Original Article

Indication and Outcome of Paediatric Keratoplasty at a Tertiary Referral Eye Hospital in Nepal

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ABSTRACT

Introduction: Paediatric keratoplasty is rarely performed surgery with high risk of graft failure. Developing countries have not benefited due to lack of sufficient facilities and trained surgeons.

Objectives: The objectives of the study were to analyze the indications and its outcome in terms of vision and graft survival.

Materials and methods: This retrospective chart review used electronic medical records from January 2017 to December 2019 of all consecutive patients aged upto18 years or below that underwent paediatric keratoplasty after ethical approval at Tilganga Institute of Ophthalmology. Outcome was defined as anatomical or visual success and graft clarity. Different demographic and surgical parameters were studied among 59 eyes of 48 patients.

Results: Mean age of recipient was 12.23± 3.81 years. Majority 37 (52.5%) had unilateral grafts with keratoconus being the most common 24 (40.6%) acquired non-traumatic indication. Mean post-operative best corrected visual acuity 0.6 Logmar was significantly ($p < 0.001$) low as compared to preoperative 1.3 Logmar. Overall graft survival rate was 47 (78%) at one-year follow-up; keratoconus accounting for 24 (100%). Major factors in contributing for graft failure were rejection, infection, and glaucoma.

Conclusion: A good outcome in terms of anatomical and visual success was achieved in our study. Keratoconus has an excellent graft survival. Visual rehabilitation by cycloplegic refraction should be done to prevent amblyopia. Enhancing the training of surgeons and addressing challenges faced in a paediatric population will help decrease corneal blindness among paediatric patients in the future.

Key words: Amblyopia, Bilateral grafts, Graft failure, Keratoconus, Paediatric keratoplasty.

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INTRODUCTION

Over the past few years, paediatric keratoplasty has proven itself to be one of the most challenging surgeries in terms of risk and higher rate of graft failure. Repeated general anaesthesia (GA) is an issue for suture related problems such as loose suture, broken suture, reforming anterior chamber and breaking synechiae where there is limited GA facility in most of the eye hospitals. There is a risk of amblyopia even after performing successful surgery. Amblyopia management is quite challenging in paediatric keratoplasty. It was rarely performed before the 1970s (Beauchamp et al, 1979; Warin et al., 1977). Higher graft failure rates and poor visual outcome have been constantly reported in paediatric keratoplasty compared to adult keratoplasty (Vanathi et al, 2009; Al-Ghamdi et al, 2007; Aasuri et al, 2000, Stulting et al, 1984; Dana et al, 1995).

In preverbal children assessment of visual function and potential have been particularly strenuous before and after surgery (Vanathi et al, 2009; Huang et al, 2009; Mc Clellan et al, 2003). Furthermore, intraoperative challenges that include surgery under GA, thinner and less rigid cornea, smaller and more crowded anterior segment, and decreased scleral rigidity require specialised surgical techniques. Recently, there has been increase in frequency and success rates of paediatric keratoplasty (Vanathi et al, 2009; Aasuri et al, 2000; Patel et al, 2005; Low et al, 2014) due to advances in corneal microsurgery, post-operative management, and better understanding of risk factors. It has helped to predict as well as prevent poor outcomes in certain cases (McClellan et al, 2003).

Few studies of paediatric keratoplasty have been reported in developed countries (Lowe et al., 2011; Patel et al, 2005; McClellan et al, 2003). There are fewer studies in developing countries. Studies in Asia have reported a good outcome and emphasised upon the challenges faced by this population undergoing surgery (Low et al, 2014;Vanathi et al, 2009; Hong et al, 2008; Sharma et al, 2007; Shi et al, 2007; Aasuri et al, 2000). This is the first study to report indication and outcome of paediatric keratoplasty in Nepal.

MATERIALS AND METHODS

This retrospective chart review collected electronic medical records from January 2017 to December 2019 of all consecutive patients of 18 years or below that underwent paediatric keratoplasty at Tilganga Institute of Ophthalmology after ethical approval (Reference number: 15/2021) from Institutional Review Committee. Information collected from the records included: age, gender, address, preoperative diagnosis, pre and post-operative visual acuity of both eyes, associated factors, type of surgery {penetrating keratoplasty (PK), deep anterior lamellar keratoplasty (DALK), corneal patch graft, and the procedures performed in addition to the main surgery}, intraoperative and post-operative complications and reasons for graft failure were also recorded. Indications for keratoplasty were divided into three main diagnostic categories: Congenital, acquired non-traumatic and acquired traumatic. These three groups included patients with keratoconus, corneal dystrophy, infectious keratitis, corneal scar due to viral keratitis, congenital corneal opacity, regraft and others. Keratoplasty performed for active bacterial,

fungal or viral ulcers were included under infectious keratitis. After performing therapeutic PK (n=13, 22%) corneal button was sent for culture and sensitivity.

Patients were examined in slit lamp if possible and under the microscope for small children who were unco-operative. Intraocular pressure was monitored by air puff or digital whichever was feasible. The preoperative age, visual acuity, indications, surgical procedures, complications and associated factors were analysed for graft survival. Graft clarity was evaluated on a slit lamp or under the operating microscope. A clear graft was defined as one with compact central stroma, without epithelial or stromal edema, that allowed a clear view of iris details. Allograft rejection was diagnosed when sudden loss of graft clarity was associated with inflammation in a previously clear graft. It was also diagnosed in the presence of an endothelial or epithelial rejection line. Allograft rejection was treated with one hourly instillation of topical steroids, which were tapered on the basis of clinical response. Outcome was evaluated on day one, day seven and every month post-operatively. The outcome of surgery was evaluated at one-year post-operatively for visual recovery and clarity of graft.

Data were entered and cleaned in Microsoft Excel. The cleaned data were then transported to IBM SPSS Statistics for Windows, version XX (IBM Corp., Armonk, N.Y., USA) for the statistical analysis. For association of categorical variable, Chi-square test was used and for the expected count less than five, Fisher exact test was used. p value <0.05 was considered as statistically significant.

RESULTS

We reviewed the records of 58 children (69 eyes) but 10 children were lost to follow-up in average for two months. Only 48 children (59 eyes) were analysed in our study. The mean recipient age at surgery was 12.23±3.81 years, range from 3-18 years. The sex distribution was 30 (62.5%) male and 18 (37.5%) female. Regarding the laterality, 31 (52.5%) were right and 28 (47.5) were left. Unilateral eyes were 37 (77.1%) and bilateral eyes were 11 (22.9%). Among unilateral cases infection was the most common indication and keratoconus in bilateral cases.

The distribution of proportion of Congenital 10 (16.9%), Acquired Non-traumatic, 48 (81.4%) and Acquired traumatic one (1.7%) was statistically different (p <0.001). As shown in (table 1), majority of paediatric keratoplasty were performed for keratoconus 24 (40.6%) followed by infectious 11 (18.6%) and corneal scar 6 (10.2%). Congenital hereditary endothelial dystrophy (CHED) was the most common indication among congenital dystrophy. Corneal scar includes adherent leukoma in childhood, leukomatous scar, traumatic scar. Corneal opacity (CO) includes Buphthalmos and CO since birth. There were three regraft procedures performed during the study period in which primary indications were keratoconus , infectious keratitis and failed graft with post-trabeculectomy. Others included one keratoglobus, one keratoglobus with acute hudrops, two keratomalacia with Vitamin A deficiency, one dermoid, and one open globe injury (OGI) with scleral perforation.

Table 1: Indications of surgery

Indication	Subtype	n (%)
Congenital, 10 (16.9%)	Dermoid	1 (1.9)
	Corneal opacity	3 (5.1)
	Corneal dystrophy	6 (10.2)
Acquired Non-traumatic, 48 (81.4%)	Keratoconus	24 (40.6)
	Infectious	13 (22.0)
	Corneal scar (Post-viral or post-microbial)	6 (10.2)
	Keratoglobus	2 (3.9)
	Regraft	3 (5.4)
Acquired Traumatic, 1 (1.7%)	OGI with scleral perforation	1 (1.9)
Total		59

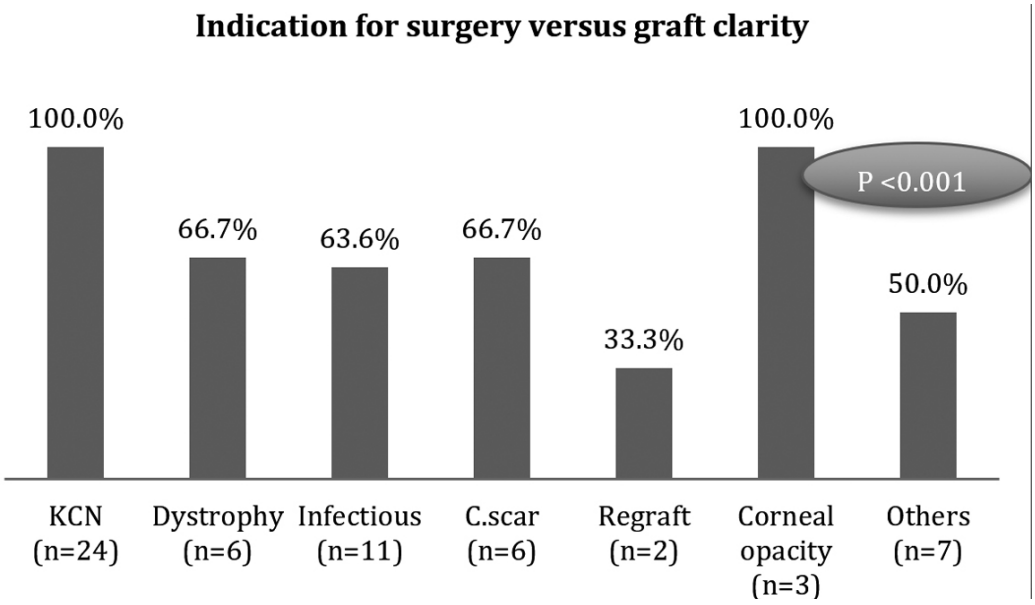

Figure 1: Indication for surgery versus graft outcome

There was a high 24 (100%) graft survival in case of keratonconus and corneal opacity and lowest in case of regraft 2 (33.3%) as shown in (Figure1). Graft was hazy in 12 (22.0%) represented by corneal oedema and vascularisation. Diagnosis is statistically different with graft clarity (P <0.001).

Among 59 eyes, PK 31 (52.5%) was the most common surgery followed by Therapeutic penetrating keratoplasty (TPK), DALK and corneal patch graft.

The above figure showed DALK surgery having the highest graft clarity and Corneal patch graft had lowest graft clarity.

Table 2: Graft survival based on types of surgery

Surgery types	Graft clarity (%)
TPK (13)	61.50
PK (30)	77.40
DALK (13)	100
Patch graft (3)	50

There were several factors for graft rejection in 54 (91.5%) of the total number of eyes. These include patient related factors such as recipient age, clinical diagnosis, and primary indication of surgery. Preoperative associated factors include allergy in 22 (40.7%) followed by active infection, genetic association, systemic disease like Vitamin A deficiency, pre-existing glaucoma, post-trabeculectomy, nystagmus, strabismus and aphakia.

Among 11 bilateral grafts, seven were keratoconus followed by two corneal dystrophy, one corneal scar, and one keratomalacia.

The common complications following surgery were glaucoma 14 (23.7%), graft rejection 8 (13.6%), cataract 7 (11.5%), infection 5 (8.5%) and others (steroid responder, endophthalmitis, peripheral anterior synechiae). Other surgery done after keratoplasty during one year of follow-up included three glaucoma surgery, two cataract, one anterior chamber reformation, intraocular lens implantation with membranectomy and one Re-TPK.

Out of 13 TPK surgeries done for infectious keratitis, organism was isolated in seven cases of excised corneal button culture. Among organisms seen, three gram positive (two Streptococcus pneumonia, one Streptococcus viridans), two gram negative (one Escherichia coli, one Klebsiella), one mixed growth and one fungal growth (Aspergillus) was isolated.

Outcome of surgery was evaluated one-year post-operative period. There were 69 keratoplasties during this interval with follow-up data available for 85.6 % (n=59). The remaining 10 (14.4%) were lost to follow up in average three months. The survival rate was determined by analysing the percentage of corneal graft that were clear at one year post-operatively. Seventy-eight percent (n=47) of grafts were clear and 22% (n = 12) failed.

Best corrected visual acuity (BCVA) was reported in 46 (77.5%) of cases that survived one year post-operatively. Post-operative BCVA of 6/18 or better in 24 (52.1%) of all keratoplasties (Table no.3). Graft was failed in 12 (20.4%) eyes. However, hand movement, perception of light, projection of rays, counting finger close to face and following of light was noted bot one eye had no perception of light.

Mean of pre BCVA was Logmar 1.3 (standard deviation 0.40) and post BCVA was Logmar 0.6 (standard deviation 0.30). p value <0.001 was significant while comparing pre and post BCVA.

Table 3: Visual acuity after one-year post-operative period.

BCVA	n (%)	Graft clarity, n (%)
Normal (6/6 to 6/12)	9 (19.1)	9 (19.5)
Mild (<6/12 to 6/18)	15 (31.9)	15 (32.6)
Moderate (<6/18 to 6/60)	17 (36.1)	17 (36.9)
Severe (<6/60 to 3/60)	2 (4.2)	2 (4.3)
Blindness (<3/60)	3 (6.3)	3 (6.5)
Unreliable (could not comment on visual acuity)	1 (2.1)	-
Total	47 (79.6)	46 (100)

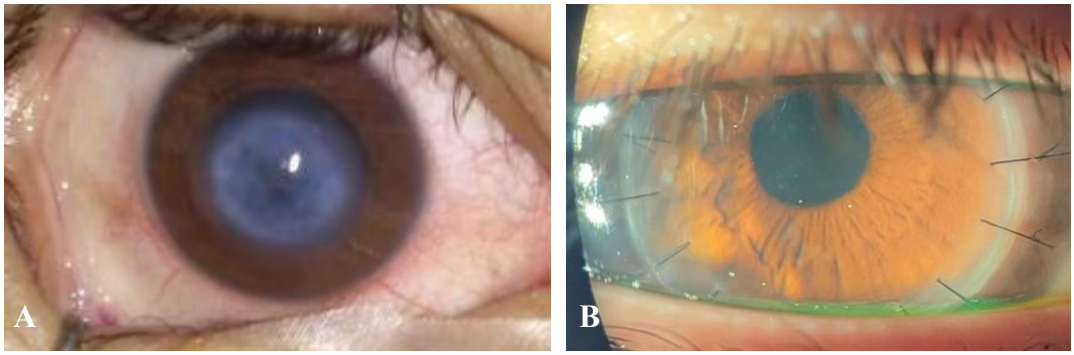

Figure : 2 A. A 14-year-old boy presented as severe keratoconus with acute hydrops; B. Post-penetrating keratoplasty (PK) after one week of surgery

Twelve (20.3%) grafts failed in our study. There were several causes of graft failure. Among them, graft rejection and infection were seen in three cases. Glaucoma and primary graft failure were seen in two patients, and pthisis bulbi and endophthalmitis were seen in one case.

DISCUSSION

Paediatric keratoplasty is a challenging surgery in developing countries where there is limited facility of general anaesthesia in eye hospitals.

Our study highlights on different issues of developing countries while performing keratoplasty. This study showed the main indication being acquired non-traumatic (82.3%) which is comparable to the other studies (Patel et al., 2005; Aasuri et al., 2000). The acquired traumatic contribute to greater proportion in other studies (Stulting et al., 1984; Cowden, 1990). In our study, congenital indication was also low 10 (17.2%) as compared to other studies (Dana et al.;1995; Cowden;1990; Stulting et al;1984) where there was a greater proportion. This might be due to limited facilities and lack of education to the guardians.

Keratoconus was the most common acquired non-traumatic indication in this study, accounting for 24 (40.6%) of all keratoplasties. This might be due to being a referral centre not confirmed diagnoses were referred from

peripheral eye hospital. In studies in the past, Patel et al (2005) showed greater proportion of keratoconus (67%) in their study probably due to keratoconus being the leading indication (45%) for keratoplasty in the adult population in New Zealand. Some studies had shown keratoconus accounted for only 0-11% of paediatric keratoplasties (Aasuri et al,. 2000; Dana et al, 1995; Cowden , 1990; Stulting et al., 1984).

Penetrating keratoplasty was the most common 31 (52.5%) among other surgeries, TPK 13 (22%), DALK 13 (22%), and patch graft 2 (3.4%). During our study period we did not come across to Descemet strippling automated endothelial keratoplasty (DSAEK) surgery. PK being common might be due to large number of keratoconus and corneal scar.

Graft survival in our study was 47 (78%) in overall indication and type of surgery performed. Reported survival rates ranged from 46-80% in different literature (Vanathi et al, 2009; Shi et al, 2007; Hong et al, 2008; McClellan, 2003;Beauchamp, 1979;Waring, 1977) . The overall survival rate of 47 (78%) in our study was high when compared to other published reports. This high percentage might be due to high keratoplasties performed for keratoconus in our study. High survival rate of keratoconus might be due to early diagnosis and less vascularisation. In our study, DALK showed 13 (100%) graft survival than PK 24 (77.4%), followed by TPK 8 (61.5%) and patch graft. DALK was performed for keratoconus which signified that survival tendency of DALK was superior to PK.

There were contributing factors such as allergy, infection, glaucoma, systemic disease like Vitamin A deficiency, Goldenhar syndrome, aphakia, regraft, strabismus, and nystagmus which might have played a role in graft failure. Microorganisms' growth seen in five (53.8%), among them gram-positive three (23.1%) and gram-negative two (15.4%), and fungal and mixed were equal one(7.7%). These reports were comparable to the study done by Bajracharya et al (2015).

Best corrected Logmar and Snellen visual acuity (BCVA) was reported in 46 (77.9%) of cases that survived one-year post-operatively. Of all paediatric keratoplasties, 24 (51%) achieved a BCVA of 6/18 or better. Mean of preoperative BCVA was 1.3, 6/120) Logmar and post-operative BCVA Logmar was 0.6, 6/24) which was significant. Clarity of graft was found in keratoconus and corneal dystrophy which aids in improvement in post-operative BCVA. Visual outcome could be poor in childhood due to amblyopia, high chance of graft failure, astigmatism and associated ocular pathology (Aasuri et al, 2000; Stulting et al, 1984; Waring, 1977).

The most common post-operative complication was glaucoma 14 (23.7%), graft rejection 8 (13.6%), cataract 7 (11.9%), infection 5 (8.5%) and others (steroid responder, endophthalmitis, peripheral anterior synechiae) in our study. Aasuri et al (2000) study showed more incidence of allograft rejection – related graft failure in children younger than five years as compared to older than five years. Graft infection was noticed in 9.1% in Aasuri et al (2000) and 8% in Dana et al (1995) eyes which is similar to our study. Loose suture could be one of the factors which contribute to graft infection. Delay in reporting to an ophthalmologist after loosening of suture appeared to be an important risk factor

for graft infection in our study. Poor socio-economic condition, long distance from the referral centre and need of general anaesthesia probably contributed to this delay.

A retrospective study and the loss of patients for follow-up could be limitation of our study.

CONCLUSION

A good outcome in terms of anatomical and visual success was achieved in our study. Keratoconus has an excellent graft survival compared to other indications for surgery. Measures to prevent graft infection, rejection and glaucoma has to be undertaken to increase the success rate of surgery. Timely cycloplegic refraction can prevent chances of amblyopia. Enhancing the training of surgeons and addressing challenges faced in a paediatric patients that have to undergo penetrating keratoplasty will help decrease corneal blindness among paediatric patients in the future.

REFERENCES

Aasuri MK, Garg P, Gokhle N et al (2000). Penetrating keratoplasty in children. Cornea;19(2):140-144.

Al-Ghamdi A, Al-Rajhi A, Wagoner MD (2007). Primary pediatric keratoplasty: Indications, graft survival, and visual outcome. American association for pediatric ophthalmology & strabismus (AAPOS) journal;11(1):41-47. https://doi.org/10.1016/j.jaapos.2006.09.012

Bajracharya L, Bade AR, Gurung R, Dhakhwa K (2020). Demography, Risk factors and Clinical and Microbiological features of Microbial keratitis at a Tertiary eye hospital in Nepal . Clinical Ophth; 14:3219-3226. https://doi.org/10.2147/OPTH.S266218

Beauchamp GR (1979). Pediatric keratoplasty: Problems in management. J Pediatr Ophthalmol Strabismus;16(6):388-394. https://doi.org/10.3928/0191-3913-19791101-13

Cowden JW (1990). Penetrating keratoplasty in infants and children. Ophthalmology ;97:324-9. https://doi.org/10.1016/S0161-6420(90)32586-1

Dana MR, Moyes AL, Gomes JA et al (1995). The indications for and outcome in pediatric keratoplasty.A multicenter study. Ophthalmology ;102(8):1129-1138. https://doi.org/10.1016/S0161-6420(95)30900-1

Edwards M, Clover GM, Brookes N, Pendergrast D, Chaulk J, McGhee CN (2002). Indication for corneal transplantation in New Zealand: 1991-1999, Cornea ; 21:152-5.

Hong JX, Xu JJ, Sheng MJ, et al (2008). Pediatric penetrating keratoplasty in Shanghai: a retrospective multiple centre study from 2003 to 2007. Chin Med J (Engl);121(19):1911-1914.

Huang C, O'Hara M, Mannis MJ (2009). Primary pediatric keratoplasty: Indications and outcomes. Cornea;28(9):1003-1008. *DOI:* 10.1097/ICO.0b013e3181a186c0

Lowe MT, Keane MC, Coster DJ et al (2011). The outcome of corneal transplantation in infants, children, and adolescents.Ophthalmology;118(3):492-497. https://doi.org/10.1016/j.ophtha.2010.07.006

Low JR, Anshu A, et al (2014). The outcomes of Primary Paediatric keratoplasty in Singapore. Am J Ophthalmol; 158(3):496-502. https://doi.org/10.1016/j.ajo.2014.05.020

McClellan K, Lai T, Grigg J, Billson F (2003). Penetrating keratoplasty in children: Visual and graft outcomes. Br J Ophthalmol ;87(10):1212-1214. http://dx.doi.org/10.1136/bjo.87.10.1212

Patel H Y, S Ormande, N H Brookes et al (2005). The indications and outcome of Paediatric corneal transplanatation in New Zealand : 1991-2003. B J Opth ;89:404-408. http://dx.doi.org/10.1136/bjo.2004.053116

Sharma N, Prakash G, Titiyal JS et al (2007). Pediatric keratoplasty in India: indications and outcomes. Cornea ;26(7):810-813. *DOI:* 10.1097/ICO.0b013e318074ce2e

Shi W, Jin H, Li S et al (2007). Indications of paediatric keratoplasty in north China. Clin Experiment Ophthalmol;35(8):724-727. https://doi.org/10.1111/j.1442-9071.2007.01618.x

Stulting RD, Sumers KD, Cavanagh HD et al (1984). Penetrating keratoplasty in children. Ophthalmology;91(10):1222-1230. https://doi.org/10.1016/S0161-6420(84)34171-9

Vanathi M, Panda A, Vengayil S, et al (2009). Pediatric keratoplasty. Surv Ophthalmol;54(2):245-271. https://doi.org/10.1016/j.survophthal.2008.12.011

Waring GO, Laibson PR (1977). Keratoplasty in infants and children. Trans Sect Ophthalmol Am Acad Ophthalmol Otolaryngol;83(2):283-296. PMID: 19537