Visual Outcomes after Penetrating Keratoplasty

Winai Chaidaroon[1]* and Sani-orn Iewsakul[1]

[1]Department of Ophthalmology, Faculty of Medicine, Chiang Mai University, Chiang Mai 50200, Thailand

**Corresponding author. E-mail: wchaidar@mail.med.cmu.ac.th*

ABSTRACT

A chart review of the hospital records of all patients who underwent penetrating keratoplasty at Maharaj Nakorn Chiang Mai Hospital between January 1996 – December 1999 was retrospectively performed. Out of total 45 corneal transplants, the best-corrected visual acuity of 6/6 to 6/12 was achieved in 8.9% (4 of 45), 6/18 to 6/36 in 22.2% (10 of 45), 6/60 to 1/60 in 44.5% (20 of 45). One (2.2%) patient could not be evaluated for visual acuity.

Key words: penetrating keratoplasty, visual acuity, light perception.

INTRODUCTION

The concept of modifying diseased cornea by surgically removing opacities is more than two centuries old. When ophthalmology emerged as a separate specialty in medicine almost 200 years ago there followed, within a few years, the concept of replacing diseased cornea with a clear substitute. Von Hippel (1886) was the first person to perform a successful human corneal transplant. Lamellar keratoplasty was the technique of choice substitute (Rycroft, 1955). Later, Stocker (1952) was the first surgeon to perform successful penetrating keratoplasty for corneal edema. The way was then opened for an increase in surgery. Penetrating keratoplasty is one of the most successful tissue transplantations worldwide (Chen et al., 2001). Continued improvement in transplantation techniques, eye banking, and pharmacological advances have made it a highly successful surgery (Damji et al., 1990). Despite a clear graft occurring after penetrating keratoplasty, age-related macular degeneration, cataract, macular hole, and glaucoma may all contribute to limiting visual results (Demers et al., 2002). We performed a retrospective study to evaluate the visual outcomes after penetrating keratoplasty.

MATERIALS AND METHODS

We reviewed the hospital charts of penetrating keratoplasty performed at Maharaj Nakorn Chiang Mai Hospital, Department of Ophthalmology, Faculty of Medicine, Chiang Mai University, Chiang Mai, Thailand between January 1, 1996 and December 31, 1999. Information that was reviewed included patients sex, age, date of surgery, preoperative clinical diagnosis, pre and postoperative visual acuity, graft clarity, and causes of postoperative decreased vision. Information was also obtained regarding surgical procedures associated with penetrating keratoplasty. Each graft included in this study had a minimum of 6 month of

follow-up. Best-corrected visual acuity data was categorized: 6/6 to 6/12, 6/18 to 6/36, 6/60 to 1/60, and count fingers to no light perception. Graft clarity was defined as either clear or opaque. Any graft that was not clear in central visual axis was classified as opaque.

RESULTS

Between January 1, 1996 and December 31, 1999, forty-five corneal transplantations were performed at Maharaj Nakorn Chiang Mai Hospital. Of the 45 corneal transplantations, 42 patients involved comprised of 25 (59.5%) male and 17 (40.5%) female. Three patients had penetrating keratoplasty in both eyes. The mean age of the patients was 48.3 years (ranging from 2 years to 94 years), with a standard deviation of 23.8 years.

Bullous keratopathy was the most common indication of penetrating keratoplasty and accounted for 13 (28.9%) cases (Table 1). Of these 13 bullous keratopathy cases, 7 (15.5%) were associated with pseudophakic bullous keratopathy, 3 (6.7%) with aphakic bullous keratopathy, and 3 (6.7%) with bee sting toxic keratopathy. Of the 7 pseudophakic bullous keratopathy cases, 6 (85.7%) were related to posterior chamber intraocular lens and 1 (14.3%) to closed-loop anterior chamber intraocular lens. Corneal scar was the second most common indication (22.2%). Corneal dystrophy and degeneration ranked as the third most common indication and accounted for 9 (20.0%) cases. Of these 9 cases, 5 (55.6%) were associated with gelatinous drop-like dystrophy, and 4 (44.4%) with Fuchs' endothelial dystrophy.

Table 1. Clinical diagnosis for penetrating keratoplasty by year

Diagnosis	year				
	1996	1997	1998	1999	Total (Percent)
Bullous keratopathy	4	4	3	2	13 (28.9)
Corneal scar	4	0	2	4	10 (22.2)
Corneal ulcer	2	0	1	5	8 (17.8)
Corneal dystrophy, degeneration	2	4	0	3	9 (20.0)
Regraft	3	1	0	0	4 (8.9)
Trauma	0	0	0	1	1 (2.2)
Total	15	9	6	15	45 (100.0)

Corneal ulcer was the fourth leading overall indication for penetrating keratoplasty in this study and accounted for 8 (17.8%) cases. Regraft was the fifth most frequent indication for penetrating keratoplasty, and accounted for 8.9 % of cases. The least common indication in this report was traumatic ruptured cornea (2.2%).

The procedures associated with penetrating keratoplasty are demonstrated in Table 2.

Table 3. demonstrates pre and postoperative results. One patient was 2 years old who can not be evaluated visual acuity. Five grafts were opaque during follow up. Three grafts showed corneal graft rejection after operation. Two grafts had severe ulcerative keratitis.

The patients with clear graft, who had count fingers to no light perception visual acuity, had macular hole (one eye), glaucoma (one eye), age-related macular degeneration (three eyes), cataract (one eye), and macular scar (one eye) (Table 4).

Of these 40 clear grafts, the visual acuity improved at least one line in 24 eyes, the visual acuity remained the same category in 15 eyes, and the visual acuity in one eye became worse because of a macular hole.

Table 2. Procedures associated with penetrating keratoplasty

Associated procedures	Eyes	Percent
Extracapsular lens extraction with intraocular lens implantation	9	52.9
Scleral fixated intraocular lens implantation with anterior	7	41.2
vitrectomy	1	5.9
Trabeculectomy		
Total	17	100

Table 3. Preoperative and postoperative visual acuity in eyes after penetrating keratoplasty

Visual acuity	Preoperative (Percent)	Postoperative (Percent)
6/6 to 6/12	0 (0)	4 (8.9%)
6/18 to 6/36	0 (0)	10 (22.2%)
6/60 to 1/60	20 (44.5%)	20 (44.5%)
Count fingers to no light perception	24 (53.3%)	10 (22.2%)
Cannot evaluate	1 (2.2%)	1(2.2%)
Total	45 (100 %)	45 (100%)

Table 4. Associated ocular diagnosis presumed to cause suboptimal visual acuity

Diagnosis	Number of Eyes
Age-related macular degeneration	3
Macular scar	1
Macular hole	1
Cataract	1
Glaucoma	1
Total	7

DISCUSSION

In this study, we reported the outcomes of penetrating keratoplasty, clinical indications for penetrating keratoplasty, and associated procedures at our hospital during a 4-year period from 1996 to 1999. When compared with the previous report (Ausayakhun and Juntaramanee,

1997), the number of penetrating keratoplasty transplants declined because of a limited number of corneal donors. The present study showed that bullous keratopathy was the major indication for penetrating keratoplasty and accounted for 28.9% of all the transplants performed. We found pseudophakic bullous keratopathy more common in the posterior chamber intraocular lens (6 in 13 cases). The possible contributing factors that explain the increase in the number of bullous keratopathy transplants include the increased number of cataract extractions with posterior chamber intraocular lens implantation performed, increased percentage of cataract extractions associated with secondary intraocular lens implantation, and the learning curve of phacoemulsification with intraocular lens implantation. Corneal scar was the second most common indication (22.2%) followed by corneal dystrophy and degeneration (20.0%), corneal ulcer (17.8%), regraft (8.9 %), and traumatic ruptured cornea (2.2%). Sugar and Sugar (2000) recently reviewed a number of large series of graft by decade and combined the results. It was evident that corneal edema after cataract surgery was the main cause for corneal dysfunction requiring penetrating keratoplasty.

The most common procedure associated with penetrating keratoplasty was extracapsular lens extraction with intraocular lens implantation. Modern microsurgical techniques and the use of viscoelastic material has led to significant advances and decreased failure in corneal graft surgery. Combined penetrating keratoplasty with extracapsular cataract extraction was associated with graft survival rates that were comparable to those of simple penetrating keratoplasty (Sanford et al., 1991; Binder, 1986).

Corneal opacity after penetrating keratoplasty occurred in five (11.0%) eyes. Three (6.7%) eyes showed allograft rejection after the operation. Two (4.3%) eyes had severe ulcerative keratitis. The graft failure rate was low, compared to others (Vail et al., 1994; William et al., 1995). This may reflect the improvement in educating the patient about the warning signs of graft rejection. In addition, an increased frequency of applied corticosteroid medication may have contributed to the overall decrease in allograft rejection. Patients with a preoperative diagnosis of corneal ulcer tended to have a higher incidence of graft failure because of stronger postoperative inflammation and a higher incidence of glaucoma. However, this study had a small sample size.

Of the 45 grafts in this study, 88.9 % (40) had a clear graft. Eighty-five percent of these clear grafts (34 of 40) had a best-corrected visual acuity of 1/60 or better, which was comparable to other report (William et al., 1991). The visual acuity improved in at least one line of Snellen's chart in 24 (60%) eyes, remained at the same category in 15 (37.5%) eyes, and became worse in one (2.5%) eye because of a macular hole. Age-related macular degeneration, cataract, macular scar, macular hole, and glaucoma contributed to limited visual results in our study although the corneal grafts remained clear.

CONCLUSIONS

This study demonstrated the visual outcomes after penetrating keratoplasty. The causes of suboptimal visual acuity were assessed. Age-related macular degeneration is the major cause of decreased visual acuity in patients with clear graft.

REFERENCES

Ausayakhun, S., and J. Juntaramanee. 1997. Clinical indications for penetrating keratoplasty in Maharaj Nakorn Chiang Mai Hospital, 1990-1995. Thai J. Ophthalmol. 11: 17-23.

Binder, P.S. 1986. The triple procedure: refractive results. 1985 update. Ophthalmology 93: 1482-1488.

Chen, W.L., F.U. Hu, and I.J. Wang. 2001. Changing indications for penetrating keratoplasty in Taiwan from 1987 to 1999. Cornea 20: 141-144.

Damji, K.F., J. Rootman, V.A. White, P.J. Dubord, and J.S.F. Richard. 1990. Changing indications for penetrating keratoplasty in Vancouver, 1978-87. Can. J. Ophthalmol. 25: 243-248.

Demers, P.E., R.F. Steinert, and E.M. Gould. 2002. Topographic analysis of corneal regularity after penetrating keratoplasty. Cornea 21: 140-147.

Rycroft, B. 1995. Corneal graft. Butterworths, London.

Sanford, D.K., L.M. Klesgers, and T.O. Wood. 1991. Silmutaneous penetrating keratoplasty, extracapsular cataract extraction, and intraocular lens implantation. J. Cataract. Refract. Surg. 17: 824-829.

Stocker, F.W. 1952. Successful corneal graft in a case of endothelial and epithelial dystrophy. Am. J. Ophthalmol. 35: 349-350.

Sugar, A., and J. Sugar. 2000. Techniques in penetrating keratoplasty. A quarter century of development. Cornea 19: 603-610.

Vail, A., S.M. Gore, B.A. Bradley, D.L. Easty, and C.A. Roger. 1994. Corneal graft survival and visual outcome: a multicenter study. Ophthalmology 101: 120-127.

William, K.A., J.K. Ash, P. Pararajasegaram, S. Harris, and D.J. Coster. 1991. Long-term outcome after corneal transplantation. Visual result and patient perception of success. Ophthalmology 98: 651-657.

William, K.A., S.M. Muehlberg, R.F. Lewis, and D.J. Coster. 1995. How successful is corneal transplantation? a report from the Australian corneal graft register. Eye 9 : 219-227.