

## A novel surgical technique employing donor sclera in strabismus surgery

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**We describe a novel surgical technique employing donor sclera as a spacer to solve the problem encountered in complicated cases of restrictive strabismus surgery when no more muscle or tendon is available for surgical extension of the eye muscle to correct the angle of deviation. This is often the case in patients who have previously undergone extensive surgery and in patients with mechanical restrictions, such as thyroid-associated orbitopathy (TAO).**

Various approaches to the problems associated with complicated strabismus have been described in the literature, including the use of suture spacers,<sup>1</sup> silicone expanders,<sup>2</sup> Dacron spacers,<sup>3</sup> Gore-Tex spacers,<sup>4</sup> fascia lata,<sup>5</sup> and amnion,<sup>6</sup> some of which may cause inflammatory reactions and fibrosis. Donor sclera has been used successfully as a spacer in eyelid surgery for decades.<sup>7</sup> We describe a surgical approach to complex strabismus cases using donor sclera that we have been using at the Department of Ophthalmology in Lund since 1994.

### Subjects and Methods

The study was reviewed by the Regional Ethics Committee in Lund/Ethics Committee of Lund. The study and data collection conformed to all local laws and were compliant with the principles of the Declaration of Helsinki. Informed consent was obtained from all patients. The technique was used in cases of previous extensive strabismus surgery with minimal available muscle tendon for conventional recession or mechanical restriction of movement because of thyroid-associated orbitopathy (TAO), long-standing paralysis, or trauma. The technique was not used in cases that could be treated using conventional surgery.

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*This study was supported by the Swedish Government Grant for Clinical Research (ALF), the Swedish Research Council (VR), the Skåne University Hospital (SUS) Research Grants, Crown Princess Margaret's Foundation (KMA), the Foundation for the Visually Impaired in the County of Malmöhus, The Nordmark Foundation for Eye Diseases at Skåne University Hospital, the Diabetes Society of South-West Skåne and the Swedish Eye Foundation.*

*Submitted September 28, 2016.*

*Revision accepted March 22, 2017.*

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*J AAPOS 2018; ■:1-3.*

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*1091-8531/\$36.00*

*<https://doi.org/10.1016/j.jaaapos.2018.05.001>*

### Surgical Technique

The sclera used for strabismus surgery is from the same eyes that are used for corneal transplants, and the same exclusion criteria obtain. On the day of surgery, donor sclera is cleaned three times with a sterile physiological balanced salt solution (BSS, Alcon, Fort Worth, TX) and laid in 0.5% gentamicin (40 mg/ml) for at least 20 minutes before using it. Sclera not used within five days must be discarded.

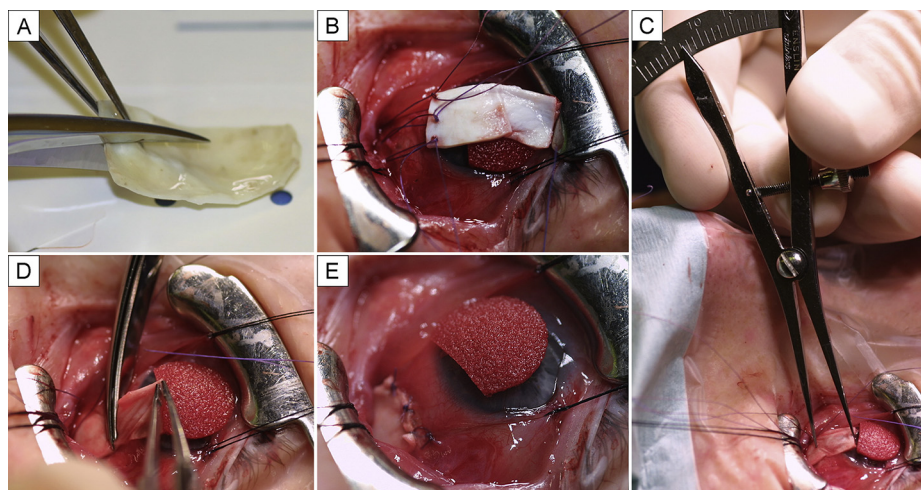
The patient is prepared as in conventional strabismus surgery. Surgery is performed under general or local anesthesia, using retrobulbar anesthesia with a combination of 2.5 ml of lidocaine and 2.5 ml of bupivacaine or topical anesthesia with tetracaine eye drops. The operation site is prepared, and the conjunctiva is opened with a fornix-based conjunctival flap. The muscle is detached from the globe as in normal strabismus procedures (Figure 1). The donor sclera implant is then prepared. The implant is cut to the appropriate width (normally the normal width of a muscle) and length (normally the planned recession). If necessary, the implant can be shortened when attached to the muscle but is usually left at its full length to allow for readjustment. The dimensions of recession are the same as in other strabismus surgery procedures. Two or three 6-0 resorbable polyglactin 910 sutures are placed between the muscle tendon and the implant and between the implant and the appropriate position on the globe, usually the insertion point of the original muscle. If necessary, the implant can be positioned farther back to ensure that the conjunctiva covers the point of attachment to ensure a good cosmetic result, because it is sometimes slightly visible under the conjunctiva (Figure 2A). However, the point of scleral attachment should not be so far away from the arc of contact that the eye cannot rotate on muscle contraction. If appropriate, a semiaadjustable technique can be used, with the middle suture being attached to both the original muscle and the implant, allowing the length of the implant to be shortened in the immediate postoperative period (Figure 2B).

The conjunctiva and Tenon's capsule are closed as in any strabismus surgery at our clinic, with 8-0 resorbable polyglactin 910 sutures. At the end of the procedure the patient is given one drop of dexamethasone and chloramphenicol ointment. Patients are instructed to use the chloramphenicol ointment 2-3 times daily for 1 week.

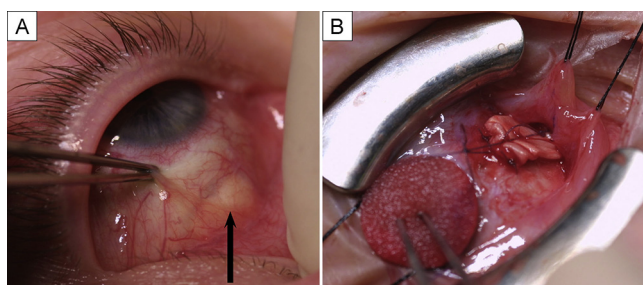
As in conventional strabismus surgery, patients are examined 1 or 2 days after surgery, and the sutures are adjusted if necessary. This applies mainly to patients who have undergone surgery under general anesthesia. In patients operated on under local anesthesia the position of the sutures can be corrected at the time of the operation. The patients are examined by an orthoptist 4-6 weeks postoperatively and thereafter based on individual needs.

### Results

Over a period of 20 years, from 1994 to 2014, a total of 284 cases underwent surgery using donor sclera at our institution. Indications for surgery included double vision (n = 140), difficulties in social interactions (n = 126) and/or abnormal head posture (torticollis; n = 96) Surgical



**FIG 1.** The surgical technique employed for the insertion of donor sclera in strabismus surgery illustrated in a case with preoperative hypotropia of the left eye due to thyroid-associated orbitopathy (TAO). A, Donor sclera is cut to the appropriate size. B, The muscle (in this case, the inferior rectus muscle) is cut loose, and the donor sclera is sutured to the muscle with three sutures. C, Donor sclera is measured for length. D, Adjustment of donor sclera. E, Donor sclera is sutured to the original muscle attachment.



**FIG 2.** A, The donor sclera can be seen through the conjunctiva after the surgical procedure (arrow). The donor sclera may be placed as far back on the globe as possible for good cosmetics. B, Surgical insertion of donor sclera for strabismus surgery using adjustable sutures that fold the implant; the sutures are generally used in patients operated under general anesthesia and can be adjusted on the day of surgery or the following day.

success (individually defined preoperatively by the surgeon) was largely achieved. In only a few cases complications encountered: 1 patient experienced local inflammation, 1 had a conjunctival cyst associated with the anterior part of the donor sclera, and 2 patients experienced mechanical restriction of eye movement.

## Discussion

In our experience, use of donor sclera in challenging strabismus cases makes the operation easier than a conventional one and allows satisfactory results. A typical clinical finding is a TAO patient with vertical strabismus with preoperative measures 20–30 D and after donor sclera surgery measures <10 D (eFigure 1).

Patients with congenital strabismus who have undergone surgery to what we consider maximal recessions using conventional techniques more often have extensive fibrosis, causing restriction of movement. These patients could benefit from our procedure. Typically we have found that a patient with congenital strabismus that has undergone extensive conventional surgery and has a residual large-angle of deviation (>30 D) due to fibrosis has a reduction in the angle of deviation to <10 D with using donor sclera.

Our technique offers many advantages and no noticeable disadvantages. Donor sclera is widely available and safe to use, given extensive preoperative tissue screening. The material has been extensively used for other kinds of eye surgery, and no adverse events associated with the material itself have been reported. No synthetic implant is required. We have found that the material maintains its shape (ie, does not stretch or shrink), with the result that the postoperative angle of deviation is maintained over time. Donor sclera is strong, with crosslinked collagen fibers that provide strength in all directions; it is thus unnecessary to cut the implant or orient it in any particular direction, as is the case with fascia lata implants. Furthermore, it is easily sutured in place, and there is no risk of tearing. Finally, our technique is simple and similar to conventional strabismus surgery. If further surgery is required, the implanted donor sclera often is attached farther back on the globe; it can be easily dissected, shortened, or recessed, thus facilitating future surgery.

Donor sclera has been used successfully in complicated strabismus cases where there is insufficient muscle or tendon. Our 20 years' clinical experience shows that the outcome is good, with highly satisfactory correction of the angle of deviation and no serious complication, which

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