CORONAL FRACTURES OF THE LATERAL FEMORAL CONDYLE

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We reviewed seven patients with coronal fractures of the lateral femoral condyle and studied the mechanism of injury and the radiological features. The influence of soft tissue attachments on the displacement and the blood supply were investigated by clinical and cadaveric studies.

All three fractures which were initially undisplaced lost position early during conservative management. Internal fixation gave good results at review, and is recommended to avoid the risk of malunion and possible secondary osteoarthritis.

An isolated fracture of a femoral condyle in the coronal plane is an unusual injury and its mechanism is uncertain. Though quoted in the standard texts as the Hoffa fracture (Hoffa 1904) (Smillie 1946; Crenshaw 1971), a review of the English literature failed to reveal a detailed analysis. A Hoffa fracture may be of either condyle, but the lateral side is more commonly injured; we present seven patients with this fracture and a cadaveric study of the pathological anatomy of the different types. We postulate a mechanism of injury for this fracture.

PATIENTS AND METHODS

Seven patients aged from 17 to 47 years (average 29.5 years) were reviewed after sustaining coronal fractures of the lateral femoral condyle. Follow-up averaged 13.5 months in six of the cases (range 12 to 17 months), and was nine years in the seventh. All were men and all were in full employment at the time of injury.

Mechanism of injury. Four patients were motorcycle riders involved in collisions with motorcars. Case 3 was squatting when a car trapped his knee against a gate post, and Case 7 was the driver of a car involved in a road traffic accident. In six cases major forces were involved, and in only one (Case 6) was the fracture caused by the domestic accident of a fall down a flight of stairs.

Classification of fracture. According to the classification of Letenneur et al. (1978) three fractures were Type III, two were Type II and two Type I (Fig. 1 and Table 1). Three of the fractures were initially undisplaced but displaced within a short period with conservative management (Fig. 2). Case 7 had an associated fracture of the ipsilateral femoral shaft.

Radiography. In two of the undisplaced fractures, the injury was not readily seen in the anteroposterior view and the lateral views were inadequate, making accurate assessment of the fracture difficult. When this is the case, tomograms or CT scans of the lower femur are needed.

Treatment. Four patients with displaced fractures were treated by early open reduction and internal fixation with cancellous screws (Fig. 3). One patient was treated initially in a plaster cylinder, but loss of reduction led to operative fixation. Postoperatively, plaster was maintained for six weeks, and followed by physiotherapy to restore knee movement.

In the other two patients (Cases 4 and 7), the fracture was initially undisplaced, but position was lost during conservative management. In Case 4 displacement of a small fragment (Type IIb) occurred after three days, and this imperfect reduction was accepted. In Case 7 the patient had multiple injuries which precluded major surgery. Initial treatment was by

Fig. 1

Classification of coronal fractures of the lateral femoral condyle (Letenneur et al. 1978).
skeletal traction and within 24 hours the fracture had displaced. Because of the condition of the patient, open reduction was not done, and the fracture united in a displaced position.

**Operative technique.** Under general anaesthesia, with full muscle relaxation, the patient lies supine with the affected limb exsanguinated and supported on a thigh bolster. A standard anterior midline incision with medial parapatellar release and lateral dislocation of the patella allows direct access to the articular aspect of the fracture. Alternatively, if the fragment is small, it may be exposed by a lateral approach between the iliotibial tract and the biceps femoris tendon.

The fracture is reduced and fixed with two cancellous screws. One screw is introduced from the intact non-articular anterolateral surface of the condyle, and is directed posteromedially to engage the fractured condylar fragment. A second screw is then placed through the condylar fragment into the shaft to provide rotational stability. Where secure fixation is obtained, mobilisation is encouraged two weeks after operation. If the rigidity of fixation is in doubt, plaster immobilisation with the knee in full extension (vide infra) for six weeks is recommended.

**RESULTS**

At review, all the fractures had united both clinically and radiologically, and there had been no serious complications of internal fixation. Except for Case 7, all knees were stable in terms of the lateral collateral ligament, the cruciate ligaments and the posterolateral structures. No patient had giving way or locking of the knee, although some had intermittent pain and swelling after strenuous exercise. On a modified version of the Letenneur et al. (1978) system of functional assessment (Table II), there were two good and three fair results in the five patients treated surgically. One patient treated conservatively has a malunited small fragment, and has a fair long-term result, with considerable discomfort when the femoral condyle articulates with the tibial plateau in full flexion. His radiographs show narrowing of the posterolateral joint space. The patient treated by traction because of other injuries has malunion and a poor result.

**Cadaveric studies.** Four normal cadaveric knees were dissected, with particular attention to the soft tissue attachment of the joint capsule, the anterior cruciate and lateral ligaments, the popliteus tendon and the lateral head of the gastrocnemius. From these studies it was apparent that in Type I and Type III injury some soft tissue elements will remain attached to the fractured condylar fragment and that there will be some blood supply to this fragment. The cleavage line in Type I fractures may pass on either side of the insertions of the anterior cruciate and lateral ligaments, but both popliteus and the lateral head of the gastrocnemius remain attached to the condylar fracture. In Type III injuries the fracture line is anterior to all four attachments.

However, the Type II fracture may be completely intra-articular and leave the condylar fragment without soft tissue attachment. The continued attachment of popliteus and the lateral head of the gastrocnemius is less likely as the fracture line is more posterior in the condyle, and is least likely in Type IIc.

**DISCUSSION**

All our patients were young men, and most were involved in road traffic accidents. Four of the seven patients were injured in high velocity motorcycle accidents. The normal riding posture of the motorcyclist involves sitting with the knees flexed to just beyond 90°, and, in this position, the lateral femoral condyle is the leading part of the knee to receive an oblique or lateral impact. It seems
Table 1. Type of fracture, treatment and results

<table>
<thead>
<tr>
<th>Case</th>
<th>Type of fracture</th>
<th>Treatment</th>
<th>Follow-up (months)</th>
<th>Displacement</th>
<th>Range of movement (degrees)</th>
<th>Final outcome*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>III</td>
<td>1-Plaster 2-Internal fixation</td>
<td>15</td>
<td>None</td>
<td>0 to 95</td>
<td>Fair, stable, pain on exercise</td>
</tr>
<tr>
<td>2</td>
<td>III</td>
<td>Internal fixation</td>
<td>17</td>
<td>None</td>
<td>0 to 130</td>
<td>Good, stable, no pain</td>
</tr>
<tr>
<td>3</td>
<td>III</td>
<td>Internal fixation</td>
<td>12</td>
<td>None</td>
<td>5 to 110</td>
<td>Fair, stable, no pain</td>
</tr>
<tr>
<td>4</td>
<td>IIb</td>
<td>Plaster</td>
<td>9 years</td>
<td>Yes</td>
<td>5 to 120</td>
<td>Fair, stable, pain on walking</td>
</tr>
<tr>
<td>5</td>
<td>I</td>
<td>Internal fixation</td>
<td>13</td>
<td>None</td>
<td>0 to 125</td>
<td>Good, stable, no pain</td>
</tr>
<tr>
<td>6</td>
<td>IIc</td>
<td>Internal fixation</td>
<td>12</td>
<td>None</td>
<td>0 to 100</td>
<td>Fair, stable, no pain</td>
</tr>
<tr>
<td>7</td>
<td>I</td>
<td>Traction</td>
<td>12</td>
<td>Yes</td>
<td>10 to 85</td>
<td>Poor, lateral instability, pain, uses one stick</td>
</tr>
</tbody>
</table>

* see Table II

Table II. Method of functional assessment

<table>
<thead>
<tr>
<th>Result</th>
<th>Range of movement (degrees)</th>
<th>Instability</th>
<th>Pain</th>
<th>Walking aids</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good</td>
<td>&gt;120</td>
<td>Stable</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Fair</td>
<td>120-90</td>
<td>+/-</td>
<td>After exercise</td>
<td>None</td>
</tr>
<tr>
<td>Poor</td>
<td>&lt;90</td>
<td>+</td>
<td>Frequent</td>
<td>Required</td>
</tr>
</tbody>
</table>

Probable that direct trauma to this area, possibly with an element of abduction, results in the typical Hoffa fracture. In Case 3, a similar mechanism is likely since the patient was squatting when his knee was trapped against a gate post. The mechanism of injury in the other two cases is uncertain.

Even when the clinical features suggest a lower femoral fracture, the interpretation of radiographs can present difficulties because the fracture is obscured in the anteroposterior projection by the intact anterior part of the condyle. If it is minimally displaced, the fracture may also be difficult to define in the lateral view.

Three fractures became displaced during conservative management. This displacement may have been caused by the flexed position of the knee which was adopted. In flexion the fractured fragment lies in contact with the posterior tibial plateau and the posterior capsule is relaxed. In full extension, the posterior capsule is taut and longitudinal load is taken by the anterior intact part of the condyle. It seems that the fully extended position should be used.

Letenneur et al. (1978) reported two cases of avascular necrosis, one of which subsequently required an arthrodesis of the knee. The fact that the condylar fragment in a Type II fracture may be entirely intra-articular and without soft tissue attachments must predispose to avascular necrosis or non-union, but we did not see either complication.

These injuries tend to occur in young, fit men and the long-term social and economic consequences of malunion, non-union, and degenerative change in a major weight-bearing joint are important. Open reduction and anatomical fixation appears to reduce the risk of these complications; we advocate this method of treatment. If, however, surgical treatment is inappropriate, then the knee should be immobilised in full extension, with frequent radiographs to detect any early displacement of this unstable fracture.

We should like to thank Mrs Karen Bolt for typing the manuscript, and the staff of the Medical Illustration Departments of The Whittington and Royal Gwent Hospitals for their assistance with the illustrations. 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