INTERNAL FIXATION FOR FRACTURES OF THE PATELLA

A COMPARISON OF TWO METHODS

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Cadaveric experiments in 10 knees were used to study the strength of two methods of internal fixation for a fractured patella. A modified AO tension band technique was compared with the combination of cerclage wiring and a tension band used at Pyrford. The repairs were stressed to failure; the combination of cerclage and tension band wiring proved to be significantly stronger and is recommended.

Several techniques have been described for internal fixation of fractures of the patella (Schauwecker 1974; Müller et al 1979; Ma et al 1984). Cerclage wiring has been used for many years but is not rigid enough to allow early joint movement (Weber et al 1980); a high proportion of poor results were reported by Levack, Flannagan and Hobbs (1985).

The tension band technique provides strong fixation for transverse fractures; one modification of this method, using two longitudinal Kirschner wires, has been described as the method of choice (Müller et al 1979). At the Rowley Bristow Orthopaedic Hospital, Pyrford, a combination of cerclage and tension band principles is used. The strength of the fixation afforded by these two methods has been studied.

MATERIALS AND METHODS

A cadaveric study was performed on five subjects (10 knees) of age range 17 to 80 years, within 48 hours of death. None of the knees had had surgery or trauma to the extensor mechanism. A transverse incision allowed a transverse osteotomy to be performed across the widest diameter of each patella with an oscillating saw; the medial and lateral patellar retinaculae were divided by scalpel to complete the simulated fracture.

The right patella of each subject was then fixed by the modified tension band technique described in the AO Manual of Internal Fixation (Müller et al 1979), being held accurately reduced by two parallel 1.6 mm diameter Kirschner wires around which a tension band of 18 G monofilament wire was tightened (Fig. 1a). The left patella was fixed using the Pyrford technique. The patella was accurately reduced and held with a circumferential cerclage wire passed in a purse-string fashion close to the bone. To complete the fixation a second wire was passed through the quadriceps tendon, looping anteriorly across

<table>
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<th>Subject number</th>
<th>Side*</th>
<th>1</th>
<th>2</th>
<th>3</th>
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<th>Significance of difference</th>
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* R side, modified tension band; L side, Pyrford technique
† failure of fixation

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the patella and through the patellar tendon to act as a tension band; both wires were of 18 G braided stainless steel (Fig. 1b). The patellar retinaculae were not repaired.

Sherman screws were then inserted into the anterior surface of each fragment of the patella perpendicular to both the longitudinal and transverse axes of the bone. Distraction was applied across the fracture by a calibrated spring balance applied to the tibia 40 cm from the joint line. At each increment of 5 kg force the distance between the screws was measured with a micrometer until failure of fixation occurred (Fig. 2). The measured displacement of the fracture at each increment of applied force was compared for the two techniques of fixation and statistically analysed using the paired t-test.

DISCUSSION
The ideal internal fixation for the fractured patella should be strong enough to allow early mobilisation to reduce post-traumatic stiffness and perhaps help the healing of the articular cartilage. The tension band principle has been progressively modified in an attempt to provide such strength.

The first edition of the AO Manual of Internal Fixation describes the use of two tension band wires passed through Sharpey’s fibres to provide fixation, and has been modified to use interfragmentary Kirschner wires as the anchorage points for a single tension band.

RESULTS
The results are shown in Table I and illustrated in Figure 3. At applied forces of 5, 10 and 15 kg there was no statistically significant difference in measured displacement. All patellae fixed using a tension band around Kirschner wires failed at an applied force of 20 kg or less; one failed at 16 kg when a Kirschner wire cut out of the patella in the porotic bone of the 80-year-old subject, two failed at 18 kg and two at 20 kg when the inferior ends of the Kirschner wires bent.

None of the specimens fixed by the Pyrford technique failed at 25 kg. On testing to destruction the soft tissues failed before the metal fixation. The increased strength of the Pyrford technique was statistically significant at an applied force of 20 kg (p = 0.02) and 25 kg (p = 0.0001).

Fig. 2
Method of testing fixation.

Mean displacement of the fracture fragments related to the force applied for the modified tension band (MTB) and Pyrford technique.
This technique has been shown to be superior to circumferential wiring and to the original method (Weber et al 1980). In that study, a load was used to simulate only the inert mass of the leg; this would approximate to an applied load of 2 kg at 40 cm from the joint line. Higher loads are generated during exercise; it has been calculated that forces through the patellar tendon increase from 850 N during level walking to 1900 N on climbing stairs (Morrison 1968). These forces approximate to loads of 5 kg and 10 kg applied 40 cm from the joint line; they may exceed 15 kg with increased knee flexion.

This study has shown that, while the AO technique is adequate for most cases, the Pyrford technique gives greater strength of fixation, certainly enough to allow early mobilisation. The Pyrford technique can also be applied to a comminuted fracture of the patella, which can be difficult to fix with interfragmentary Kirschner wires and a simple tension band. It is strong enough to allow early knee flexion exercises to the 45° of flexion required for patellofemoral contact and the moulding of damaged articular surfaces.

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No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

REFERENCES


