Osteo-odonto-keratoprosthesis for End-stage Cornea Blindness

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SUMMARY

We report the first case of Osteo-odonto-keratoprosthesis (OOKP) who successfully underwent surgery in Malaysia following a grade 4 (severe) chemical injury in both eyes in 2006. The patient's left eye was eviscerated and his right eye underwent penetrating keratoplasty. However, the corneal graft failed and became opaque. His right eye could only perceive light. The OOKP was offered to him hoping to recover some functional vision. He underwent a 2-stage surgery to implant the OOKP into his right eye. However, 2 months post-operation, he developed vitreous haemorrhage. A successful pars plana vitrectomy (PPV) was performed via the limited view through the lens. He attained a final visual acuity of 6/60 (N36). He was able to mobilize more independently, feed, dress himself and read large print.

INTRODUCTION

Osteo-odonto-keratoprosthesis (OOKP) is the procedure of choice for restoring sight in patients with end-stage ocular disease not amendable to penetrating keratoplasty. The OOKP could uniquely withstand a hostile dry keratinized ocular surface. OOKP is a technique in which the patient's own tooth root is used to support an optical cylinder. It was invented by Strampelli in 1963[1]. Falcinelli modified the original Strampelli technique, which has led to improved visual results and retention of the device. OOKP surgery is a complex surgery requiring 2 stages[2]. It requires a multi-disciplinary approach involving ophthalmologist and maxillofacial surgeons. Stage 1 surgery involved covering the ocular surface with buccal mucous membrane graft as well as harvesting a tooth for preparation of OOKP lamina. A lens was inserted through the tooth. Stage II involves retrieval of the OOKP lamina, removal of part of the cornea, the entire iris and the lens. This is followed by implantation of the OOKP lamina complex onto the host's eye.

CASE REPORT

A 54-year old police man sustained bilateral grade 4 chemical injuries in 2006. Left eye was eviscerated due to severity of the injury. His right eye developed cornea perforation and endophthalmitis. Right eye penetrating keratoplasty (cornea transplant) with intravitreal antibiotic was performed at a different centre. The cornea graft failed and became opaque with secondary glaucoma. He was totally dependent on others as he could not walk or feed by himself.

On presentation in December 2007, his right eye vision was only perception to light. The right cornea was opaque and fully vascularised without discernible iris detail and symblepheron at the inferior fornix (Figure 1). The intraocular pressure was 20 mm Hg. B-scan of right eye showed flat retina. Flash visual-evoked potential was done to assess the optic nerve function and showed positive amplitude 10.9uV although the latency delayed at 150ms. These indicate some amount of optic nerve impairment.

Stage 1 right OOKP surgery was performed on the 7th of January 2008. A 3 cm x 3 cm buccal mucosa was harvested and transplanted onto his right cornea. Simultaneously, the patient's lower right canine was harvested. A hole was drilled through the tooth and a polymethyl methacrylate lens was inserted (Figure 2). This was then inserted under the lower left eyelid to allow vascularisation. This patient recovered uneventfully.

He underwent stage2 right OOKP surgery 3 months later. During this stage, the OOKP lamina was retrieved from the lower left eyelid. A 5mm corneal button was removed using a trephine and the iris-lens complex was removed, followed by anterior vitrectomy.

OOKP lamina was implanted on the right eye underneath the buccal mucosa. The buccal mucosa in front of the optical lens was removed using a trephine. His right eye vision improved to perception of hand movement on the third day post-surgery. There was very limited fundal view due to vitreous opacities.

Six weeks post-stage 2 surgery, his vision dropped to perception of light only. B-scan showed vitreous haemorrhage. He underwent right PPV with miniquad XL lens and endolaser. Intraoperatively, it was noted that his retinal vessels appeared sclerosed. No retinal detachment was noted.

His condition remained stable and at 6 months post-PPV, his right eye vision improved to 6/60, near vision of N36 (Figure 2) and the fundus view was clear. He was able to walk around his house more independently, dress and feed himself. He is also able to read large prints.

Unfortunately, he then defaulted further follow up.

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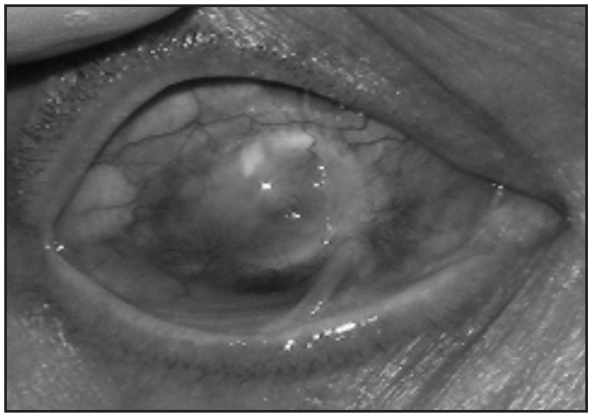

Fig. 1: Right vascularised and opaque cornea with symblepharon.

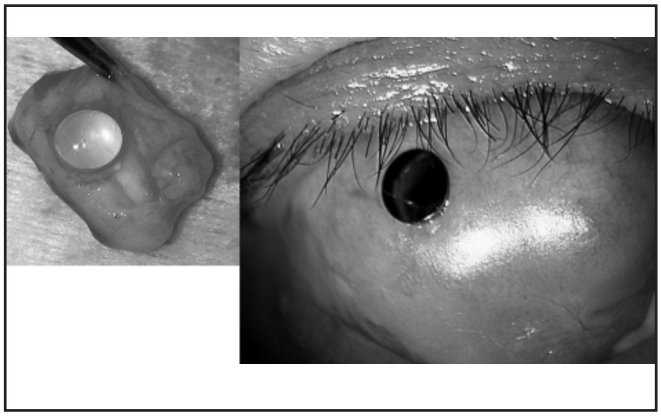

Fig. 2: Lower right canine with a PMMA optical cylinder (left), Right eye, 2 months post-stage 2 OOKP surgery (right)

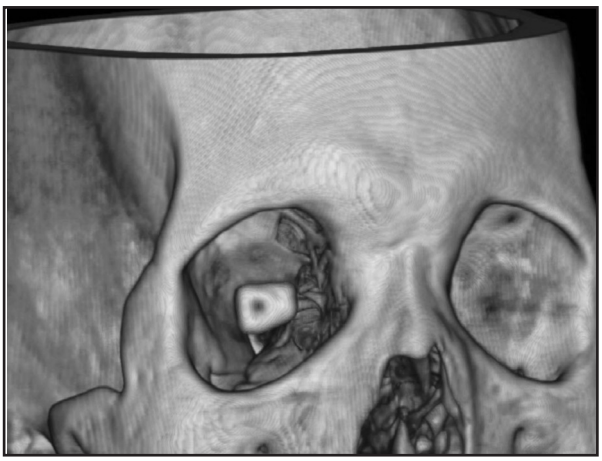

Fig. 3: 3-D CT scan showing the OOKP in the right socket.

DISCUSSION

OOKP surgery is a technique used to replace damage cornea in a blind eye, where cornea transplantation is doomed to fail. This technique is especially resilient against hostile environment such as keratinized eye resulting from severe chemical injury, Steven-Johnson syndrome, trachoma, ocular cicatricial pemphigoid or patients who had previous failed cornea transplantation. It is only indicated for patients who are blind in both eyes. The better or only eye should have vision worse than counting finger. Only one eye will be rehabilitated with OOKP. Patients should also need to be counseled regarding the eventual poor cosmesis of the procedure.

The ideal kerathoprosthesis is to replace the damaged and opaque cornea. It should have excellent biointegration, provide resistance against infection, and long lasting. Strampelli described using autologous tooth root and alveolar bone as a support for the PMMA optical cylinder, other surgeons such as Casey used cartilage whereas Temprano used tibial bone[2]. Comparison between various techniques is difficult as most of the published studies were retrospective and uncontrolled.

There are several challenging issues concerning OOKP. One of the commonest problems is glaucoma. It may be due to underlying pathological condition or secondary to the keratoprosthesis. There was no reliable measurement of intraocular pressure through the PMMA lens. The small size of the optical cylinder in keratoprosthesis may not allow detection of early visual field defect. Therefore the diagnosis of glaucoma mainly relies on digital palpation, optic nerve head appearance, and visual field changes. Managing glaucoma is also a challenge as the penetration of ocular drugs is significantly reduced due to the surrounding fibrosis. Very frequently the only reliable method of reducing the intraocular pressure is systemic acetazolamide.

Retinal detachment is one of the complications associated with OOKP surgery[3,4]. Patient may have symptoms such as floaters and flashes of light. Detection is through fundus examination and B-scan ultrasound. Retinal detachment surgery in an OOKP eye is challenging due to the small optical field, surgeons may need BIOM systems or temporarily replacing the OOKP lamina using Eckardt keratoprosthesis.

Stoiber et al reported 2 % resorption and extrusion of the OOKP lamina, which will caused decentration of the optical cylinder[5]. Therefore continuous evaluation of the lamina is needed such as serial CT scan or electron beam tomography[3].

CONCLUSION

OOKP remains the keratoprosthesis of choice for end-stage corneal blindness. It provides some form of vision so that patients are more independent. The patients will have limited peripheral vision but they should be able to navigate, read at least large print, feed and dress themselves without assistance by others.

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