

OSTEO Odonto Keratoprosthesis: Make Way for the Tooth Cyborg Eye

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Abstract: *Hearing about medical and dental advancements throughout the centuries is amazing. From the invention of dental cleaning tools to specialist procedures, innovation is always the best way to help serve the people. However, in some rare cases like Stevens-Johnson syndrome, a patient's only option is to take any chance of seeing again. Medically known as Osteo-Odonto-Keratoprosthesis (OOKP), tooth in eye surgery is the last resort for patients suffering from corneal blindness. The procedure was pioneered in 1963 by an Italian ophthalmic surgeon named Benedetto Strampell. Through this surgery, its purpose is to make the tooth a replacement for the cornea of the eye. Nowadays, the procedure is spread through different countries for the desire of restoring their vision.*

Keywords: osteo odonto keratoprosthesis, tooth for an eye

1. Introduction

A Keratoprosthesis is used to replace damaged cornea. The Osteo - Odonto - Keratoprosthesis (OOKP) also known as 'tooth in eye surgery' is an auto graft used for the treatment of severe corneal opacities not suitable for corneal transplantation. The cornea is replaced by a polymethyl methacrylate (PMMA) optical cylinder glued to a biological support (haptic) made by human living tissue. Currently available KPro devices range from the totally synthetic, such as the Boston KPro, to the totally biological tissue-engineered artificial cornea. The Osteo-odonto-Keratoprosthesis combines a synthetic optic with a biological haptic.

2. Indications

- Severe end-stage Stevens–Johnson syndrome
- Ocular cicatricial pemphigoid
- Chemical or thermal burns, physical injury (fire, liquid aluminum, etc.)
- Corneal failure after vitrectomy with silicone oil filling that can't be removed safely
- Lyell Syndrome
- *Loss of the lids (e.g., Crouzon disease) following other causes*
- *Erythema multiforme*

Containdications

- Children under the age of 17 (high rate of turnover of bone during growth in this age)
- Eyes with no perception of light (surgery will only harm the patient)
- Evidence of phthisis (due to high risk of loss of remaining perception of light)
- Advanced glaucoma
- Irreparable retinal detachment
- Smoking and betel nut chewing

Preoperative Patient Assessment

Multidisciplinary approach is required. Surgical team comprises ophthalmologist, oral surgeon, and radiologist. This involves assessment of the eye and the oral structures

Preoperative Ophthalmological Assessment

If the patient can discern hand movement or even has finger counting abilities, one can expect a good functional outcome. Assessment involves

- Primary diagnosis and previous surgical interventions (detailed general ophthalmic history and careful examination)
- Determining intact and functional retina and optic nerve
- Echography, A-scan, B-scan, ultrasound examinations A have to be performed

Preoperative Oral Assessment

a) Buccal mucosa assessment

- Tissue condition (severe scarring)
- Quit habits
- Smoking (to improve graft revascularization)
- Betel nut chewing (compromise tissue quality)

b) Dental assessment : **Healthy tooth root**

3. Surgical Procedure

Stage 1

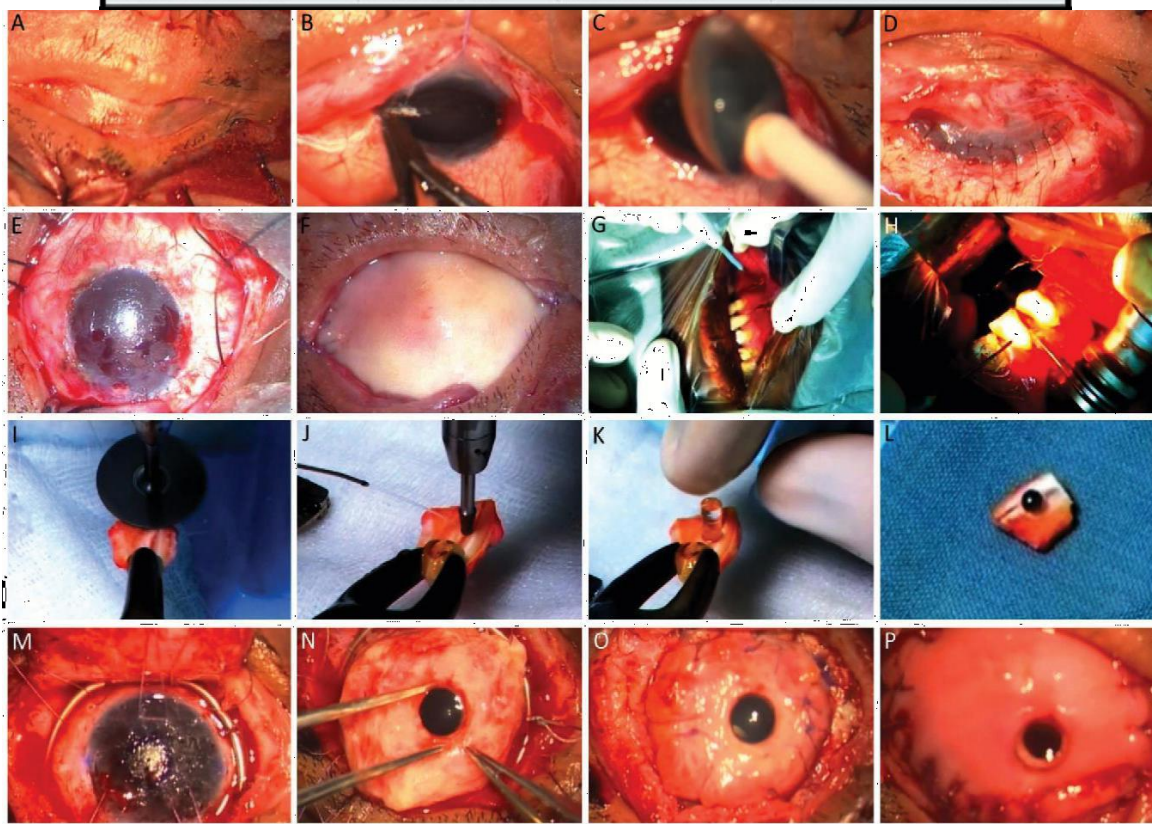
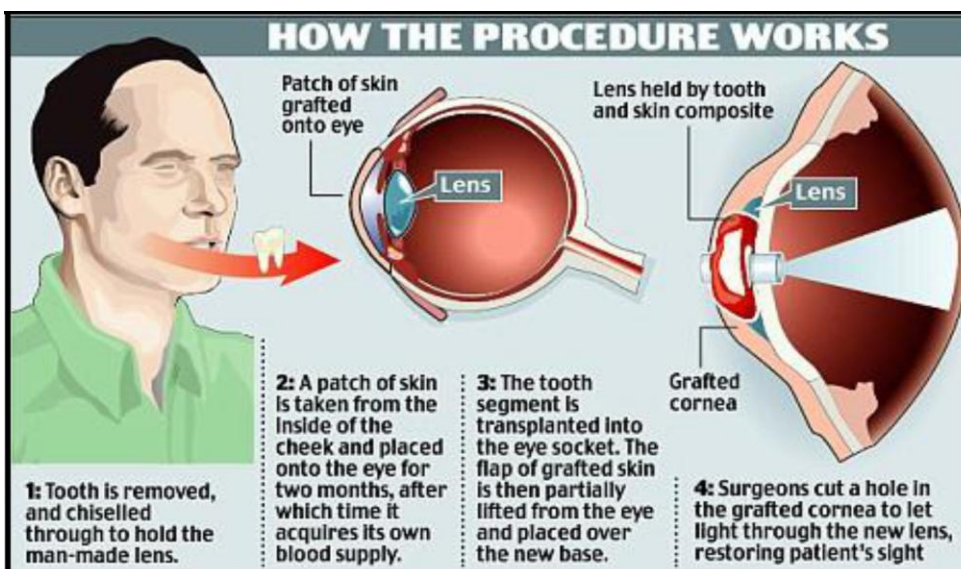
The first part of the surgery requires two proponents, a canine tooth and a person's cheeks. A patient's canine tooth is removed from their mouth and then molded for insertion with the optical polymethyl methacrylate (also known as PMMA) cylinder. The piece is then surgically implanted under the muscles of the cheek to let the bone and tissue be familiar with it. Since the canine tooth is the largest tooth with a single root, it provides a source of life for the tissues to naturally adapt to it. 3 months after the surgery shows signs of a fibrous capsule in the buccal mucosal tissue. This tissue from the cheek is removed afterward to mimic the front part of the eye. Another recovery for both the tissue and the tooth is underway for about 2 to 3 months before the next stage of the surgical procedure.

Stage 2

The first part involves the tooth and mouth, now the fibrous capsule is ready for the transplant. The lining of the buccal mucosa tissue needs to be flapped so the damaged cornea is exposed. The surgeons will drill a hole in this part to remove the iris, vitreous, and the eye lens. The tooth implant is then inserted into the cornea with supplementary ophthalmic

surgeries. The PMMA cylinder with the tooth is placed and the buccal mucosal flap is stitched back in the eye. The final procedure is to cut a hole in the buccal mucosal through which the PMMA cylinder can be seen. Intravenous mannitol has by then been administered to reduce the intra ocular pressure. 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. The iris is then completely removed. The posterior part of the lamina is inserted through the central corneal hole and the lamina is sutured onto the cornea and sclera. The eye is re-inflated with filtered air. The Flieringa

ring is then removed. The mucosal flap is replaced after cutting a hole to allow the protrusion of the anterior part of the optical cylinder. At the end of the procedure, the patient is kept in the supine position for 5 to 6 days until complete resorption of intravitreal air (verified by either ophthalmoscopy or echography). Postoperative medical treatment includes antibiotics, corticosteroids, and ocular hypotensive drugs (acetazolamide) administered systemically. Intraocular pressure is routinely controlled daily up to at least 10 days. One month after surgery, a cosmetic prosthesis placed over the external ocular surface.



4. Role of a Dentist

Patients are then referred to a prosthodontist for replacement of the missing tooth along with adjacent tissues. However,

due to the presence of ridge defect, conventional-fixed prosthesis and implant options prove to be a failure due to poor quality and quantity of bone present. In such situations, Andrew's bridge [Figure 6] is the best option available. Dr.

James Andrews of Amite, Louisiana introduced fixed removable Andrew's system which combines advantages of removable and fixed prosthesis.

It consist of crowns over the abutment teeth connected by a bar supporting removable pontics through bar attachment. This option provides better esthetics, phonetics, retention, stability, hygiene, along with reduced bulk.



Preoperative intra oral view



Superstructure attached to the removable prosthesis



Fixed removable prosthesis

5. Complications

Possible complications of this procedure include

Ulceration of the implant buccal mucosa, ocular infection, secondary glaucoma, extrusion, retinal detachment and retroprosthetic membrane formation

- Risk of damage to the parotid duct during preparation of the mucous membrane covering
- Perforation or leakage of the cornea during preparation of the globe
- Oromaxillary fistula formation, fracture of the mandible
- Expulsive hemorrhage during Stage 2 surgery

Follow Up

Follow-up is life-long in order to detect and treat complications, which include oral, oculoplastic, glaucoma, vireo-retinal complications and extrusion of the device. At weekly intervals for one month, then monthly for three months, then every two months for six months, then every four months for stability of the prosthesis and intraocular pressure measurements .Once it became stable followup can be at longer interval.



6. Conclusion

The OOKP is considered the only device capable of offering long-term visual rehabilitation in patients with end-stage ocular surface disease with severe tear deficiency (with or without lid defects). The surgical technique involves the removal of the canine tooth for the preparation of the Osteo-dental-acrylic lamina complex. 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. OOKP surgery is complex and requires meticulous care at each step to ensure the overall success rate. Oral structures have to be sacrificed. As there's a saying

“Desperate Times, Desperate Measures”

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