The use of non-absorbable suture in the fixation of patellar fractures: a preliminary report

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We describe the use of a non-absorbable, braided, polyester suture, 5 Ti-Cron (Davis and Geck, Gosport, Hampshire), for the fixation of patellar fractures as an alternative to stainless steel wire. Seven patients had their fractures fixed with this material and all progressed to union with good restoration of knee function. The ease of use of the suture allowed accurate reduction of the fractures and reduced operative and tourniquet time. None of the patients suffered significant complications from the procedure although two patients required removal of the suture because of knot symptoms. This was easily performed under local anaesthetic on an out-patient basis. We believe that non-absorbable suture is a good substitute for stainless steel wire and reduces the need for a second procedure for wire removal. © 1998 Elsevier Science Ltd. All rights reserved


Introduction
It is widely accepted that preservation of the patella in part or whole is preferable to patellectomy following fractures of this bone and several techniques have been advocated for reconstruction. All methods in common practice utilize stainless steel wire; either alone or in combination with Kirschner wires or interfragmentary screws. Stainless steel wire, although a strong material, is difficult to manipulate and is associated with a number of complications. These often necessitate a second procedure for its removal. In an attempt to avoid these complications, we describe our use of a non-absorbable, braided, polyester suture, 5 Ti-Cron (Davis and Geck, Gosport, Hampshire), instead of stainless steel wire.

Methodology
Over a period of 1 year, seven patients with patellar fractures underwent operative fixation with Ti-Cron suture. There was one male and six females aged from 44 to 87 years-old. Fractures were of both simple transverse and transverse type with comminution. Straight leg raise was impossible in all patients and the degree of separation of fragments as seen on plain radiographs confirmed rupture of the extensor mechanism. The case details and results are shown in Table 1.

A comparison of the tensile strengths of 5 Ti-Cron and the same gauge of monofilament stainless steel

<table>
<thead>
<tr>
<th>Case</th>
<th>Age</th>
<th>Sex</th>
<th>Fracture pattern</th>
<th>Hospital stay</th>
<th>Time of follow-up</th>
<th>Comment</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>V.R.</td>
<td>56</td>
<td>F</td>
<td>Transverse with comminution</td>
<td>7 days</td>
<td>3 months</td>
<td>Additional screw used. Knot palpable, required removal</td>
<td>Pre-injury knee function restored</td>
</tr>
<tr>
<td>N.K.</td>
<td>48</td>
<td>F</td>
<td>Simple transverse</td>
<td>8 days</td>
<td>6 months</td>
<td>Post-operative swelling slow to subside. Required removal</td>
<td>Pre-injury knee function restored</td>
</tr>
<tr>
<td>M.F.</td>
<td>87</td>
<td>F</td>
<td>Simple transverse</td>
<td>10 days</td>
<td>4 months</td>
<td>No complications</td>
<td>Pre-injury knee function restored</td>
</tr>
<tr>
<td>I.G.</td>
<td>75</td>
<td>F</td>
<td>Simple transverse</td>
<td>8 days</td>
<td>6 months</td>
<td>No Complications</td>
<td>Pre-injury knee function restored</td>
</tr>
<tr>
<td>D.R.</td>
<td>76</td>
<td>F</td>
<td>Transverse lower 1/3</td>
<td>10 days</td>
<td>3 months</td>
<td>Ipsilateral tibial plateau fracture</td>
<td>Pre-injury knee function restored</td>
</tr>
<tr>
<td>M.M.</td>
<td>44</td>
<td>M</td>
<td>Transverse with comminution</td>
<td>8 days</td>
<td>6 weeks</td>
<td>Removed splint</td>
<td>Fracture united</td>
</tr>
<tr>
<td>M.M.</td>
<td>65</td>
<td>F</td>
<td>Transverse with inferior pole comminution</td>
<td>14 days</td>
<td>6 weeks</td>
<td>Ipsilateral ankle fracture</td>
<td>Fracture united</td>
</tr>
</tbody>
</table>
Table II. Tensile strength results (all values in kg)

<table>
<thead>
<tr>
<th></th>
<th>Ti-Cron</th>
<th>Stainless steel</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Straight pull</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minimum</td>
<td>14.72</td>
<td>34.55</td>
</tr>
<tr>
<td>Mean</td>
<td>14.80</td>
<td>34.91</td>
</tr>
<tr>
<td>Maximum</td>
<td>14.89</td>
<td>35.26</td>
</tr>
<tr>
<td><strong>Knot pull</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minimum</td>
<td>10.80</td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>12.56</td>
<td></td>
</tr>
<tr>
<td>Maximum</td>
<td>14.35</td>
<td></td>
</tr>
</tbody>
</table>

wire was performed for us by the laboratories at Sherwood Davis and Geck (Table II).

Operative technique
All patients were treated using the Pyrford technique (Figure 1). One fracture was treated with an additional interfragmentary screw. The patella was approached through either a vertical midline or transverse incision according to the preference of the surgeon. The fracture margins were prepared as usual. A 5 Ti-Cron suture was then passed circumferentially close to the margin of the patella and then tied at one corner. A further suture was then passed through the attachments of the quadriceps and patellar tendons over the anterior surface to act as a tension band. The articular surface was then assessed for apposition and interfragmentary compression through a range of movement from 0 to 90° of flexion. The retinacula were then repaired with absorbable sutures.

Post-operative management
Continuous passive motion was used in the immediate post-operative period for 48 h and patients then commenced knee exercises and were full weight-bearing in a removable splint within a few days. The subjects were followed up at 6 weeks at which time a check radiograph was taken. Ability to straight leg raise was taken as a sign that the cricket pad (extension) splint could be dispensed with. Out-patient medical and physiotherapy follow-up was continued until knee function was normal.

Results
The results are shown in Table I. All of the patients were treated without plaster, all of the fractures united, and pain-free knee function was restored at 6 weeks (Figure 2). One patient had mild knee swelling for 6 months but this resolved uneventfully. Two patients required removal of the suture because the knot from the circumferential loop caused irritation. This was performed under local anaesthetic in the out-patient setting. The results of the in vitro tensile strengths of the two materials are shown in Table II.

Discussion
The Pyrford technique was described by Curtis in 1993. In a cadaveric study, he found that patellar fixation in the way described above, gave a stronger repair than the modified AO tension band method. Burvant et al. have confirmed that this is an adequate fixation technique, although they found the best method to be lag screw fixation with an anterior tension band. The latter study showed that significant strength of repair is afforded by repair of the retinacula and therefore an open repair would seem preferable to the percutaneous methods of fixation proposed by some authors. The above studies as well as that of Weber et al. looked at the fixation of simple transverse fractures only and the Pyrford technique seems to be the most satisfactory for the treatment of injuries involving a degree of comminution. All the above studies used stainless steel wire in their fixations.

Stainless steel wire is a material with a high tensile strength and is therefore suitable for fixation of patellar fractures (Table II). However, it is a difficult material to manipulate through tissues and this may result in poor fixation of the fracture. It is also possible that kinks in the wire at the time of operation straighten out with knee motion and this reduces the rigidity of the construction. A further consideration is that wire does not tolerate long term cyclical loading well and has a tendency to fragment with time. Although breakage usually occurs after fracture union, the broken wire may then proceed to protrude through the skin or even migrate to become
an intra-articular foreign body. Due to the superficial position of the patella, patients commonly complain of irritative symptoms from the wire or the knot. Studies show that the incidence for these symptoms varies from 30 to 50 per cent and it is generally accepted that many patients will require a second procedure to remove metal-work. This is not always easy to accomplish and most patients will require a general anaesthetic for the operation.

The use of an absorbable polyglycalide suture with polyglycalide plugs has been described with satisfactory results. However, this study required the use of materials specifically designed for the project. Concern has also been raised about the use of an absorbable suture (Vicryl) causing a prepatellar bursitis. It is also possible that the variable rate of loss of tensile strength may make duration of fixation unpredictable.

Ti-Cron is a braided, polyester, non-absorbable suture that is currently indicated for use in cardiac surgery and has been proven to maintain its tensile strength in vivo. We find that it has several advantages over wire. First, it is easy to handle and the ability to use a needle to pass the suture allows accurate placement in the soft tissues and does away with the need for the guides required with steel wire. If placement is not ideal the suture can easily be repositioned. Therefore, as well as giving good reduction of the fracture operative time and tourniquet time is reduced (Figure 3). Furthermore, the

![Figure 2. Pre-operative and 6-week follow-up radiographs of case M.F.](image-url)
The braided nature of the suture allows easy, secure knotting. In our experience, patients generally tolerate the suture better than wire, although two of our cases did require removal of the suture because the knot from the circumferential loop was prominent. Unlike stainless steel wire, however, the removal could be performed simply under local anaesthesia. The knot is located and the suture cut. This allows the suture to be pulled out of the wound in one piece. These two cases were the first to undergo this technique and since then we have buried the knot in the soft tissues.

The reduced tensile strength of Ti-Cron does not seem to be a problem and has provided adequate fixation for the young male case in our series. Suture breakage, if it occurs, is unlikely to cause any problems. All of our patients have progressed to union with satisfactory knee function and the strength of fixation was such that it allowed early knee exercises and early mobilization without the need for plaster of Paris. In one patient a supplemental screw was used because the upper pole of the patella was split into two large articular fragments and it was felt that better compression could be achieved by using a lag screw between these pieces.

Our preliminary findings support the continued use of non-absorbable suture in place of stainless steel wire in the fixation of patellar fractures. The ease of use and reduced problems of implant irritation benefit the patient at all stages of their treatment and doing away with the need for a second general anaesthetic procedure reduces treatment costs.

References


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