A new synthetic material for the brow suspension procedure

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SUMMARY This report describes the use of a new synthetic material, combining polyester with carbon, in nine brow suspension procedures. The mechanical properties of polyester, with the fibrous tissue inducing properties of carbon, combine to produce a scaffolding on which fibrovascular ingrowth is possible. Subsequent fibrosis gives a permanent effect. Early results indicate that the material is tolerated well in the eyelid, but the problem of early slippage remains.

The brow suspension procedure also known as frontalis sling or frontalis suspension is the treatment of choice for ptosis characterised by minimal levator function and a narrow interpalpebral aperture.¹⁻⁵ Many methods of brow suspension have been advocated, but the use of autogenous fascia lata remains the most popular and the most effective.⁶ However, this technique is not possible in children under 3 years old because the fascia lata has not developed sufficiently in them.⁷ Stored irradiated fascia and lyophilised fascia have been recommended, but the results are less satisfactory, and fascial banks are necessary for storage.⁸ A further alternative is to use extensor tendons which are sufficiently developed by the age of 6 months and make suitable material.⁹

Many synthetic materials have been used, the most popular being a polyester cable type (Supramid). A high incidence of granuloma formation, progressive loosening, and fracture has been recorded with this material.¹⁰ This report describes early experience with a new synthetic material which combines polyester and carbon.

Materials and methods

Each child selected for this procedure had severe ptosis with minimal levator function. The timing of surgery was dictated by the severity of the ptosis and the associated problems of compensatory head posture and occlusion of the visual axis. Fox's tech-

nique was employed and adapted for use with this material.⁴ A Frost suture was placed in the lower lid on completion of surgery and was removed on the second postoperative day. Topical lubrication was applied on a regular basis for two to six weeks. The child was assessed on the second day and at two, six, and 12 weeks after surgery.

The new suture material used is called the ABC (Active Bioprosthetic Composite) ligament and tendon repair material; it is produced by Surgicraft Ltd (Britten Street, Redditch, Worcs B97 6HF, England).

Early reoperation was required in one child because of immediate surgical failure. At surgery a biopsy of the old suture track was taken, and this was examined by both light and electron microscopy (Figs. 1, 2).

Results

Nine brow suspension procedures were carried out on five children. Follow-up ranged from three to seven months, mean five months, and there have been no instances of wound infection, stitch granuloma, fistula, or tattooing in the follow-up period.

Patient 1 was a 4-year-old girl with mitochondrial cytopathy and bilateral ptosis. The interpalpebral apertures measured 3-4 mm, and surgery resulted in the apertures measuring 7 mm for the right eye and 9 mm for the left eye.

Patient 2 was a 3-year-old girl with bilateral congenital ptosis. The right interpalpebral aperture measured 4 mm, requiring surgery. The immediate

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Fig. 1 Collagen and adipose tissue, with no evidence of granuloma or residual suture material. Haematoxylin and eosin, $\times 100$.

postoperative result was poor, and a levator resection was subsequently performed seven months later. A biopsy of the original suture track was obtained, and, though a well defined cord-like structure was identified, both light microscopy and electron microscopy studies showed fibrous tissue and adipose tissue only. No suture material was identified (Figs. 1, 2). Patient 3 was a 9-year-old girl with bilateral congenital ptosis, the upper lids just clearing the pupil, with no demonstrable levator function. The immediate post-operative results were good in both eyes and maintained in the left, but the right lid returned to its original position by the second week. The skin crease also disappeared, and it is likely that the suture material slipped.

Patient 4 was a 22-month-old boy with bilateral ptosis. The interpalpebral apertures measured 4 mm in the right eye and 5 mm in the left. Surgery resulted

Fig. 2 Electron micrograph, showing bands of collagen (C) and adjacent fibroblasts (F). Lead citrate and uranylacetate, $\times 518500$.

in apertures measuring 7 mm in the right eye and 8 mm in the left eye.

Patient 5 was a 14-month-old boy with bilateral congenital ptosis. The interpalpebral apertures measured 5 mm, and initially brow suspension procedures using nylon were performed. Both subsequently slipped within two years, and brow suspension procedures were again performed with the new material when he was aged 4 years. The interpalpebral apertures eventually returning to 8 mm in the right eye and 7 mm in the left eye.

Discussion

It is not known when the repair of ptosis was first attempted. There are reports that Celsus in the first century AD described excision of eyelid skin.¹¹ This was again proposed by Arabian surgeons and subsequently adopted and modified by Scarpa in 1801, Hunt in 1830, and others.¹² The levator muscle was replaced in various ways and the superior rectus muscle incorporated, often with limited success.¹²

The use of the frontalis muscle to elevate the lid by attaching the upper border of the tarsus subcutaneously to the muscle overlying the eyebrow is now the treatment of choice in severe degrees of ptosis with limited levator function. Various materials have been used, including skin,¹³ levator tendon,¹⁴ orbicularis muscle,¹⁵ frontalis muscle strips,¹² or corrugator supercilii strips.¹²

Payr was the first to use autogenous fascia lata as a sling.¹⁶ Wright¹⁷ described the technique in detail, and it was later modified by Crawford.¹⁸ Fascia lata remains the most popular material, as it is capable of producing a permanent effect, probably because it retains its cellular viability.¹⁹ The requirement for a second operative site to obtain autogenous fascia lata and the lack of suitable tissue in children under the age of three years have been major drawbacks. Banked allogeneic fascia lata obviates these difficulties but has not been widely used because of its relative inaccessibility and a potentially lower success rate. Lyophilised fascia has been used, and there is histological evidence that this is replaced by the recipient's own fibroblasts, suggesting that this may also be capable of producing a permanent effect.²⁰ In the short term this has proved to be effective, though there is a significant incidence of slippage within the first three months.⁸

Other materials, including tendon,^{9,21} preserved sclera,²² sutures such as catgut and silk, metals such as gold, silver, and platinum, silicone threads or strips, and stainless steel wire springs have also been tried.¹² The most widely used synthetic material is a polyfilament cable type suture, which has the advantages of ease in handling and commercial availability but does

have an increased incidence of granuloma formation, progressive loosening, susceptibility to trauma, and eventual failure.¹⁰

Factors that need to be considered in the development of a new material include accessibility, infection and rejection rates, ease of handling, degree of permanency, granuloma and fistula formation, and tattoo rates. The degree of permanency may depend on the ability of the material to provoke a fibroblastic reaction, as is seen with fascia lata.

A bioprosthetic ligament material made of an assembly of carbon and polyester fibres is now being used in knee ligament surgery.²³ Both materials have been used independently for this in the past and have shown the so-called 'new ligament' effect by acting as a biological scaffold for the ingrowth of mesenchymal cells, which lay down collagen tissue and its supporting vascular elements.²⁴ This mechanism has therefore enabled the repair and reconstruction of ligaments and tendons in both humans and animals.²⁵ Its effect has been confirmed histologically in man²⁶ and seen in several different anatomical sites.²⁷ Neither of the materials in isolation shows an ideal mechanical behaviour under stress, but, when combined, the polyester fibres are prevented from over-extension by the carbon fibres, which are in turn protected from the sheer stresses by the polyester.²⁸ Polyester is more resilient and handles more readily, carbon fibres are more likely to become infiltrated by and incorporated into fibrous tissue.²⁹

This paper reviews our early experience with this material in the subcutaneous tissue of the eyelid as a frontalis sling. All patients had a minimal follow-up period of three months.

The new material handled well. It was smooth, firm, resilient, and easy to tie. The functional results of surgery were comparable with any series of brow suspension procedures. The children appeared to tolerate the procedure well, and bruising was minimal. Cosmetically acceptable results were recorded in all nine operations.

None of the procedures were complicated by fistula formation, granuloma, infection, or tattooing. It seems therefore that this material is safe to use in the eyelid.

During the first three months the surgical objective was achieved in all but two lids. Failure was immediate in both instances and almost certainly due to slippage. A biopsy of the suture track taken from one patient seven months after the original surgery revealed fibrous tissue and adipose tissue only. There was no sign of added fibroblastic activity or suture material. It is assumed that the suture material retracted back after early slippage into the brow, resulting in a limited response. Previous biopsies at operation sites have shown a predictable response,

with evidence of the suture material (Strover AE, personal communication, 1987).

CONCLUSION

This new material may provoke the fibrous tissue reaction seen when using fascia lata and responsible for the permanence of the result. It appears to be tolerated well in the first three months, but it remains to be seen from long-term follow-up how effective the material really is.

We thank the staff of the Orthoptic Department, Children's Hospital, Birmingham, for their willing help.

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Accepted for publication 5 November 1987.