

CURRENT PROBLEM CASE

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Low tibial osteotomy for moderate ankle arthritis

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Abstract Low tibial osteotomy is one of the significant advances of ankle reconstruction techniques that has been made recently in an effort to halt arthritis in its early stages and leave fusion as the last, not the only, alternative treatment of ankle arthritis. From 1989 to 1995, we performed 18 low tibial osteotomies which included 6 cases of post-traumatic arthritis and 12 cases of degenerative arthritis. The ages of the 7 male and 11 female patients ranged from 18 to 78 years with an average of 41.9 years. The follow-up period lasted a mean of 47.7 months, ranging from 25 to 82 months. The average functional score changed from 49.6 pre-operatively to 88.5 at the last follow up, and showed yearly improvement. Complications included one case of late infection and two cases of implant failure, none of which led to nonunion. The indication for low tibial osteotomy is the intermediate stage of moderate ankle arthritis with a medial joint lesion and intact lateral facet. Using pressure redistribution on the joint surface, this procedure is an alternative treatment for ankle arthritis which may save an arthritic ankle from the fate of fusion or at least postpone fusion surgery.

Keywords Ankle arthritis · Corrective osteotomy

Introduction

In the lower extremities, pressure concentration on the joint surface will induce cartilage wear and joint deformity, which will concentrate the pressure even more, producing a vicious cycle and progression of the arthritis

[13]. Although replacement arthroplasty or arthrodesis may be required for the advanced stage of ankle arthritis, the management of the intermediate stage is controversial. One method of intermediate stage treatment is low tibial osteotomy, which has been developed since the 1980's [5, 14]. It is an aggressive method that tries to halt ankle arthritis and save it from fusion by changing the tibiotalar angle and redistributing the pressure for restoration of the joint space. Herein we report our experience with cases with 2 or more years of follow-up.

Materials and methods

We classified the ankle arthritis on weight-bearing radiographs using a modified Cedell's classification (Table 1) [2]. Degree 1 was considered mild, degrees 2 and 3 moderate, and degree 4 severe arthritis. We chose the cases according to our protocol of management and treatment for ankle arthritis (Fig. 1). The candidates for low tibial osteotomy have moderate arthritis (degree 2 or 3) with only the medial joint involved. From 1989 to 1995, 18 patients (7 men and 11 women) underwent a low tibial osteotomy. They ranged in age from 18 to 78 years with an average of 41.9 years.

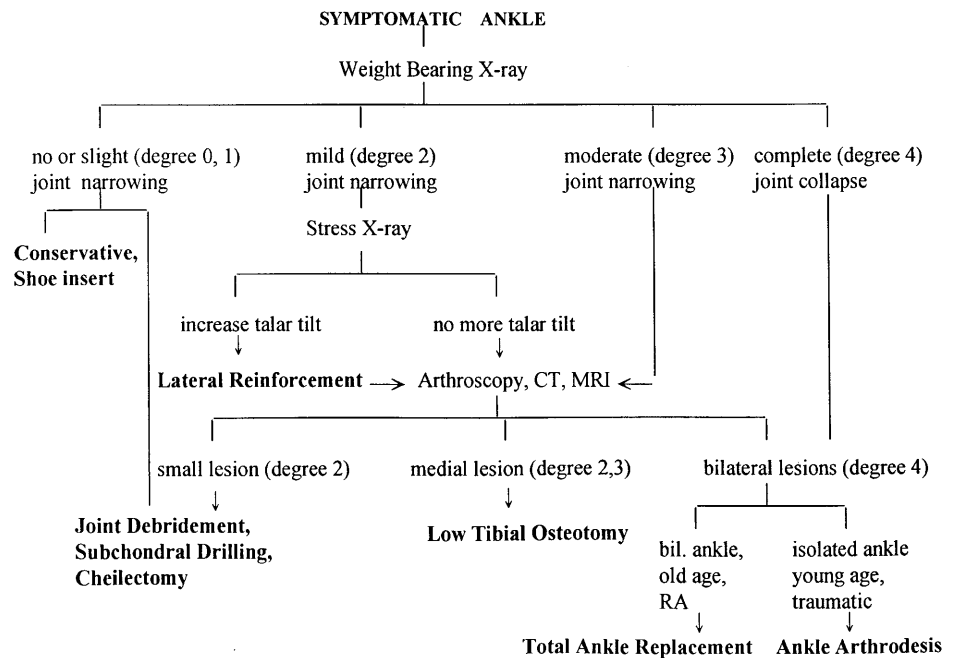
Table 1 Classification of arthritis on weight-bearing radiographs

Degree	Roentgenographic changes
0	No reduction of the joint space Normal alignment
1	Slight reduction of the joint space Slight formation of deposits at the joint margins Normal alignment
2	More pronounced change than mentioned above Subchondral osseous sclerotic configuration Mild malalignment
3	Joint space reduced to about half the height of the uninjured side Rather pronounced formation of deposits Obvious varus or valgus alignment
4	The joint space has completely or practically disappeared

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Fig. 1 Protocol for the management of ankle arthritis according to the degree of arthritic change



The causes of the disability were post-traumatic arthritis in 6 and degenerative arthritis in 12. All patients had symptoms of arthritis like pain on walking and motion limitation, and a weight-bearing radiograph showed narrowing of the medial joint space, which leads to varus deformities. Arthroscopy performed on 6 patients before the osteotomy proved that the lateral surface cartilage was still preserved.

Valgus and anterior open-wedge osteotomy of the tibia was done 5 cm proximal from the tip of the medial malleolus after oblique osteotomy of the fibula. We tried to correct both the anteroposterior and lateral radiographic tibio-ankle surface angle (\angle TAS) to the ideal normal values, which are $87.8 \pm 3.0^\circ$ and $81.1 \pm 2.2^\circ$, respectively. The osteotomy was then fixed by AO plate and screws, and cancellous bone autograft was used to fill the opened space (Fig. 2). A short leg cast was applied after surgery and removed 6–8 weeks postoperatively if the follow-up X-ray showed callus formation. Full weight-bearing was allowed in only those cases with solid union.

During the follow-up, standing radiographs were used to measure the corrected angle and to evaluate the condition of arthritic change. A rating scale [3], including 50 points for pain, 40 points for function, and 10 points for motion, was employed to evaluate the functional results, excellent being 85–100 points, good 70–84 points, fair 45–69 points, and poor 0–45 points.

Results

The 18 patients were followed for an average of 47.7 months (ranging from 25 to 82 months). There was one late infection 4 months after surgery, but since the osteotomy had united, removal of the implants and local wound care cured the infection. There were two cases of delayed union with implant failure. A salvage operation of revisional osteotomy was done, and eventually these two patients also obtained good clinical results (Fig. 3).

The tibio-ankle surface angle (\angle TAS) measured on the anteroposterior radiograph changed from an average of 81° (range 75° – 86°) preoperatively to an average of 90° (range 89° – 93°) at follow-up, and on the lateral view, it changed from an average of 79° (range 77° – 82°) preoper-

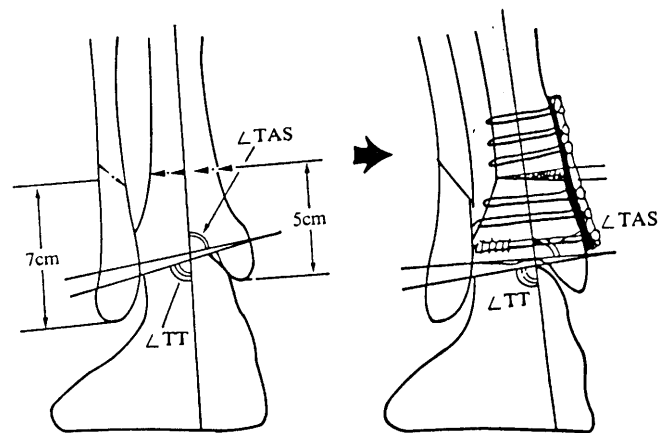


Fig. 2 Open wedge osteotomy done at the distal tibia to correct the tibio-ankle surface angle (\angle TAS) from varus to valgus

atively to an average of 82° (range 80° – 87°) on follow-up. According to the functional scale evaluation, all patients showed dramatic improvement. Pain relief improved from a preoperative average of 24.4 (range 0–45) to 47.5 (range 45–50), function improved from a preoperative average of 20.4 (range 3–35) to 32.9 (range 24–38), and the score of ankle motion also improved from a preoperative average of 4.8 (range 0–6) to 8.1 (range 4–10). The total score improved from a preoperative average of 49.6 to a follow-up average of 88.5. Ten patients (55.5%) enjoyed good and 8 (44.5%) excellent results at the time of the final follow-up.

Three patients underwent arthroscopy when remove the implants, and thus the results could be compared with their preoperative arthroscopy. All showed improvement of the chondromalacia from grade 3 or 4 to grade 1 or 2 according to Outerbridges' classification [11]. On the

Fig. 3 A–C A 60-year-old female patient suffered from degenerative arthritis of the right ankle. **A** Preoperative standing X-ray; **B** after the initial operation when implant failure was noted; **C** revisional osteotomy and the result

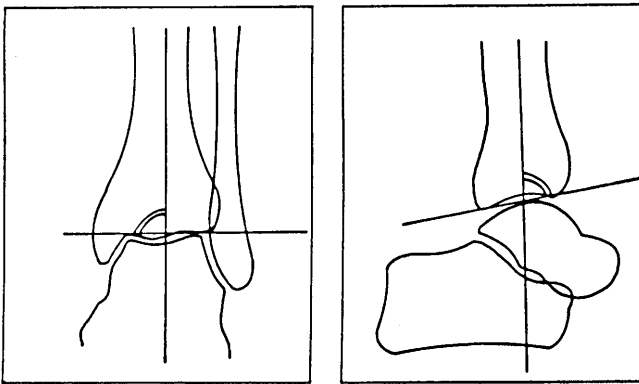
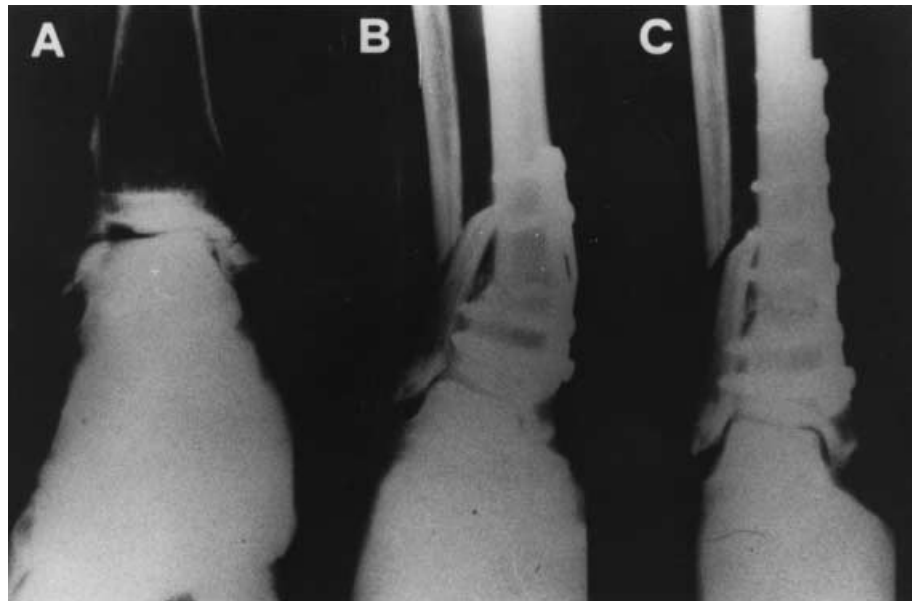


Fig. 4 The tibia-ankle surface angle (\angle TAS). *Left*: anterior-posterior view and normal anteroposterior \angle TAS = $87.8^\circ \pm 3.0^\circ$; *right*: lateral view and normal lateral \angle TAS = $81.1^\circ \pm 2.2^\circ$

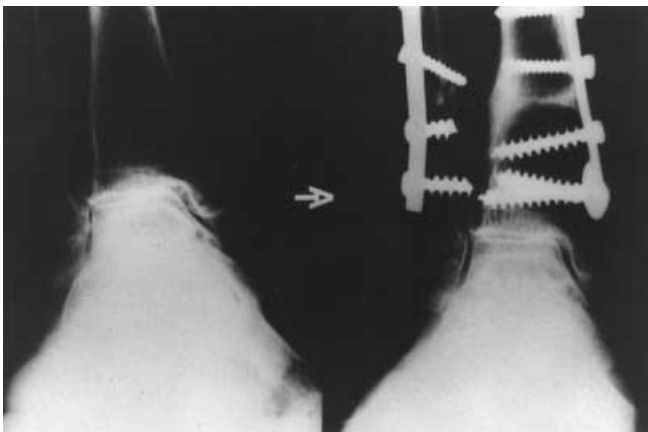


Fig. 5 A case of moderate degenerative arthritis treated by low tibial osteotomy with a good functional result

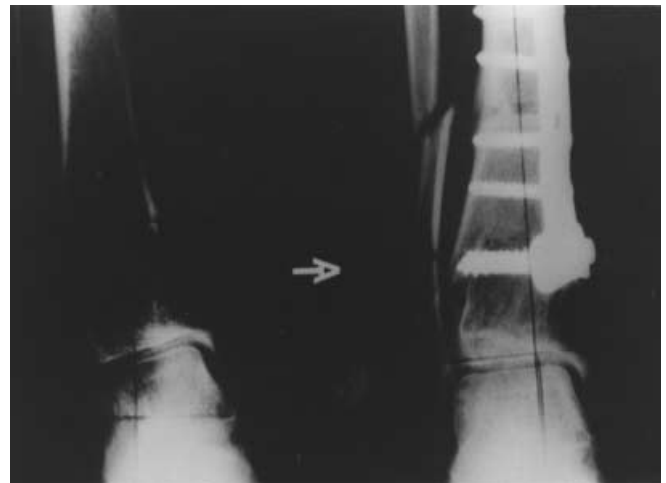


Fig. 6 A case of post-traumatic arthritis after ankle fracture treated by low tibial osteotomy with an excellent functional result

postoperative radiographs, all patients showed medial joint space opening which gradually increased during follow-up. Finally, there was no indication of advanced arthritis.

Discussion

Since the two treatment methods for late-stage ankle arthritis (ankle arthrodesis and ankle replacement) are not completely satisfactory [1, 4, 9, 12], the treatment of ankle arthritis should aim to halt arthritis in its earlier stages. It is well-known that uneven pressure on the articular surface of lower extremities has a close relationship to the degeneration of cartilage which may induce arthritis and deform the joints [13]. Weight-bearing pressure redistribution by variable osteotomy has been used to treat arthritis based on this theory, and high tibial osteotomy for

varus deformity with medial compartment arthritis of the knee is a well-known and well-accepted surgical procedure. According to an experimental study on a cadaver model [15], angulation at the distal tibia is most likely to change the weight-bearing area of the ankle, and valgus angulation will cause a lateral shift of this surface. The aim of low tibial osteotomy is to produce joint pressure redistribution by changing the tibia-ankle surface angle (\angle TAS). The normal anteroposterior \angle TAS is $93.3^\circ \pm 3.2^\circ$ according to Inman's data [8], but it is $87.7^\circ \pm 3.0^\circ$ according to Mozi [10], whose data was obtained from Oriental people (Fig. 4). Thus, the aim of our corrective angle was 90° – 93° , as too much overcorrection is not recommended. As for the lateral \angle TAS, Mozi's data showed that $81.1^\circ \pm 2.2^\circ$ was normal. Therefore, we aimed for a recommended angle of 83° , and an angle less than 80° should be avoided.

Degenerative arthritis of the ankle is rare, and ankle arthritis is usually secondary to trauma such as fracture or ligamentous injury [6, 7]. Treating degenerative arthritis of the ankle by low tibial osteotomy has been reported to have 83.3% excellent and good results [14]. Our preliminary reports [3] and this advanced series both have comparable outcomes and show that low tibial osteotomy is effective for both degenerative (Fig. 5) and traumatic arthritis (Fig. 6). However, for rheumatoid and infective arthritis, this procedure is contraindicated due to their tendency toward pan-articular involvement and progressive joint deformity.

It took 1 year after low tibial osteotomy before the radiographic evidence showed that the joint space had widened enough to demonstrate regeneration of the arthritic ankle, and since then, improvement seems to continue year by year. We do not know how long this satisfactory result will last, or if it may be degraded eventually just like high tibial osteotomy for the arthritic knee. However, this current follow-up demonstrates the potential value of low tibial osteotomy.

While arthrodesis remains the most highly recommended method for the treatment of ankle arthritis, it should be the last alternative if ankle arthritis is detected

during less severe stages. Our clinical results have shown that low tibial osteotomy can improve the pain, function, and motion so much that arthrodesis may be avoided.

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