Original Article

Outcomes of Corneal Patch Grafts in a Tertiary Eye Hospital in Nepal

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ABSTRACT

Introduction: Corneal patch graft is a surgery performed as a temporary or definitive treatment of corneal perforations or thinning and descemetoceles.

Objective: To determine the outcomes of corneal patch grafts, in corneal thinning or perforations, in terms of anatomical and functional success.

Methodology: This retrospective study included a total of 28 eyes of 27 patients who underwent corneal patch grafts for the treatment of corneal perforations or thinning >2 mm. The preoperative indications for performing corneal patch grafts, the size and site of corneal perforation or thinning and preoperative best corrected visual acuity (VA) were recorded. The post-operative results were evaluated in terms of structural integrity (anatomical success), using a slit lamp biomicroscopy and visual outcome (functional success) by testing best corrected VA, defined as best corrected VA ≥6/60, at final follow-up.

Result: The mean age (mean ± SD) of patients was 35.75 ± 21.40 years, and 71.42% were males. Corneal thinning or perforations due to microbial keratitis was the most common indication for corneal patch grafts (46.42%), followed by immune-mediated peripheral ulcerative keratitis (21.42%). Peripheral corneal perforation or thinning was the most common location (71.42%). The mean follow-up was 8.43 ± 7.92 months. While anatomical success was seen in 24 of 28 eyes (85.71%), functional success was attained in 17 out of 28 eyes (60.71%).

Conclusion: Corneal patch grafts showed a high success in terms of both maintaining anatomical integrity and functional success. Corneal patch grafts could be used as a good therapeutic modality for the treatment of corneal thinning and perforations.

Key words: Anatomical success; corneal patch graft; corneal perforation; corneal thinning; functional success; ocular emergency.

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INTRODUCTION

Corneal perforation, a serious sight-threatening condition, is an ocular emergency caused by corneal diseases of infectious and non-infectious in nature (Yokogawa et al., 2014).Microbial keratitis, neurotrophic keratitis, trauma, persistent epithelial defects, immune-mediated diseases, corneal xerosis, exposure keratitis and corneal degenerations are the causes of corneal perforations or thinning (Jhanji et al., 2011; Sharma et al., 2021). A perforated cornea can result in shallowing of the anterior chamber, glaucoma, cataract formation, or microbial endophthalmitis (Rodríguez-Ares et al., 2004).

The treatment of corneal perforations depends upon the site, size, and the underlying aetiology (Jhanji et al., 2011). Cyanoacrylate glue can be used for smaller perforations (Fogle, Kenyon, and Foster, 1980; Sharma et al., 2021; Yin et al., 2019), while fibrin glue and amniotic membrane graft can be used to safely manage perforations up to 3 mm (Hick et al., 2005). Tenons patch graft, conjunctival flaps, lamellar corneal grafts, and full thickness corneal grafts are some of other options for the treatment of corneal perforations (Croghan et al., 2018; Korah et al., 2016; Rodríguez-Ares et al., 2004; Vanathi et al., 2002). Tectonic corneal-scleral patch grafting is used as a temporary or permanent treatment for peripheral corneal perforations and descemetoceles when perforation does not require full sized penetrating keratoplasty but is too large for tissue adhesive (Jhanji et al., 2011; Fernandes and Vira, 2015).

The study hypothesised that corneal patch grafts could successfully restore eyeball integrity and achieve functional vision. The aims of the study were to determine common causes of corneal perforations or thinning and to explore the structural (anatomical integrity) and functional (visual) outcomes of corneal patch grafts used for the treatment of corneal thinning or perforations. To date, to best of authors' knowledge, this is the first study from Nepal in patients undergoing corneal patch grafts.

METHODOLOGY

This was a retrospective study which included of 28 eyes of 27 patients with corneal thinning or perforations, for whom the corneal patch graft procedure was performed between 2021 January to 2023 June at Biratnagar Eye Hospital (a tertiary eye care hospital of Nepal). This study was approved by the Institutional Review Committee of Biratnagar Eye Hospital (Reference number: BEH-IRC-104/2024). The study adhered to the Declaration of Helsinki.

Patients with central, paracentral, and peripheral corneal perforations or thinning >2 mm in any one dimension or in patients among whom other modalities had failed to seal the perforation and required tectonic or therapeutic patch grafting were included in this study. All eyes in which the location of thinning or perforation was beyond the limbus or patients with less than two months follow-up were excluded from the study. Socio-demographic characteristics, diagnosis of corneal diseases, and best corrected visual acuity (BCVA) of patients were noted from the medical record database. The BCVA in the diseased eye was noted at each follow-up, using a Snellen chart, and were categorised as follows: no perception of light (NPL),<1/60 ≥ PL, <3/60 ≥ 1/60, <6/60 ≥ 3/60, <6/18 ≥ 6/60, and ≥ 6/18 (Dandona and Dandona, 2006)

Slit lamp examination findings of the location of the corneal perforation and the area of corneal thinning and the presence of infiltrates were noted. The site of the perforations was categorised into central (up to 4 mm from the centre of the cornea), paracentral (4-8 mm from the centre of cornea), and peripheral (8 mm to limbus).

Indications for surgery included traumatic sterile corneal perforation, corneal thinning or perforation secondary to microbial keratitis, immune-mediated peripheral ulcerative keratitis (PUK), Terrien marginal degeneration (TMD), limbal dermoid, dry eye, and vernal keratoconjunctivitis. In cases of immune-mediated diseases, a complete systemic work-up was performed in consultations with internal medicine physician and treated accordingly, while in cases of infective keratitis, a complete microbiological work-up was performed in consultation with a microbiologist and appropriate antimicrobial therapy was initiated. In TMD, corneal patch graft was performed if the corneal thickness was <150 microns at the site of the degeneration (Li et al., 2018). Two patients with grade III TMD (Ding et al., 2019) who were initially planned for lamellar corneal patch grafts ultimately underwent full-thickness grafts due to intraoperative perforation.

To analyse the results of the primary procedure, two outcome measures were used: anatomical and functional. The anatomical success was defined as grafts where tectonic globe stability was maintained after primary procedure without requirement of any additional surgical interventions for tectonicity within the next two months. Functional success was defined as BCVA of 6/60 or better after two months of intervention.

An appropriately sized trephine was used to outline the area of thinning or perforation and the donor tissue was prepared likewise. When an appropriate sized trephine was not available, free hand dissection was performed in both the host cornea and the donor tissue. In cases of peripheral cresenteric thinning or perforation, corneal trephine was used to outline the lesion on the limbal side and free hand dissection was performed on the corneal side. The defect was measured in all dimensions and then the donor tissue was marked. Again, corneal trephine was used to cut the peripheral margins of the donor tissue while the other side was dissected free hand oversizing by 0.5 mm. The graft was sutured onto the host with 10-0 monofilament nylon sutures and water-tight compartment was achieved (Sharma et al., 2021)

RESULT

The study included 28 eyes of 27 patients who underwent corneal patch graft. The mean age (mean ± SD) of the patients was 35.75 ± 21.40 years. The number of males (20, 71.42%) was two and a half times higher than females (8, 28.57%). Fourteen grafts were done with corneas preserved in Cornisol medium, and 14 grafts were done with glycerin-preserved corneas.

The most common indication of tectonic grafts was corneal thinning or perforation secondary to microbial keratitis (13 eyes, 46.42%), followed by corneal thinning or perforation secondary to immune-mediated peripheral ulcerative keratitis (six eyes, 21.42%), sterile traumatic corneal perforation with tissue defect (three eyes, 10.71%), post-surgical corneal thinning in dermoid excision (two eyes, 7.14%), corneal

thinning in TMD (two eyes, 7.14%), perforated shield ulcer (one eye, 3.57%) and corneal perforation secondary to dry eye (one eye, 3.57%). One patient with immune-mediated peripheral ulcerative keratitis underwent bilateral tectonic grafts for corneal perforation.

Regarding locations, peripheral corneal thinning or perforation was seen in 20 eyes (71.42%). Paracentral and peripheral involvement was seen in five eyes (17.85%), followed by only paracentral involvement in two eyes (7.14%), and central and paracentral involvement in one eye (3.57%) (Table 1).

Anatomical success after tectonic grafts was achieved in 24 of 28 eyes (85.71 %) at the mean follow-up of 8.43 ± 7.92 months. Among four cases where anatomical failure was observed, two patients were of microbial keratitis, one patient with immune-mediated peripheral ulcerative keratitis and one patient with corneal thinning following dermoid excision. In both cases of microbial keratitis, there was evidence of reinfection of the graft. Due to significant scleral involvement, evisceration was necessary in one patient, and cyanoacrylate glue and bandage contact lenses were required for the second patient. After three months, the latter was lost to follow-up. When tectonic graft was used to treat corneal thinning associated with

Table 1: Preoperative characteristics of 28 eyes and the outcomes of corneal patch graft for 27 patients.

Parameters	Anatomical success n (%)	Functional success n (%)
Indications		
Microbial keratitis (n = 13)	11 (84.61)	6 (46.15)
Immune-mediated PUK (n = 6)	5 (83.33)	2 (33.33)
Sterile corneal perforation with tissue defect (n = 3)	3 (100)	3 (100)
Terrien marginal degeneration (n = 2)	2 (100)	2 (100)
Miscellaneous (n = 4)	3 (75)	3 (75)
Preoperative BCVA		
<3/60 ≥ PL/PR (n =16)	13 (81.25)	7 (43.75)
<6/60 ≥ 3/60 (n = 5)	4 (80)	4 (80)
<6/18 ≥ 6/60 (n = 5)	4 (80)	3 (60)
≥6/18 (n = 2)	2 (100)	2 (100)
Site of perforation/ thinning		
Peripheral (n = 20)	16 (80)	12 (60)
Peripheral and paracentral (n = 5)	4 (80)	2 (40)
Paracentral (n = 2)	2 (100)	1 (50)
Paracentral and central (n = 1)	1 (100)	1 (100)

PUK = peripheral ulcerative keratitis.

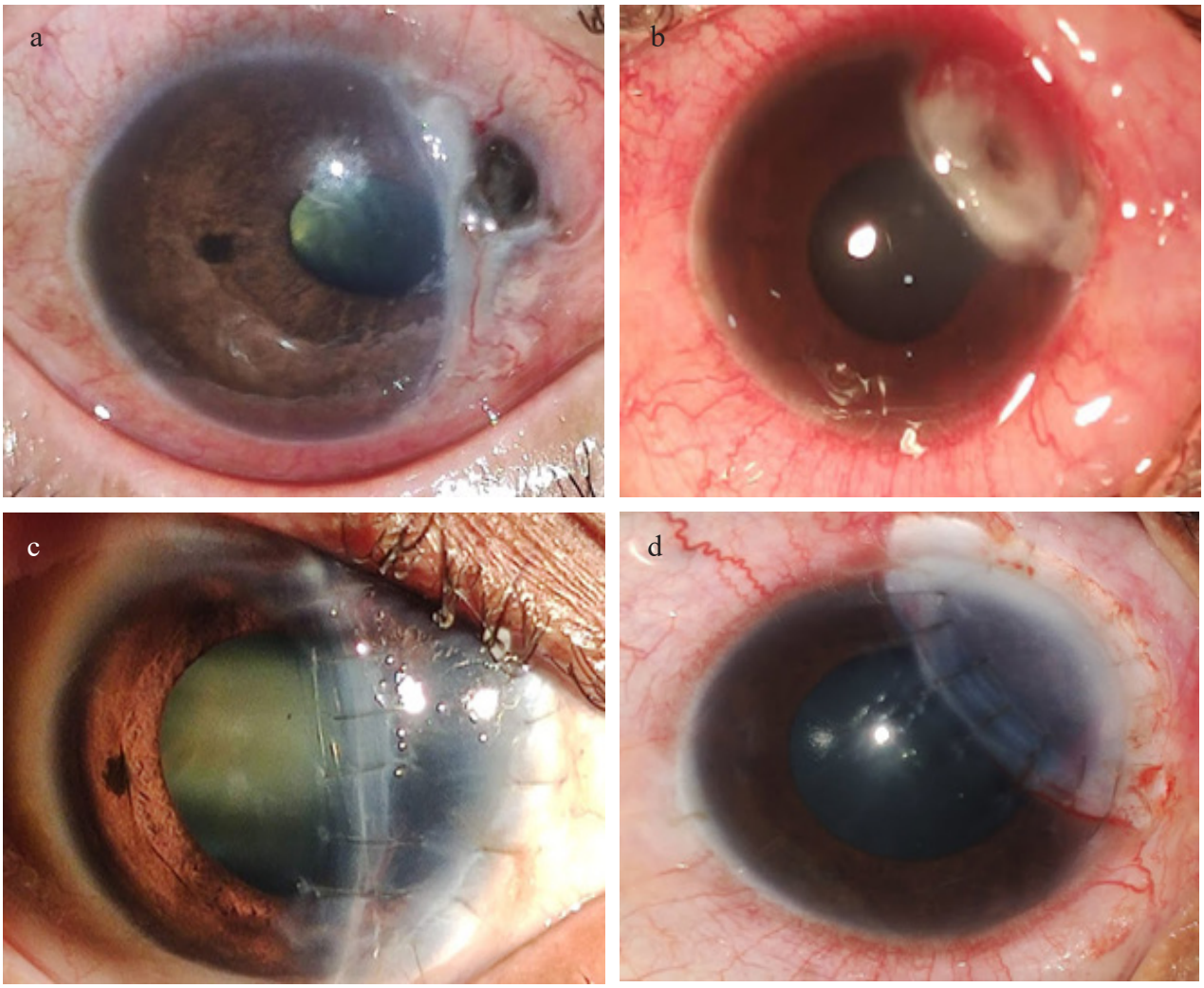

Figure 1: Clinical photographs of two study patients with corneal perforation managed with corneal patch grafts; (a) Corneal perforation due to immune-mediated peripheral ulcerative keratitis; (b) Perforated corneal ulcer due to microbial keratitis; (c) two months post-surgery image; (d) one month post-surgery image**.**

dermoid excision, graft melting was observed, necessitating therapeutic penetrating keratoplasty. In another instance involving immune-mediated PUK, cyanoacrylate glue and bandage contact lens were used to treat graft melting. Functional success was achieved in 17 of 28 (60.71 %) eyes. Representative clinical images are shown in Figure 1. The causes of functional failure despite anatomical success were cataract (six eyes, 21.42) and corneal opacity (one eye, 3.57%).

DISCUSSION

This study demonstrated that microbial keratitis and immune-mediated peripheral ulcerative keratitis were the main causes of corneal perforations or thinning among patients attending the cornea clinic of a tertiary eye care hospital in Nepal. Importantly, corneal patch grafts showed a good therapeutic modality for both maintaining anatomical integrity of the eye

and achieving functional vision for the treatment of corneal perforations or thinning among these patients.

This study showed that corneal patch grafts are favourable for the treatment of corneal perforations or thinning. Corneal patch graft is a better alternative to performing a penetrating keratoplasty with a large graft in cases of peripheral perforations that are larger than 2-3 mm. There are several advantages of corneal patch grafts over the conventional penetrating corneal keratoplasty. Firstly, there is maximal preservation of the limbal stem cells and the angle structures with patch grafts compared to a large therapeutic graft (Sharma et al., 2021). Secondly, the risk of graft rejection and secondary glaucoma is much higher in cases of larger grafts (>9.5 mm) which are usually performed in cases of peripheral perforations. Therefore, in these cases corneal patch grafts provide better option for tectonic support (Rodríguez-Ares et al., 2004). Additionally, the corneal patch graft limits the use of topical steroids for a prolonged period of time, thus reducing complications like steroid induced cataract and secondary glaucoma. Current study also recommends the use of patch grafts as the authors found a high success of this patch graft for maintaining integrity of eye (anatomical success) and regaining functional vision (functional success).

This study reported that nearly half (46.42%) of indications for corneal patch grafts was corneal thinning or perforation secondary to microbial keratitis, which was similar to results in northern and southern India (Sharma et al., 2021; Vanathi et al., 2002). However, studies from the United States and Turkey revealed that corneal perforation secondary to systemic autoimmune diseases was the commonest indication for tectonic grafts (Soong et al., 2000; Calli et al., 2022). In this study, immune-mediated peripheral ulcerative keratitis was the second most common (21.42%) indication for corneal patch. The authors of current study also found that five out of six eyes did well after tectonic grafts while in one patient graft melting was observed. All the patients were on topical steroids, systemic steroids and systemic immunomodulators post-surgery.

This study found that around 61% of patients receiving corneal patch grafts had functional success (BCVA of 6/60 or better). This result is lower than that of a prior study that found 70.73% of patients had VA of 6/24 or better (Vanathi et al., 2002). Findings suggested the utilisation of the corneal patch grafts for the treatment of corneal thinning and perforations in order to maintain ocular integrity and to restore vision. Given that the presence of cataracts was the reason for functional failure among six of the patients in current study, secondary vision restoration procedures such as cataracts extraction can be carried out in cases of functional failure (Vanathi et al., 2002). Cataracts formation can be attributed to chronic inflammation, disruption of aqueous humor dynamics and prolonged anterior chamber collapse (Sharma et al., 2021). Furthermore, the lack of improvement of vision in corneal perforations can be due to several associated ocular comorbidities such as macular oedema, irreversible damage to the angle structures and intraocular adhesions (Vanathi et al., 2002).

This study found that 7.14% of the eyes had graft melting, which is lower than several prior

studies that found graft melting in the range of 12 to 19% (Vanathi et al., 2002; Soong et al., 2000; Calli et al., 2022). However, these previous studies showed that the autoimmune-mediated aetiology was higher, ranging from 29% to 43%, in contrast to in the current study which showed this to be only 21.42% of the eyes. These studies have suggested that graft melting is more likely in autoimmune-mediated illnesses since these conditions can persist even after tectonic grafts (Vanathi et al., 2002; Soong et al., 2000; Calli et al., 2022).

The current study also showed that glycerin-preserved corneas could be used for tectonic grafts. The authors of this study performed fourteen of grafts with glycerin-preserved corneal tissues with favourable anatomical and functional success. Importantly, this indicated that this approach of corneal patch grafts could be especially useful in developing nations like Nepal, where there is a scarcity of donor tissues with high optical quality.

This study has some strengths and limitations. The study has important strengths in that well-established and standardised surgical procedures have been used for the treatment of corneal perforations or thinning. The study provides new knowledge regarding the positive impact of corneal patch grafts, particularly from a developing country like Nepal. This study has some limitations. First, this study was retrospective in design. Second, the astigmatism component, which is important for evaluating the visual outcome, was not examined. Third, patients' follow-up period was not consistent.

CONCLUSION

In conclusion, corneal patch graft is a useful therapeutic option for the treatment of corneal thinning and perforations larger than 2 mm size. This surgical procedure could provide favourable outcomes in the restoration of anatomical integrity and functional success of such patients. Moreover, the donor tissue of lower quality may be used for the procedure.

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