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Tibial Crest Osteotomy in Extensile Knee Exposure—A Modified, Low-Energy, Suture Technique

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A B S T R A C T

Background: Tibial crest osteotomy is an established extensile knee approach. Complications include mal-union, non-union, and fixation problems.We have designed a technique aimed at reducing complications through the principles of low-energy osteotomy and suture repair.
Methods: We reviewed our clinical and radiological results in 159 consecutive patients 181 osteotomies with a mean age of 66 years, and an average follow up of 22 months.
Results: Union occurred in all osteotomies (100%) at a mean period of 11 weeks. Proximal migration averaging 11.5 mm occurred in 6 osteotomies (3%). Crest fragmentation occurred in 11 osteotomies (6%), with all cases resulting in uncomplicated union. No extensor mechanism failure or complications related to the suture material occurred.
Conclusion: We conclude that this technique results in satisfactory outcomes whilst avoiding hardware-related problems.

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Extensile surgical exposures are frequently necessary during revision knee arthroplasty, with some reporters recording rates approaching 50% [1,2]. Compared to the quadriceps turndown technique, the quadriceps snip has the advantages of technical simplicity, uncomplicated rehabilitation protocols, and less incidence of persistent extensor lag [1]. However, the technique may not be sufficient to achieve the desired exposure in stiff knees [3]. In a recent study, Sun et al [4] observed a higher rate of intraoperative partial patellar tendon avulsion in the quadriceps snip group (24%) compared to the tibial tubercle osteotomy group (7%) in patients undergoing second-stage revision total knee arthroplasty for infection.

In contrast, the tibial tubercle osteotomy allows an unimpeded access to the knee joint and the tibial metaphyseal region. In addition, its direct bone-to-bone healing has the potential of minimizing the risks of extensor mechanism laxity and persistent extension lag.

Reattachment of tibial tubercle osteotomy (TTO), used in extensile approaches to the knee, is most commonly carried out using cerclage wiring or interfragmentary screw-compression techniques. Despite widespread use of the technique, the reported rate of complications remains relatively high. The most common complications are related to hardware prominence, osteotomy fragment fracture, and malunion, mostly in the form of proximal migration [5-7]. We have developed modifications of the standard technique, designed to minimize these complications [8]. The modifications are based on the principles of low-energy osteotomy, increased length (tibial crest rather than tubercle), preservation of the lateral musculoperiosteal hinge, fixation with intraosseous suture (5-Ethibond; Ethicon, Edinburgh, UK), and unrestricted postoperative knee rehabilitation.

The difference between a tibial tubercle and tibial crest osteotomy (TCO) may seem small, but the increased length and surface area of the crest osteotomy are important factors in achieving secure closure, fixation, and bone union. In this study, we evaluated the clinical and radiologic outcomes of this technique, the TCO, in the largest reported series of extensile knee exposures.

Materials and Methods

Tibial Crest Osteotomy Surgical Technique

For any surgical technique to be repeated, successfully in multiple hands, it must have well-defined steps that allow reproducibility during surgery and predictable outcomes postoperatively. The key steps in the TCO are length, vascularity, and repair.

Length

The TCO should ideally be 6 to 8 cm in length. This provides a larger surface area for osteotomy repair and bone union. With the limb in

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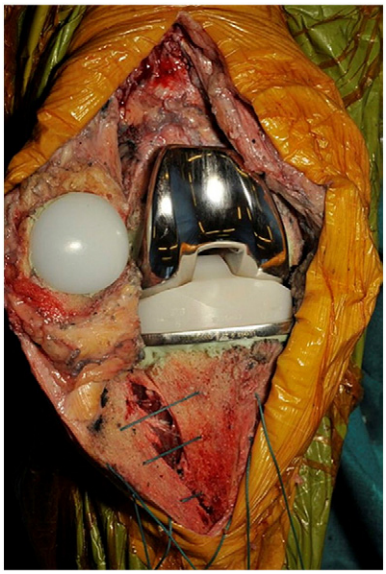

Fig. 1. Intraoperative photograph of knee during revision arthroplasty showing the TCO giving extensile exposure with a retained muscular lateral attachment. Intraosseous sutures have been passed through 2-mm drill holes.

neutral rotation and adequate initial exposure obtained, the modified TCO technique follows defined steps. An initial osteotomy line is drawn on the medial cortex using cautery/scalpel. The medial cortex is breached using a sharp osteotome, beginning at the level of the anterior lip of the implanted tibial tray and continuing until the anterior tibial cortex is reached distally. The osteotomy length will thus typically be approximately 6 to 8 cm in length. If longer than this without reaching the anterior tibial cortex, then an oblique anterior cut with the osteotome is used to prevent excessive distal propagation. Fig. 1 shows the osteotomy giving extensile exposure with a retained muscular lateral attachment.

Vascularity

Potentially, devitalizing the osteotomy occurs in 2 ways. First, the use of power saws to cut the bone leads to high-energy transfer causing local bone necrosis. Second is failure to preserve the lateral soft tissue envelope from which the proximal tibia and crest obtains the majority of blood supply postoperatively. Devitalizing the crest osteotomy can be avoided by using multiple, sharp osteotomes. Two to 3 broad osteotomes are used to horizontally crack the lateral cortex. Once done, the osteotomes are used en-masse to open the osteotomy, hinging on the intact periosteal or muscular lateral attachment in a low-energy osteotomy.

Repair

At the end of the operation, the hinged crest osteotomy is closed and secured with 3 intraosseous sutures (5-Ethibond) which are hand tied in extension. A 2-mm drill bit is used to make matching suture holes, 3 on the medial tibial cortex and 3 in the crest osteotomy. The sutures are passed from medial cortex, through the osteotomy, and under the bony attachment of the patella tendon to prevent necrosis and enhance fixation. Tie and tension the sutures in extension. A useful tip is to ask the assistant to pull the upper and lower sutures medially to hold the crest osteotomy in the reduced position while the surgeon secures the middle suture. The second and third sutures are then tied, and all 3 suture knots are slid medially allowing the soft tissues to cover them as the knee wound is closed. Having tensioned the osteotomy in extension, on table knee flexion is seen to compress the osteotomy confirming secure fixation and allowing a free range of postoperative movement (Fig. 2A and B). The secure fixation thus obtained requires no

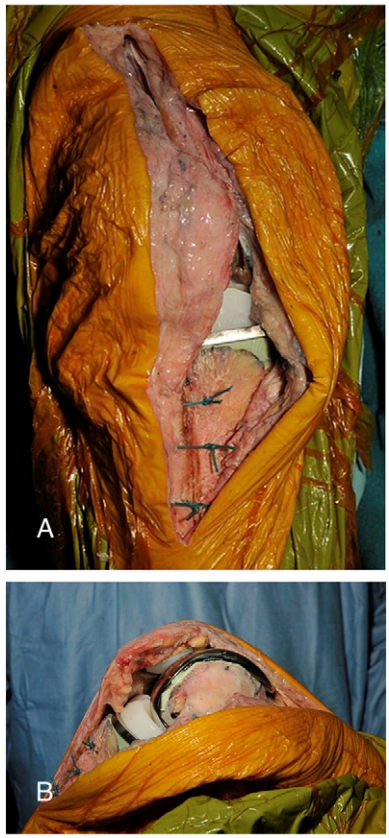

Fig. 2. (A and B) Intraoperative photographs of the same knee as in Fig. 1, showing the reduced osteotomy secured with hand tied 5-Ethibond sutures with knots placed medially. Note the increased osteotomy compression in flexion.

postoperative restriction of movement or bracing. All patients are allowed immediate full weight bearing.

Schematic representations of the technique are shown in Fig. 3A to C.

Outcome Assessment Method

Clinical and radiologic review of revision and complex primary knee arthroplasty exposures was performed on all patients between January 2008 and December 2012. Patient demographics, surgical indications, number of revisions, and follow-up duration were recorded. The tourniquet time was recorded. In addition, the intraoperative notes were reviewed to establish any compromise to proximal tibial reconstruction and implant fixation relating to the TCO. Clinical review of wound healing was made to evaluate any delayed or adverse healing event related to the TCO. The extensor mechanism was assessed for extensor lag.

The radiographs taken in the immediate postoperative period were evaluated for baseline osteotomy reduction compared with preoperative radiographs. Comparisons were then made with radiographs taken at subsequent follow-up visits. Time to radiologic union was taken at the point when bony trabeculae crossing the osteotomy site were first observed. Proximal migration of the crest fragment was defined as any projection proximal to the cut surface of the tibia or, in the case of radiologic obscurity, to the inferior edge of the tibial baseplate (Fig. 4). The presence of fragmentation of the crest osteotomy was recorded.

Results

A total of 240 complex knee reconstructive or salvage procedures were performed between January 2008 and December 2012. There were 59 patients excluded from the study for the following reasons: