# Penetrating Keratoplasty Following Scleral Patch Graft Procedure

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**Abstract**

**Purpose :** To present the benefit of preserved sclera for immediately repairing perforated corneal ulcer and report the clinical outcome of patients undergoing penetrating keratoplasty after scleral patch graft.

**Patients and Method :** The results of perforated corneal ulcer patients, who underwent penetrating keratoplasty after scleral patch graft between January 1996 and December 2002, were reviewed retrospectively. The causes of the corneal ulcer were also included.

**Results :** Penetrating keratoplasty was performed after scleral patch graft for perforated corneal ulcer on four patients, three males and one female. The culture results from corneal scraping showed *Fusarium spp* in two cases and *Streptococus pneumoniae* in one. One patient had a presumed bacterial corneal ulcer. The post-penetrating keratoplasty visual acuity ranged from hand motions to 20/40.

**Conclusion :** The scleral patch graft procedure for perforated corneal ulcer may benefit in circumstances of unavailable corneal donors. The results of penetrating keratoplasty after scleral patch graft were favorable.

**Key word :** Penetrating Keratoplasty, Perforated Corneal Ulcer, Scleral Patch Graft

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One of the most serious complications in corneal ulcer is perforation. Emergency penetrating keratoplasty can be performed to prevent invasion of the eye by microorganisms with secondary infectious endophthalmitis[1], and the globe can be saved with useful vision remaining. However, with corneal donors

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being unavailable and limited in number at our eye bank, most penetrating keratoplasty operations were elective cases. Scleral patch suturing at the perforated site and antimicrobial agents were considered as alternative therapy. Penetrating keratoplasty at an appropriate time was a definite treatment[2].

The objective of this study was to present the benefit of preserved sclera for immediately repairing perforated corneal ulcer and report the clinical outcome of patients undergoing penetrating keratoplasty after scleral patch graft.

## PATIENTS AND METHOD

Retrospective noncomparative case series of penetrating keratoplasty after scleral patch graft for perforated corneal ulcer were collected from medical records in Maharaj Nakorn Chiang Mai Hospital, Department of Ophthalmology, Faculty of Medicine, Chiang Mai University, Chiang Mai, Thailand from 1996 to 2002. The patient's age, sex, history and ocular examination, cause of corneal ulcers, scleral patch graft characteristics, pre- and post-scleral patch graft visual acuity, characteristics of penetrating keratoplasty and associated operations, time between scleral patch graft procedure and penetrating keratoplasty, final visual acuity, and follow-up were analyzed

## RESULTS

Four patients who suffered from perforated corneal ulcers underwent surgery. The surgery included repairing perforated corneal ulcers immediately with a preserved scleral button in 100 per cent glycerine followed at a suitable time by the standard technique of penetrating keratoplasty with or without cataract extraction. The scleral graft was cut using a handheld trephine. The scleral patch graft diameter was determined by the viable corneal tissue for suturing and perforation size. The scleral graft diameter was 6.0 to 8.0 mm. Donor sclera was obtained from donors without neurological disease and it tested negative for HIV and hepatitis B. All scleral grafts (except in Case 2) while waiting for penetrating keratoplasty were partially melted without vascularization. The scleral graft in Case 2 had not changed. For penetrating keratoplasty, the corneal host button included a scleral patch, and surrounding sutures were cut using a Hessburg-Barron trephine. The recipient diameter was 7.5 to 8.5 mm. The diameter of the corneal graft was 8.0 to 9.0 mm. All operations were performed by one of the authors (WC).

### Case 1

A 65-year-old-man presented with a history of vegetable-contaminated trauma. He had blurred vision, pain, and photophobia in the left eye. His visual acuity was 20/20 in the right eye, with hand motions (HM) in the left eye. An eye examination demonstrated a 5.0 x 6.0 mm epithelial defect with stromal infiltration in the left eye. Culture results from a corneal scraping showed *Fusarium spp.* The patient was hospitalized and given topical natamycin every hour daily. Twenty days after treatment, the corneal ulcer perforated. The size of perforation was 2.0 mm. He was treated with scleral patch graft under general anesthesia because no corneal donors were available. A full-thickness of scleral patch, 8.0 mm in diameter, was sutured using the interrupted technique with 10/0 nylon. Topical natamycin was tapered every 2, 4, and 6 hours daily and there was a clinical improvement. The patient was then discharged from hospital. The scleral patch graft interfered with the visual axis and caused visual acuity to light perception after topical natamycin was discontinued. Eight months later, the patient was readmitted to hospital for penetrating keratoplasty and extracapsular cataract extraction with intraocular lens implantation. The host corneal button included the scleral patch and surrounding sutures. The patient underwent an unremarkable post-operative period on topical steroids. His visual acuity improved from light perception to 20/100 with the best correction after 7 months. A clear graft was found in the left eye at 4 years' follow-up and the best-corrected visual acuity was 20/40.

### Case 2

A 59-year-old woman had pain in the left eye 7 days prior to admission. The patient denied a history of ocular trauma. At the initial examination, her visual acuity in the right eye was 20/25, with light perception in the left eye. The left eye showed a 3.5 x 5.0 mm central corneal infiltration associated with hypopyon. After scrapings were collected from the lesion for a smear and culture, fortified topical antibiotics (33 mg/ml cefazolin and 14 mg/ml gentamicin) were administered to the left eye every 1 hour with 1 per cent atropine. Both culture and smear results showed no microorganism. One month later, a central corneal perforation occurred and the perforated size was 1.5 mm. With no donor corneas available, the scleral patch graft was performed under general anesthesia. A full-thickness of scleral patch, 7.0 mm in

diameter, was sutured in interrupted-style with 10/0 nylon. Two weeks after surgery, with topical 0.3 per cent ciprofloxacin treatment in the left eye, penetrating keratoplasty and cataract extraction with intraocular lens implantation were performed. The graft had marked edema on the first day of the post-operative period and there was no improvement after intensive topical steroid treatment. The histologic examination of excised corneal button was not performed. The graft became opaque at 1-month follow-up with HM visual acuity. Unfortunately, the patient was lost to follow-up.

**Case 3**

A 36-year-old man presented with phthisis of the right eye and corneal scar of the left one. He was waiting for corneal transplantation on his left eye, which inflicted a stinging sensation, redness, and blurred vision. His visual acuity was no light perception in the right eye and light perception in the left one. There was a corneal infiltration with positive fluorescein staining for a 3.0 x 5.0 mm epithelial defect in the left eye. Hypopyon was found in about 1/3 of the anterior chamber. Corneal scrapings were performed for a smear and culture. There were gram positive diplococci with many polymorphonuclear cells in the Gram stain. The fortified topical antibiotics (33mg/ml cefazolin and 14 mg/ml gentamicin) were administered to the left eye every 1 hour with 1 per cent atropine during hospitalization. The culture results confirmed *Streptococus pneumoniae*. Six weeks later, the corneal lesion had not improved and perforation occurred. The perforated size was 2.0 mm. Scleral patch graft with a 6.0 mm full-thickness flap was performed for globe forming. The post-operative treatment regimen included 33 mg/ml cefazolin, 14 mg/ml gentamicin, and atropine eyedrops. All medications were tapered until the infection was controlled. Two years later, the patient was called for penetrating keratoplasty. The surgery comprised penetrating keratoplasty and cataract extraction with intraocular lens implantation. No intra-operative complication was found. The post-operative treatment regimen included topical antibiotics and steroids. The graft remained clear at 12 months follow-up with 20/80 visual acuity.

**Case 4**

A 30-year-old man presented with pain in the right eye for 5 days. A wooden splinter caused trauma to the right eye as he attempted to cut wood. He went to a provincial hospital and the splinter was removed. His right eye still caused pain and redness had progressed with time. At the first presentation, his visual acuity was 20/20 in both eyes. The right eye showed ciliary injection and a rust stained cornea with surrounding corneal edema. Hospitalization was advised, but the patient rejected it. Topical ciprofloxacin was prescribed as a home medication. He was lost to follow-up for 5 months before coming to the hospital with pain and photophobia. The visual acuity was light perception in the right eye and 20/20 in the left eye. The eye examination showed a 5.0 x 6.0 mm central corneal hypopyon ulcer with full thickness infiltration. Two days after admission, the anterior chamber was flat and the corneal ulcer perforated. The size of perforation was 2.0 mm. Corneal scrapings were performed for a smear and culture. The wet smear, with 10 per cent potassium hydroxide, demonstrated many hyphae. The perforated corneal ulcer was patched with 7.0 mm full scleral thickness and interrupted sutures were performed. *Fusarium spp* was identified on the cultures. Topical natamycin administration was started to the right eye every 1 hour and tapered to 4 times daily in 4 months. Eight months after the first operation, the patient underwent penetrating keratoplasty with an 8.0 mm donor size and a 7.5 mm recipient size, and peripheral iridectomy was performed. During the post-operative period, 0.3 per cent ciprofloxacin and 1 per cent prednisolone acetate were instilled 4 times daily, with the medications being tapered off. The clear graft was seen after the 1 year-follow-up. The patient's final visual acuity in the right eye was 20/40.

Table 1 summarizes the patient's characteristics of scleral patch graft and outcome. The penetrating keratoplasty characteristics and outcome after scleral patch graft procedure are shown in Table 2.

## DISCUSSION

Perforated corneal ulcers and impending perforation corneal defects caused by infection display serious clinical situations that threaten vision. Emergency treatment must be considered to preserve the globe of the patient by preventing deep infection. Moreover, the risks of peripheral anterior synechiae formation induced angle-closure glaucoma were decreased. The immediate treatment was therapeutic keratoplasty, which was the most common indication in penetrating keratoplasty[3]. Most therapeutic keratoplasties were able to eradicate pain and improve

**Table 1. The patient's characteristics of scleral patch graft and outcome.**

| Patient no. | Age (yrs) | Sex | Diagnosis | Pre-operative visual acuity | Scleral graft diameter (mm) | Post-operative visual acuity |
|---|---|---|---|---|---|---|
| 1 | 65 | Male | Fungal perforated corneal ulcer OD | HM | 8 | LP |
| 2 | 59 | Female | Presumed bacterial perforated corneal ulcer OS | LP | 7 | LP |
| 3 | 36 | Male | Bacterial perforated corneal ulcer OS | LP | 6 | LP |
| 4 | 30 | Male | Fungal perforated corneal ulcer OD | LP | 7 | LP |

HM = hand motion, LP = light perception, OD = right eye, OS = left eye,

**Table 2. The penetrating keratoplasty characteristics and outcome after scleral patch graft procedure.**

| Patient no. | Age (yrs) | Pre-operative visual acuity | Surgery performed | Sutured techniques | Donor/recipient diameter (mm) | Final visual acuity and follow-up (mos) |
|---|---|---|---|---|---|---|
| 1 | 66 | LP | PK and ECCE with IOL implantation | interrupted | 9.0/8.5 | 20/40, 48 |
| 2 | 59 | LP | PK and ECCE with IOL implantation | interrupted | 8.0/7.5 | HM, 1 |
| 3 | 38 | LP | PK and ECCE with IOL implantation | combined continuous and interrupted | 8.0/7.5 | 20/80, 12 |
| 4 | 30 | LP | PK | interrupted | 8.0/7.5 | 20/40, 12 |

LP = light perception, HM = hand motion, PK = penetrating keratoplasty,
ECCE = extracapsular cataract extraction, IOL = intraocular lens.

vision. When corneal donors were not available, scleral patch graft was a temporary measure that maintained ocular integrity.

Human scleral tissue is an excellent biological material that excites a minimal reaction and host acceptance, which is almost universal[4]. Recently, many studies have demonstrated the advantage of sclera in ophthalmic use. It had been used to patch in globe perforation from retinal detachment[5]. In oculoplastic surgery, there were various procedures that involved sclera such as socket reconstruction[6], exposure of orbital implants[7], trichiasis and entropion correction[4,8], and correction of the lower eyelid retraction in ophthalmic thyroid disease[9]. In glaucoma surgery, sclera was used to cover the tube shunt [10] and repair the bleb leakage[11-13]. Scleral patch grafts were also useful in infectious scleritis[14-16].

In the present study, three patients who underwent scleral patch graft had an infectious perforated corneal ulcer. One was presumed to have bacterial corneal infection as it improved with antibiotic treatment. The organisms were identified in these three cases. *Streptococus pneumoniae* corneal ulcer tended to be accompanied by a marked anterior chamber reaction, including hypopyon, and perforation was more common[17], while *Fusarium spp* infection might gradually progress, causing formation of desmatocele and finally perforation[18]. Lack of corneal donors in critical situations, especially for corneal perforation, is a major problem for emergency penetrating keratoplasty in the referral center. For this reason, the authors performed scleral patch graft as a temporary procedure and penetrating keratoplasty as the second operation. Case 2, who had penetrating keratoplasty 2 weeks after scleral patch graft, demonstrated primary corneal graft failure. Others had a good result, with post-operative visual acuity ranging from 20/80 to 20/40. The grafts remained clear for at least 12 months and the longest follow-up period was 4 years, with minimal topical steroid usage. None of these grafts developed secondary steroid-induced glaucoma. The authors hypothesized that the primary graft failure in Case 2 might have been caused by the preoperative inflamed eye or poor endothelial function of the corneal donor. However, penetrating keratoplasty was advised once inflammation of the eye with scleral patch graft was controlled. Although this effective procedure was used as a temporary strategy for

preserving the remaining visual function, it may be unacceptable to patients concerned with their cosmetic appearance.

In conclusion, the authors present other benefit of sclera as a temporary patching method in perforated corneal ulcer cases when a corneal donor is not available. Penetrating keratoplasty is the definite treatment and should be performed when the eye is not inflamed. The post-operative visual outcomes are favorable.

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# การปลูกถ่ายกระจกตาหลังจากการเย็บปิดกระจกตาด้วยสเคอรา

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**วัตถุประสงค์** : เพื่อแสดงประโยชน์ของสเคอราในการเย็บปิดทันทีของแผลทะลุและติดเชื้อที่กระจกตา และผลการรักษาหลังจากที่ผู้ป่วยได้รับการปลูกถ่ายกระจกตาในเวลาต่อมา

**ผู้ป่วยและวิธีการ** : การศึกษาแบบย้อนหลังในผู้ป่วย 4 ราย ที่เป็นแผลทะลุของกระจกตาติดเชื้อ ซึ่งได้รับการผ่าตัดโดยใช้สเคอราเย็บปิดแผลทะลุ และรักษาโดยการปลูกถ่ายกระจกตาในเวลาต่อมา รวมถึงศึกษาเชื้อที่เป็นสาเหตุของโรค

**ผลการศึกษา** : พบว่ามีผู้ป่วยทั้งหมด 4 รายเป็นผู้ชาย 3 ราย และผู้หญิง 1 ราย ที่ได้รับการปลูกถ่ายกระจกตาหลังจากใช้สเคอราเย็บปิดแผลทะลุในครั้งแรกตั้งแต่เดือนมกราคม 2539 ถึง เดือนธันวาคม 2545 และเชื้อที่เป็นสาเหตุของแผลกระจกตาเกิดจากเชื้อรา *Fusarium spp* 2 ราย เชื้อแบคทีเรีย *Streptococcus pneumoniae* 1 ราย อีก 1 รายน่าจะเกิดจากเชื้อแบคทีเรีย หลังการปลูกถ่ายกระจกตาผู้ป่วยมีระดับการมองเห็นตั้งแต่รู้มือเคลื่อนไหวจนถึง 20/40

**สรุป** : การใช้สเคอราปิดแผลทะลุของกระจกตาติดเชื้ออาจมีประโยชน์ในกรณีที่ไม่สามารถหากระจกตาได้ ซึ่งผลการรักษาหลังการปลูกถ่ายกระจกตาเป็นที่น่าพอใจ

**คำสำคัญ** : การปลูกถ่ายกระจกตา, แผลกระจกตาทะลุ, การเย็บปิดด้วยสเคอรา

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