A brief report on managing infected nonunion of a high tibial osteotomy in two stages

A CASE SERIES INVOLVING SEVEN KNEES

The management of nonunion following high tibial osteotomy by total knee replacement (TKR) has been reported previously. We have extended the treatment to embrace cases with an infected high tibial osteotomy by performing an initial debridement with a period of antibiotic treatment followed by TKR. We have reviewed the results of seven knees in six patients with a mean follow-up of 40.5 months (20 to 57) after the staged TKR. At the latest follow-up, all the pseudarthroses had healed and there had been no recurrence of infection. The mean Hospital for Special Surgery knee score improved from 51.2 (35 to 73) to a mean of 91.7 (84 to 98) at final review.

Management of nonunion following high tibial osteotomy with a TKR can be extended to infected cases when treated in two stages with a debridement and antibiotic therapy prior to TKR.

Nonunion and infection are rare complications following high tibial osteotomy (HTO) for medial compartment osteoarthritis. This may account for the limited literature on the management of this difficult problem. External and internal fixation with simultaneous bone grafting have been reported in treating this complication.

We have identified only eight cases in the literature of nonunion of an HTO treated by total knee replacement (TKR). However, none of these cases was infected. Our aim in this paper is to present our experience in treating infected nonunions following HTO.

Patients and Methods

Our study comprises a consecutive series between 2005 and 2008 of seven knees in six patients involving four women and two men with a mean age of 60.8 years (50 to 76) at the time of the reconstruction.

All the patients presented with pain and joint stiffness and required crutches to walk. In all cases the HTO had been performed elsewhere. Plain radiographs showed a pseudarthrosis with a mean duration since osteotomy of 22.4 months (9 to 36) and degenerative changes involving the medial and lateral compartments of the knee (Fig. 1). The ESR and CRP were elevated in all patients. Of the patients, two were obese and a third patient had diabetes.

They were treated by a two-stage procedure. Firstly, an extensive debridement with removal of the hardware and infected tissues was performed and cultures were taken. Care was taken not to open the joint and an antibiotic-loaded spacer was not needed in any patient, nor was a fibular osteotomy required to achieve alignment at revision in any case. After debridement the knee was stabilised in a thermoplastic splint in extension so that the patients could mobilise with crutches and complete antibiotic treatment as determined by the microbiology results as an outpatient. They were routinely monitored with monthly ESR and CRP measurements. Once these had returned to normal levels for a period of one month, TKR was undertaken using a long-stemmed tibial component with a posterior cruciate sacrificing femoral prosthesis (NexGen LPS; Zimmer, Warsaw, Indiana) (Fig. 2). All patients had poor flexion prior to the TKR and fixed inserts were used.

After TKR, all patients were allowed to bear as much weight as they could tolerate. Physiotherapy was started on the first post-operative day, with patients allowed to bear weight as tolerated. All patients received standard treatment, including continuous passive motion, active-assisted and active range of movement exercises, isometric and isotonic strengthening exercises and gait training. They were reviewed at two, four, six, 12, 26 and 52 weeks.

The Hospital for Special Surgery (HSS) knee score was recorded pre-operatively and at
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final follow-up. This is based on a total of 100 points with the score divided into seven categories: pain, function, range of motion, muscle strength, flexion deformity, instability, and subtractions. Scores between 85 and 100 points are considered excellent results; between 70 and 84 good; between 60 and 69 fair and \( \leq 60 \) are considered poor results.

Results
Positive cultures were obtained from the deep-tissues in all patients. These comprised coagulase-negative \textit{Staphylococcus} in three patients and \textit{Actinomyces}, \textit{Enterococcus} and \textit{Streptococcus epidermidis} each in the others, the last being the patient with bilateral ununited osteotomies. The demographic information of the patients is shown in Table I.

The mean time between the debridement and TKR was 3.1 months (1.5 to 9), and the mean follow-up was 40.5 months (20 to 57). All patients had radiological evidence of callus formation at the end of three months. The mean pre-operative HSS score of 51.2 (35 to 73) improved to a mean of 91.7 (84 to 98) at the latest follow-up. The mean pre-operative knee flexion was 83.0° (70 to 104), which improved to a mean of 120.7° (110° to 135°). The mean pre-operative loss of knee extension was 8.3° (-5° to -15°) and this was decreased to a mean loss of 0.7° (0° to 5°) at the latest follow-up.

None of the patients required revision or showed clinical or radiological signs of loosening or infection. All patients showed radiological union of the osteotomy at three months post-operatively.

Discussion
Nonunion is a rare complication of HTO with reports ranging from 0.7% to 5%,\textsuperscript{12,13} but without specific mention of infected pseudarthrosis.

Although nonunion after HTO may be treated by internal or external fixation,\textsuperscript{4,5} the choice in our cases was limited due to deep infection. Internal fixation after debridement was considered inappropriate because of the high risk of recurrence of the infection.\textsuperscript{14} External fixation in general is considered the most appropriate treatment for infected nonunions,\textsuperscript{14} but during removal of the implant and debridement we observed that the proximal tibia was osteopenic and fragmented. This would have made external fixation

| Table I. The demographic details of the patients |
|------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Patient | Age (yrs) | Gender | Level of osteotomy | Pseudarthrosis duration (mths) | Side | Follow-up (mths) | Isolated bacteria |
| 1       | 56       | F      | Metaphyseal       | 9.5                         | L    | 44              | CNS*             |
| 2       | 76       | F      | Metaphyseal       | 30                         | R    | 44              | Actinomyces      |
| 3       | 61       | M      | Metaphyseal       | 24                         | L    | 57              | Enterococcus    |
| 4       | 67       | F      | Diaphyseal        | 9                          | R    | 40              | CNS             |
| 5       | 55       | F      | Diaphyseal        | 24                         | R    | 38              | Streptococcus epidermidis |
| 6       | 50       | M      | Metaphyseal       | 36                         | R    | 20              | CNS             |

* CNS, coagulase-negative \textit{Staphylococcus}
technically difficult and of questionable value in the presence of an arthritic knee. Accordingly consideration was given to replacing the knee with a ‘tumour’-type prosthesis with the resection of the proximal tibia" and with a conventional TKR with a stemmed tibial component.4,7,8 We used a conventional stemmed TKR as described previously,9 recognising the need for an implant which would be durable but also offer the opportunity for an uncomplicated revision should further surgery be required.9

The use of a primary stemmed TKR has also been described in treating peri-articular fractures of both the femur and the tibia in the presence of arthritis of the knee.15,16

Our post-operative rehabilitation regimen is similar to that described by Gandhi et al7 with patients allowed to walk fully weight-bearing immediately after operation.

Our experience in treating seven infected nonunions following HTO by a two-stage procedure suggests that TKR is a reliable method of treatment for this complication once the infection has been eliminated following the first stage.

Supplementary material
A table showing the results of individual patients is available with the electronic version of this article on our website at www.jbjs.org.uk

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


