Extensile Exposure in Revision Total Knee Arthroplasty Using an Osteomyofascial Flap

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ABSTRACT
Adequate exposure is essential for a successful revision total knee arthroplasty. A technique of approach by developing an osteomyofascial flap over the tibial tubercle is introduced in this article. Between September 1998 and August 2000, this technique was applied to assist in the surgical exposure of the knee in 22 patients undergoing revision total knee arthroplasty. When this procedure is performed, a thin bony flap is developed over the tibial tubercle and upper tibia. The overlying soft tissue including fascia, muscle, and periostem is not disturbed during this procedure. Simple sutures were used to reattach the flap, and no special devices such as screws or wires are needed. The postoperative rehabilitation program is the same as that undertaken in primary cases. At the average follow-up time of 49 months, 21 patients have satisfactory results. This technique has the merits of its simplicity: there is no need to use a special device to fix the flap when closing the wound, the continuity of the extensor mechanism is maintained, and the normal postoperative rehabilitation program is not disturbed. Good clinical results could always be anticipated by using this technique when it is performed carefully. Keywords: exposure, revision, total knee arthroplasty, tibial tubercle, osteomyofascial flap

HISTORICAL PERSPECTIVE
Adequate exposure is the most important part of revision total knee arthroplasty. Eversion of the patella is sometimes needed to achieve adequate exposure, but it is usually difficult because of scarring and fibrosis of the soft tissue envelope. The patellar tendon insertion might be in jeopardy when the patella is everted, especially in patients with a restricted range of motion or hard scar contracture. Several methods have been applied to facilitate eversion of the patella to optimize intraoperative exposure when performing revision total knee arthroplasty, including the V-Y turn-down, the quadriceps or rectus snip, and the tibial tubercle osteotomy. The V-Y turn-down, first described by Coonse and Adams, is subsequently modified by Insall, and is rarely used because of the problems with damaging the quadriceps tendon, devascularizing the patella, and producing extension lag. The quadriceps snip, as described by Garvin et al, is simpler to perform and has fewer complications. Indeed, in most cases, no restrictions in postoperative motion or changes in the standard rehabilitation are required. However, occasionally the exposure obtained with this technique is insufficient, and other methods such as the V-Y turn-down or tibial tubercle osteotomy must be considered. The tibial tubercle osteotomy was first described by Dolin in 1983 and has subsequently popularized by Whiteside. Although tibial tubercle osteotomy can help avoid catastrophic complications with the extensor mechanism and aid in exposure, surgical complications including tibial shaft fractures, displacement of the osteotomized tibercle, and patellar tendon rupture have been reported to occur in up to 23% of cases performed even by experienced surgeons. In this report, we will describe our modification of the tibial tubercle osteotomy, which is easier to perform, and complications occur less commonly.

INDICATIONS AND CONTRAINDICATIONS
This technique is indicated when soft tissue contracture or fibrotic scar impairs lateral patellar eversion. If it is performed forcefully, the patellar tendon may be avulsed from the tibial tubercle. This problem may be encountered in revision cases and some primary cases. In our experience, if there is any difficulty in getting adequate exposure of the lateral tibial plateau after appropriate soft tissue release, no hesitation should be undertaken to proceed to this technique. This technique could be applied repeatedly in staged revision. It is also suitable for the knee to receive multiple operations. No absolute contraindications have been identified since this technique was first used.
PREOPERATIVE PLANNING

General principles of preoperative planning for revision total knee arthroplasty are undertaken. Careful preoperative evaluation of the patient's comorbidities and optimization of these conditions may help prevent postoperative complications. These conditions include malnutrition, obesity, rheumatoid arthritis, diabetes mellitus, corticosteroid use, smoking, anemia, and peripheral vascular disease. Patient-specific knee anatomy such as previous skin incisions, significant malalignment, bony abnormalities, patella baja, restricted motion, or ankylosis should be scrutinized. These conditions can make the surgery technically more difficult. Records of the previous surgery, and preferably discussion with the index surgeon, will greatly facilitate the planned revision surgery. The type and size of the implant that is present must be elucidated. Implants must be available to accomplish the surgery. Members of the surgical team must be familiar with the surgical plan and the instruments that are going to be used. If allograft bone is required, this also must be available from a bone bank. Preoperative consideration of these factors allows the surgeon to facilitate a safe and expeditious procedure.

TECHNIQUE

Skin Incision and Capsulotomy

The skin incision is made through the previous surgical scar (Fig. 1). Any fibrotic tissue including hypertrophied scar and subcutaneous fibrosis should be excised in this stage. This incision is extended 3 cm more distally to about 6 to 8 cm distal to the tibial tubercle. A medial parapatellar capsulotomy is then performed by sharp dissection. The distal part of this dissection is carried out directly to the bony surface of the proximal tibia along the medial border of the tibial tubercle.

Medial Dissection

A medial soft tissue flap is developed subperiosteally from the upper medial tibial cortex (Fig. 2). This dissection is started from the prosthesis-bone junction and is carried out medially and distally by sharp dissection. At the end of this dissection, the medial circumference of the upper tibia at the joint line level is completely exposed. This will facilitate external rotation of the tibia and subsequent removal of the prosthesis. A thick soft tissue cuff along the margin of the flap should be preserved during this dissection to provide secured bites for final repair.

Development of Osteomyofascial Flap

The medial border of the flap is first marked by scalpel. It starts from the medial border of the patellar tendon, extends along the medial side of the tibial tubercle, and ends about 6 to 8 cm distal to the tibial tubercle. The distal half of the flap is dissected subperiosteally from the tibial cortex. A thick soft tissue cuff should also be created at this part of the dissection to facilitate the final repair. The proximal half of the flap is peeled off carefully from the tibial tubercle by osteotome (Figs. 3 and 4).

The overlying soft tissue including fascia, muscle, and periosteum is left attached to the elevated segment during this procedure. The dense fibrous tissue adhesions between the flap and the upper tibia are divided sharply with a scalpel. The bony part of this flap is measured about 30 to 40 mm in length, 20 to 25 mm in width, and 2 to 4 mm in thickness (Fig. 5).

Lateral Dissection

The flap is elevated further laterally by sharp subperiosteal dissection along the lateral tibial plateau (Fig. 6). At the end of the dissection, the patella can easily be everted when the knee is in the extended position. By gradually flexing the knee, the entire lateral circumference of the

FIGURE 1. Skin incision and capsulotomy.

FIGURE 2. Sharp dissection to develop the medial soft tissue flap.
FIGURE 3. After the distal soft tissue part of the osteomyofascial flap has been developed, the osteotome is aimed to prepare the subsequent dissection.

upper tibia at the joint line could be exposed by folding of the quadriceps mechanism and the osteomyofascial flap laterally (Fig. 7).

Reattachment of the Flap
No special fixation devices such as screws or wires are needed for the reattachment of the flap. The distal soft tissue part of the flap is repaired first. Then the proximal bony part of the flap is reattached to the medial soft tissue flap also by direct sutures (Fig. 8). The suture needle usually could pass through the thin bony fragment without difficulty. In some cases with hard bone, pre-drilling of the bony fragment may be needed for safe passage of the needle. The strength of the reattachment is checked after complete repair of the extensor mechanism by flexing the knee.

FIGURE 4. A thin bony flap is carefully peeled off from the tibial tubercle by using an osteotome.

POSTOPERATIVE MANAGEMENT
No protection is needed if secure fixation is obtained and confirmed by deep flexion of the knee intraoperatively. Unrestricted passive and active range of motion exercise and full weight bearing are allowed during the first week of recovery. Quadriceps setting is performed by isometric exercise in either lying or sitting position. Gentle straight-leg-raising exercise in standing position is also encouraged. If disruption of the extensor mechanism occurs, a knee brace is used for protection during the first postoperative month.

RESULTS
Between September 1998 and August 2000, this technique was applied to assist in the surgical exposure of the knee in 22 of 46 patients (47.8%) undergoing revisional

FIGURE 5. The development of the bony part of the flap is completed, and the flap is everted.

FIGURE 6. The flap is elevated further laterally by sharp subperiosteal dissection along the lateral tibial plateau.
At the time of the last follow-up, all patients had a fully formed osteomyofascial flap. The average length of stay was 10 days (range 7–14 days). All but 1 patient could bend the knee beyond 90 degrees at the end of the hospitalization. The average increase of the Knee Society Score was 35 (range 21–44). At the time of the last follow-up, the bony part of the flap healed soundly in all patients. The average range of motion was 103 degrees (range 95–125 degrees). The knees of 14 patients were rated as excellent, and those of 7 patients as good. The only patient rated as fair was a case who sustained a slip-down accident resulting in forcefully deep bending of the operated knee at home on the day of her discharge. A 12-cm transverse laceration occurred beyond the lower end of the healed wound. The bony component of the flap was found displaced 2 cm proximally by the x-ray examination. No attempt was made to repair the flap to prevent contamination of the joint cavity during debridement and closure of the laceration wound. The knee was protected with a brace for 2 months. This patient could finally walk with the aid of a cane. But an extension lag of 10 degrees and weakness bothered her persistently.

## COMPLICATIONS

Disruption of the continuity of the osteomyofascial flap may occur over the distal part of the flap. This could be avoided by dissecting the distal half of the flap from the tibial cortex subperiosteally before peeling off the proximal bony part of the flap. If this complication occurs, the extensor mechanism will be jeopardized. Even in such cases, the reattachment of the flap can still be carried out as usual. However, the postoperative protection, such as a ROM brace, should be used to avoid excessive flexion of the knee. The degrees of flexion allowed should be tailored individually according to the security of the repair.

## POSSIBLE CONCERNS AND FUTURE OF THE TECHNIQUE

Eversion of the patella is not always a necessity to achieve good exposure in performing revision total knee arthroplasty. Fehring et al.\(^\text{15}\) have described their patella inversion method for exposure in revision total knee arthroplasty and reported that only 5% of their revision cases resorted to extensile measures such as quadriceps snip or tibial tubercle osteotomy. We agree with Berger and Rosenberg\(^\text{16}\) that surgical exposure should consist of a series of steps that should always be made in a logical and sequential manner. Our stepwise progression consists of a fibrolysis of the suprapatellar pouch, releasing of the medial and lateral gutters, followed by peeling off the soft tissue all around the medial tibial plateau. At this stage, exposure of the knee joint and lateral tibial plateau is tried by gradual external rotation of the tibia and careful flexion of the knee without everting the patella. If there is any possibility that the patellar tendon is in

**FIGURE 7.** The entire lateral circumference of the upper tibia at the joint line is exposed by folding of the quadriceps mechanism and the osteomyofascial flap laterally.

**FIGURE 8.** Reattachment of the flap is performed by simple sutures.
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jeopardy, or the lateral plateau can still not be well exposed, we will not hesitate to proceed to the technique of developing the osteomyofascial flap to evert the patella. With this philosophy, 47.8% of our revision cases needed this extensile measure. This percentage is similar to that of Barrack’s series.3

In summary, the technique described in this paper has several advantages over other techniques. It is versatile and can be applied to many difficult cases of knee surgery where extensile exposure is needed. Furthermore, it is simple and does not require special devices to fix the flap when closing the wound. In addition, the continuity of the extensor mechanism is maintained, which allows routine postoperative rehabilitation to be used. Finally, good clinical results with low complication rates have been demonstrated in patients in whom this technique has been used. Therefore, surgeons who routinely undertake complex knee cases may wish to consider the use of this technique when exposure is difficult.

■ REFERENCES