantation (SLET). It uses less donor tissue than that used for conventional autografting, does not require a specialized laboratory and a cell biologist and is less expensive. At the same time, the outcome of this procedure is comparable to all earlier described procedures of limbal cell transplantation in LSCD. In this paper we describe our learning experience in this new and novel procedure.

MATERIALS AND METHODS

This retrospective interventional case series included the prospectively collected data of first 6 patients of unilateral limbal stem cell deficiency secondary to ocular surface injuries who underwent limbal epithelial transplantation using the SLET method.

The data collected included age and gender of the patients and clinical data like duration of the chemical injury prior to SLET, history of any prior ocular surgery, quadrants of symblepharon, presence of a persistent epithelial defect, cumulative degree of conjunctivalisation, pre-operative and post-operative best corrected visual acuity (BCVA).

Surgical Technique

The surgical technique was similar to one described by Sangwan et. al. In brief it consisted of the following steps: A 3x2 mm size limbal biopsy was harvested from the contra-lateral donor eye from the superior limbus. Subconjunctival dissection was continued until the limbus followed by a shallow dissection 1 mm into the clear cornea. This limbal tissue was excised and kept in balanced salt solution. The excess conjunctiva was reposited back and sealed with fibrin glue (TISSEEL Kit from Baxter AG, Vienna, Austria). The recipient eye was freed all around of the vascularised pannus, bleeders were cauterized and human amniotic membrane (hAM) graft was placed over the bared ocular surface and sealed with fibrin glue (TISSEEL Kit from Baxter AG, Vienna, Austria). Donor tissue was cut into 6-8 small pieces, lenticules or limbal transplants, with either Vannas scissors or No 15 surgical blade (Asian Surgicals, Hyderabad, India). Limbal transplants were then uniformly distributed on the hAM leaving a clear visual axis and were held in place with...
fibrin glue. In the 1st 4 cases, the lenticules were placed at limbus only while in the last two cases 4 lenticules were placed at limbus and few other lenticules were placed 2-3 mm inside the limbus. A correct orientation of lenticules, epithelial side up, was maintained and it was ensured that the lenticules covered all quadrants. At the end of the surgery, a soft bandage contact lens was placed over the cornea. A symblepharon ring was placed in 4 cases (Case 1, 3, 4 and 6) and fornix forming sutures were also put in one case (Case 4). Topical 5% povidone-iodine was instilled to both eyes. The recipient eye was patched overnight.

Topical prednisolone acetate 1% 8 times a day was started in the donor eye the same day after surgery and in the recipient eye from the following day. It was administered for 4 weeks to the donor eye and up to 3 months in the recipient eye depending upon the ocular surface inflammation. Preservative free lubricants were used in both eyes. Patient was seen every day till he was discharged, then at post-operative week 2, month 1 and month 3.

Outcome was defined as a complete success when a completely epithelialised, avascular and stable corneal surface was achieved and partial success when there was an epithelialised ocular surface with recurrence of LSCD not involving the visual axis.

RESULTS
The data included 6 eyes of 6 patients. Male:Female ratio was 3:2. Mean age of the patients was 15.8±12.4 years. Mean duration of injury after which the surgery was done was 19±21.6 months. The mode of injury was alkali in 4/6 patients and injury with fire-cracker and with pressurized steam due to a burst pressure cooker in 1/6 patient each. The median quadrant of symblepharon was 3, none of the patients had PED and all patients had 360° conjunctivalisation. Pre-operative BCVA ranged from perception of light to 6/60.

At a mean follow-up of 17.8±16.2 months, post-operative BCVA ranged from hand movements close to face (HMCF) to 6/60. Outcome was a success in 1/6 cases and partial success in 4/6 cases. BCVA failed to improve further due to the presence of corneal scarring. One patient had a failure of outcome. The corneal surface though was stable without any PED, the pannus partially covered the visual axis. None of the donor eyes showed a decrease in BCVA or any sign of donor site deficiency.

DISCUSSION
Simple Limbal epithelial Transplantation (SLET) combines the advantages of CLAU and CLET by being a single-stage, easily affordable procedure which
utilizes a minimal donor tissue and does not need a stem cell laboratory.\cite{Sangwan2012} Besides it shows promise that it can be repeated at different centres across the world because of its easily adaptable surgical technique.

SLET appears to be a promising technique for the treatment of ocular surface burns. We could independently replicate the results as shown in the pilot study published earlier. However we believe that certain specific areas still remain unexplored in SLET. As this procedure continues to grow around the world, we might have prospective studies with a larger sample size. We continue to do this surgery and would be able to come up with a larger series with a long follow-up later.

REFERENCES


Visual and Clinical Outcome of Cases Undergoing Descemet Membrane Endothelial Keratoplasty (DMEK)

Dr. Vipul Bhandari, Dr. Pratik Chaugule, Dr. Smita Karandikar, Dr. Ramani G.S.

Corneal endothelial dysfunction, as well as the resulting reduced transparency due to corneal oedema, remains a major indication for corneal transplantation. Until 1998, the only known technique for exchanging the corneal endothelium was a full thickness corneal transplantation-Penetrating Keratoplasty (PKP), even though the disease affects only endothelium.

In 1998, Dr. Melles published results from first successful transplantation of the posterior corneal layer- posterior lamellar keratoplasty. Its main advantages are a rapid improvement in visual functions, lower incidence of serious postoperative complications, a sutureless technique, higher comfort for the patient, no problems with intralamellar opacities and the vision after surgery is very often excellent.

The disadvantages of these surgeries are the relatively high technical difficulty involved and the high loss of transplanted endothelium cells during the procedure in the early post-operative period.

Aim and Objectives

To evaluate the visual outcome, endothelial cell density and complications of DMEK.

MATERIALS AND METHODS

Six consecutive eyes of 6 patients suffering from endothelial dysfunction due to various pathologies, underwent a DMEK procedure. Four patients were men and 2 women, ranging from 32 to 64 years of age. All patients signed an informed consent. They were followed up for 6 months post operatively. Pre and post operative (6 months) best corrected visual aquity (BCVA), endothelial cell density (ECD) and complications were noted.

Surgical procedure is described as follows. From donor globes obtained less than 6 hours postmortem, corneo-scleral buttons were excised and stored in K-SOL (Cornisol-Aurolab) with endothelial side up. Descemet’s membrane (DM) was stained with trypan blue (Appasamy Rhex ID-Rx-188). Using a trephine of 8-9 mm partial thickness graft was cut. Peripheral part of the corneal endothelium was removed. Then the central part of the graft to be transplanted is stripped from the posterior stroma using two blunt forceps, so that a 8.0-9.0 mm diameter flap of posterior DM with its endothelial monolayer was obtained.
Owing to the elastic properties of the membrane, a ‘Descemet-roll’ formed spontaneously, with the endothelium at the outer side. This ‘Descemet-roll’ is then placed in Balanced Salt Solution (BSS).

In recipient eyes, a 8.0-9.0 mm diameter epithelial mark was made to outline the area of DM excision. A 3.0 mm tunnel incision was made just within the limbus, entering the anterior chamber just at the mark. With an inversed Sinskey hook (Appasamy–AA-1465), a circular portion of DM was scored and stripped from the posterior stroma, so that a 8.0-9.0 mm diameter ‘descemetorhexis’ was created, and the central portion of DM was removed from the eye.

The donor Descemet-roll which was stained with a 0.08% trypan blue solution (Appasamy Rhex ID-Rx-188), is sucked into a custom made injector to transfer the tissue from BSS to the anterior chamber. Using the injector, the donor Descemet-roll was inserted into the anterior chamber and the graft was oriented endothelial side down (donor DM facing recipient posterior stroma) by careful, indirect manipulation of the tissue with air and fluid. Anterior chamber is slightly collapsed. Cornea is continuously tapped from outer epithelial side to unroll the graft with endothelial side down. Then, an air bubble was injected underneath the donor

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<th>Name</th>
<th>Sex</th>
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<th>Eye</th>
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<th>Pre operative vision</th>
<th>Post operative vision</th>
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*PKP- Penetrating Keratoplasty; #PBK- Pseudophakic Bullous Keratopathy; $Hm+ - Hand movements in front of face appreciated.
DM to position the tissue onto the recipient posterior stroma. The anterior chamber was completely filled with air for 2 hours followed by minimal air release to prevent peripheral anterior synechiae (PAS). In the eye bank, donor Endothelial Cell Density (ECD) and viability were evaluated in vitro with an inverted light microscope (Eye Bank Keratoanalyzer, EKA-10, KonanTM Medical). In patient eyes, the endothelium was photographed and evaluated in vivo using a Topcon SP3000p non-contact autofocus specular microscope (Topcon Corp, Tokyo, Japan). Images of the central corneal window were analysed and manually corrected and three measurements of endothelial cell density were averaged.

RESULTS
Out of the 6 cases being operated 5 cases had BCVA better than 6/18. One case had vision up to 6/6 and one up to 6/9. The first case which underwent DMEK had a partial detachment seen on postoperative day 1. Subsequently the graft failed and PKP was done. The patient had BCVA of 6/36 post PKP.

Excluding the case which failed, Mean ECD of the donor tissue pre-operatively was 2479, whereas post operatively it was reduced to 2144. Mean reduction in ECD pre and post procedure was 13.51%.

DISCUSSION
The overall visual recovery for the patients undergoing DMEK, may compare favourably to PKP and the early endothelial keratoplasty techniques, like Deep Lamellar Endothelial Keratoplasty (DLEK) and Descemet Stripping (Automated) Endothelial Keratoplasty (DSEK/DSAEK). This finding is consistent with the other studies.3,4 In conclusion, our study shows that DMEK is a feasible procedure with a relatively steep learning curve and may require specific training in surgical technique and tissue handling.

This study also have a few limitations, the small size of study population is one of them. In order to draw reliable conclusions, similar studies with larger population size are needed. Moreover a longer follow up period is necessary to comment on the long term efficacy and safety of DMEK. With all these factors in view and considering visual outcome and endothelial cell density as clinical outcome parameters, the incidence and severity of complications DMEK may soon be preferred over PKP and DSEK/DSAEK, in the management of various endothelial pathologies requiring transplant of a healthy donor endothelium.

REFERENCES
Outcomes of CXL in Pediatric Patients and its Comparative Evaluation with Adult CXL

Dr. Abhishek Dave, Dr. Roshni Shetty, Dr. Padmanabhan Prema

Keratoconus is a slowly progressive, non-inflammatory corneal ecstatic disorder characterized by changes in corneal collagen structure and organization. Decreased mechanical corneal stability plays an important role in the progressive ectasia of the keratoconic cornea, resulting in mild to marked impairment of visual acuity resulting from irregular astigmatism, progressive myopia, corneal thinning, and central corneal scarring.\cite{1,2} Progression of the disease can be dramatically faster in children, with increasing visual impairment, inability to obtain satisfactory correction with spectacles or soft contact lenses, and intolerance to rigid gas permeable contact lenses. Keratoconus progression is frequent and faster in children when the age at the time of diagnosis is younger than 18 years.\cite{3} Corneal transplant may be required at an early age in children for cases with advanced keratoconus with or without scarring. In children, graft failure rates are higher and visual prognosis is poor with penetrating keratoplasty.\cite{4} Corneal collagen cross-linking (CXL) is a promising treatment modality for keratoconus, as it is the only intervention that can potentially slow down the progression of the disease.\cite{5} Recently, studies by Caporossi\cite{6} et. al. and Vinciguerra\cite{7} et. al. have reported good clinical results concerning safety and efficacy of epithelium-off CXL treatment in patients aged 18 years or younger. However no reports are there comparing it with adult CXL. In this study we retrospectively analyzed the refractive, topographic, tomographic and specular microscopy data of pediatric patients (≤ 18 years), preoperatively, and at 1 year after CXL and compared the same with CXL in adult patients.

**MATERIALS AND METHODS**

Retrospective analysis of data of 176 eyes of 135 pediatric patients and 150 eyes of 118 adult patients who underwent isotonic CXL in the last 5 years.
was done. The surgical procedure of corneal collagen cross-linking involved: premedication with 2% pilocarpine in the eye to be treated 30 minutes before the operation, topical anesthesia with 0.5% proparacaine 15 minutes before the operation, placing the patient under the operating microscope and inserting a lid speculum with closed valves, opening a disposable 0.1% riboflavin–20% dextran solution, marking the epithelium with a 8mm trephine and removing the epithelium with a blunt metal spatula, 30 minutes corneal soaking in 0.1% riboflavin–20% dextran solution before the start of UVA irradiation, irradiation of the 8-mm corneal surface with UV-A (9mW/cm2) for 10 minutes, instillation of riboflavin–dextran solution every 2 to 3 minutes during UVA irradiation, washing the eye surface with balanced saline solution and instillation of 2 to 4 drops of ciprofloxacin at the end of the procedure, and dressing the eye with a therapeutic soft contact lens for 4 days. At each follow-up visits all patients underwent refraction, corneal topography on Allegro Topolyzer, corneal tomography on Oculus Pentacam HR and specular microscopy on Tomey EM3000 Specular Microscope. A comparative evaluation of this data, preoperatively, and at 1 year was done between the 2 groups.

RESULTS
Of the 253 patients studied 176 were males and 77 were females (M:F-2.3:1). Mean age of patients in the pediatric group was 15.3 ± 2.26 (9-18) years and in the adult age group was 26±8.59 (19-42) years. The mean Best Spectacle Corrected Visual Acuity (BSCVA) in the pediatric group, expressed in logarithm of the minimal angle of resolution units (log MAR), improved by 0.02 ± 0.19. The mean BSCVA in the adult group improved by 0.02 ± 0.21. There was no significant difference in the BSCVA improvement between the two groups (P=0.75). The mean Best Contact Lens Corrected Visual Acuity (BCLCVA) in the pediatric group improved by 0.01 ± 0.11 and in the adults improved by 0.01 ± 0.14 log MAR units. The difference between the two groups was not significant (P=0.19). The mean Spherical Equivalent Refraction (SER) reduced by 0.51 ± 1.78 D (P=0.001) in the pediatric group and by 0.58 ± 2.00 D (P=0.005) in the adults. The difference within the groups was significant but there was no significant difference in the improvement of mean SER between the 2 groups (P=0.74). The mean Kmax reduced by 0.86 ± 2.55 D (P=0.001) in the pediatric group and by 0.90 ± 2.59 D (P=0.003) in the adults. Though the Kmax decreased significantly in either group but the difference between the two groups was not significant (P=0.90). There was a reduction in mean Pentacam thinnest pachymetry by 25.32 ± 20.02 in the pediatric group and by 24.07 ± 23.08 in the adults. The difference between the two groups was not significant (P=0.60). Specular microscopy data existed for 32 eyes in the pediatric group. The baseline endothelial cell count was 2767.46 ± 299.62/mm2. The endothelial count at 1 year in these eyes reduced to 2654.12 ± 290.30/ mm2. The reduction
in the endothelial cell count was significant in the pediatric group (P=0.001). There were no complications in either group.

**DISCUSSION**

In its early stages, keratoconus is under diagnosed as visual acuity is not severely influenced and it may be improved by means of spectacles or other visual aids. However, the onset of keratoconus during puberty is linked with a higher risk of progression. Progression of the disease in pediatric patients usually leads to poor visual function and, at the late stages, to penetrating keratoplasty. The introduction of CXL has provided a new treatment modality, and because it offers corneal stability, it is more beneficial for patients, in terms of visual acuity outcomes, with early stages of keratoconus, when corneal surface irregularities are limited. Our study showed a stabilization of keratometric, visual, refractive and pachymetric values in 176 eyes of patients ≤ 18 years of age. It was found to be as efficacious as CXL in adult patients. Further follow-up is required to ascertain whether CXL in children will be as effective as in adults in the longer term. The higher viscosity and lower resistance of younger corneas may make a difference in the end result. It is therefore crucial to make an early diagnosis to intervene at the early stages and thereby halt progression of keratoconus.

**Conclusion**

CXL in children is as efficacious as in adults with possible advantage of early arrest of disease progression. The decrease in endothelial cell count is however a cause for concern.

The authors do not have any financial interests.

**REFERENCES**

Safety and Efficacy of Simultaneous Topography Guided Prk and Collagen Cross Linking for Keratoconus (KC)

Dr. Rohit Bang, Dr. Manasi Jadhav, Dr. Girish Shiva Rao, Dr. Bhaskar Srinivasan

• Keratoconus is characterised by progressive, asymmetrical non inflammatory corneal thinning with irregular astigmatism
• Standard excimer laser treatment cannot be used in these patients due to obvious factors

Inclusion criteria
• Documented keratoconus progression
• Pachymetry (minimum) more than 450 μ
• No scar in visual axis
• No active allergy /inflammation in eye
• Mild-moderate grade keratoconus

MATERIALS AND METHODS
• 54 Eyes of 40 patients of documented progressive keratoconus were retrospectively analyzed for pre and post-operative results
• Visual parameters ucva, bcva, mrse and mrce
• Pachymetry
• Keratometry
• Posterior corneal elevation were assessed
RESULTS

- MRSE improved from -3.86D pre-op to -1.92D at 18 months
- MRCE decreased from -4.23D pre-op to -1.81D post-op
- Posterior corneal elevation stabilised from 38.54μ to 26.66μ at 18 months
- Steeper keratometry value decreased from 50.52D to 46.12 D
- None of the cases progressed at 18 months as seen on topography

Major factors affecting treatment of keratoconus are corneal biomechanical stability and irregular astigmatism

DISCUSSION

- Major factors affecting treatment of keratoconus are corneal biomechanical stability and irregular astigmatism
- T -CAT + C3R helps in tackling both
- Kymionis et. al. reported a series of 31 patients of T-CAT & C3R with decrease in mean SE of 1.22 and 48% had increase in Snellens visual acuity by 1 line
Conclusion

• T-CAT with C3R is a safe and effective treatment modality for progressive keratoconus having good visual and topographic outcomes

REFERENCES


Complications of Uneventful Deep Anterior Lamellar Keratoplasty

Dr. Parul Jain, Dr. Ritu Arora, Dr. Goyal J.I., Dr. Deepa Gupta, Dr. Gaurav Goyal

Penetrating keratoplasty (PK) is being replaced by various types of lamellar techniques that aim to replace only damaged tissue, while maintaining healthy tissue intact. The introduction of several new dissection techniques have provided new possibilities for managing anterior corneal disorders. Compared with conventional PK, deep anterior lamellar keratoplasty (DALK) provide safer “closed system” surgeries with less morbidity and better clinical outcomes. The main objective of this report is to evaluate long term postoperative complications after uneventful deep anterior lamellar keratoplasty at the same center over a 10-year period of follow-up.

MATERIALS AND METHODS

We performed a retrospective study of the records of 110 eyes of 88 patients who had undergone DALK, performed by the same surgeon between 2000 and 2012 at a tertiary eye care centre with eye banking facilities. The main indications of surgery were keratoconus (60 eyes), salzman nodular degeneration (12), corneal scars (12), stromal dystrophies (16), pellucid marginal degeneration (5), mucopolysaccharidoses (3) and post chemical burn stem cell failure (2). The surgery was performed as per Anwar s big bubble technique. The patients with intraoperative complications were excluded from the study. All patients in this report had follow-up ranging from at least 6
months to 10 years. The mean visual acuity over the follow up period ranged from 4/60 to 6/12. 6 patients developed graft rejection at an average follow up of 6 months to 5 years which was managed with topical steroids. There was recurrence of keratoconus in 3 eyes at 2-6 years follow up period which was managed with contact lenses. In our series, descemet striae were seen as a complication in 3 patients who underwent DALK for keratoconus. 3 patients developed interface keratitis postoperatively at 1-3 years follow up and were managed with intensive antimicrobial therapy with resolution of infiltrates.4 patients with macular corneal dystrophy had persistent stromal edema since first postoperative day. Preoperatively ASOCT had not shown any descemet’s involvement. They underwent PK for this complication. 1 patient developed shield ulcer and reactivation of vernal keratoconjunctivitis (VKC) after DALK at 9 months follow up. He had undergone DALK for keratoconus associated with VKC which at the time of surgery was controlled with 2% cyclosporine. He was treated with systemic steroids and topical antinflammatory drugs. 2 patients had recurrence of granular dystrophy in the lenticule and were managed with contact lenses. 4 patients had interface vascularisation with gradual opacification of the interface at the graft host junction at 3-5 years follow up. They were managed with topical steroids and withdrawal of contact lenses. 1 patient had double chamber in the immediate postoperative period that resorbed on its own by third day and gradual restoration of visual acuity. There was recurrence of viral keratitis and subsequent lenticule melt in one patient at 3 weeks follow up. She underwent penetrating keratoplasty under antiviral cover.

DISCUSSION
Lamellar keratoplasty to treat corneal disease was first described by Zirm in the early 20th century. PK became the surgical technique of choice in corneal graft surgery in the second half of the 20th century when improved surgical techniques facilitated better visual outcomes and corticosteroid therapy reduced rejection and graft failure rates. However, in the last 20–30 years, lamellar keratoplasty has again increased in popularity with the advent of several different surgical methods aimed at replacing only the diseased corneal tissue.1,2 However DALK has its own set of peculiar complications even after an uneventful surgery.3,7 In our series of 110 eyes many complications were seen in the postoperative follow up period. Although DALK eliminates the risk of endothelial rejection, other types of graft rejection (subepithelial and stromal) may still develop. The clinical course of subepithelial and stromal graft rejection after DALK is very similar to that of PK. Frequent topical steroid usually leads to reversal of the rejection. Although rejection after LK is easy to control, subepithelial and stromal graft rejections must be treated
appropriately to prevent less-severe yet important complications such as suture abscess and graft vascularization that can lead to poor visual outcomes and even lamellar graft failure.

2) **Recurrence of Keratoconus:** There was recurrence of keratoconus in 3 eyes at 2-6 years follow up. One speculative mechanism is failure to completely excise the cone which may lead to progression of keratoconus in the host tissue with possible involvement of the donor.

3) **Descemet S Striae:** 3 patients had DM striae. Folds in the DM following DALK are usually transient and improve over time. The folds are often located peripherally and have no impact on vision. Central folds can decrease the visual acuity likely due to an increased level of higher-order aberrations. A mismatch between the donor button and the recipient bed size is responsible for folds in the DM.

4) **Interface Infection:** 3 patients developed interface keratitis postoperatively. The interface left during DALK is a potential dead space and introduction of microorganisms intraoperatively can proliferate within this space without a host immune response. These patients were managed with intensive antimicrobial therapy with resolution of infiltrates.

5) **Persistent non Immunological Lenticular Edema:** 4 patients with macular corneal dystrophy had persistent stromal edema since day one.

6) **Occurrence of Shield Ulcer:** 1 patient developed shield ulcer and reactivation of vernal keratoconjunctivitis (VKC) after DALK and was managed with systemic steroids. Control and close monitoring of VKC in young keratoconus patients undergoing DALK is required. Prompt management of shield ulcer with systemic steroids in DALK results in maintainence of graft clarity and visual acuity.

7) **Recurrence of Granular Dystrophy:** 2 patients had recurrence of macular dystrophy.

8) **Recurrence of Viral Keratitis** occurred in one patient with subsequent melting. One hypothesis for recurrence is that there is never complete disease inactivity with a small number of undetectable virus particles continuously being released within the cornea and a resultant persistent subclinical inflammation.

9) **Interface vascularisation:** 4 patients had interface vascularisation with gradual opacification of the interface at the graft host junction. The occurrence of surface and suture complications may stimulate vascularization of the graft and interface. This vascularization leads to early. Extensive vascularization may result in lipid and protein extravasations leading to interface opacification and hence visual acuity reduction.
10) **Intradescemetic Air Trap**: 1 patient had double chamber in the immediate postoperative period that resorbed on its own by third day and gradual restoration of visual acuity. Deposition of mucopolysaccharides in corneal stroma with poor visibility of air bubble in our case probably facilitated intradescemetic cleavage with air entrapment.

**Conclusions**

DALK appears to be an acceptable alternative to PK in stromal corneal diseases. However, there are still some aspects of DALK that require further study. More extensive studies with longer follow-up periods are required to understand the advantages and disadvantages of DALK.

**REFERENCES**


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**Effect of Intraocular Pressure after DSEK in Eyes with and without Preexisting Glaucoma**

**Dr. Geet M. Shah**, Dr. Ekta Patel, Dr. Amit P. Patel, Dr. Satani Dipali Rameshchandra

Endothelial dysfunction from surgery or diseases is one of the leading indications for corneal transplantation. The only solution for this dysfunction over the past 100 years has been penetrating keratoplasty (PK).1 Penetrating keratoplasty was considered to be the gold standard for endothelial dysfunctions but its disadvantages are well known.2,3 They are
delayed rehabilitation, long visual recovery time, and poor visual quality due to high and irregular astigmatism. Furthermore, there are surface and suture-related problems, more chance of graft rejection or infection, greatest risk of trauma and wound dehiscence, frequent and long follow-up visits, and problems of long-term use of topical steroids.\textsuperscript{4}

Here we describe early challenges and techniques to promote donor tissue adherence in Descemet’s stripping with endothelial keratoplasty (DSEK) during learning curve. Intraocular pressure (IOP) elevation is reported to be a common complication after DSEK.\textsuperscript{5} Poorly controlled IOP not only causing glaucomatous optic nerve changes but also increase risk of endothelial loss and subsequent graft failure.\textsuperscript{6,7} Studies determining the incidence of IOP elevation post-DSEK are common, however those excluding glaucomatous patients still rare.\textsuperscript{8}

**MATERIALS AND METHODS**

This is a prospective interventional study of the 52 consecutive cases of DSEK performed at Nagri Eye Hospital from June 2010 to June 2012. IRB approval was obtained and an informed consent was signed by all patients.

All patients underwent Comprehensive ophthalmic examination. Post operatively Patients are reviewed on post-op day 1, 1 week, 1 month, 3 month, and 6 months.

Preexisting glaucoma defined as IOP more than 21 mmHg with c:d ratio >0.5, Prior glaucoma surgery, on antiglaucoma medications. Graft failure: persistent graft edema at 6 months.

Post op IOP elevation: IOP >21 at any post operative examination

**Improvement:** clear graft and vision more than 0.4 on log mar at 6 months.

**Exclusion criteria**

1. Corneal pathology involving epithelium and superficial stroma
2. Contraindication for keratoplasty example lid pathology, advanced Dry eye.

All patients underwent DSEK by standard technique. The tissue was dissected at 300 μm (45 cases) or 350 μm (7 cases) (After dissection with either technique, the donor tissue was transferred to a punching system and cut with an 8.5mm (3 cases), 8.0 mm (41 cases) 7.5 mm (8 cases) diameter trephine. Scoring of DM done with a modified Sinskey hook around the perimeter of the area to be stripped. Donor tissue inserted with ‘taco technique’. Subsequently, the anterior chamber.

Postoperatively the patient received topical prednisolone 1% eye drops 6 times a day for 1 month than tapered off till 6 months. Antibiotic eye drops, cycloplegic eye drops used for 3 weeks.
Outcome measures: Using SPSS software (version 17.0, SPSS, Inc.). Chi square test is applied to check statistical difference between glaucoma and graft outcome. Pearson correlation formula used to measure correlation between uncontrolled IOP and graft failure. A P value less than 0.05 was considered statistically significant.

RESULTS

Median pre-op UCVA being CF 1 Ft, which improves to 0.913+/−0.35 at 3 months and 0.613+/− at 6 months. Refraction corrected with +1.91+/− 1.92 mean spherical and +2.20 +/- 1.49 mean cylinder power.

Table 1 shows Early rise (during first week) in IOP seen immediate post-op DSEK in 40(76.9%) patients. at the end of 6 months 14 eyes (30%) showed uncontrolled IOP out of which 7 eyes did not show any visual improvement at the end of 1 year. One of the major advantages of DSEK is the minimal influence on IOP observed in patients with Fuchs’ dystrophy.

Table 2 shows at 1 year 28(54%) eyes showed improvement, 4(8%) eyes showed improvement with uncontrolled IOP while 2 eyes (66.66%) with AGS showed improvement.

Chi – square value is 7.09 (P < 0.05) which is highly significant.
DISCUSSION

The advantages of DSEK far outweigh the challenges. These visual outcomes equalled or exceeded those in the largest reported PKP of Fuchs’ and endothelial dysfunction cases.\textsuperscript{2,5,7}

With the associated factor glaucoma, the outcome remains not so shiny. The overall incidence of post keratoplasty glaucoma may be as high as 30%\textsuperscript{v}. The presence of glaucoma prior to the keratoplasty is an important risk factor despite adequate control.

Incidence of Glaucoma, Following DSEK has been reported to be from zero to 28%. Vajaranant \textit{et al.}\textsuperscript{4,11} reported a relatively high incidence of IOP elevation after DSEK in 35% of patients with no prior glaucoma, 45% of patients with prior glaucoma, and 43% of patients with prior glaucoma with pre-existing glaucoma surgery. We are having IOP rise in all of prior glaucoma patients and 66.6% of with pre-existing surgery done. The overall incidence appears to be lower, less severe, and with better outcomes than that reported with PKP\textsuperscript{7,3}.

In the early postoperative period, pupillary block from air behind the pupil may occur.\textsuperscript{10} In the later postoperative period, the development of PAS and prolonged steroid use are important causes. Another mechanism of glaucoma after DSEK could be distortion of the angle and inflammatory glaucoma.\textsuperscript{7,3}

In Medical Management Vajaranant \textit{et al.} reported that glaucoma medications were started during the first year after DSEK in 18% of patients without pre-existing glaucoma and were increased in 33% of patients with pre-existing glaucoma.\textsuperscript{4,11}

Most patients managed well medically with increase in their glaucoma medications and/or tapering of steroids or switch to less potent steroids. In our study those patients with early rise of IOP were given on monotherapy B blocker, if target IOP (30% reduction) not achieved than switched over to combination alpha agonist and B blocker in 12 patients and On 8 occasions systemic acetazolamide.

IOP Measurement Following DSEK

Unfortunately, no ideal technique for IOP measurement in diseased or transplanted corneas exists. No experimental study has ever validated the accuracy of AT in patients with DSEK.\textsuperscript{9,12} Dynamic tonometry is still under research. Cornea behaves like as if only 450 micron recipient bed and only that would contribute to their elastic property during measurement. Our analysis of outcomes from DSEK eyes has shown that central corneal thickness is not significantly correlated with postoperative Snellens acuity.\textsuperscript{3,11} In future to control glaucoma, use of Glaucoma drainage device in post DSEK EYE may be helpful.\textsuperscript{13,14}
Conclusion

IOP elevation appears to be a common postoperative complication of DSEK during learning curve. Patients without pre-existing glaucoma but with higher pre-op IOP need to be followed up carefully after DSEK. Studies describing long-term IOP and IOP Treatment-related outcomes will be important in the future. One of the major advantages of DSEK is the minimal influence on IOP observed in patients with Fuchs’ dystrophy.

REFERENCES


