Original Article

Outcome of Sclerokeratoplasty in Devastating Sclerocorneal Infections

Shreya Thatte[1], Ankita B. Dube[1], Trupti Dubey[1], Malvika Krishnan[1]

[1]Department of Ophthalmology, Sri Aurobindo Medical College and PG Institute, Indore, Madhya Pradesh, India

Abstract

Purpose: To assess the achievement of anatomical integrity after primary tectonic sclerokeratoplasty procedure and outcome after subsequent secondary procedures to manage devastating corneoscleral infection threatening the structural integrity of the eyeball.

Methods: This prospective interventional study comprised 60 patients with severe devastating corneoscleral pathology of infective origin with varying degrees of scleral involvement who underwent tectonic sclerokeratoplasty. They were grouped into three groups according to the involvement of scleral quadrants, i.e., Group A with only one quadrant, Group B with two quadrants, and Group C with more than two quadrants. The demographics, clinical features, microbiological status, postoperative complications, need for secondary procedures, and tectonic outcome in terms of anatomical success were analyzed in all three groups during follow-up between 2 and 5 years.

Results: The donor graft size in Groups A, B, and C was 9.5–10.5, 11–12, and 12.5–14 mm, respectively. Globe integrity after primary procedure was noted in all patients of Group A, 76% of Group B, and 38% of Group C. Reinfection was observed in 19 cases of Groups B and C, from which 5 Group C patients were eviscerated and 14 underwent regrafting. Postoperative complications (suture related, rejection, graft failure, and secondary glaucoma) were encountered more frequently in Group C patients. Secondary procedures (cataract/posterior segment surgery, secondary intraocular lens, and trabeculectomy) were required more in Groups B and C. After regrafting, 7 eyes were salvaged and 7 (3 in Group B and 4 in Group C) resulted in phthisis bulbi. Thus, tectonic outcome was achieved in 80% of cases.

Conclusions: Sclerokeratoplasty is an effective tectonic treatment for restoring the globe anatomy in severe corneoscleral infection. Outcome depends on involvement of scleral quadrants, graft size, and severity of disease. Subsequent regrafting procedures are required to overcome reinfection of the primary graft.

Keywords: Corneoscleral, Infective sclerokeratitis, Reinfection, Scleral quadrant, Sclerokeratoplasty, Tectonic

Address for correspondence: Shreya Thatte, Chaitanya, 17 Yeshwant Colony, Indore - 452 003, Madhya Pradesh, India.
E-mail: shreyathatte@gmail.com

Submitted: 06-May-2019; **Revised:** 15-Jul-2019; **Accepted:** 04-Aug-2019; **Published:** 23-Mar-2020

Introduction

Diseases affecting the cornea are a major cause of preventable blindness worldwide.[1] Refractory infective corneal pathologies involving adjoining sclera threatening the structural integrity of the anterior segment are always a challenge. Mainstay of management is sclerokeratoplasty by removing the diseased part of the cornea and sclera and replacing it with a stronger healthy donor tissue, thus providing support to the globe. If these situations are left untreated, they can progress to significant vision-threatening complications and even phthisis bulbi.[2,3]

Sclerokeratoplasty in infective sclerocorneal pathology poses a higher risk than a routine penetrating keratoplasty. The degree of involvement of adjoining sclera, severity or chronicity of the primary infective disease, concurrent distortion of anatomy of anterior segment, and also the use of a larger graft increase chances of serious complications such as recurrence of the primary pathology, graft rejection, graft failure, and secondary

Access this article online

Quick Response Code:

Website: www.jcurrophthalmol.org

DOI: 10.4103/JOCO.JOCO_24_20

How to cite this article: Thatte S, Dube AB, Dubey T, Krishnan M. Outcome of sclerokeratoplasty in devastating sclerocorneal infections. J Curr Ophthalmol 2020;32:38-45.

glaucoma, making secondary procedures mandatory to obtain a desirable outcome.[2] Therefore, it requires a great deal from the surgeon to provide tectonic results.

Considering the above facts, the present study was undertaken to assess the achievement of anatomical integrity after primary tectonic sclerokeratoplasty procedure and outcome after subsequent secondary procedures to manage devastating corneoscleral infection with variable scleral involvement.

Methods

This prospective interventional study was undertaken in a tertiary health-care teaching hospital. Clearance from the institutional ethics committee was taken before the start of the study. It included 60 eyes of 60 patients with severely infected corneoscleral tissue of variable degree, belonging to the age group of 18–78 years. The inclusion criteria comprised all patients with infective corneal pathology involving part of or complete adjoining scleral rim <2 mm width and having accurate perception and projection of light in all directions with no involvement of posterior segment. Patients with infective corneoscleral pathology extending beyond 2 mm of scleral rim, corneal pathology other than infection, posterior segment involvement due to infective pathology, and having inaccurate perception and projection of light in all directions were excluded from the study.

All patients were asked about detailed history of course of infective pathology and previous treatment. They underwent a series of routine and special ocular investigations. Thorough slit-lamp examination, digital intraocular pressure (IOP) assessment, and B scan were performed to note the status of posterior segment. Special care was taken in corneal perforation when performing these investigations. Size and site of infectious corneal pathology along with degree of affection of scleral quadrant was noted.

All the patients with corneoscleral infection were divided into three groups on the basis of involvement of scleral quadrants [Figure 1].

- Group A: One quadrant of scleral disease [Figure 1a]
- Group B: Two quadrants of scleral disease [Figure 1b]
- Group C: Three or all four quadrants of scleral disease [Figure 1c].

Conjunctival swab and corneal scraping were retrieved and sent for culture and sensitivity. Systemic investigations were done to rule out any septic foci.

Written informed consent was taken to explain guarded prognosis, complications, necessity of secondary procedures, and compliance in regular follow-ups.

Antibiotics according to culture and sensitivity, cycloplegics, and anti-glaucoma drugs were started in each case. Intravenous mannitol 20%, 1 g/kg body weight, was given preoperatively to reduce the intraoperative IOP. Tectonic sclerokeratoplasty was carried out under general anesthesia by a single surgeon in large corneal perforations, young children, and uncooperative patients. Local anesthesia was preferred in moderate perforation and refractory infective sclerokeratitis.

All the patients underwent this surgery in acute stage of the disease. Conjunctival peritomy was performed at the site of corneoscleral involvement; the devitalized host tissue was gently marked using a trephine in cases with pre-Descemet's infection or in small perforation. In cases with large perforation and severe infection with melting of the cornea where trephination was not possible, devitalized host tissue was removed manually, and irregular margins were excised with corneal scissors. In cases with graft size of 9.5–10 mm of diameter, donor graft size was kept half mm larger, whereas in cases with more than 10 mm diameter, graft was kept 1 mm larger than the host defect and was procured either with a corneal punch or freehand dissection depending on its size and shape.

Recipient bed was prepared with excision of host edge obliquely keeping the base toward the sclera and slope toward the iris to avoid destruction of angle structures [Figure 2a]. Similarly, donor tissue was excised obliquely but in reverse manner with thinner part toward the sclera and base toward the iris for proper fitting of graft on recipient bed [Figure 2b]. When suturing the sclera to the cornea, longer sutures were taken than suturing the cornea to the cornea. Many intraoperative modifications were carried out as per pathological situation. They were fibrinoid pupillary membrane removal [Figure 2c], thorough anterior chamber (A/C) wash with ringer, intracameral antibiotics and antifungal as per etiology and sensitivity report (commonly used antibiotic was preservative-free moxifloxacin 0.5% and antifungal was amphotericin B 10 μg/0.1 ml and voriconazole 50 μg/0.1 ml), synechiolysis [Figure 2d], iris reconstruction in case of intraoperative severe damage to iris [Figure 2e], cataract removal [Figure 2f], intraocular lens (IOL) implantation, and vitrectomy. Peripheral iridectomy was performed in all eyes to avoid postoperative glaucoma.

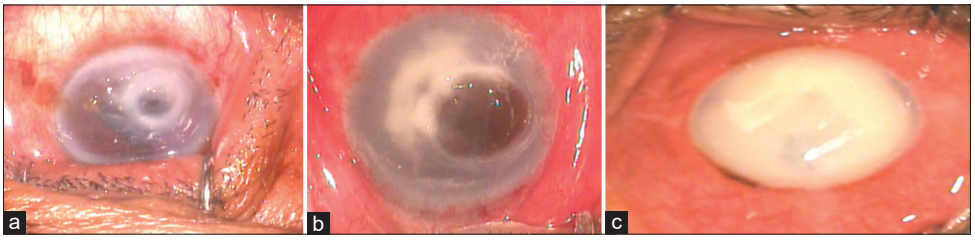

Figure 1: Scleral quadrant involvement as seen preoperatively and groups created accordingly, (a) Group A, (b) Group B, (c) Group C

Postoperatively, all patients were given systemic and topical antibiotics according to culture and sensitivity report along with cycloplegics, anti-glaucoma, and lubricating drops. We refrained from administering corticosteroids in any form for a minimum of 15 days, postoperatively. Frequent follow-ups were done to record signs of recurrence of infection. If no infection was noted within 15 days, trial of prednisolone acetate 1% eye drops was administered three times a day under close observation. In cases of reinfection, steroids were stopped, and after a week, steroid trial was given again. In case of no untoward finding, topical steroids were increased in frequency up to six times a day and gradually tapered in 9–12 months. This was supplemented with oral prednisolone 1 mg/kg body weight gradually tapered over the period of 1 month.

During follow-up, patients were assessed for recurrence of disease; signs suggestive of persistent inflammation, graft rejection, and reinfection; suture-related complications; graft clarity; visual acuity; IOP; need for secondary procedures; and other complications. Appropriate medical and surgical interventions were done as and when required. The tectonic outcome after the surgery was assessed in terms of anatomical success and, thus, achievement of globe integrity.

Results

All three groups included the eyes with either refractory infective sclerokeratitis or corneal perforation. Out of a total of 60 cases, 14 (23.3%) belonged to Group A, 25 (41.6%) to Group B, and 21 (35%) to Group C [Table 1]. Oblique dissection of recipient sclera was limited to diseased scleral quadrants only, thus making the grafts eccentric in all patients of Groups A and B. Out of the 21 eyes in Group C, 8 eyes had involvement of three scleral quadrants. In the remaining 13 eyes, all the scleral quadrants were involved, but 6 had involvement of just the scleral rim and 7 cases had 360° full thickness, ≥1 mm scleral involvement.

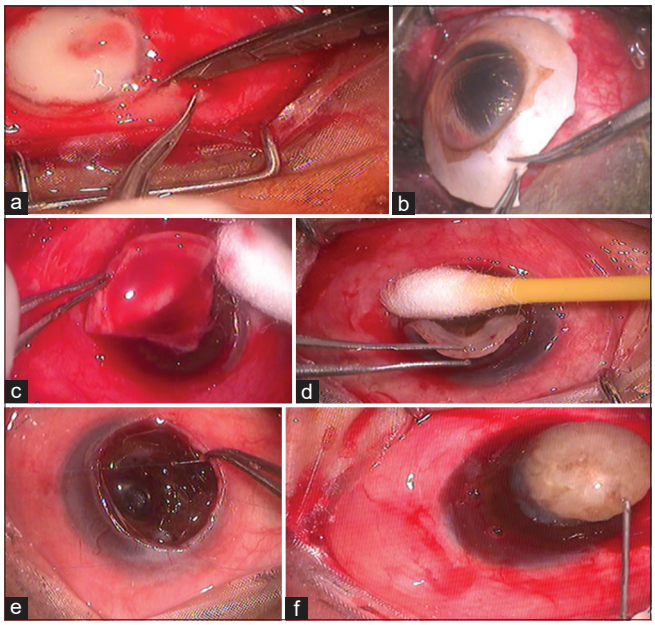

Figure 2: Surgical steps and necessary intraoperative modifications, (a) Preparation of recipient bed, (b) Preparation of donor corneal button, (c) Removal of organized thickened pupillary membrane, (d) Release of anterior synechiae, (e) Reconstruction of iris, (f) Cataract extraction

The patients were followed up for a period of 2–5 years. The mean follow-up (years) and standard deviation (SD) in Groups A, B, and C was 3.64 ± 0.94, 3.22 ± 0.79, and 3.40 ± 0.70, respectively.

In this study, the patients ranged from 18 to 78 years of age. We observed female preponderance in our study (38 cases, 63.3%), and the majority of cases belonged to the age group of 39–58 years (34 cases, 56.6%). The mean age (years) and SD in Groups A, B, and C was 49.73 ± 14.24, 50.31 ± 14.16, and 52.63 ± 11.85, respectively [Table 2].

The most frequently encountered growth on culture was fungal (48.3%), followed by bacterial (26.6%). *Fusarium* (28.3%) was the most common among fungi, whereas *Staphylococcus* (15%) was the most common among bacterial genera [Table 3]. Interestingly, Group A cases had only fungal growth. In Group C, specific growth on culture, either fungal or bacterial, was seen in only 12 cases. The growth was non-specific in the rest of the 9 (15%) cases of Group C and 6 (10%) cases of Group B. No correlation was noted between causative organism and scleral quadrant involvement.

In the majority of patients, more than one surgical modification had to be done simultaneously to enhance the outcome of surgery [Table 4]. Thorough A/C wash and intracameral antibiotic injection was performed in all eyes. Intracameral antifungal was only given to patients with microbiological confirmation of fungal infection. Simultaneous cataract extraction was done in 9 (14.9%) eyes. Anterior vitrectomy without IOL implantation was performed in 5 (8.33%) eyes (4 in Group C and 1 in Group B) with preexisting perforation and lens extrusion. Modifications such as removal of synechiae and pupillary membrane indicating extensive anterior segment inflammation and distortion were needed more frequently in Group C (18/21 eyes) as compared to other groups. Two (3.33%) eyes from Group C also needed iris reconstruction.

Table 5 depicts the significant complications faced in the postoperative period. These complications were frequently encountered in Groups B and C compared to Group A. The majority of eyes (40%) suffered complications related to suture [Figure 3a]. Thus, sutures were removed as early as 6 months (or even before that) followed by resuturing, if

Table 1: Groups as per graft size and scleral involvement

Groups	Donor graft size (mm)	Quadrant of scleral involvement	Total, *n* (%)
A	9.5-10.5	One quadrant	14 (23.3)
B	11-12	Two quadrants	25 (41.6)
C	12.5-14	Three or all four quadrants	21 (35)

Table 2: Age- and gender-wise distribution of cases

Age groups (years)	Number of males (22/60; 36.7%), *n* (%)			Number of females (38/60; 63.3%), *n* (%)			Total (*n*=60), *n* (%)
	Group A (11.6%)	Group B (8.33%)	Group C (16.6%)	Group A (13.33%)	Group B (26.6%)	Group C (23.33%)	
18-38	2 (3.33)	1 (1.66)	1 (1.66)	1 (1.66)	3 (5)	1 (1.66)	9 (15)
39-58	3 (5)	3 (5)	6 (10)	5 (8.33)	8 (13.3)	9 (15)	34 (56.6)
59-78	2 (3.33)	1 (1.66)	3 (5)	2 (3.33)	5 (8.33)	4 (6.66)	17 (28.3)
Mean age (years±SD)	48.36±16.53	48.40±14.32	52.45±12.76	50.94±12.94	50.91±14.53	52.75±11.66	

SD: Standard deviation

Table 3: Distribution of cases as per the growth observed on culture

Growth on culture, *n* (%)	Group A, *n* (%)	Group B, *n* (%)	Group C, *n* (%)	Total, *n* (%)
Fungal-29 (48.3)				
Fusarium	8 (13.3)	5 (8.33)	4 (6.66)	17 (28.33)
Aspergillus	2 (3.33)	4 (6.66)	2 (3.33)	8 (13.33)
Candida	4 (6.66)	0	0	4 (6.66)
Bacteria-16 (26.6)				
S. aureus	0	6 (10)	3 (5)	9 (15)
S. pneumoniae	0	3 (5)	0	3 (5)
Pseudomonas	0	1 (1.66)	2 (3.33)	3 (5)
Providentia	0	0	1 (1.66)	1 (1.66)
Nonspecific-15 (25)				
No growth	0	6 (10)	9 (15)	15 (25)

S. aureus: Staphylococcus aureus, S. pneumoniae: Streptococcus pneumoniae

needed. These suture-related complications were maximally seen in Group C cases. The second most common complication was pupillary membrane formation in 14 (23.3%) cases noted equally between Groups B and C. Among the 13 (21.6%) eyes with synechiae reformation, Group C patients had a higher incidence than Groups B and A.

Early graft rejection [Figure 3b] was noted between 6 and 15 months in 11 (18.3%) cases, more in Group C (1 in Group A, 4 in Group B, and 6 in Group C), which was aggressively managed by intravenous methyl prednisolone 1 g/day for 3 days followed by oral prednisolone 1 mg/kg body weight accompanied by intensified topical treatment. However, only 5 (8.3%) eyes responded to treatment and could be salvaged. The remaining 6 (10%) cases (1 in Group B and 5 in Group C) landed up with graft failure [Figure 3c and d]. No patient from Group A had reinfection, but it was observed in 19 (31.6%) patients of other groups (6 in Group B and 13 in Group C) [Figure 3e]. Out of these 19 cases, 5 (8.3%) of the Group C cases developed severe reinfection involving posterior segment and were eviscerated as shown in Table 6. The remaining 14 (23.3%) (6 in Group B and 8 in Group C) cases underwent regrafting between 4 and 8 weeks after primary procedure.

Reinfection in the five eviscerated eyes occurred between 8th and 32nd postoperative days as shown in Table 7. Causative organism for reinfection was found to be *Staphylococcus* and

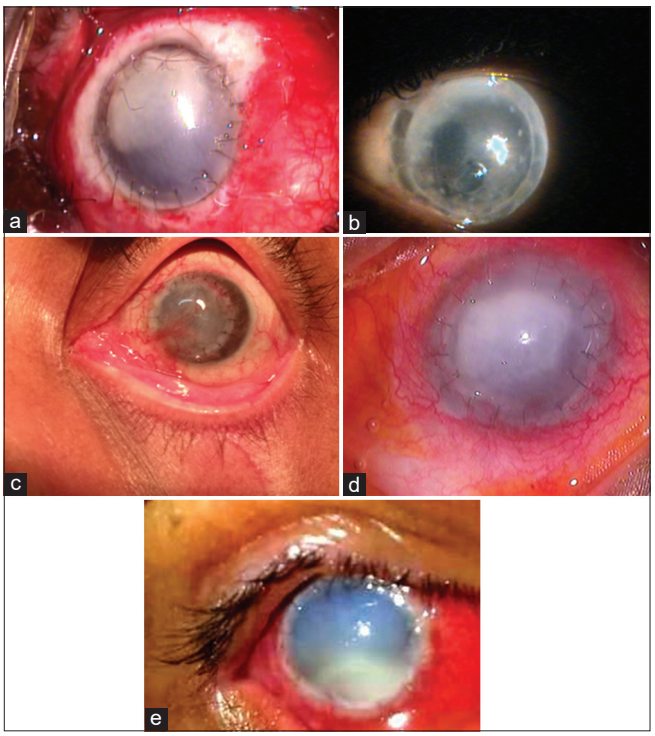

Figure 3: Postoperative complications, (a) Suture-related complication (loose and broken sutures), (b) Graft rejection, (c and d) Graft failure (opaque, vascularized graft), (e) Graft reinfection

Aspergillus in two cases. In the remaining three cases, after evisceration, the corneal button along with infected material was sent for culture, and sensitivity showed pseudomonas in one of the three patients earlier shown to be culture negative. The other two cases showed no growth.

Other secondary procedures performed are also shown in Table 6. Out of the 5 aphakic patients postsclerokeratoplasty, 4 (6.6%) patients with clear graft underwent secondary IOL implantation, whereas one patient with opaque graft was kept aphakic. Cataract extraction with IOL implantation was performed only after a minimum of 12 months postsclerokeratoplasty in all 7 (11.6%) cases. Trabeculectomy was done in all 6 (10%) patients of Group C with secondary glaucoma, but the IOP was maintained in only 5 eyes. The remaining one patient with failed trabeculectomy subsequently underwent glaucoma drainage device implantation. Retinal detachment surgery was done in 1 (1.6%) case of Group C,

Table 4: Modifications of surgical steps

Modifications during surgery	Group A, *n* (%)	Group B, *n* (%)	Group C, *n* (%)	Total, *n* (%)
Cataract extraction with IOL	0	2 (3.33)	2 (3.33)	4 (6.66)
Cataract extraction without IOL with anterior vitrectomy	0	1 (1.66)	4 (6.66)	5 (8.33)
Release of anterior/posterior synechiae	2 (3.33)	12 (20)	18 (30)	32 (53.33)
Pupillary membrane removal	1 (1.66)	12 (20)	18 (30)	31 (51.66)
Thorough anterior chamber wash	14 (23.33)	25 (41.66)	21 (35)	60 (100)
Intracameral injection of antibiotic	14 (23.33)	25 (41.66)	21 (35)	60 (100)
Reconstruction of iris	0	0	2 (3.33)	2 (3.33)

IOL: Intraocular lens

Table 5: Postoperative complications

Postoperative complication	Number of patients, *n* (%)			Total, *n* (%)
	Group A	Group B	Group C	
Shallowing of A/C	1 (1.66)	1 (1.66)	4 (6.66)	6 (10)
Reappearance of hypopyon or signs of early reinfection	0	2 (3.33)	3 (5)	5 (8.33)
Reformation of synechiae	1 (1.66)	5 (8.33)	7 (11.66)	13 (21.66)
Reformation of pupillary membrane	0	7 (11.66)	7 (11.66)	14 (23.33)
Suture related	3 (5)	9 (15)	12 (20)	24 (40)
Early graft rejection	1 (1.66)	4 (6.66)	6 (10)	11 (18.33)
Reinfection	0	6 (10)	13 (21.6)	19 (31.66)
Secondary glaucoma	0	0	6 (10)	6 (10)

A/C: Anterior chamber

Table 6: Secondary procedures postsclerokeratoplasty

Secondary procedures after reinfection	Group A, *n* (%)	Group B, *n* (%)	Group C, *n* (%)	Total number of patients, *n* (%)
Regrafting	0	6 (10)	8 (13.33)	14 (23.33)
Evisceration	0	0	5 (8.33)	5 (8.33)
Other secondary procedures	**Group A (23.33%), *n* (%)**	**Group B (46.66%), *n* (%)**	**Group C (35%), *n* (%)**	**Total number of patients, *n* (%)**
Cataract surgery	1 (1.66)	3 (5)	3 (5)	7 (11.66)
Secondary IOL	1 (1.66)	1 (1.66)	2 (3.33)	4 (6.66)
Trabeculectomy	0	0	6 (10)	6 (10)
Retinal detachment surgery	0	0	1 (1.66)	1 (1.66)
PPV	0	1 (1.66)	1 (1.66)	2 (3.33)

IOL: Intraocular lens, PPV: Pars plana vitrectomy

Table 7: Summary of Group C cases with reinfection subjected to evisceration

Case	Preoperative diagnosis	Surgery (mm)	Diagnosis of postoperative reinfection	Onset of postoperative reinfection
1	RE-severe refractory infectious sclerokeratitis involving all four quadrants of sclera with causative agent *Aspergillus*	RE-sclerokeratoplasty with graft size 12.5	RE-postkeratoplasty sclerokeratitis with causative agent *Aspergillus*	21st postoperative day Eviscerated 6th week
2	LE-severe refractory infectious sclerokeratitis involving all 4 quadrants of sclera with no specific growth	LE-sclerokeratoplasty with graft size 13	LE-postkeratoplasty sclerokeratitis with causative agent *pseudomonas*	8th postoperative day Eviscerated 4th week
3	RE-infective corneal perforation involving 2 scleral quadrants with no specific growth on culture	RE-sclerokeratoplasty with graft size 12.5	RE-postkeratoplasty sclerokeratitis with no specific growth on culture	23rd postoperative day Eviscerated 8th week
4	LE-infective corneal perforation involving 2 quadrants of sclera with no specific growth on culture	LE-sclerokeratoplasty with graft size 12.5	LE-postkeratoplasty sclerokeratitis with no specific growth on culture	18th postoperative day Eviscerated 5th week
5	RE-infective corneal perforation involving all quadrants of sclera with causative organism *S. aureus*	RE-sclerokeratoplasty with graft size 13	RE-postkeratoplasty sclerokeratitis with causative organism *S. aureus*	32nd postoperative day Eviscerated 8th week

S. aureus: Staphylococcus aureus, RE: Right eye, LE: Left eye

whereas pars plana vitrectomy was performed for vitreous hemorrhage one in each case of Groups B and C (2.3%).

Tectonic outcome after primary procedure was achieved in 41 (68.3%) out of 60 patients [Figure 4a-c]. Globe integrity

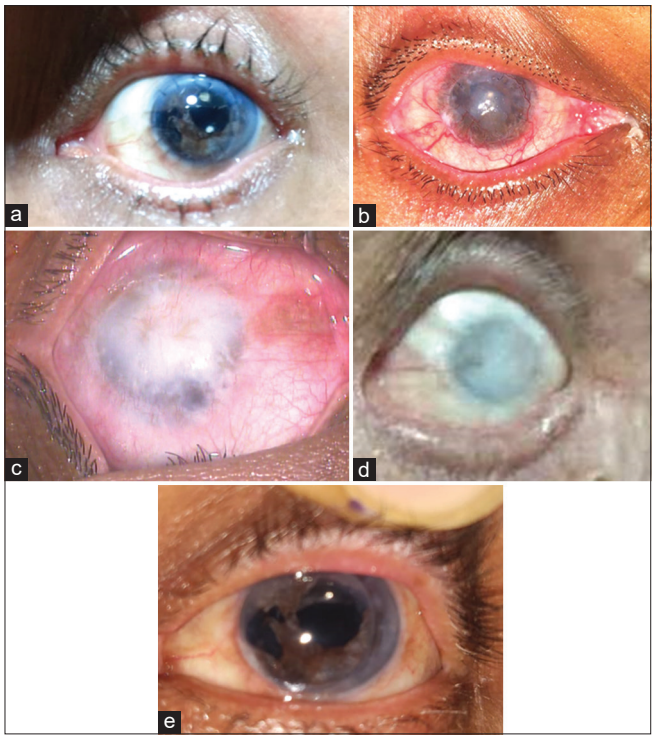

Figure 4: Outcome, (a) Tectonic outcome achieved with clear graft, (b) Tectonic outcome achieved with hazy, vascularized graft, (c) Tectonic outcome achieved with opaque graft, (d) Phthisis bulbi, (e) Pseudophakic eye 3 years after sclerokeratoplasty

after primary procedure was noted in all patients of Group A, but in only 19/25 cases (76%) of Group B and 8/21 cases (38%) of Group C [Table 8].

After regrafting in 6 cases of Group B, 3 (5%) failed to achieve tectonic outcome and resulted in phthisis. Among the 13 eyes of Group C with reinfection, 5 were eviscerated due to recalcitrant reinfection, and 8 eyes underwent regrafting. However, only 4 (6.6%) regrafts could be salvaged, and the remaining 4 (6.6%) regrafts failed and eventually landed up with phthisis bulbi [Figure 4d].

Thus, taking into consideration the outcome after primary procedure and secondary procedures done after reinfection, globe integrity was noted in overall 48 (80%) out of 60 cases, that is, 14 (100%) out of 14 patients of Group A, 22 (88%) out of 25 patients of Group B, and 12 (57%) out of 21 patients of Group C [Figure 4e].

Discussion

Infective microbial keratitis involving the limbus and the adjoining sclera, if not timely intervened, can result in disintegration of globe, spread of infection to posterior segment, and even phthisis bulbi, leading to irreversible loss of visual acuity.[4] In such scenarios, primary therapeutic/tectonic sclerokeratoplasty is the treatment modality of choice wherein the main aim is restoration and maintenance of ocular integrity. This becomes a challenging task in terms of graft survival, as these cases are operated under an inflamed and infective situation.[5,6]

Table 8: Tectonic outcome

Groups	After primary procedure, *n* (%)		
	Achieved with clear graft	Achieved with hazy to opaque graft	Not achieved (reinfection of graft)
A	12 (20)	2 (3.33)	0
B	12 (20)	7 (11.66)	6 (24)
C	3 (5)	5 (8.33)	13 (61.90)
Groups	**After regrafting in reinfection (14 cases; 23.3%), *n* (%)**		
	Achieved		**Not achieved leading to phthisis bulbi**
B	3 (5)		3 (5)
C	4 (6.66)		4 (6.66)

There are many studies in literature related to sclerokeratoplasty that have either compared outcomes in sclerokeratoplasty and penetrating keratoplasty or included all etiological groups or different types of keratoplasty (lamellar and penetrating), or only case reports were published.[7-10]

In our study, we have exclusively evaluated infective etiology cases of sclerokeratitis with varying degrees of scleral involvement managed by tectonic sclerokeratoplasty. We have also compared the incidence of complications and finally the success rate in achieving globe integrity between the three groups created in our study on the basis of involvement of scleral quadrants and studied its correlation to the tectonic outcome in sclerokeratoplasty. Unlike our study, Panda *et al*.[7] did a comparative analysis between therapeutic sclerokeratoplasty and therapeutic penetrating keratoplasty in cases of refractory corneal ulcer, and Jonas *et al*.[11] reported the outcome of a double comparative study with perforated or predescemetal corneal ulcers treated by emergency procedures and compared it with elective keratoplasty.

In their studies, Krysik *et al*. and Rush and Rush[5,6] found bacteria to be the most common causative organism. However, in our study, fungal etiology was the most common mainly due to the fact that the majority of cases in our study were farmers by occupation with a history of vegetative trauma to eye. Furthermore, no specific growth of organism recorded in 15 (25%) patients may be because of the long duration of prior medical treatment in these cases with chronic infection.

Tectonic sclerokeratoplasty in this study was performed with graft size between 9.5 and 14 mm and with a rim of sclera present in either one or more than one quadrant as we aimed for excising only the devitalized corneoscleral tissue and preserving the healthy part. This correlation between quadrant involvement (graft size) and related outcome is not discussed in other studies,[9-11] but our study clearly showed that complications such as suture related, inflammatory reaction causing reformation of synechia and inflammatory

pupillary membrane, reinfection, graft rejection, and secondary glaucoma were more in Groups B and C with larger grafts.

Jonas *et al*.[11] reported that suture loosening is significantly higher in patients undergoing keratoplasty for active corneal ulcers with/without perforation than in patients undergoing elective keratoplasty for inactive corneal scars. Studies have also identified such loose or broken sutures as a triggering factor for graft infection and, thus, have recommended early suture removal.[12,13] In our study, early suture removal was done in such eyes, i.e., even before 6 weeks following sclerokeratoplasty, which was also done by Panda.[14]

As these were refractory, chronic course cases of infective origin with variable scleral involvement, the main concern was to stop reinfection. This was observed in 68.3% of eyes and could be achieved with smaller additional procedures such as A/C wash, intracameral injection of appropriate antimicrobial, and removal of infective necrotic membrane. We also refrained from administering systemic or topical steroids for the initial 15 days despite being an organ transplant, and steroids were gradually escalated monitoring the signs of any reinfection. Hence, only 19 (31.6%) patients developed reinfection. These additional steps helped achieve the targeted goal of tectonic and prevent recurrence of infection. This was not mentioned in previous studies.[9,10] Other studies[2] in their cases of reinfection with fungal keratitis diagnosed 3 weeks after penetrating keratoplasty have successfully used intracameral amphotericin B.

Panda *et al*. and Barbany *et al*.[15,16] have also reported the incidence of reinfection in sclerokeratoplasty. Identifying the offending pathogen, its drug sensitivity, and modifying the medical treatment accordingly goes a long way in sustaining a recurrence-free status after transplant.[4] However, the offending organism was unidentified in two of five cases of reinfection that underwent evisceration in our study. The duration between sclerokeratoplasty and evisceration ranged from 4 to 8 weeks. Hirst and Lee[10] in their study reported this duration ranging from 0 to 80 months and performed evisceration in 9 of 23 eyes.

Regrafting was done in the eyes with medically uncontrolled reinfection, and this facilitated in achieving the tectonic outcome in 50% of the regrafted eyes, thus emphasizing the importance of timely performed regrafting procedure, unlike other studies.[10]

Panda *et al*.[15] reported no significant association of secondary glaucoma with sclerokeratoplasty when compared to penetrating keratoplasty. Larger corneoscleral grafts may distort angle anatomy, thus anticipated to have increased chances of secondary glaucoma.[2] Modified oblique dissection of host and donor graft edge which is the simplest technique helped prevent damage to angle structure and subsequent development of glaucoma. Therefore, in our study, secondary glaucoma was encountered in only six of Group C cases. In other groups, the scleral involvement restricted to ≤ 2 quadrants with preserved normal architecture in the remaining sclera may have precluded the development of glaucoma. Furthermore, the majority of the Group C cases had marginal and partial thickness scleral involvement, and this can be the reason for the low incidence of glaucoma in our study compared to other studies. In the study by Hirst and Lee,[10] 13 of 23 patients developed glaucoma, of which 6 required surgery, which is similarly described by Taylor and Stern.[9] Cobo *et al*.[17] used angle-supported sutures for the preservation of angle anatomy. Burk and Joussen[18] and Jonas *et al*.[11] depicted the technique of lamellar preparation of the scleral bed for preventing this damage.

In addition, larger grafts are known to be associated with an elevated incidence of graft rejection. A large graft (corneoscleral graft) compromises the immune-privileged status maintained by a corneal graft when sutured into an avascular clear cornea of the recipient as seen in keratoplasty.[14,19-21]

Graft rejection can also be attributed to the delayed commencement of topical steroids in view of preventing disease recurrence, although topical and systemic steroids were gradually started to its full dose in our study after careful observation for 15 days. Another compounding factor for rejection in a few cases could be the poor quality of donor cornea. This consideration was not mentioned in other studies.[22-24]

Performing sclerokeratoplasty in such actively inflamed and infected eyes comes with its own share of pros and cons compared to routinely done elective keratoplasty. We were successful in maintaining the globe integrity (tectonic outcome) in 48/60 cases (80%) after regrafting as the outcome. While complications such as reinfection, suture related, reformation of hypopyon, iris synechiae and pupillary membrane, and graft rejection were more frequent with larger grafts and increased scleral involvement as seen in Group C, subsequent procedures to manage them can improve the graft survival and tectonic outcome.

Thus, sclerokeratoplasty in these hopeless situations, though not sufficient in restoring vision, is definitely helpful in attaining the structural integrity of eye.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1. Gupta N, Tandon R, Gupta SK, Sreenivas V, Vashist P. Burden of corneal blindness in India. Indian J Community Med 2013;38:198-206.
2. Koçluk Y, Sukgen EA. Results of therapeutic penetrating keratoplasty for bacterial and fungal keratitis. Int Ophthalmol 2017;37:1085-93.
3. Rozycki R, Nowak-Gospodarowicz I, Bialas D, Pawlik R, Rekas M. Sclerokeratoplasty as the therapy for corneal perforation due to exposure and neurotrophic keratopathy. Case Rep Ophthalmol Med 2014;2014:467249.
4. Barraquer J. Total penetrating keratoplasty. Proc R Soc Med 1961;54:1116-8.
5. Krysik K, Wroblewska-Czajka E, Lyssek-Boron A, Wylegala EA,

Dobrowolski D. Total penetrating keratoplasty: Indications, therapeutic approach, and long-term follow-up. J Ophthalmol 2018;2018:9580292.
6. Rush SW, Rush RB. Outcomes of Infectious versus Sterile Perforated Corneal Ulcers after Therapeutic Penetrating Keratoplasty in the United States. J Ophthalmol 2016;2016:6284595.
7. Panda A, Sharma N, Angra SK, Singh R. Sclerokeratoplasty versus penetrating keratoplasty in anterior staphyloma. Ophthalmic Surg Lasers 1999;30:31-6.
8. de la Torre-Gonzalez E, de León Ascencio CP. Staged penetrating sclerokeratoplasty and penetrating keratoplasty for management of advanced acquired anterior staphyloma. J Ophthalmic Vis Res 2011;6:147-50.
9. Taylor DM, Stern AL. Reconstructive keratoplasty in the management of conditions leading to corneal destruction. Ophthalmology 1980;87:892-904.
10. Hirst LW, Lee GA. Corneoscleral transplantation for end stage corneal disease. Br J Ophthalmol 1998;82:1276-9.
11. Jonas JB, Rank RM, Budde WM. Tectonic sclerokeratoplasty and tectonic penetrating keratoplasty as treatment for perforated or predescemetal corneal ulcers. Am J Ophthalmol 2001;132:14-8.
12. Siganos CS, Solomon A, Frucht-Pery J. Microbial findings in suture erosion after penetrating keratoplasty. Ophthalmology 1997;104:513-6.
13. Vajpayee RB, Boral SK, Dada T, Murthy GV, Pandey RM, Satpathy G. Risk factors for graft infection in India: A case-control study. Br J Ophthalmol 2002;86:261-5.
14. Panda A. Lamellolamellar sclerokeratoplasty. Where do we stand today? Eye (Lond) 1999;13(Pt 2):221-5.
15. Panda A, Sharma N, Angra SK, Singh R. Therapeutic sclerokeratoplasty versus therapeutic penetrating keratoplasty in refractory corneal ulcers. Aust N Z J Ophthalmol 1999;27:15-9.
16. Barbany M, Gris O, Güell JL. [Therapeutic sectorial full-thickness sclero-keratoplasty for recurrent fungal keratitis]. Arch Soc Esp Oftalmol 2015;90:385-8. [Article in Spanish].
17. Cobo M, Ortiz JR, Safran SG. Sclerokeratoplasty with maintenance of the angle. Am J Ophthalmol 1992;113:533-7.
18. Burk RO, Joussen AM. Corneoscleroplasty with maintenance of the angle in two cases of extensive corneoscleral disease. Eye (Lond) 2000;14(Pt 2):196-200.
19. Esquenazi S, Shihadeh WA, Abderkader A, Kaufman HE. A new surgical technique for anterior segment ectasia: Tectonic lamellar sclerokeratoplasty. Ophthalmic Surg Lasers Imaging 2006;37:434-6.
20. Khodadoust AA, Silverstein AM. Studies on the nature of the privilege enjoyed by corneal allografts. Invest Ophthalmol 1972;11:137-48.
21. Khodadoust AA. The allograft rejection reaction: The leading cause of late failure of clinical allografts. In: Corneal Graft Failure. Amsterdam: Elsevier; 1973. p. 151-67.
22. Kirkness CM, Ficker LA, Rice NS, Steele AD. Large corneal grafts can be successful. Eye (Lond) 1989;3(Pt 1):48-55.
23. Skeens HM, Holland EJ. Large-diameter penetrating keratoplasty: Indications and outcomes. Cornea 2010;29:296-301.
24. Cristol SM, Alfonso EC, Guildford JH, Roussel TJ, Culbertson WW. Results of large penetrating keratoplasty in microbial keratitis. Cornea 1996;15:571-6.