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KNEE REVISION SURGERY

Tibial tubercle osteotomy in septic revision total knee arthroplasty

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Abstract
Purpose The incidence of revision knee arthroplasty for infection is increasing and the required surgical approach for the revision is a challenge for surgeons. Extensile approaches are frequently used when it is impossible to evert the extensor mechanism. The aim of this paper is to report our experience with tibial tubercle osteotomy (TTO) and the functional results in patients who underwent a two-stage revision due to prosthesis infection.
Methods Twenty-six patients underwent a TTO as a surgical approach in the second stage of revision for infection. The patients were clinically assessed by means of functional scales (the Knee Society Score and WOMAC) and X-rays.
Results The TTO healed without complications in 22 patients (84.6 %) and the average length of follow-up was 3.4 years. Non-union was observed in two patients. One patient presented an extension lag of 5°. A total of 23 patients (88.4 %) were free from infection. Twenty-five patients (96.1 %) had better scores on the Knee Society Score and WOMAC after the procedure.
Conclusions In patients undergoing the second stage of revision total knee arthroplasty for infection, the TTO approach provides a large operating field. This enables surgeons to withdraw spacers and position new implants without damaging the extensor mechanism of the knee or altering the postoperative rehabilitation process. The complications that have been reported as a result of this procedure could be reduced by performing a meticulous surgical technique.
Level of evidence Retrospective case series, Level IV.

Keywords Septic · Revision · Osteotomy · Tibial tubercle

Introduction

The incidence of revision knee arthroplasty for infection is increasing every year [1]. The surgical approach to be used in this procedure is a challenge for the surgeon; the knee in some cases has a limited mobility, quadriceps contracture or patella baja. As a result, the eversion of the patella is difficult, and could lead to rupture or disinsertion of the patellar tendon, which has a severe impact on the function of the extensor mechanism of the knee. Extensile approaches to revision knee arthroplasty are frequently applied when the extensor mechanism cannot be everted. The reported techniques are the rectus snip, Coonse Adams release, the quadriceps turndown and tibial tubercle osteotomy (TTO), which allows for good exposure without damaging the knee extensor mechanism [2–4].

Since it was first described by Dolin in the 1980s [5], TTO has been used as an alternative surgical approach for revision knee arthroplasty. In the literature, the results obtained with this technique support its use. For example, Whiteside described no major complications in a series of 136 patients [3]. Mendes et al. reported that TTO was particularly effective in patients who required a two-stage revision of infected total knee arthroplasty [6].

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The aim of this paper is to report our experience with TTO and the functional results in patients who underwent a two-stage revision for prosthesis infection.

Materials and methods

Demographic data

We carried out a retrospective study of a prospective database that contained information on 26 patients. All of the patients had undergone a TTO as a surgical approach in the second stage of a revision for infection. The surgeries were from January 2003 to July 2007. The average age at the time of surgery was 73 (range 64–88 years); 14 patients were women and 12 were men. The average body mass index was 29.8 (range 24–37). The average number of previous operations on the knee was 2.2 (range 2–4 operations). The infecting microorganism was known in 24 patients (92.3 %) in 18 cases (69 %) it was *Staphylococcus* spp. An antibiotic-loaded dynamic cement spacer (Spacer-K®, Tecres SpA, Verona, Italy) was inserted in all patients between the first and second stages of surgery. The average duration of antibiotic treatment in this period was 67 days (range 23–240 days). After normalisation of C-reactive protein, the second stage was undertaken. On average, there were 133 days between the two operations (range 40–291).

Before the revision, the patients were evaluated clinically using functional scales (the Knee Society Score (KSS) [7] and WOMAC [8]) and X-rays. In the postoperative period, follow-up was carried out at 2 weeks, 6 weeks, 3 months, 6 months and then annually. During the follow-up, information was gathered on any complications that had arisen and on the range of movement, with particular emphasis on assessing the extension lag. The knee X-rays that were included in the evaluations were anteroposterior with support, lateral with no support and axial. We assessed the presence of non-union or displacement of over 5 mm at the osteotomy site, the integrity of the fixation system, and the presence of fractures in the tibial metaphysis and the patellar alignment. Functional analyses using the KSS and WOMAC scales were undertaken in the annual follow-ups.

Surgical technique

All of the operations were undertaken by the surgeons JM and JS. A medial parapatellar arthrotomy was performed on all patients. It extended distally 10 cm from the tibial tubercle and proximally 6 cm above the medial patella to the quadriceps tendon. The decision to use a TTO for exposure was made intraoperatively if the patella could not be retracted with the knee at 90° of flexion without risking patellar tendon avulsion. The osteotomy was carried out with an oscillating saw, as described by Whiteside and Ohl [12]. With a curved osteotome, the tubercle and the tibial crest were separated, whilst the periosteum, the crural fascia and the musculature on the lateral face of the tibia were left intact. The osteotomy was 1.5–2 cm deep at the level of the tibial tubercle. Its width varied according to the size of the tibia, but usually ranged 2–3 cm at the level of the tibial tubercle as shown in Fig. 1. When required, the osteotomy was used to remove intramedullary cement from the tibia.

Fig. 1 The photograph shows the tibial tubercle osteotomy during surgery

In 24 patients, the surgeons implanted a Profix (Smith and Nephew, Memphis, USA) cemented replacement prothesis with modular femoral and tibial stems. The tibial component was 100 mm long, and positioned below the osteotomy. Two patients were operated with an Endo-Model rotating hinge prostheses (Waldemar Link GmbH & Co) primary titanium prosthesis, one patient was allergic to nickel and the other had a valgus deformity of over 20°. In 13 patients, the lateral capsule needed to be released laterally to improve the alignment of the patella. Osteosynthesis was performed at the end of the procedure with two number 18-gauge monofilament stainless steel wires, which were passed over the tibial tubercle and the medial tibial cortex, tightened and concealed in the medial face of

the tibia. In one case, Ethibond sutures were used instead of wire, as the patient was allergic to nickel. In 20 cases, the osteotomy segment was placed in its anatomical position. In four cases it was reduced by 1–2 cm proximally, as patella baja had been detected preoperatively. In two cases, it was reduced medially to improve the alignment of the patella.

The postoperative rehabilitation was the same as that used in the centre for primary total knee arthroplasty. Patients received a femoral nerve block in the first 48 h of surgery. Passive mobility was recovered on the day after surgery with gradual increases in flexion until the patient was discharged. Ambulation began the second day after surgery. Home rehabilitation was provided for 30 days after discharge. All patients received antithrombotic therapy for 3 weeks.

Results

The average length of the follow-up period was 3.4 years (range 2.4–6.1 years). One patient died 30 months after surgery for reasons unrelated to the intervention. In this case, the patient's last annual visit was taken into account for the evaluation. The average preoperative KSS knee score for the 26 patients was 59 (SD 9.8) and the average KSS function score was 51 (SD 23.4). The averages at the last follow-up were 78 (SD 15.5) and 70 (SD 16.6), respectively. The average scores on the WOMAC index were 55 (SD 29.5) preoperatively and 88 (SD 13.2) at the last follow-up. One patient had worse results postoperatively, due to a functional disorder that was not related to the osteotomy.

The average preoperative flexion was 90° (range 60–100), whilst the average flexion at the last postoperative follow-up was 95° (range 60–110). All patients showed better flexion of the knee in the follow-up than in the preoperative evaluation. One patient (3.8 %) had a 5° extension lag that had not been present preoperatively. None of the patients who had undergone an intentional proximal osteosynthesis for patella baja had an extension lag. None of the patients underwent manipulation under anesthesia or arthrolysis for an extension lag.

At follow-up, 23 patients (88.4 %) were free from infection. Three patients had infections in the postoperative period and two patients (7.6 %) required surgical debridement after the second phase, as well as antibiotic therapy until normalisation of C reactive protein (6 months). Suppressive antibiotic therapy was begun in one patient (3.8 %), due to comorbidity and medical conditions.

In 22 patients (84.6 %), the osteotomy had healed with no complications by the 3- or 6-month follow-up visits. In 12 patients, osteotomies had healed by the 3-month visit and in 10 patients it had healed by the 6-month visit (Fig. 2). Four patients had minor complications: two patients (7.6 %) presented a stable non-union that did not affect function; one patient had a transverse fracture of the tibial tuberosity at the level of the upper cerclage, with correct healing of the osteotomy in the X-rays taken at the 6 month follow up; and one patient presented a 5° extension lag during postoperative follow-up.

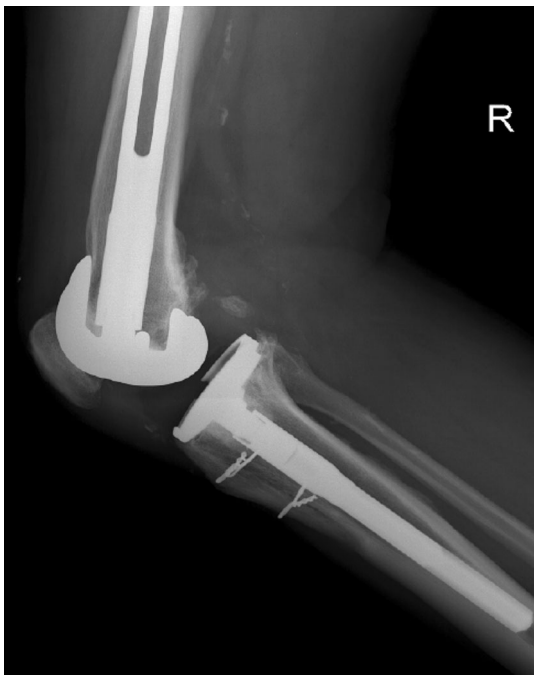

Fig. 2 Knee lateral radiograph shows the consolidation of the anterior tibial tuberosity

Discussion

One challenge of the surgical approach during revision knee arthroplasty is to obtain the surgical exposure needed to remove and replace the prosthesis without damaging the extensor mechanism. The situation is frequently more complex when revision surgery is undertaken in a patient with a prosthetic infection, as there is more fibrosis and soft tissue inflammation [6]. A lesion in the extensor mechanism due to rupture of the patella tendon may have a devastating impact on the patient, due to the long rehabilitation required and the poor functional results [9].

TTO as a surgical approach in total knee arthoplasty was first described by Dolin [5] and then disseminated by Whiteside [3, 4], who reported on a series of 136 patients with a 2-year follow-up. In this series, the average range of movement in the knee was 93.7° and no patients developed

an extension lag in the postoperative period. Hence, Whiteside [4] concluded that the procedure was safe and effective. In a series of 67 patients, Mendes et al. [6] reported good and excellent results in 87 % of the cases, and stated that this procedure was particularly effective in patients who underwent two-stage revisions for prosthetic infection. Infections were eliminated in 90 % of the cases and there were no TTO-related complications. More recently reports have shown the efficacy of the OTT for the treatment of revision surgery for septic TKR (total knee replacement); these reports have demonstrated an improvement of functional scales and improved ranges of mobility; and did not show a higher incidence of complications. [10–14].

Wolff et al. [15] reported complications in 23 % of their patients after the TTO, with proximal osteotomy displacements and extension lags. In a series of patients in which they compared different approaches to revision knee surgery, Barrack et al. [2] reported that patients who underwent TTO had less extension lag than patients who underwent a quadriceps turndown. In our series, the average KSS knee and function scores at the last follow-up were 80 and 78, respectively. Good or excellent results were obtained in 80 % of the cases. The average on the WOMAC index at the last follow-up was 88. In a series of 42 patients who had undergone a TTO, Young et al. [16] reported good or excellent results in 73 % of the patients. Mendes et al. [6] reported good or excellent results in 87 % of their patients. However, in the results of both these series, there were no differences between patients who underwent revisions for infection and those who had revisions for other reasons. Both sets of results are in agreement with those of our series. The postoperative mobility results in our series concur with the ranges of mobility obtained in series of revision total knee replacements [17].

The complications that occurred in our series were all minor and in agreement with those found by Whitesides [3]. The osteotomy healed without complications in 22 patients (84.6 %). Two patients (7.6 %) presented a stable non-union that did not affect function and one patient had a transverse fracture of the tibial tuberosity at the level of the upper cerclage, with appropriate healing of the osteotomy. A 5° extension lag was identified in one patient during the postoperative follow-up. In one case, Ethibond sutures were used instead of wire, in a patient was allergic to nickel with normal union as reported by Deane et al. [18].

There are studies where have been used for the fixation of the TTO, absorbable suture, screws or wire, and in the majority of the patients showed an adequated bone union, regardless of the method used [10–12]. The use of cerclages to fix the osteotomy is a good option as it leads to few complications, is easy to undertake and provides stability. Davis et al. [19] recommend creating an upper shelf in the osteotomy to ensure that it does not migrate. However, in our practice we do not recommend to do it, because the osteosynthesis may be required 1–2 cm above the place of origin, for example, in cases of patella baja. The creation of the shelf would make it difficult to carry out the osteosynthesis.

In summary, we have reported our experience of TTO in patients who underwent the second stage of a revision for infection. Our functional results are similar to those reported by Whiteside and Mendes et al. [3, 4, 6]. Complications due to the TTO were only minor, with no variations in the functional results. This revision surgery technique provides good surgical exposure that enables the spacer to be removed and the new implant to be positioned without damaging the extensor mechanism of the knee or altering the postoperative rehabilitation. With these results we consider that the correct size and careful fixation of the osteotomy are steps of vital importance to perform the extensile approach in the revision total knee arthroplasty.

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