High Tibial Osteotomy: Comparison of Three Different Surgical Techniques

M. S. Moukaied, N. R. Naccache, S. A. Abdulle

Of the 89 osteoarthritic knees treated by proximal tibial osteotomy at the King Khalid National Guard Hospital, Jeddah from 1983 to 1987, 54 patients (63 knees), with varus deformity were followed for at least 2 years, the average follow-up being 3.6 years. They were classified into three groups I, II and III, according to the surgical technique performed in each group. There were 12 knees in Group I where an external fixation and fibular osteotomy was used; in Group II there were 19 knees which had transverse incision, division of the capsule of the superior tibiofibular joint, a one-step staple to hold the osteotomy closed and a plaster cylinder for 6 weeks. In Group III there were 32 knees where the operation was done through a lateral vertical skin incision with a fibular osteotomy, a one-step staple and a plaster cylinder for 6 weeks. The worst results were obtained from Group I and there was no difference between the results of Groups II and III.

Osteoarthritis of the knee is a very common condition amongst the Saudi community. Pathological studies have shown that this joint is more commonly affected by degenerative changes than any other joint in the body. The principal causative and accelerating factors are abnormal stress produced by biomechanical alteration.

We believe that the causes of the high incidence of this condition in the Middle East are multifactorial. Traditions and habits play a prime role namely the squatting position at rest and in the Arab toilet. Most of the sufferers are still in their active years, therefore a tibial osteotomy is a treatment to relieve their pain.1

The first report published about tibial osteotomy2 was by Jackson in 1958. Subsequently different techniques have been published. The purpose of this paper is to assess our results after high tibial osteotomy comparing three different surgical techniques for the treatment of osteoarthritis of the knee.

Material and Methods
At the King Khalid Hospital between January 1983 and December 1987 89 patients (102 knees) had a unilateral or bilateral tibial osteotomy because of osteoarthritis.
The indications for surgery were disabling pain and deformity. During 1989 the files of all these patients were reviewed and 54 patients (63 knees) were found to have regular follow-up. They were classified into three groups, I, II and III, according to the surgical technique performed in each group. The remaining 35 patients failed to attend for more than 1 year and were excluded from the study.

Before operation, all patients had standing postero-anterior radiographs, the mechanical and anatomical axis drawn and the size of wedge resection calculated. Normally the mechanical axis of the lower extremity (the line joining the centre of the femoral head with the centre of the ankle joint) passes through the centre of the knee joint (Fig. 1). The force transmitted through the compartment towards which the mechanical axis is displaced is markedly increased. The osteotomy was designed to shift the load to the compartment in which there was less osteoarthritic involvement; thereafter the mechanical axis would return to the centre of the knee joint.

In Group I there were 12 patients (12 knees), eight females and four males. Six operations were performed on the right side and six on the left. The average age of the patients was 53 years (range 45–61). Seven knees had a combined procedure i.e. patelloplasty and tibial osteotomy. The operation was carried out through a lateral skin incision. The knee joint was opened in the combined procedure only. The lateral wedge was resected proximal to the tibial tubercle, the tethering effect of the fibula was eliminated by a fibular osteotomy through a separate skin incision and the osteotomy was held closed using two Steinmann’s pins and a Charnley’s clamp.

Active knee exercises were started on the first postoperative day and full weight bearing mobilization after 7 days. The external fixator was usually removed after 6 weeks.

In Group II there were 17 patients (19 knees), nine female and eight male. Twelve operations were carried out on the right side and seven on the left. The average age of the patients was 60 years (range 45–70). The operation was performed using a transverse incision at the level of the tibial tubercle, and the lateral popliteal nerve was identified and safeguarded. The patellar tendon was separated from the underlying fat, the muscle on both sides was retracted distally with the periosteum and the level of the osteotomy identified by using Steinmann’s...
pins and an image intensifier. The wedge of bone was removed with a reciprocating saw and osteotomes. The tethering effect of the fibula was eliminated by dividing the capsule of the proximal tibiofibular joint. The osteotomy was held closed by a one-step staple, a plaster cylinder was applied for 6 weeks or until the osteotomy was united (Fig. 2) and the patient usually started on mobilization with full weight bearing 2–4 days after surgery.

In Group III there were 25 patients (32 knees), 12 female and 13 male; 14 operations were performed on the right side and 18 on the left. The average age was 55 years (range 45–70).

The operation was carried out through a lateral skin incision, the bony wedge was resected and the bone ends held with a one-step staple; also a mid-shaft fibular osteotomy through a separate incision was performed. A plaster cylinder was applied for 6 weeks (Fig. 3). Mobilization with full weight bearing was usually started on the second postoperative day.

Results
The results of each group were evaluated with the rating system described by Coventry:

Good
1. when all or most of the pain was relieved;
2. at least 90 degrees flexion was achieved;
3. patient had returned to full work status.

Fair
1. patient still complaining of some mild pain;
2. flexion less than 90 degrees;
3. mild instability requiring the use of one cane;
4. returned to work with less pain than before surgery.

Poor
1. pain was not relieved;
2. severe stiffness;
3. grossly unstable knee.

Group I: (Table 1)
Five patients had severe pain and seven had moderate pain preoperatively. Seven patients had a combined procedure (high tibial osteotomy and patellectomy). According to Coventry's rating system the results were good in two; of whom one patient had a combined procedure. Fair results were obtained in eight; four of whom had combined procedures. Two had poor results; one of them had a combined procedure; both of these patients had a total arthroplasty after 2 years.

Two patients could not tolerate the external fixator so it was removed from the first patient after 3 weeks. Plaster was applied for another 5 weeks due to delayed union. The knee was manipulated 4 weeks after removal of plaster under general anaesthetic, because of stiffness. Following manipulation the knee progressed to a full range of movement. The external fixator was removed from the second patient after 1 week. Plaster was applied for a total of 6 weeks and the knee was then mobilized.

Group II: (Table 2)
Eight patients had severe pain and 11 had moderate pain before operation. The results were good in 12, fair in six,

Figure 2. A patient from Group II. Upper: before operation; Lower: after operation.
Table 1
Pain assessment in Group I

<table>
<thead>
<tr>
<th></th>
<th>Total</th>
<th>Good</th>
<th>Fair</th>
<th>Poor</th>
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<tbody>
<tr>
<td>Pain before</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>operation</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Severe</td>
<td>5</td>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Moderate</td>
<td>7</td>
<td>1</td>
<td>6</td>
<td>-</td>
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<tr>
<td>Total</td>
<td>12</td>
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<td>8</td>
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Table 2
Pain assessment in Group II

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<th></th>
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<tbody>
<tr>
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<tr>
<td>operation</td>
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</tr>
<tr>
<td>Severe</td>
<td>8</td>
<td>3</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Moderate</td>
<td>11</td>
<td>9</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td>19</td>
<td>12</td>
<td>6</td>
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and poor in one, this last patient had a total arthroplasty 2 years later. Four patients had removal of their staples and one patient deteriorated rapidly after 3 years; he was put on the waiting list for a total arthroplasty.

Group III (Table 3)
Seven patients (nine knees) had severe pain and 18 patients (23 knees) had moderate pain preoperatively. The results were good in 20, fair in 11 and poor in one. Four patients had removal of their staples and two patients had a patelloplasty later on.

Complications
Group I had the highest number of complications. Four patients developed pin tract infections, which were treated with antibiotics. One patient who had a combined procedure developed septic arthritis which was treated successfully with surgical drainage, continuous irrigation for 1 week and antibiotics. One patient had non-union of the fibula. Two patients could not tolerate the external fixator which had to be removed, two patients had fractures of their tibial plateaux, and in five patients the pin had cut through, (two happened during surgery; therefore the procedure was abandoned and plaster was applied, these two patients were excluded from the study).

In Group II there were two cases of delayed union, so the plaster was kept on for 8 and 10 weeks respectively.
In Group III there were five cases of delayed union; in four cases the plaster was removed after 8 weeks and in one patient it was removed after 11 weeks. Two patients developed foot drop due to transient lateral popliteal nerve palsy. Both recovered after 6 months.

Table 3
Pain assessment in Group III

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<th>Poor</th>
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<tr>
<td>operation</td>
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<tr>
<td>Severe</td>
<td>9</td>
<td>2</td>
<td>7</td>
<td>-</td>
</tr>
<tr>
<td>Moderate</td>
<td>23</td>
<td>18</td>
<td>4</td>
<td>1</td>
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<tr>
<td>Total</td>
<td>32</td>
<td>20</td>
<td>11</td>
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Figure 3. A patient from Group III. Upper: before operation; Lower: after operation.
High Tibial Osteotomy

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<td>Duration of hospitalization</td>
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<tr>
<td>Weeks</td>
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<tr>
<td>No. of patients</td>
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<tr>
<td>Group I</td>
</tr>
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<td>Group II</td>
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<td>Group III</td>
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Discussion
High tibial osteotomy is an operation of proved value for relieving pain, restoring stability and improving function in the osteoarthritic knees.\(^5,6\)

In 1958, Jackson\(^2\) first reported on the use of tibial osteotomy in the treatment of pain due to osteoarthritis of the knee joint. Efforts have been made to simplify the operative technique in order to achieve optimum results. Subsequently different osteotomy techniques have been published.

Percutaneous skeletal fixation with pins was first recommended by Gariepy\(^7\) and later by Devas.\(^8\)

Internal fixation with staples was advocated by Coventry\(^9\) in 1965.

The tethering effect of the fibula can be eliminated either by osteotomizing the shaft of the fibula,\(^2\) excising the head of the fibula,\(^7\) or by dividing the capsule of the superior tibiofibular joint.\(^10\)

In our series three different techniques were used. The worst results were in Group I, because the complications from using pins were very frequent. Also, fractures of the tibial plafaux, especially common in osteoporotic bones, occurred. Pins tended to cut through, and a high incidence of infection occurred. The major disadvantage in using percutaneous pins in our series was the length of stay in the hospital. The average stay for Group I was 5.5 weeks, for Group II 2.2 weeks and for Group III 2.75 weeks (Table 4). Therefore, the technique used for Group I was abandoned. The results obtained from Group II and III were similar to each other.

The incision and the release of the tethering effect of the fibula did not influence the follow-up results. Recently we have modified our technique and we have discontinued the use of staples for internal fixation to avoid the patient undergoing further surgery.

Acknowledgements
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References