

OSTEO-ODONTO-KERATOPROSTHESIS: A TOOTH FOR AN EYE

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Abstract : The OOKP (Osteo – Odonto – Keratoprosthesis), although described 40 years ago, is a complex two stage surgical procedure in which a patient's own tooth and surrounding alveolar bone is used to help restore their sight. A plastic lens cemented in to a section of decalcified tooth that is then stiched in to an opening cut in a totally opaque cornea to restore vision. Follow up is life long in order to detect and treat complications one of which is oral. Regular imaging with spiral CT or electron beam tomography can help detect bone and dentine loss. This article aims to describe this complex two stage procedure.

INTRDOUCTION

The Osteo-Odonto – Keratoprosthesis (OOKP) is a two stage complex surgical procedure which is used to replace damaged cornea in blind patients for whom cadaveric corneal transplantation is doomed to be a failure. This technique was developed about 40 years age by Strampelli and uses the patients own tooth root and alveolar bone to support an optical cylinder. Early British followers of this techniques reported poor retention results. Prof. Gian Carlo Falcinelli of Italy, a student of Prof. Strampelli has refined and improved the technique was re-introduced in Britain (UK) at the Sussix Eye Hospital in 1996. The Falccinelli OOKP is now recognized internationally be corneal surgeons worldwide as the treatment of choice for patients with end stage inflammatory corneal disease as in the case of severe dry eye. Because of its complexity the procedure is at present performed by less than 10 centres in the world. India for the first time surgery was performed in Maharashtra at Taparia Eye Institute of Bombay Hospitalo, New Marine Lines, Mumbai.

INDICATIONS (Table 1)

Table 1: Indications for OOKP surgery

- Bilateral corneal blindness resulting from severe end stage Stevens – Johnson syndrome
- Ocular cicatricial pemphigoid
- Chemical burns
- Trachoma, Dry Eyes
- Multiple corneal graft failure

CONTRAINDICTION (Table 2)

Table 2: Contraindication

- Previous history of retinal disease
- Glaucoma (advanced)
- Optic nerve disease
- Ocular perforation
- Pre-phthisis
- Children under age of 17
- Irreparable retinal detachment

Suitable persons who wants to undergo this complex two stage procedure should understand that surgery can be prolonged – they may require multiple procedures and that there is a significant risk of serious complications including loss of eye.

The patient must be able to commit to life long follow up and not

have unreasonable expectations of outcome and cosmesis.

COMPLICATIONS

Table 3: Potential complications of OOKP surgery

Eye
<ul style="list-style-type: none"> • Buccal mucous ulceration • Lid malposition and loss of fornix • Secondary glaucoma • Tilting of optical cylinder • Extrusion of keratoprosthesis • Retroprosthetic membrane formation • Retinal detachment • Endophthalmitis
Mouth
<ul style="list-style-type: none"> • Poor mouth opening • Damage to adjacent tooth • Oro-antral fistula • Jaw fracture
Systemic
Complications of cyclosporine treatment – Scleroderma / renal crisis

PATIENT ASSESSMENT

The patient assessment can be divided into:

- The ophthalmic assessment
- The oral assessment
- Psychological assessment

The patient assessment is a joint assessment by as ophthalmologist (CL) and a maxillofacial surgeon (JH) and a psychiatrist

In pre-operative assessment, a detailed history is recorded and the primary diagnosis and previous surgical interventions especially ocular perforations, glaucoma, or a history of amblyopia is obtained preoperative examination involves determining an intact and functioning retina and optic nerve, by relatively accurate projection of light in all quadrant a normal B scan and in selected cases flash Electroretinogram (ERG) and Visual Evoked Potential (VEP).

ORAL ASSESSMENT

The oral assessment must take in to account both the buccal mucosal graft donor site and selection of an appropriate tooth to form a dentine / bone lamina. Following oral examination and radiography a choice is made as to which tooth (usually a canine) to harvest depending on the length and girth of the root amount of gum recession, and it associated alveolar bone for fashioning a lamina.

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In the absence of suitable single rooted tooth the use of an HLA – matched relative's tooth is possible but prolonged immunosuppression with cyclosporine will be necessary.

The surrounding anatomy is assessed to avoid possible complications and to reduce to a cosmetic defect to a minimum. There also needs to be an adequate space between the teeth to harvest the tooth without damage to its neighbour. The overall oral health and particular reference to oral hygiene and periodontal bone loss must be assessed. Gingival disease with no bone loss can be easily reversed. Clinical assessment of bone loss can be useful but radiographs are essential. There is usually little choice in these parameters between upper or lower canine. Other single rooted teeth can be used in the absence of canine. The mainstay radiographic views are orthopantomograms (OPT) and intra oral periapical radiographs (IOPA) and CT scans. All other things being equal the choice of upper or lower canine depend on the proximity of maxillary sinus in the upper and the proximity of mental foramen in the lower. The lower canine harvesting is straight forward but the buccal plate is occasionally a little thin and the lingual mucoperiosteum is more difficult to procure. The upper canine occasionally gives too much bone palatally and there is a risk of violation of the antrum, however, technically the harvesting is easier. The patient's regular dental practitioner should be informed at this stage so that preparation to replace the missing tooth be made, also oral hygiene and periodontal condition can be optimized pre operatively.

PSYCHOLOGICAL ASSESSMENT

The patient must be fully informed of the procedure and risks. The patient who has no other teeth and undergo this complex surgical procedure must be psychologically assessed carefully and must understand that the formation of an osteo-odonto-keratoprosthesis involves multiple operations, usually over a period of months and sometimes years. During that time there will be multiple hospital admissions and follow up visits and these are likely to be setback along the way which may or may not be readily rectifiable, the patient must also appreciate the significant financial, time and emotional stresses that they and those close to them will encounter.

SURGICAL TECHNIQUE

The OOKP surgery is performed usually in 2 stages spaced 2 to 4 months apart. The gap allows soft tissue to grow around the osteo-odonto-lamina and for ocular surface reconstruction with buccal mucosa membrane grafting to become vascularized.

Each stage takes approx. 6 hours and special anesthetic precautions are necessary. Prior to OOKP surgery it is important to treat pre-existing glaucoma by cyclodestruction. Fornix reconstruction, where necessary, can be carried out before hand or at the time of stage I procedure.

Stage I

A monoradicular tooth is harvested to prepare as osteo-odonto-lamina. The root and surrounding jaw bone is sliced sagittally and then removed by cutting across the bridging bone. Whilst the crown is grasped with extraction forceps, the bone are pared down on either the mesial or outer surface with a diamond dusted fly wheel to expose pulp that is removed. The crown of the harvested tooth is used as a handle; whilst the attached tooth root and surrounding bone is worked into a lamina with dentine on one side and bone on the other. Periosteum is conserved and where possible glued back with fibrinogen adhesive. A hole is drilled through dentine through which the anterior part of PMMA optical cylinder is cemented in place. The crown is removed prior to drying with filtered O₂ and the

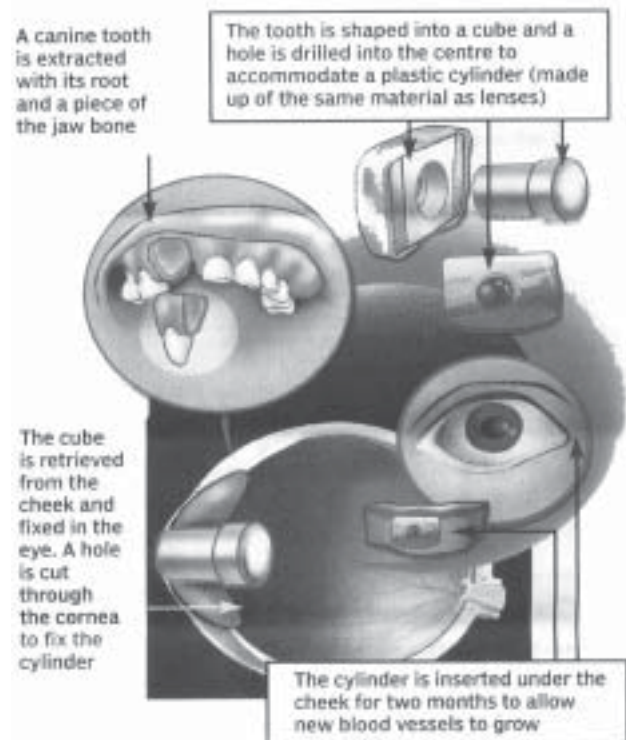
cementing of the optical cylinder. The saw, flywheel and drill and burrtips are constantly irrigated with balanced salt solution to provide cooling. Where periosteum has been detached it is glued back with fibrin glue. The KprO is then implanted in to a submuscular patch (often the lower eyelid of fellow eye) for the period of 2-4 months.

Stage II

Stage II surgery is carried out two to four months after Stage I in order for soft tissue to invest in to the bone pores of the lamina. The interval also allows the lamina to recover from thermal damage, and any infection introduced from the oral cavity can be treated whilst the lamina is submuscular rather than on the eye. Stage 2 starts with retrieval of the osteo-odonto lamina from its sub-muscular pocket and excess soft tissue is removed from the bone surface. On the dentine surface, no soft tissue is allowed to remain. The lamina is reinserted in to its pocket until the eye is ready to receive. The buccal mucosal graft is reflected to allow access to the cornea. A Flieringa ring is sutured in place. The centre of the cornea is marked, and a small hole is trephined, the diameter of which corresponds to that of posterior part of the optical cylinder. Relieving incisions are made and total iridodialysis, lens extraction and anterior vitrectomy are performed.

The posterior part of the lamina is inserted through the central corneal hole and the lamina is sutured in to the cornea and sclera.

The eye is re-inflated with sterile filtered air. The mucosal flap is replaced after cutting a hole to allow the protrusion of the anterior part of the optical cylinder.



ANAESTHESIA FOR OOKP

The technique of general anaesthetic for OOKP surgery, both stage I and Stage 2 is similar. Both stages require the administration of antibiotics at induction of the anaesthesia. During the first stage the oral surgeon will require access to the mouth and so a nasotracheal tube is used, for the second stage a RAE or similar orotracheal tube

can be used. After placement of an 18 gauge intravenous cannula, anesthesia is induced; The conduct of the anaesthetic is aimed at obtaining good operating conditions for the surgeon; to this end a little "head up" position for the operating table and the maintenance of a hypotensive technique is employed.

POSTOPERATIVE CARE

After Stage I, a conformer is often in place over the buccal mucous membrane and daily glass rodding is carried out to the fornices to keep them open. The patient uses chlorhexidine and nystatin mouth washes.

Post Stage II, Diamox, steroids and antibiotics are continued. The optic is cleaned and the health of the buccal mucous membrane monitored. The skin sutures are removed after 5 days and the patient is admitted for 1 week for each stage.

FOLLOW UP VISITS

The follow up is life long and at weekly intervals for one month, then monthly for three months then every two months for six months, then every four months.

If stable then follow up can be at longer intervals possibly shared with the referring ophthalmologist.

At the follow up visits the vision is checked, unaided and with correction and pinhole, and a refraction performed. The intraocular pressure is checked digitally, the lids examined, the buccal mucous membrane assessed, including colour, dryness and presence of any areas of thinning or laceration. The optical cylinder is examined specifically looking at the cement, seeing if there is tilting or lengthening and the presence of a retroprosthetic membrane.

The stability of the optical cylinder is also tested by prodding with a cotton tipped stick. Fundoscopy is carried out to check the optic disc and macula, B-Scan to detect early peripheral detachments and visual field assessments are made 6 monthly for diagnosis and monitoring glaucoma. Resorption of the bone may be assessed clinically by palpating the mass and dimensions of the lamina, and radiologically using spiral CT, MRI or electron beam tomography, degeneration can affect statistical results for visual improvement.

CONCLUSION

OOKP surgery is complex and requires meticulous care at each step to ensure the overall success rate. Therefore, surgeons must not attempt to provide a service without first having undergone adequate training. Oral structures have to be sacrificed. All patients experience glare and a restricted visual field. The cost of OOKP surgery is high and formal cost benefit analysis has confirmed its cost effectiveness (un published data) Although it is far from perfect, modern OOKP surgery is the only hope for restoring sight in the long term for desperate cases of corneal blindness not amenable to conventional corneal surgery.

RECOMMENDED READING

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LITERATURE REVIEW

Renal outcome in patients with congenital anomalies of the kidney and urinary tract

Sanna-Cherchi et al Kidney International 2009,76,528-533

Congenital Anomalies of the Kidney and Urinary Tract (CAKUT) are a major cause of morbidity in children. We measured the risk of progression to end-stage renal disease in 312 patients with CAKUT preselected for the presence of anomalies in kidney number or size. A model of dialysis-free survival from birth was established as a function of the renal CAKUT categories of solitary kidney; unilateral and bilateral hypodysplasia; renal hypodysplasia associated with posterior urethral valves; and multicystic and horseshoe kidney. Cox regression analysis took into account the concomitant presence of vesicoureteral reflux, year of diagnosis, and time-varying values of serum creatinine, proteinuria, and hypertension. By 30 years of age, 58 patients had started dialysis, giving a yearly incidence of 0.023 over a combined 2474 patient risk years. The risk for dialysis was significantly higher for patients with a solitary kidney or with renal hypodysplasia associated with posterior urethral valves (hazard ratios of 2.43 and 5.1, respectively) compared to patients with unilateral or bilateral renal hypodysplasia, or multicystic or horseshoe kidney, and was independent of other prognostic factors. Our study shows that sub-clinical defects of the solitary kidney may be responsible for a poorer prognosis compared to more benign forms of CAKUT. Prospective studies are needed to validate these results.

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