Total Knee Arthroplasty With Retained Tibial Implants: The Role of Minimally Invasive Hardware Removal

Gregory M. Georgiadis, MD, FACS, and William C. Skakun, DO

Abstract

Patients with retained tibial implants may later undergo total knee arthroplasty (TKA) after tibial osteotomy or fracture. Previous knee surgery can increase the rate of complications of joint replacement. Surgical scars may not be in optimal position for hardware removal and arthroplasty. The need for multiple incisions or larger subcutaneous skin flaps in at-risk areas may increase the possibility of wound complications and infection.

In this article, we report 3 cases in which a patient who had knee arthrosis and retained tibial implants underwent single-stage conversion to TKA. In each case, selected minimally invasive hardware removal was performed through small incisions under fluoroscopic guidance. For insertion of the tibial base plate, only screws were removed; the retained plates were not disturbed. This technique allowed the TKA to be performed without making significant secondary incisions or raising larger-than-normal skin flaps.

Technique

The patient is positioned on a radiolucent table, and a mobile fluoroscopy unit is available. A tourniquet is applied to the upper thigh but typically is not inflated during the percutaneous hardware removal portion of the operation. It is crucial to have information on retained implants so the correct screwdrivers for screw removal can be selected. In addition, provisions for stripped screws should be made. In each of the 3 cases we managed, the Synthes Screw Removal Set was available. Presence of an implant system known to have problems with cold welding of screws (eg, Less Invasive Stabilization System; Synthes) may necessitate additional preparations, such as making conical extraction devices available.[1]

After preoperative administration of antibiotics, the surgeon typically removes only those proximal tibia screws that are preventing insertion of the tibial base plate. Fluoroscopic guidance is used to locate these screws and then remove them with percutaneous stab incisions. (Retained plates are not removed.) The exact method of localizing and removing the screws percutaneously is crucial. A small stab incision is made in the dermal layer. The number of stab incisions to be made depends on the number of screws to be removed. One small incision is needed for each screw hole. Occasionally mobilizing the skin and redirecting the screwdriver in the deep tissues can allow 2 screws to be removed through a single skin wound. The screwdriver head can be inserted through the muscle and fascial layers without the need for deep dissection. The plate is then felt with the screwdriver and the screw head located. It is very important that the screw head be adequately engaged to prevent stripping. The surgeon should not rush this step. The C-arm can be helpful here. Fluoroscopy not only can guide the screwdriver to the screw hole but can confirm the screwdriver is at right angles to the plate, not oblique. Only when the surgeon is completely satisfied that the screw head is well engaged should the attempt to back out the screw be made. If the screw strips, the screwdriver can be removed, and an attempt can be made to insert a percutaneous stripped screw removal device.[1] If this fails, then the technique must be abandoned

Authors' Disclosure Statement: The authors report no actual or potential conflict of interest in relation to this article.

Table. **Patient Data**

	Patient		
Parameter	**1**	**2**	**3**
Age, y	60	80	65
Sex	Female	Female	Female
History	Previous proximal tibial osteotomy	Split-depression lateral tibial plateau fracture after fall	Bicondylar tibial plateau fracture after fall
Side	Left	Left	Left
Orthopaedic Trauma Association (OTA) class	N/A	41-B3	41-C3
Retained implants	Lateral plate and screws	Lateral plate and screws	Lateral, medial, and posteromedial plate and screws
Comorbidities	Ulcerative colitis, hypothyroidism, depression	Hypertension, cerebrovascular disease	Tobacco use, osteoporosis, acute distal femur fracture
Time from insertion of tibial hardware to TKA, mo	168	6	60
TKA incision	Previous anterolateral	Previous anterolateral	New midline
TKA implants	Biomet, cemented, primary, cruciate-retaining femur, I-beam tibial base plate, anterior stabilized polyethylene	Biomet, cemented, cruciate-retaining femur, long cemented stem, anterior stabilized polyethylene	Biomet, cemented, long-stemmed, Orthopaedic Salvage System rotating hinge
Operating room time, min	215	246	338
Fluoroscopy time, s	21	56	129
Blood loss, mL	25	1200	800
Complications	None	Intraoperative blood transfusion	Stripped screw, intraoperative blood transfusion
Follow-up, mo	59	40	10

Abbreviation: TKA, total knee arthroplasty.

for a more traditional approach.

Plating complex tibial plateau fractures through a separate posteromedial approach is now popular.[2] The deep location and screw orientation of posteromedial hardware make percutaneous removal unfeasible. In these cases, a separate posteromedial incision may be needed—usually posterior enough so it minimally compromises the anterior soft tissues. The incision typically uses the old posteromedial surgical scar but may not need to be as large as the original approach, as only selected screws need be removed. The saphenous neurovascular bundle may still be at risk, depending on the location of these incisions. The plate is not removed.

After the necessary screws are removed, the tourniquet can be inflated, if desired. The total knee arthroplasty (TKA) then proceeds in usual fashion through a single incision and a medial parapatellar arthrotomy.

Results

Between January 2009 and February 2014, Dr. Georgiadis converted 3 cases of retained tibial hardware and severe knee arthrosis to a TKA in a single operation. These cases were reviewed after Institutional Review Board approval was obtained. One patient underwent a closing-wedge high tibial osteotomy 14 years earlier, and the other 2 sustained tibial plateau fractures. Clinical details of the 3 cases are presented in the **Table**. The data were derived from a review of inpatient electronic healthcare records. We did not specifically record the time needed for percutaneous implant removal or TKA. Follow-up consisted of a retrospective chart review of wound status, range of motion, and radiographs; knee function scores were not obtained.

In 2 of the cases, anterolateral surgical scars were present. New, separate percutaneous stab incisions were used to remove screws, which

meant less of the original skin incision could be used for the TKA (**Figures 1A, 1B**). The medial parapatellar arthrotomy was then performed with less lateral dissection and no exposure of the anterolateral plate.

In the third case, involving multiple plates, a similar strategy was used, but an additional small posteromedial incision was required (**Figures 2-5**). The TKA then proceeded through a new midline incision. This case was performed for tibiofemoral arthrosis in the setting of an acute distal femur fracture, but this had no bearing on the technique. After the proximal tibial screws were removed, the case proceeded in the usual manner, though a stripped screw required insertion of a conical extraction device for percutaneous removal.

Tibial base plates were inserted in the usual manner. Length and type of tibial stem were left to the discretion of the surgeon. There were no changes from the usual surgical technique. All patients went on to routine, uneventful wound healing. Follow-up ranged from 10 months to 59 months.

Discussion

If the decision is made to proceed with TKA after previous knee surgery, careful preoperative planning is needed. The most common reasons for retained implants are previous proximal tibial osteotomy and previous fracture.

For young patients with knee arthrosis and angular deformity, it has been recommended that proximal tibial osteotomy be performed to delay the need for joint replacement.[3,4] Although a wide variety of osteotomy techniques is available, plates and screws are often used. With long-term follow-up, knee arthrosis can be expected to progress, and some of these cases will be converted to knee arthroplasty.[3,4]

Displaced tibial plateau fractures are intra-articular injuries. Treatment requires surgery. Treatment principles include restoration of articular anatomy, mechanical alignment, early motion, and, usually, open reduction and internal fixation (ORIF) with plates and screws. In the past, complex bicondylar fractures were often treated with medial and lateral plating through a single anterior approach. The resulting high infection rate was attributable to the initial soft-tissue injury and the additional surgical stripping.[5-8] In the more fragment-specific approach that was subsequently developed, combined anterolateral and posteromedial plating decreased but did not eliminate the risk of infection.[9-11]

Posttraumatic arthrosis is not an uncommon radiographic finding after ORIF of tibial plateau fractures.[12,13] However, only a relatively small percentage of these patients go on to TKA.[14,15]

In the presence of previous incisions and retained hardware, TKA is expected to be more technically difficult. Satisfactory outcomes of tibial osteotomy have been reported,[16] as have poorer outcomes.[17,18] In many cases, lateral staples and not plate–screw constructs had been retained. Rates of complications (wounds, infections) after conversion of tibial plateau fractures to TKAs were higher in numerous studies.[19-21]

Blood work for inflammatory markers (erythrocyte sedimentation rate, C-reactive protein level) should be performed before surgery. In the event

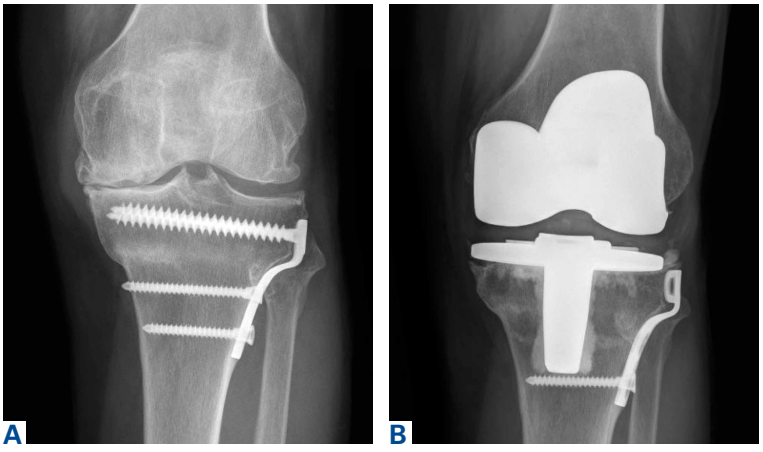

Figure 1. (A) Preoperative anteroposterior radiograph of healed proximal tibial osteotomy with retained lateral plate (patient 1, Table). (B) Postoperative radiograph of total knee arthroplasty after percutaneous screw removal.

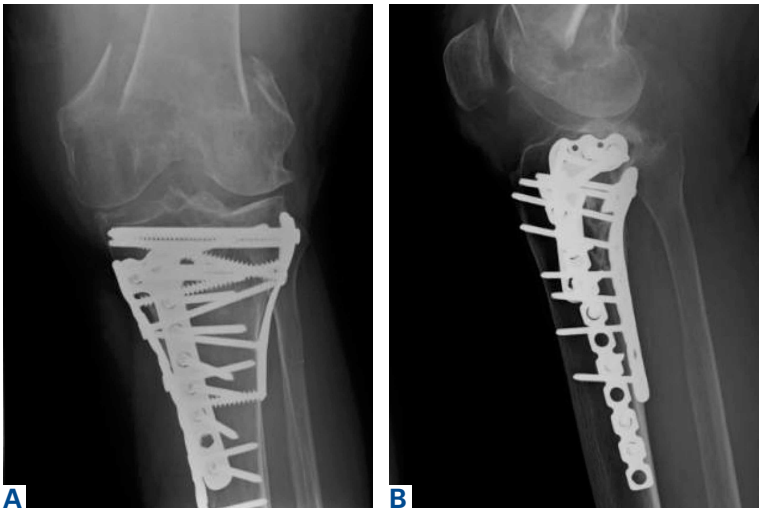

Figure 2. Preoperative (A) anteroposterior and (B) lateral radiographs of acute distal femur fracture in patient with previous complex tibial plateau fracture, retained hardware, and posttraumatic arthritis (patient 3, Table).

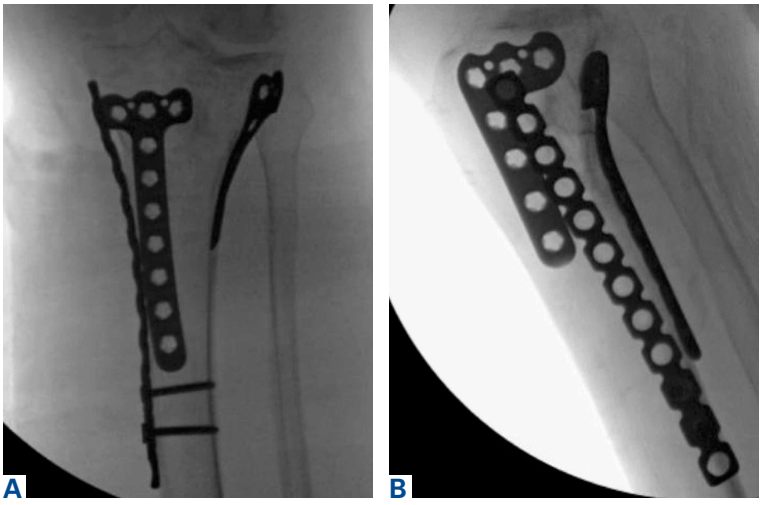

Figure 3. Intraoperative (A) anteroposterior and (B) lateral fluoroscopic images after minimally invasive screw removal.

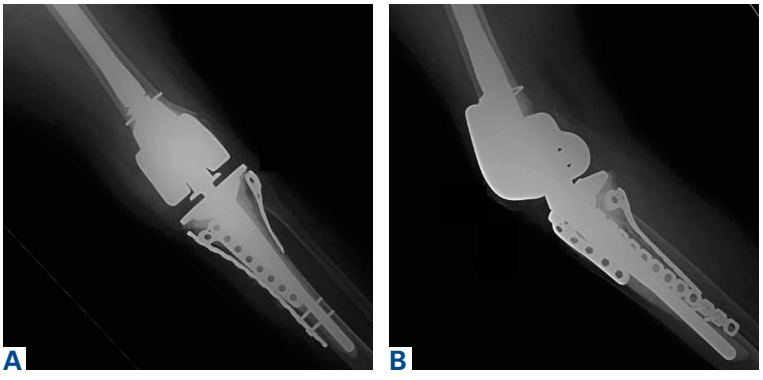

Figure 4. (A) Anteroposterior and (B) lateral radiographs after hinged total knee arthroplasty.

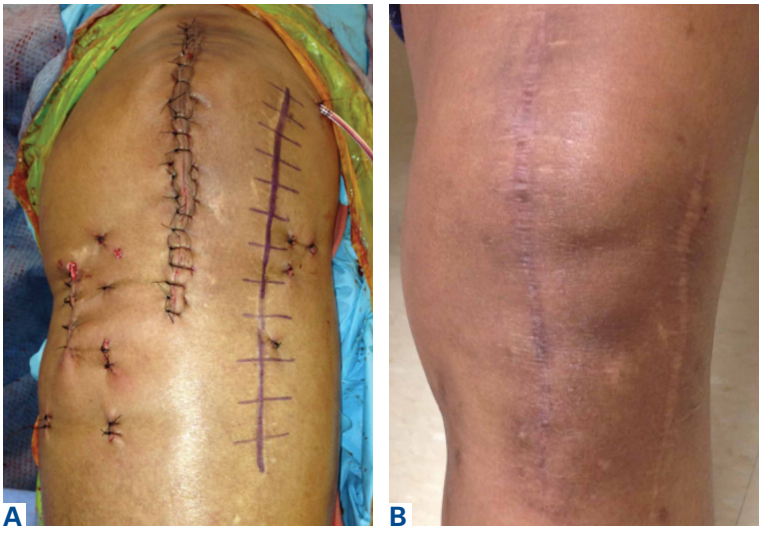

Figure 5. (A) After closure: midline incision, healed lateral scar from previous plateau fracture (surgical marker), and minimally invasive incisions used for screw removal. (B) Knee at 10-month follow-up.

of an elevated laboratory value or clinical suspicion (joint effusion), the joint should be aspirated before any arthroplasty procedure.

Preoperative planning for hardware removal is essential.[22] The correct screwdriver and a metal cutting burr (for stripped screws) should be available. These needs may be anticipated with certain types of locking plates.[1] In such situations, minimally invasive hardware removal may not be possible. Meticulous planning regarding type of prosthesis is needed as well. Revision implants with long tibial stems are often needed to bypass previous tibial hardware or stress risers. We did not encounter any soft-tissue or bony difficulties in implanting a tibial base plate with a retained lateral tibial fracture plate in this 3-case series.

Surgical incision planning is also crucial in preventing wound problems that can lead to deep prosthetic infection.[23,24] Blood supply to the skin of the anterior knee is primarily medially derived; incisions that are more medial put lateral skin flaps at risk.[25] Use of the most recently healed or previous lateral-based scars has been recommended. In cases of adherent skin or poor soft-tissue envelope, plastic surgery (eg, soft-tissue expansion, gastrocnemius muscle, fasciocutaneous flaps) may be necessary.[26-28]

Surgeons must decide to perform either a single operation or a multiple-stage operation. Naturally, most patients prefer a single procedure. All previous hardware can be removed, or only the hardware that is preventing insertion of the tibial base plate. Removing the least amount of hardware is advantageous in that surgical stripping and soft-tissue damage are reduced.

In this initial series, we successfully converted 3 tibial implants to TKAs (each as a single operation) by removing only screws in percutaneous or minimally invasive fashion—the prosthetic joint approach did not involve additional soft-tissue stripping. We did not specifically record the time needed for implant removal separately from the time needed for TKA. As the Table shows, this technique can lengthen surgery. Operative time and blood loss can be more variable because of numerous factors, including scar tissue and an altered surgical field from previous surgery, in addition to hardware removal difficulties. Therefore, surgeons should budget more operative time for these procedures. Although longer operations theoretically may increase infection rates, we think the risk is mitigated by the percutaneous aspects of the described technique.

We do not think that most orthopedic surgeons

addressing retained plate–screw constructs consider minimally invasive screw removal and plate retention. To our knowledge, the literature includes only 1 case report of a similar technique.[29]

This technique has many potential drawbacks, the foremost being use of intraoperative fluoroscopy. For more complex fractures, fluoroscopy time can be significant if the surgeon is committed to a true percutaneous approach (Table). In addition, use of a mobile fluoroscopy unit adds personnel to the operating theater, which potentially increases the infection rate. There may be cases in which tibial hardware interferes with tibial cuts, necessitating plate removal, but we did not encounter this in our series. This technique is potentially time-consuming. Operating room time can be expected to increase relative to wide exposures that allow quick access to existing implants. For this reason, some surgeons may decide to forgo this technique. Most modern proximal tibial fracture plates are contoured to fit well over the bone. However, some may still be prominent, and surgeons may choose to perform an open approach to remove them. Last, the clinical impact of plates retained without screws in the proximal tibia is not known. Theoretically, they may still act as a nidus for occult infection, and may act as a stress riser for peri-implant fracture. Therefore, for each patient, the surgeon must decide if the extra surgical time, fluoroscopy exposure, and plate retention are worthwhile.

In this 3-case series, screws were removed percutaneously over the proximal tibia. There were no neurovascular injuries in these cases, though there is potential for nerve and artery injuries with percutaneous screw removal, as in the anterolateral area of the distal third of the tibia.[30,31] Thus, our technique may not be applicable in such cases. Most patients with plates and screws retained after proximal tibial surgery do not need to have the screws removed from the distal tibia. There also is the potential for saphenous nerve injury if a small medial or posteromedial incision is made. No such injury occurred in our small series.

Surgeons must consider many factors when deciding whether to proceed with TKA in the setting of existing tibial hardware. If staged reconstruction is not planned, consideration can be given to percutaneous screw removal without plate removal in an attempt to minimize further soft-tissue stripping. This has the theoretical advantage of decreasing wound complications. We have been pleased with our initial patient experience and continue to use this technique.

Dr. Georgiadis is Chair of Orthopaedics, Orthopaedic Trauma Service, Department of Orthopaedic Surgery, Promedica Toledo Hospital, Toledo, Ohio. Dr. Skakun is an Orthopaedic Surgeon, Healthstar Orthopaedics and Sports Medicine, Morristown, Tennessee.

Address correspondence to: Gregory M. Georgiadis, MD, FACS, Orthopaedic Trauma Service, Department of Orthopaedic Surgery, Promedica Toledo Hospital, 2121 Hughes Dr, Toledo, OH 43606 (tel, 419-291-6825; fax, 419-480-8701; email, gregory.georgiadismd@promedica.org).

Am J Orthop. 2016;45(7):E481-E486.

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