Patients give eye teeth to see

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The osteo-odonto-keratoprosthesis (OOKP) is an excellent option for patients who are not good candidates for corneal transplantation, according to Christopher Liu MD, Sussex Eye Hospital in Brighton, England

"OOKP surgery is the procedure of choice for patients with corneal blindness who cannot have a natural corneal transplant from a cadaver because their eyes are too dry," said Dr Liu in an interview with *EuroTimes*.

The technique involves creating a support for an optical cylinder from the patient's own tooth root and alveolar bone. Fully synthetic prostheses, in which the support is made from materials such as hydrogel or PMMA, cannot be used in people with dry eye.

The original OOKP technique was developed by the late Italian surgeon Benedetto Strampelli MD in the 1960s. The technique was largely abandoned in the 1970s due to poor results, but a second Italian surgeon, GianCarlo Falcinelli MD, made numerous improvements and began achieving good rates of device retention and vision improvement at a hospital in Rome in the 1980s. In the early 1990s, Dr Falcinelli taught the technique to Dr Liu in Brighton, Günther Grabner MD in Salzburg, Austria, and Konrad Hille MD in Homburg/Saar, Germany.

Over the past few years, the procedure has undergone further refinements, which are referred to as the Rome-Vienna Protocol. It is now available in Barcelona, Spain; New Delhi and Chennai, India; Cairo, Egypt; Osaka, Japan; and Singapore. A hospital in Hong Kong will begin offering the procedure later this year.

A difficult technique, slow to catch on

One reason for the procedure's slowness to catch on was the lack of publications and presentations in English, said Dr Liu, who needed to study Italian before learning the procedure from Dr Falcinelli. Even now, few articles on the technique have been published in English in peer-reviewed journals. In addition, the procedure is very time consuming and expensive to perform, with a steep learning curve. The OOKP surgery takes about five years to master, Dr Grabner told *EuroTimes*.

As with other types of keratoprosthesis surgery, OOKP surgery carries a risk of extrusion, infection, glaucoma, retinal detachment, globe perforation, vitreous haemorrhage and retroprosthestic membrane formation (although retroprosthetic membrane formation is rare with OOKP). Other possible risks include resorption of the lamina and fistula formation. The main advantage of the OOKP over other types of keratoprostheses is that it can withstand a dry, keratinised eye surface.

The procedure can be used in people with corneal blindness in both eyes due to severe Stevens-Johnson syndrome, ocular cicatricial pemphigoid, chemical burns, trachoma, dry eyes or multiple corneal graft failure. The better-seeing eye should be able to perceive light or see hand movements, but vision should not be better than that needed to count fingers.

The technique should not be used in people who are satisfied with their current level of vision, people under age 17, or eyes with evidence of phthisis, advanced glaucoma or retinal detachment that cannot be repaired. Patients need to be prepared for multiple operations and life-long follow-up, and need to understand that the prosthesis will not look like a normal eye.

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The Procedure

Surgery can be scheduled after a satisfactory assessment of the patient's retina and optic nerve, skin inside the cheek, teeth, and psychological state. OOKP surgery is performed in at least two stages, and requires surgery on both the mouth and eye. Just one eye is rehabilitated.

In the first stage, a maxillofacial surgeon harvests a canine tooth and part of the surrounding jaw and shapes the tissue into a flat lamina. A hole is drilled in the middle of the lamina and an optical cylinder is inserted in the hole and cemented in place, creating the prosthesis. The prosthesis is temporarily inserted into a pocket below a layer of muscle, often under the opposite eye, so that soft tissue can grow into the prosthesis.

Also as part of the first stage, a layer of mucous membrane about 3.0 cm in diameter is harvested from the inside of the cheek. The mucous membrane graft is soaked in an antibiotic solution, cut into an oval shape, and sutured to the four recti muscles and the sclera of the eye. If there is a risk that the mucous membrane graft might not take, the first stage can be broken down into two steps: mucous membrane grafting, followed by tooth harvesting at a later date.

The second stage of surgery usually occurs two to four months after the first stage. It begins with retrieving the buried prosthesis for inspection. If the prosthesis has not become resorbed and is of adequate size, it is temporarily returned to the pocket and surgery can proceed.

Next, the ophthalmologist retracts the mucous membrane graft, cuts the cornea, and removes the iris, lens and vitreous. The prosthesis is sutured in place behind the buccal mucous membrane graft, and the graft is reattached. The optical cylinder protrudes through a hole in the graft.

Good longterm results

In a series of 234 patients followed from 1973 to 2002, called The Rome Series, Dr Falcinelli found that an average of 9.4 years after the procedure (range, 3 months to 29 years), final visual acuity was 20/40 or better in 66% of patients. These results will be published in Cornea later this year.

Drs Liu, Grabner and Hille have had results approaching these, but with shorter follow-up. For example, Dr Liu recently presented results at the 2005 World Cornea Congress in Washington, DC from a cohort of 35 patients who underwent the procedure at the Sussex Eye Hospital. After a mean follow-up of 2.5 years (range: 3 months to 8 years), 72% had improvements in vision and 49% had a final visual acuity of 20/40 or better.

All of Dr Liu's patients had end-stage inflammatory ocular surface disease and no cases were turned away due to low visual potential, such as pre-existing damage to the optic nerve or retina, which may explain why these results were not quite as good as those in Falcinelli's series.

One of the major advances made by Dr Liu and his colleagues is using an optical cylinder that provides 90 to 100 degrees of peripheral vision, a major improvement over the 40 to 50 degrees possible with other cylinders. Another advance involves the ability to track the lamina's size on an image so that signs of resorption can be detected early. Dr Liu and his team also are working on developing better drainage tubes for dealing with glaucoma, and optical cylinders that provide even-better peripheral vision.

Dr Liu and his colleagues will be publishing a review of the OOKP procedure called 'The osteo-odonto-keratoprosthesis' later this year in Seminars in Ophthalmology.

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