Incidence of inadvertent globe perforation during strabismus surgery

R J Morris, P H Rosen, P Fells

Abstract
Visual loss following strabismus is rare and usually follows inadvertent perforation of the globe at the time of surgery. Previous studies have reported that the incidence of this complication occurs in 8% to 12.1% of patients undergoing conventional strabismus surgery, and higher incidences have been reported for posterior fixation sutures. We conducted a prospective study to determine the incidence of this complication in our patients. We identified one case of globe perforation in 67 patients (100 eyes). Twenty-two patients (44 eyes) had undergone previous strabismus surgery, and there was no evidence of previous scleral perforation in this group. We discuss the recent advances in strabismus surgery which may account for this difference in the incidence of scleral perforation.

Inadvertent perforation of the globe is a recognised complication of strabismus surgery. It usually occurs during intrascleral passage of needles and may involve the sclera, choroid, or retina. It has been reported when disinserting a muscle from the globe and may also occur when passing sutures through a muscle prior to its disinsertion. In the majority of cases scleral perforation is undetected at the time of surgery and discovered later by the presence of a chorioretinal scar, which may represent deep choroidal involvement rather than actual retinal perforation.

Sequela leading to visual loss are rare and include retinal detachment, endophthalmitis, posterior chamber haemorrhage, cataract, lens dislocation, hyphaema, and glaucoma. Reports of the estimated incidence of retinal detachment in strabismus surgery vary from less than 1 in 10000 to 1 in 37000. The reported incidence of endophthalmitis has varied from 1 in 3500 to 1 in 8000, but Locatcher-Khorazo and Seegal did not find one case in 12263 cases of strabismus surgery reviewed.

As the majority of cases of scleral perforation are minor and produce no complications, the true incidence of scleral perforation is not well-established. It has been reported as occurring in 8%,13 9-2%,1 and 12-1%12 of patients during standard strabismus surgery, and higher incidences are described for posterior fixation sutures.11 Inadvertent scleral perforation was not identified at the time of surgery in any of these studies. Mittelman and Bakos13 predicted that, if the incidence of this complication is 9-2%, as reported by Gottlieb and Castro,1 then in the United States there would be an incidence of 7600 globe perforations a year.

These retrospective studies were reported before the widespread use of modern suture materials and needles in strabismus surgery, and it was our impression that with the use of modern surgical techniques the incidence of scleral perforations was much lower than previously reported. To try to establish the incidence of globe perforation in our patients we conducted a prospective study in consecutive patients undergoing strabismus surgery.

Material and methods
Sixty-seven consecutive patients undergoing strabismus surgery in the six-month period October 1988 to March 1989 were included in the study. There were 33 males and 34 females, and the age range was from six months to 52 years (mean 11.2 years).

Prior to surgery the pupils of the operated eyes were dilated with cyclopentolate hydrochloride 1% and phenylephrine hydrochloride 2-5%. Fundal examination was performed by indirect ophthalmoscopy and scleral indentation, and any chorioretinal abnormalities noted. After surgery and before suturing the conjunctiva the retina was re-examined over the site of each scleral suture by the indirect ophthalmoscope in order to identify any chorioretinal haemorrhages, retinal tears, or vitreous haemorrhage indicative of inadvertent scleral perforation. The suture knot was held with a fine Colibri forceps so that gentle scleral indentation could be applied directly over the site of the scleral passage of the needle. In those cases with posterior fixation sutures this was not always possible, and the globe was gently indented with a squid hook over the site of the suture.

SURGICAL TECHNIQUE
Surgery was performed with the operating microscope. All extracocular muscle surgery was performed with limbal conjunctival incisions. The muscle insertion was directly visualised before isolating it on a squid hook, and the muscle was then cleaned of its fascial attachments and the intermuscular septum.

Muscle resections. A single armed 6-0 Vicryl (polyglyclatin 910) suture on a three-eights circle spatulate needle was passed through the muscle tendon from the centre to each border and lock bites taken to incorporate the outer one-third of the muscle tendon. The muscle was disinserted from the globe with Wescott scissors and haemostasis secured by bipolar cautery. The muscle was then reattached to the globe at the appropriate distance behind its original insertion. Scleral bites were passed from the outer border of the muscle tendon towards the centre, and the suture was tied to its free end; the second suture...
was then reattached in the same way. The inferior oblique muscle was recessed to a position 5 mm posterior and 3 mm lateral to the lateral border of the inferior rectus by a single suture through the anterior border of the muscle.

Muscle resections. The muscle was identified and cleaned in the same way as for a recession. Two Chavasse muscle hooks were then placed under the muscle and two single armed 6-0 Vicryl sutures, on a three-eighths circle spatulate needle, placed through each border of the muscle, with lock bites being taken to secure the suture. The muscle was resutured to the globe at the original insertion. If there was any bowing of the insertion another suture was placed through the central portion of the muscle.

Faden procedure. The technique used for Faden sutures has been described in a previous paper from Moorfields Eye Hospital. 18

Muscle transposition procedures. The vertical recti were identified and two 6-0 Vicryl sutures passed through the tenon, as in a muscle recession, and the muscle was fully transposed laterally. 19 In one case the horizontal recti were transposed inferiorly by a similar technique.

Results

The diagnosis at presentation in the 67 patients undergoing strabismus surgery can be seen in Table 1.

One hundred and thirty-seven muscles in the 67 patients (100 eyes) underwent surgery. One hundred and thirty-four required resuturing to the globe; the remaining three muscles underwent superior oblique tenotomy (Table II). In only one patient did inadvertent perforation of the globe occur at the time of surgery. This occurred in a five-year-old boy with right Duane's syndrome (type I). One year previously he had undergone a right medial rectus recession of 5 mm and right lateral rectus resection of 5 mm at another institution. In order to correct reduced abduction associated with a persistent abnormal head posture a temporal transposition of the vertical recti in the right eye was performed. Scleral perforation was suspected during the procedure when the medial border of the superior rectus muscle was resutured to the globe, though there was no prolapse of uveal tissue or vitreous. This was subsequently confirmed at the end of the procedure by indirect ophthalmoscopy, when a small deep retinal haemorrhage was identified at the site of suture placement. This was not associated with a retinal hole or vitreous haemorrhage, and no transcleral cryotherapy was therefore applied to the site. No complications developed over a six-month follow-up.

Prior to inclusion in the study 22 patients (44 eyes) had previously undergone strabismus surgery: 17 on one occasion, 4 on two occasions, and 1 on three occasions. The total number of muscle procedures in which the muscle had been resutured to the globe was 60. In addition, one patient had an injection of botulinum toxin to the medial rectus five days before temporal transposition of the vertical recti for a sixth nerve palsy. In none of these patients was there any

<table>
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<tr>
<td>Esotropia</td>
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<td>Esotropia</td>
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<td>IV nerve palsy</td>
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Discussion

Strabismus surgery is one of the commonest procedures performed by the general ophthalmologist. Although the risk of visual loss is remote, it is usually related to perforation of the globe at the time of surgery, 20 and every precaution should be taken to keep this risk to a minimum.

In the 67 patients (100 eyes) studied prospectively, we identified only one case of scleral perforation in the 134 procedures in which the muscle was resutured to the globe. In this case the perforation was suspected at the time of suture placement and confirmed by the presence of a small deep retinal haemorrhage on fundal examination. No evidence of scleral perforation was found in the 22 patients who had had previous muscle surgery. In total only one scleral perforation was identified in 194 muscle procedures (144 eyes). This incidence of scleral perforation is lower than previously described. Although Gottlieb and Castro reported an incidence of 9.2% in their series, they did not state whether the 68 patients recalled was the total number of patients operated on over a five-year period or only those who attended for re-examination. Kaluzny et al. in their retrospective study recalled 91 patients operated on over an eight-year period and report an incidence of 10.2% in 108 eyes operated upon. 21 In both these studies it is not clear if the figures represent a true incidence of consecutive patients operated on or only the incidence in those patients they examined. Rojas et al., 22 however, reported on consecutive patients but did not examine the fundus before surgery, and, as in the other studies, they included any retinal or choroidal abnormality as indicative of perforation. Therefore it is possible that the reported figures

<table>
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<tr>
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<tr>
<td>Superior oblique tenotomy</td>
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overestimate the incidence of globe perforation. Nevertheless we consider these figures are unacceptably high and that with appropriate precautions and careful surgical technique a lower incidence of complications can be achieved.

It is well documented that the sclera is thinnest (0.3 mm) behind the insertion of the rectus muscles and thicker (0.6 mm) at the muscle insertions. Scleral perforation is commoner during muscle recessions than resections. Mills et al. and Capó et al. have recommended the use of hang-back sutures to reduce the risk of scleral perforation during standard muscle recessions. This procedure has the theoretical disadvantage that the recessed muscle may creep forwards or slip, causing vertical deviations. However, perforation has been reported after muscle resection and during suture placement at the original muscle insertion for adjustable sutures. In Gottleib and Castro's series four of the 10 patients developed perforation as a result of muscle resections, and in none of these patients did they describe which suture material or needle was used. Scleral perforation has also been reported as the sutures are passed through the muscle before the globe is disinserted and may occur during disinsertion of the muscle from the sclera. Although the sclera is thinner behind the insertion of the rectus muscles, it is clear that this is not the only factor associated with scleral perforation.

We suggest that all strabismus surgery should be performed with some form of magnification, either with the operating microscope or a spectacle mounted loupes. The operating microscope provides excellent lighting and magnification, but does reduce the field size and depth of focus and restrict the surgeon's mobility. With loupes a headlight affords excellent lighting as an alternative to the standard overhead operating room lights.

When dissecting tissues in order to isolate muscles it is important to directly visualise tissues before using sharp dissection, particularly in the presence of scar tissue in reoperations and in restrictive conditions such as thyroid eye disease. Before disinserting a muscle or passing a suture through the sclera it is essential to ensure good haemostasis and adequate exposure, by means of a Fison or Desmarres retractor if necessary. When a muscle is reattached, the needle should be placed through the superficial 1/3 to 1/2 of the scleral thickness and passed tangential to the sclera, with the tip visible at all times. Magnification enables direct visualisation of the intrascleral course of the needle as well as the intrascleral course of the vortex veins.

The most commonly used suture material in strabismus surgery is now 6-0 Vicryl (polyglactin 910). It has the advantages of causing minimal tissue reaction, having a high tensile strength, good knot holding ability, and a predictable absorption rate, but has the disadvantage of adhering to tissues. Its high tensile strength allows 6-0 sutures to be used with small needles. Our preference is to use a fine spatulate needle which cuts tissue at the sides and tip. Other spatulate needles with a point below lead to a deeper bite than those with a point above and are more likely to cause scleral perforation. Pro-

vided the edges of the needle are parallel to the sclera during its intrascleral course the risk of inadvertent perforation is low. We use a three-eighths circle spatulate needle, but in some situations where access is difficult a half circle spatulate needle can be advantageous. It has the disadvantage of allowing a shorter scleral bite, but of the same depth as a three-eighths circle needle. A reverse cutting needle has a cutting edge on the convex surface and therefore has a theoretically greater risk of causing scleral perforation. However, some surgeons prefer it, as, unlike the wider spatulate needles, it does not have to remain exactly parallel to the scleral surface during its intrascleral course. Posterior fixation sutures are inserted postequatorially on larger needles where the sclera is thin and access difficult; this is the likely explanation for the higher incidence of scleral perforations with this procedure.

The management of such perforations is controversial. Some authors recommend that they should be treated with transcleral cryotherapy regardless of the depth of perforation, to reduce the incidence of retinal detachment. Mittleman and Bakos, however, in animal experiments found a higher incidence of retinal detachment associated with heavy retinal cryotherapy, and they suggest that unless vitreal haemorrhage occurs or the patient has a predisposing risk factor for retinal detachment no treatment is indicated. Retinal detachment may be secondary to vitreous traction and presentation delayed, so that with globe perforation complicating strabismus surgery should be followed up long term. If scleral perforation is detected at the time of surgery, conjunctival cultures should be obtained and antibiotics without steroids administered because of the small risk of endophthalmitis. Such patients should be followed up closely for signs of infection in the early postoperative period.

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