HIGH TIBIAL OSTEOTOMY FOR OSTEOARTHRITIS OF THE KNEE

J. P. JACKSON, W. WAUGH and J. P. GREEN, HARLOW WOOD, ENGLAND

From the Harlow Wood Orthopaedic Hospital, near Mansfield, Nottinghamshire

Osteoarthritis of the knee is often the cause of considerable disability, and pathological studies have shown that this joint is more commonly affected by degenerative changes than any other in the body (Heine 1926). The knee consists of three compartments: the medial tibio-femoral, lateral tibio-femoral and patello-femoral. When osteoarthritic changes are present they nearly always involve one compartment predominantly (Fig. 1). This paper is concerned with the surgical management of osteoarthritis of the tibio-femoral compartments, which is often associated with valgus or varus deformity of the knee.

The deformity may be primary or secondary. The development of a secondary deformity is illustrated in radiographs of a patient with osteochondritis dissecans of the lateral femoral condyle (Fig. 2). A gradual loss of height of the articular cartilage of the lateral compartment produced a valgus deformity. The opposite deformity results from localised osteoarthritic changes in the medial compartment (Fig. 3). The loss of articular cartilage in the early stages may be seen radiographically before there is an obvious angular deformity. Osteoarthritis of the medial or lateral compartment may follow a primary lateral deformity. This is relatively uncommon but is illustrated by the radiograph of a patient with a malunited fracture of the shaft of the femur (Fig. 4).

The cause of pain in osteoarthritis is not understood. A number of factors such as capsular fibrosis (Lloyd-Roberts 1953) and venous congestion (Phillips, Bulmer, Hoyle and Davies 1967) have been suggested. The pain is often worse on standing or walking, probably because a valgus or varus deformity is increased by bearing weight. Greater pressure is exerted on the side of the knee that is mainly affected and the ligaments on the opposite side are stretched.

Surgical treatment in the past has included joint "debridement" (Magnuson 1941) and attempts at resurfacing by drilling (Pridie 1959). Arthrodesis is generally not acceptable to the patient as there is nearly always a useful range of movement. Arthroplasty is not yet
reliable and is only rarely indicated in osteoarthritis. Osteotomy of the tibia or femur has been done for many years to correct primary deformities of the knee but it has been recognised only recently for its value in the treatment of osteoarthritis (Jackson 1958). Jackson and Waugh (1961) confirmed that tibial osteotomy was successful in relieving pain. Bouillet and van Gaver (1961) discussed the indications for femoral and tibial osteotomy. Publications by Wardle (1962), Venemans (1962), Jackson and Waugh (1963), Torgerson (1965) and Coventry
(1965) have all indicated that the operation of tibial osteotomy is reliable in properly selected cases. This paper gives the results of further experience at Harlow Wood Orthopaedic Hospital.

CLINICAL MATERIAL

Sixty-three patients treated by tibial osteotomy have been reviewed. Seven patients had had the operation on both knees, making a total of seventy osteotomies. There were twenty-three men and forty women. The youngest was thirty and the oldest eighty-one years old, most being in the seventh decade (Table I). Forty-six knees had a varus deformity and twenty-four valgus. Most of the patients were seen in the second, third and fourth years after operation, the shortest follow-up being one year (Table II).

INDICATIONS FOR OPERATION

The operations were done for relief of pain from osteoarthritic of the knee not responding to conservative treatment. The osteoarthritic changes were localised to the medial or lateral compartments, and were often associated with an obvious lateral deformity. Some of the patients had a certain amount of laxity of the collateral ligaments but none of the knees was grossly unstable. A useful range of movement was present: all but five had flexion to at least 90 degrees. Fixed flexion deformity of more than 20 degrees was a contra-indication to osteotomy.

TECHNIQUE OF OPERATION

The fibula was divided first through a separate incision, a section being removed if varus deformity was to be corrected. The tibia was then divided at the level of the tuberosity by a curved osteotomy, convex upwards. This allowed the angular deformity to be corrected while preserving adequate contact and stability at the site of the osteotomy. The lateral deformity was then corrected so that the limb was straightened.

<table>
<thead>
<tr>
<th>Age at operation</th>
<th>Number of osteotomies</th>
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</thead>
<tbody>
<tr>
<td>30–39</td>
<td>1</td>
</tr>
<tr>
<td>40–49</td>
<td>5</td>
</tr>
<tr>
<td>50–59</td>
<td>14</td>
</tr>
<tr>
<td>60–69</td>
<td>38</td>
</tr>
<tr>
<td>Over 70</td>
<td>12</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Follow-up period in years</th>
<th>Number of osteotomies</th>
</tr>
</thead>
<tbody>
<tr>
<td>1–2</td>
<td>20</td>
</tr>
<tr>
<td>2–3</td>
<td>16</td>
</tr>
<tr>
<td>3–4</td>
<td>11</td>
</tr>
<tr>
<td>4–5</td>
<td>6</td>
</tr>
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<table>
<thead>
<tr>
<th>Follow-up period in years</th>
<th>Number of osteotomies</th>
</tr>
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<tbody>
<tr>
<td>5–6</td>
<td>7</td>
</tr>
<tr>
<td>6–7</td>
<td>7</td>
</tr>
<tr>
<td>7–8</td>
<td>2</td>
</tr>
<tr>
<td>Over 8</td>
<td>1</td>
</tr>
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IMMOBILISATION AND AFTER-CARE

Two methods of fixation were used. In a first group the leg was immobilised in a full length plaster. The patients were allowed to bear weight four weeks after operation and the plaster was usually removed at twelve weeks. Knee flexion exercises were then started.
In a second group the bone was held rigidly by four Steinmann nails (two proximally and two distally) fixed in a compression clamp. Plaster was not used and knee flexion was allowed. The fixation device was removed six weeks after operation and the osteotomy was usually found to be united. A plaster cylinder was applied if union was unsound and the patient allowed to bear weight. The combination of a plaster cylinder with a clamp and two nails was used in a few cases.

RESULTS

Relief of pain—Before operation all the patients had moderate or severe pain. After operation fifty knees were completely free of pain and seventeen had improved considerably. There was no improvement in three. Forty-seven patients said that the distance they could walk had increased. The results of treatment of valgus or varus deformities were similar (Table III).

<table>
<thead>
<tr>
<th>Deformity before operation</th>
<th>Number of operations</th>
<th>Complete relief of pain</th>
<th>Partial relief of pain</th>
<th>No relief of pain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Varus</td>
<td>46</td>
<td>31</td>
<td>13</td>
<td>2</td>
</tr>
<tr>
<td>Valgus</td>
<td>24</td>
<td>19</td>
<td>4</td>
<td>1</td>
</tr>
</tbody>
</table>

Recovery of movement—Patients treated by immobilisation in plaster were slower to recover the movement present before operation than those treated by compression. Three patients in the former group required manipulation under anaesthesia before regaining a useful range of movement. At the follow-up examination sixty-five knees had flexion to 90 degrees or more and the remaining five had flexion to between 70 and 90 degrees.

Correction of deformity—The most severe deformity before operation was tibio-femoral varus angulation of 30 degrees. This was present in two patients. Each had complete relief of pain following operation. Results were not related to the severity of the angulation so far as relief of pain was concerned although patients with a clinically obvious deformity were pleased with the improved appearance.

Antero-posterior radiographs taken when lying and standing may show an increase in tibio-femoral angulation on bearing weight. In twelve patients this increase of angulation was between 5 and 15 degrees before operation. All these patients were relieved of pain, indicating that some ligamentous laxity did not prejudice the result. This is related to the fact that after osteotomy the increase in angulation on bearing weight was no longer present. Standing radiographs (Figs. 5 and 6) confirm this.

Radiographic appearances—Radiographs taken before and after operation were compared. A few showed improvement such as decrease in sclerosis but in most the appearances were unaltered. However, there were none in which the osteoarthritic changes progressed after osteotomy.

COMPLICATIONS

Delayed union—Those osteotomies in which the leg was immobilised in plaster took longer to unite than those treated by compression. Union was so delayed in three patients that bone grafting was performed. Results in these three were eventually satisfactory, one patient having no pain and the other two being improved. All three patients had a range of flexion to at least a right angle.

Weakness of dorsiflexion—Weakness of one or more muscles supplied by the lateral popliteal nerve was noted in eight patients when they were examined at follow-up. Although some of
Fig. 5
The first radiograph shows an osteoarthritic knee with the patient lying down. Valgus angulation is 13 degrees. The second radiograph of the same knee with the patient bearing full weight shows valgus angulation of 22 degrees.

Fig. 6
The first radiograph is of the same knee as shown in Figure 5 four years after osteotomy. Valgus angulation with the patient lying is 9 degrees. The second radiograph shows the same knee bearing full weight. Valgus angulation remains 9 degrees.
the patients were aware of the weakness it was not sufficient to cause disability. This complication was not related to the correction of a valgus deformity. In most cases the method of immobilisation had been by compression and the fibula had been divided between five and fifteen centimetres below the tip of the styloid process.

Infection—In four patients there was superficial wound infection which caused some delay in wound healing. There were thirteen cases of infection of the nail track, usually involving the lowest nail. All healed finally.

Other complications—One patient had deep vein thrombosis in the leg operated upon and another developed deep vein thrombosis in the opposite leg. A third patient had a pulmonary embolus which was treated successfully. There was no evidence of damage to the posterior tibial vessels in any patient.

DISCUSSION

Pain from osteoarthritis of the hip is usually relieved by intertrochanteric osteotomy (Campbell and Jackson 1956, Nicoll and Holden 1961, Green 1967). Provided the hip is stable, with no tendency to extrusion of the head of the femur, osteotomy may be successful even with almost no displacement of the fragments (Nissen 1966) and factors other than alteration in the joint mechanics are likely to be significant. Pain due to osteoarthritis of the knee is relieved equally well by tibial osteotomy in which a pre-existing angulation is corrected and the joint is realigned. A possible explanation is that the line of weight-bearing is altered and pressure is transferred to the more normal side of the joint. The tendency to increase of angulation on weight-bearing with associated ligamentous stretching is diminished (Figs. 5 and 6).

Relief of pain may be due to other factors. There is some evidence that venous congestion may play a part (Helal 1965) and that tibial osteotomy acts by forming a barrier of new bone, thus lowering the venous pressure in the medulla of the tibia proximal to the osteotomy. However, in our experience the pain does not recur even when the medullary cavity reforms at the osteotomy site.

Valgus deformity is usually associated with obliquity of the joint line viewed in the antero-posterior radiograph. Bouillet and van Gaver (1961) suggested that supracondylar femoral osteotomy should be done in this type of case so that the joint line is horizontal when the patient stands. In our experience tibial osteotomy relieves the pain successfully and an oblique joint line does not affect the result.

Immobilisation after operation has been either by plaster or by compression. The advantages of compression are that rigid fixation is obtained and that knee movement can be continued while the osteotomy is uniting. Union is more rapid and the pre-operative range of knee flexion is regained earlier. In practice there have been technical difficulties. Two nails have to be placed in the proximal fragment, one in front of the other, and two more driven through the hard bone of the tibial shaft. The operation is thus made more difficult and, since the advantages of fixation do not outweigh the disadvantages, this method has been abandoned.

Tibial osteotomy is a safe and reliable procedure in properly selected patients. No subsequent operation, such as excision of the patella or arthrodesis of the knee, has been necessary in any of the patients in this series.

In a more recent series of operations the tibia has been divided above the tubercle. A hand saw is passed beneath the ligamentum patellae and a wedge of bone removed. If possible, the section should be proximal to the head of the fibula but when varus deformity is to be corrected it may be necessary to remove part of the fibula in order to close the wedge. Staples are inserted for fixation and only about six weeks of immobilisation in a plaster cylinder is necessary, the patient being allowed to bear weight after two weeks. Early results in thirty patients have been satisfactory.
The principles underlying the use of tibial osteotomy are the same whether the bone is divided above or below the tibial tubercle, but the more proximal operation is simpler and seems to have fewer complications. We hope to make a detailed comparison of the results of these two methods at a later date.

CONCLUSIONS

1. If osteoarthritis of the knee is confined mainly to one tibio-femoral compartment and the range of flexion is 90 degrees or more it can be treated safely and reliably by proximal tibial osteotomy.

2. The operation relieves pain in a large proportion of cases while retaining a useful range of knee flexion.

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REFERENCES


