THE ROLE OF ARTHROSCOPIC SURGERY IN THE TREATMENT OF FRACTURES OF THE INTERCONDYLAR EMINENCE OF THE TIBIA

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Thirty-five patients were treated for Type III fractures of the intercondylar eminence of the tibia and were followed up for two to seven years. There were 20 Type IIIA fractures and 15 Type IIIB fractures. The avulsed fragment was reduced by operative arthroscopy and maintained either by extension and immobilisation in a cast or by crossed percutaneous pin fixation. Involvement of the medial collateral ligament or lateral meniscus was confirmed by valgus stress radiographs and by arthroscopy. Primary surgical repair through a separate incision was required in a significant number of patients.

At follow-up, few patients suffered ligamentous instability, lack of extension, atrophy of the quadriceps, pain or effusion, and symptoms were minimal. Patients requiring surgical repairs of collateral ligaments or of peripheral detachments of the meniscus generally required a longer period of rehabilitation.

Arthroscopic reduction and percutaneous pin fixation provided an effective treatment and significantly decreased the time spent in hospital and the morbidity experienced after alternative treatments.

The management of fractures of the intercondylar eminence of the tibia is uncomplicated and straightforward when the fracture has minimal displacement (Type I) or when only one-third or a half of the eminence is elevated (Type II) (Meyers and McKeever 1959, 1970). However, the treatment of complete separation (Type III) has been controversial since the first attempt by Pringle (1907) at open reduction. The various modes of reduction and fixation proposed for these fractures have generally resulted in considerable morbidity and a slow return to normal activity (Meyers and McKeever 1959, 1970; Roberts and Lovell 1970; Tachdjian 1972; Rockwood and Green 1975; O'Donoghue 1976; Wilson 1976; Zaricznyj 1977; DeHaven 1978; Clanton et al. 1979; Roberts 1979).

In adults, two-thirds of all ruptures of the anterior cruciate ligament have associated meniscal involvement and two-thirds of these involve the lateral meniscus (Glick, Gordon and Sheck 1975; DeHaven 1978). Similarly, in fractures of the intercondylar eminence, Clanton et al. (1979) have shown that either meniscus may be involved in the child or adolescent.

Trauma in children and adolescents usually produces fractures or physical injuries (Rang 1974). Ruptures of the collateral ligaments of the knee in children with fractures of the intercondylar eminence are uncommon but have been described by Clanton et al. (1979) and Hyndman and Brown (1979).

Arthroscopic surgery has provided a new mode of treatment. Eilert (1978) reported the arthroscopic removal of a fragment after a longstanding fracture of the intercondylar eminence which was found in a patient who failed to gain full extension after a fracture of the lateral femoral condyle. This study shows how, in Type III fractures of the intercondylar eminence, arthroscopic surgery may be used in the reduction or fixation to promote early rehabilitation and return to previous activities.

MATERIALS AND METHODS

Patients for this study were selected from the records of the Children's Hospital at Los Angeles, Los Angeles County--University of Southern California Medical Center, Centinella Valley Hospital and Northern Inyo Hospital from 1974 until 1979. The age, the mechanism of injury, the initial physical findings, the type of fracture and the treatment were studied. All patients with suspected ligamentous injuries had radiographs taken in positions of varus and valgus stress, which were classified using the technique of Kennedy (1979). At follow-up standard and stress radiographs were taken and patients were evaluated for pain on activity, effusion, atrophy, range of movement, stability of the knee and the ability to participate in their pre-injury activities.

The 3.5 millimetre arthroscope with 30 degrees of angulation was introduced in the standard manner by either a superior or an inferior approach. After copious irrigation the fracture site was visualised. With the knee in 90 degrees of flexion and using a dental sinus ring curette, fibrous tissue and osteochondral fragments were removed from the fracture site. Next a probe was introduced and the fracture reduced; the reduction was maintained by extension of the knee. Reduction was verified by radiography and was considered satisfactory if there was...
less than two millimetres of offset. A cylinder cast was then applied in full extension. The patient was immobilised thus for three weeks and then for a further three weeks in 20 degrees of flexion.

If the fragment could not be held reduced in extension, percutaneous pinning was deemed necessary. The arthroscope was removed and two or three smooth Kirschner wires were introduced in a crossed fashion 0.5 centimetres proximal to the tibial tuberosity and on either side of the patellar tendon. Proper replacement was verified by image intensification. The arthroscope was then reintroduced and the Kirschner wires were withdrawn in a retrograde manner until just beneath or flush to the articular surface. Twenty millilitres of 0.5 per cent Marcain were introduced into the knee joint. The Kirschner wires were then cut at the skin level and a dynamic coaction fibreglass splint was applied in 20 degrees of flexion. Limited extension was allowed after three weeks. The pins were removed six weeks later.

The majority of patients used a Staodyne transcutaneous nerve stimulator after the operation.

RESULTS
Thirty-five patients had been treated for Type III avulsion fractures of the intercondylar eminence, and had been followed up for two to seven years. Their ages ranged from 6 to 33 years, and there was a predominance of male patients.

Table I. Treatment of the 35 Type III fractures

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Type IIIA</th>
<th>Type IIIB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduced by extension</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Reduced by arthroscopy</td>
<td>16</td>
<td>6</td>
</tr>
<tr>
<td>Reduced and pinned</td>
<td>2</td>
<td>9</td>
</tr>
<tr>
<td>Associated procedures</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Repair of lateral meniscus</td>
<td>8</td>
<td>6</td>
</tr>
<tr>
<td>Repair of medial ligaments</td>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td>Combined repair of ligaments and meniscus</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Total number of fractures</td>
<td>20</td>
<td>15</td>
</tr>
</tbody>
</table>

Treatment. Type III fractures were divided into those where the avulsed fragment was merely separated (Type IIIA) and those that were separated and rotated (Type IIIB). There were 20 Type IIIA and 15 Type IIIB. All knees with Type IIIA fractures were initially gently extended under anaesthesia and re-examined using the image intensifier. In this manner two patients were

![Figures 1-6](image-url)
satisfactorily reduced with less than two millimetres of offset (Table I). The remaining 18 patients with Type IIIA fractures and 15 of the Type IIIB fractures were reduced arthroscopically (Figs 1 to 3, 4 to 6). However, in two Type IIIA fractures and in nine Type IIIB fractures the reduction could not be maintained and these fragments were fixed by percutaneous pins (Figs 7 to 12).

Associated involvement of the lateral meniscus was demonstrated in eight Type IIIA and six Type IIIB fractures. Peripheral detachment was evident in 11 patients, while fragment rotation, osteochondral debris and interposition of the meniscus occasionally impeded reduction. Peripheral tears of the lateral meniscus were sutured to the synovium through a separate small vertical incision directly over the lesion visualised. In addition, three parrot-beak lesions of the lateral meniscus were excised by operative arthroscopy.

Ligamentous instability was evident in most patients after aspiration of the haematoma and the infusion of Marcain. There was a positive Lachman's test in 25 patients. Suspected involvement of the medial collateral ligament was demonstrated by stress radiographs in four patients with second-degree sprains and in 10 patients with third-degree sprains. The latter were associated with seven Type IIIB and three Type IIIA fractures and were primarily repaired through a separate vertical incision. Seven patients had peripherally detached lateral menisci which were repaired simultaneously through the same incision (Table I).

Twenty patients used transcutaneous nerve stimulation during their immediate postoperative recovery, decreasing their requirements of narcotic analgesics and enhancing their compliance during rehabilitation. In addition, 12 patients used a Lennox Hill brace for contact sports during the first six to nine months.

Table II: Morbidity at follow-up

<table>
<thead>
<tr>
<th>Symptoms</th>
<th>Type IIIA</th>
<th>Type IIIB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anterior instability (positive Lachman's test)</td>
<td>2*</td>
<td>3*</td>
</tr>
<tr>
<td>Medial laxity (Grade 1+)</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Effusion</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Pain</td>
<td>2</td>
<td>2*</td>
</tr>
<tr>
<td>Decreased range of movement</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Quadriiceps atrophy of greater than one centimetre</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

* One patient treated by arthroscopy alone

Follow-up. Four patients who had undergone an associated arthroscopy had knee effusions and four had pain on activity (Table II). Ligamentous instability was demonstrated in five patients by a positive Lachman's test and four patients had laxity of the medial collateral ligament (Grade 1+). Inability to extend the knee completely was evident in six patients and atrophy of the quadriceps in three, all having had associated repairs of the meniscus or the collateral ligaments.

Patients treated by arthroscopy alone or in conjunction with percutaneous pin fixation were able to return to their previous activities at 9 to 16 weeks, whereas those with associated surgical repairs of ligaments required two to six weeks longer.
Beaking of the tibial spine was evident in three patients with narrowing of the joint space, and ligamentous calcifications were present in one patient.

**DISCUSSION**

Though previously considered uncommon (Meyers and McKeever 1959, 1970; Clanton et al. 1979; Hyndman and Brown 1979; Roberts 1979), the association of injury to the medial collateral ligament with Type III fractures of the intercondylar eminence is frequent, as demonstrated in 10 of 35 patients in the present study. Evacuation of the haematoma and the taking of painless stress radiographs before operation will enable the diagnosis to be made and eliminate unnecessary morbidity.

The medial meniscus inserts anteriorly to the anterior cruciate ligament, while the lateral meniscus inserts posteriorly. In the presence of a fracture of the intercondylar eminence this relationship is distorted and may reflect the high incidence of peripheral tears of the lateral meniscus. In contrast, three parrot-beak lesions indicated compression and rotation of the lateral meniscus in its altered position by the lateral femoral condyle during the initial injury or with later weight-bearing. Although involvement of the medial meniscus was not seen in this series it does occur (Clanton et al. 1979).

Involvement of the medial collateral ligament in conjunction with the lateral meniscus occurred predominantly with Type IIIB fractures. Therefore numerous complex factors, such as bone, ligament and epiphysial relationships in the presence of compressive strain and shear forces, determine the site of ligamentous or associated meniscal involvement. A positive Lachman's test in the presence of a fracture of the intercondylar eminence is indicative of associated rupture of the medial collateral ligament, unless proven otherwise.

One should not disregard closed reduction in Type III fractures since two patients with Type IIIA fractures were successfully treated in this manner. However, manipulation should be avoided in the rotated Type IIIB fracture as it appeared to be ineffective and further damage to the fragment is likely.

Operative arthroscopy effectively decreased the morbidity and complications of arthrotomy, minimising the stay in hospital and shortening the convalescence. Removal of the percutaneous pins at six weeks was uneventful and uncomplicated. Although mild ligamentous laxity persisted in a few patients this was unassociated with symptoms of instability. Transcutaneous nerve stimulation noticeably decreased pain and the drug requirements, and exercise was more vigorous. Lennox Hill bracing provided adequate protection when desirable, preventing recurrence of the injury.

In conclusion it should be stressed that adequate physical examination, local anaesthesia and stress radiographs are essential in evaluating a patient with a fracture of the intercondylar eminence of the tibia for possible associated ligamentous injury. Operative arthroscopy provides an effective alternative to arthrotomy in the diagnosis and treatment of these fractures and the associated involvement of the lateral meniscus. A satisfactory reduction is generally uncomplicated and may be maintained with extension and a cast. However, in more complicated Type IIIB fractures percutaneous pin fixation may be necessary.

**REFERENCES**


