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Step-cut tibial tubercle osteotomy for access in revision total knee replacement

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Abstract

In this retrospective cohort, the results of step-cut tibial tubercle osteotomy (TTO) in 39 revision total knee arthroplasty, using the Continuum Knee System (CKS), are determined. In 39 revision, total knee arthroplasties, adequate exposure was obtained after step-cut TTO. All knees were recently reviewed for clinical and radiological results. Symptomatic TTO-related complications occurred in three out of 39 patients. Two patients had proximal migration of the tibial tubercle due to an insufficient step-cut. Another patient had posttraumatic avulsion of the tibial tubercle. No TTO-related extensor lag or tibial fracture occurred.

We conclude that, when adequate exposure cannot be obtained, step-cut TTO is a safe and reproducible procedure if strict attention is paid to technique and fixation. It does not compromise the functional results of TKA.

Keywords: Tibial tubercle osteotomy; Revision TKA; Exposure; Step-cut; Approach

1. Introduction

The number of revision total knee arthroplasties (TKA) continues to increase annually. Of primary TKA, 5–10% need a revision TKA after 10–15 years [1–3]. Clinical results of revision total knee arthroplasty still have not matched those of primary total knee arthroplasty. Failure of primary TKA most frequently occurs because of septic or aseptic loosening, instability and component malposition [4,5]. Accurate component positioning is an important issue in TKA for long-term success. To accomplish this goal, adequate exposure is required. In revision TKA exposure problems can be caused by many factors: poor preoperative range of motion, patella baja and obesity. The integrity of the extensor mechanism is at risk in such cases. Therefore, exposure-techniques have been developed in order to protect the extensor mechanism: V–Y quadriceps-plasty, patellar turndown procedure, quadriceps-snip and tibial tubercle osteotomy (TTO). TTO is gaining in popularity as exposure technique in revision TKA. TTO provides excellent exposure of both femoral and tibial side, can be useful in tibial component removal, and correction of patellar height is possible. TTO has the benefit of bone-to-bone healing and it does not jeopardize blood supply to patella or surrounding soft tissues.

The goal of this retrospective cohort study is to measure the clinical and radiological outcome and complications of step-cut TTO in revision TKA and to compare our results with those of previously reported series in literature.

2. Materials and methods

Patients who had a total knee revision between 1999 and 2002 were selected from the hospital database. Patients who had a revision for a failed unicompartmental prosthesis, revision of one component only or exchange of the polyethylene insert only were excluded from the study. This resulted in 54 patients, 12 male and 42 female patients, with 56 revision TKA. All patients had a revision of both

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Table 1
Reasons for revision TKA

Reason for revision	Number
Aseptic loosening	16
Infection	9
Component malposition	5
Instability	6
Pain	1

femoral and tibial components after a primary or revision TKA. All revisions were performed by the two senior authors (AW and GH).

In 39 revisions, we did a step-cut TTO to obtain adequate exposure. In two revision TKAs due to proximal tibial fracture, a rectus snip was performed instead of TTO. Safe and adequate exposure could be obtained without TTO or proximal release of the extensor-apparatus in the other 15 revision TKAs because of pre-existent laxity or instability in four knees, previous patellectomy in three knees and extensive wear in eight knees.

The patient's medical records were analyzed to obtain demographic data, patient's medical history, preoperative Knee Society Scores and range of motion, and intra- and postoperative data. Preoperatively, bone defects were classified according to Engh and Ammeen [6]. The selected patients were invited for clinical and radiological evaluation by an independent observer (CvdB). Clinical evaluation included a review of patient history after revision, Knee Society Score assessment [7], range of motion and patient satisfaction measured by Visual Analog Scale (VAS-score). During radiological evaluation (AP, lateral view of the knee in approximately 20 ° flexion and axial patella view), serial radiographs including those at the most recent follow-up evaluation were analyzed for each patient for the presence of union and/or displacement of the osteotomy site, as well as patellofemoral congruity. We also measured thickness and length of the TTO and the quality of the step-cut. When the proximal cut was stepped, the step-cut was called adequate (Fig. 2).

Thirty-seven patients were available for follow-up and are involved in the clinical and radiological results. The mean age at the time of revision surgery was 64.2 years (range 37–78 years). The mean body mass index (BMI) was 27.7 (range 18–40).

The diagnosis leading to the primary TKA was degenerative osteoarthritis in 35 knees, rheumatoid arthritis in one knee and posttraumatic osteoarthritis in one knee. The reasons for revision TKA are listed in Table 1. In 29 knees, this revision was the first, in five knees the second and in three knees the third revision. Tibial bone defect classification is listed in Table 2. (The two patients who underwent revision TKA because of proximal tibial fracture were not classified. They are not included in Table 2.) The interval between the index arthroplasty and the first revision ranged from 5 to 219 months (average, 56 months). Mean operation time was 143 min (range 85–240).

3. Operation technique

Surgery was started, and when possible was completed, without tourniquet control. All patients received antibiotics (cefazoline) perioperatively, after cultures were taken. A medial parapatellar arthrotomy was performed. If adequate exposure could not be obtained safely after intra-operative adhesiolysis, a step-cut TTO was performed to evert the patella. The TTO consists of a transverse osteotomy of the tibial crest over approximately 6–8 cm distal to the step-cut and 1.0–1.5 cm in its thickest part, using a powered oscillating saw and osteotome (Fig. 1a–c). The step-cut at the proximal end of the osteotomy is made with a thin (1 cm) osteotome. The proximal cut is stepped to allow for additional prevention of proximal migration of the bone-fragment [8]. The distal end of the osteotomy is gradually angled out of the anterior cortex, in order to reduce the stress riser effect in the tibial metaphysis (Fig. 2). The osteotomy is opened by two osteotomes. The lateral periosteum and musculature remain attached and act as a soft tissue hinge. The femoral and tibial components were removed using osteotomes or a sagittal saw. Then the general steps for reconstructing the knee-joint were performed, as described by Bourne and Crawford [1]. The revision Continuum Knee System (CKS; Biomet, Warsaw, USA) is a modular non-constrained revision-system, containing adjunct stems and spacers to manage various degrees of bone loss. In revision TKA, all components was cemented with Palacos antibiotic loaded bone cement, after pulse lavage. When necessary, resurfacing or patellaplasty is performed. The tibial tubercle was re-attached using small fragment lag screws. In one patient, only cerclage was used for fixation. Usually, the postoperative management was similar to that after primary arthroplasty. Continuous passive motion was started after drain removal, 24 h after surgery and weight bearing was begun on the first postoperative day. Only in cases where fixation of the tibial tubercle was poor or correction of patellar height was performed, a removable extension cast for 6 weeks was recommended ($n=1$).

Statistical analysis was done with the SPSS (Statistical Package for Social Sciences).

4. Results

The mean duration of follow-up after revision was 28.4 months (range 12–46). In 35 out of 37 patients, immediate weight bearing was allowed without extension cast. In three patients, partial weight bearing during 6 weeks was allowed because of major bone

Table 2
Classification of tibial bone defects according to Engh and Ammeen [6]

	TTO ($n=37$)	No TTO ($n=15$)
T1	18	7
T2a	14	7
T2b	5	1
T3	–	–