# Setting Yourself Up for Success: Locked Plating in Periprosthetic Fractures About Total Knee Arthroplasty

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**Summary:** As the incidence of total knee arthroplasty increases, a concurrent increase in periprosthetic fractures will also occur. This article focuses on the most common fracture types and current strategies adopted to overcome this challenging clinical problem. Our goal is to outline the role of locking plates in the management of knee periprosthetic fractures.

**Key Words:** knee fracture, periprosthetic fracture, knee arthroplasty, distal femoral fracture, fragility fracture

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## INTRODUCTION

By 2030, the total number of total knee arthroplasty (TKA) procedures in the United States will reach 3.5 million per year, which represents a growth of 600%, coinciding with a rise in incidence of periprosthetic fractures.[1–3] The typical challenges experienced while approaching those fractures are associated with the poor bone quality, short epiphyseal fragment, uncertainty about the stability of the replacement components, and conflict of space between those components and new fixation devices.[4] Here, the role of locked plating (LP) in the femur, tibia, and patella when faced with periprosthetic fractures about TKA is reviewed.

## Distal Femur Periprosthetic Fractures

The most used classification system for distal femur periprosthetic fractures was described by Lewis and Rorabeck, and it takes into consideration 2 variables, namely the displacement of the fracture and the stability of the femur component.[5] Type I is a nondisplaced fracture. Type II is a displaced supracondylar fracture with a stable femoral component. Type III is a fracture with an unstable femoral component. The most prevalent of these groups is type II, which may be managed by means of a standard plate, either a LP or an intramedullary nail (IMN). Systematic reviews of the literature demonstrate that LP and retrograde IMNs (rIMNs) offer superior outcomes when compared with nonoperative treatment or fixation with standard plates. LP may be associated with higher incidences of nonunion, if compared with rIMN. In the other way around, rIMNs are associated with higher rates of malunion, when compared with LP.[3]

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## The author's Preferred Method of Treatment

At the admission of the patient, a detailed history is obtained. The goals are to determine the following:

1. Time elapsed since the total knee replacement;
2. How functional was the knee before actual trauma;
3. If pain or inflammatory signals were present before trauma;
4. If this is a knee that has been operated multiple times or has been infected before actual trauma;
5. The design of the prosthesis—depending on the design of the femoral component, a retrograde nail could be considered as an option for surgical fixation;
6. Patient's comorbidities—special attention to factors associated with higher morbidity as noncontrolled diabetes mellitus, morbid obesity, and vascular diseases.

The clinical history and initial radiographs may suggest loosening of the femoral component, but not necessarily this is the case. In case there is no concern for a femoral component loosening, and depending on the orientation of the fracture plane, indirect reduction of the fracture by means of manual or skeletal traction and minimal invasive plate fixation (with the use of a long anatomical lateral locking plate) is a reliable treatment method for most of the cases. One has to be careful to avoid malalignment of the fracture, reassuring that the mechanical axis has been restored and that the distal femoral fragment is not hyperextended because of the insertion of the gastrocnemius muscles. Fluoroscopic control in multiple projections is recommendable. The operated leg is placed on top of a radiolucent foam wedge, keeping it higher than the opposite leg, which facilitates the fluoroscopic control for a proper reduction and hardware placement.

In case there is a concern about the stability of the prosthesis, an arthrotomy is recommended, and a complete inventory of the joint should take place. A lateral parapatellar approach can facilitate both exposure of the TKA and placement of a lateral LP; if medial plating is needed, the parapatellar approach can be extended proximally to mobilize the extensor mechanism medially to expose the anteromedial distal femoral surface. Percutaneous incisions are performed proximally to fix the lateral plate to the femoral shaft. A hybrid fixation approach is used, combining cortical and locking screws in the femoral shaft avoiding excessive stiffness aiming to reduce the risk of nonunion[6] (Fig. 1).

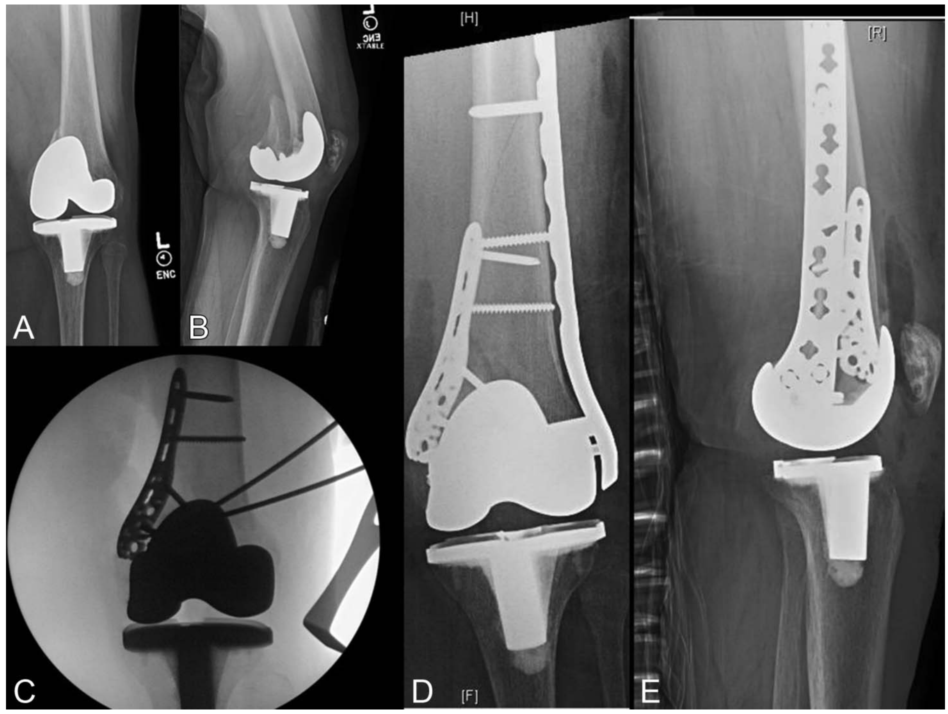


**FIGURE 1.** A and B, X-ray in anteroposterior and lateral views showing a periprosthetic Rorabeck type 2 fracture (displaced fracture with stable prosthesis). Observe the short lateral epiphyseal fragment and the medial apex of the fracture. C, Fluoroscopy image depicting fracture reduction, provisional fixation with K-wires, and an antiglide plate to buttress the medial apex of the fracture using an upside down proximal humeral locking plate. D and E, Fixation was then complemented with a lateral locking plate applied in a minimally invasive fashion. Observe that the first screw of the lateral plate proximal to the fracture is a cortical screw to avoid excessive stiffness.

In case the femoral component is considered loose, as confirmed at the time of the arthrotomy, the surgeon should be prepared for a revision TKA which most likely will imply in a distal femoral replacement.

The author's algorithm for the use of plates in periprosthetic fractures around the knee is outlined in Fig. 2.

## Proximal Tibia Periprosthetic Fracture

Periprosthetic proximal tibial fractures are rare and occur in less than 1% of patients after TKA.[7] Felix has described a classification system taking into consideration the location of the fracture line and the stability of the tibial component.[8] The most common type of fracture is type I, which is a fracture that extends from the metaphyseal area to the articular tibial plateau. If the component is stable in place, this fracture may be fixed with a LP. If the component is unstable, this requires a revision knee replacement. If the fracture happens intraoperatively, at the time of TKA, it will be up to the surgeon to decide whether he would favor a revision tibial component with a longer stem or a complement with plate fixation. The positioning of the plate will depend on the main fracture plane and the location of the apex of the fracture. In case of medial tibial plating, it is

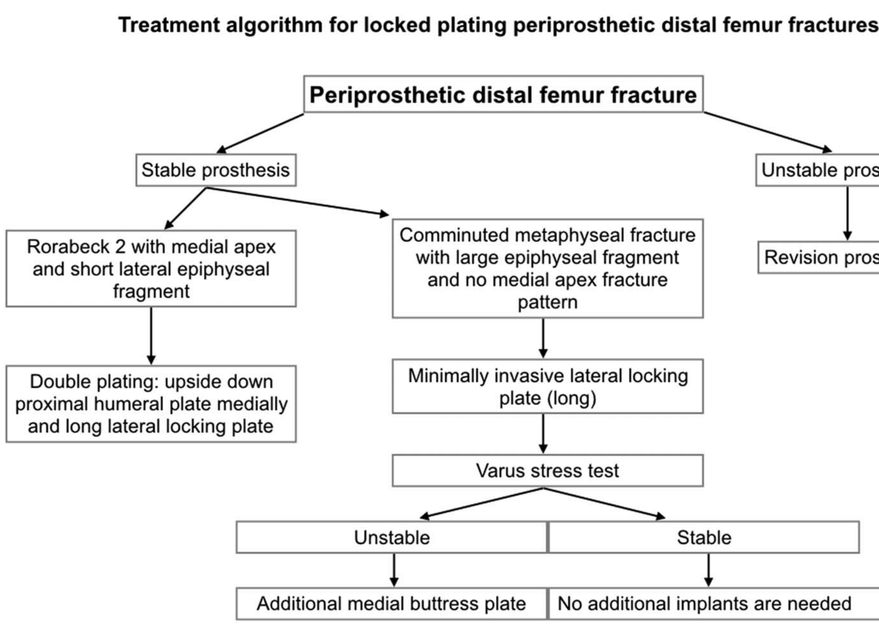


**FIGURE 2.** The author's algorithm for the use of plates in periprosthetic distal femur fractures.

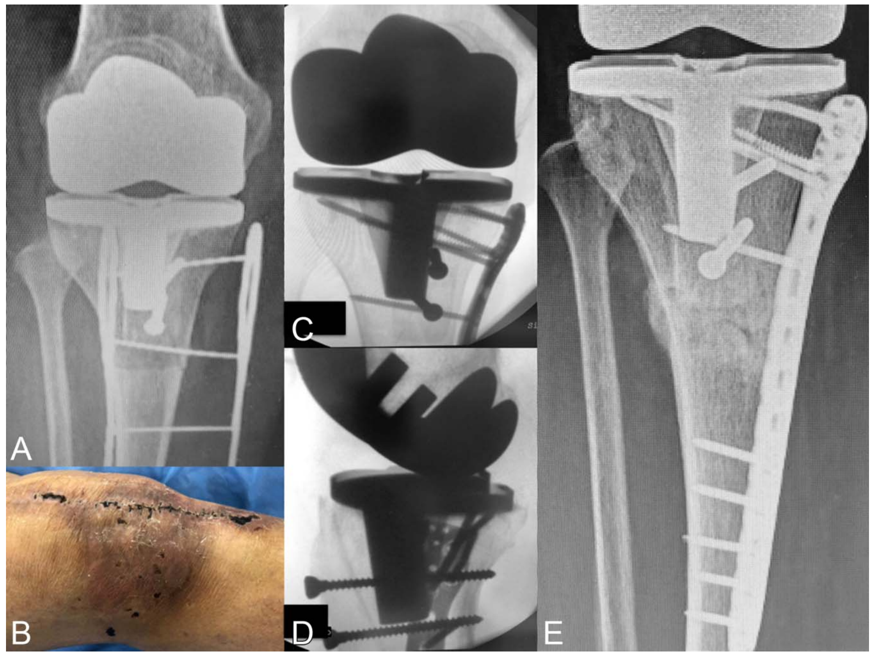


**FIGURE 3.** Treatment of a type 1 subclass A fracture pattern according to the Felix classification system in a patient who underwent patellar realignment 1 month before fracture due to rotational malalignment: A, Radiograph in anteroposterior view depicting a type 1 fracture in the fragility area of the anterior tuberosity osteotomy. B, Poor soft-tissue conditions in the lateral side of the knee before fracture fixation. C and D, Fluoroscopy images in anteroposterior and lateral views showing fracture fixation with a proximal humeral locking plate medially. Note the location of the plate in relationship to the axis of the tibial shaft and also the orientation of the screws regards to the tibial stem aiming to opttimize the fixation construct. E, Radiograph in the anteroposterior view showing fracture healing 4 months after operation. **Editor's Note**: A color image accompanies the online version of this article.

important to avoid periosteal and medial collateral ligament stripping, as this would result in knee instability. For the medial fixation of the tibia, once again, we advocate the use of the proximal humerus LP because of its low profile and proper conformity to this segment of the tibia (Fig. 3). The principles of treatment are to restore the axis, rotation, and length of the lower limb, building up a stable construct that will afford early motion and weight bearing.

## Patellar Periprosthetic Fracture

Patellar periprosthetic fractures are rare, and there are few reports in the literature regarding protocols of treatment.[9] Periprosthetic patellar fracture has a prevalence of 0.7%–1.2% after TKA. Predisposing factors include component malalignment and excessive resection of bone. Basically, the decision is guided by 2 factors. First, it is important to determine whether the extensor mechanism is intact. In case of tear of the extensor mechanism, a surgical repair is indicated. In case the fracture is marginal to the patellar component, or vertically oriented without compromise of the extensor mechanism, conservative treatment may be considered. This consists of weight bearing as tolerated and a hinge knee brace to provide comfort until the fracture is healed. In cases of disruption of the extensor mechanism, one has to determine whether the fracture is amenable

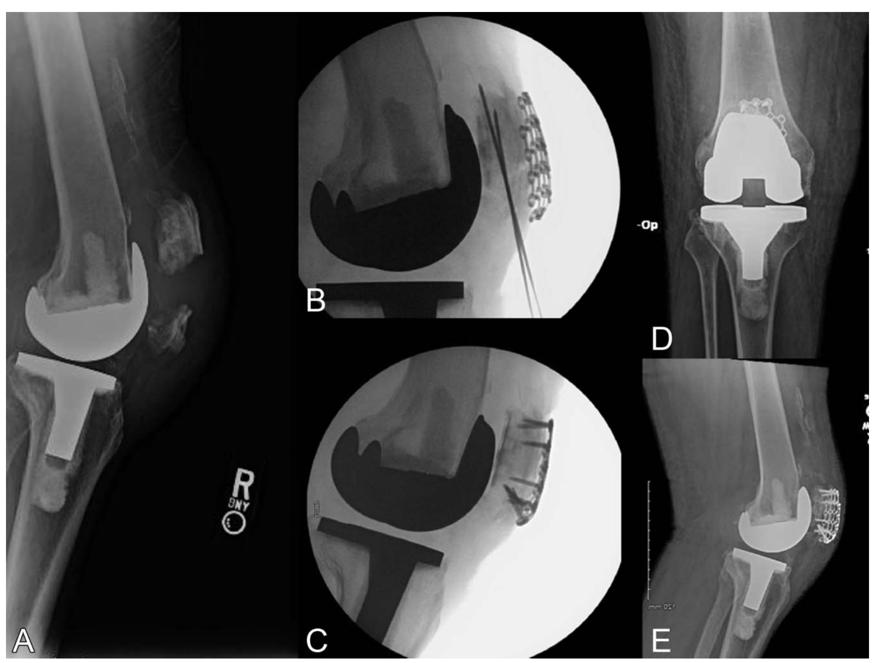


**FIGURE 4.** A, X-ray of a periprosthetic patellar fracture in the lateral view. B, Fluoroscopy image showing fracture reduction and provisional fixation with K-wires. C, Fluoroscopy image depicting fracture reduction and internal fixation with a mesh plate. D and E, X-ray in anteroposterior and lateral views showing fracture fixation with a mesh plate.

for fixation and whether the patellar component is stable in place. Transosseous sutures may be considered to reattach a very small inferior pole of the patella, aiming to repair the patellar tendon avulsion and fixing the sutures at the level of the superior pole of the patella. A protective circumferential cerclage may be applied to secure early motion while the extensor mechanism heals. More recently, the use of low-profile mesh plates has been described for the treatment of comminuted patellar fractures and even periprosthetic patellar fractures (Fig. 4).[10] The principle is to reduce the fracture with provisional Kirschner wires, restoring the continuity of the extensor mechanism. Sutures are placed to repair the retinaculum of the patella and the fiber of the extensor mechanism. The plate is precontoured and applied to the anterior aspect of the patella. The screws are unicortical and locked to the plate. The construct requires at least 4 locking screws on each side of the fracture. Early motion is tested intraoperatively and documented by fluoroscopy. Once the construct is stable, the patient is welcome to mobilize his knee as tolerated in the postoperative set.

## Postoperative Rehabilitation Protocol

For periprosthetic distal femur fractures fixed with a single lateral distal locking plate, we prefer a protected postoperative rehabilitation protocol. With the double-plate fixation protocol, active assisted range of motion and immediate weight bearing are initiated. In case of the elderly patients, the clinical comanagement of significant medical comorbidities should be provided.

## CONCLUSIONS

Periprosthetic knee fractures are gaining more awareness because of the increase in its incidence. The distal femur is the most common site of periprosthetic fractures around the knee. LP and rIMN are implant alternatives for these fractures. Buttressing the main fracture plane and in case of a comminuted fracture in a very frail bone, the fixation of the medial and lateral columns of the femur can provide improved biomechanical stability. This may be achieved by the combination of medial and lateral plates, or lateral plate and rIMN. Tibial periprosthetic fractures are rare and may occur intraoperatively or postoperatively. Fractures amenable to be fixed may be suitable to the use of locking plates. Care should be taken to avoid compromise of the medial collateral ligament when dealing with the intraoperative medial tibial plateau fracture. Periprosthetic patellar fractures should be operated in case there is compromise of the extensor mechanism of the knee. Depending on the location and pattern of the fracture, the use of low-profile locking plates may be considered.

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