

Periprosthetic Fractures After Total Knee Arthroplasty

Ravi Tharani, MD, Cass Nakasone, MD, and Kelly G. Vince, MD, FRCS(C)

Abstract: Fractures around total knee arthroplasties are challenging clinical problems and include the following: stress fractures of the pelvis and femoral neck, supracondylar femur fractures, fractures of the proximal tibial metaphysis and diaphysis, and patellar fractures. Treatment focuses on restoration of the patient's prefracture functional status. The etiology of supracondylar femur fractures is multifactorial and treatment includes immobilization, retrograde intramedullary nailing, open reduction and internal fixation, and revision arthroplasty. The "Less Invasive Stabilization System" plate has recently been added to the list of viable fixation options. Tibial metaphyseal and diaphyseal fractures are less common and usually treated with revision arthroplasty. In the absence of maltracking or component loosening, vertical patellar fractures often respond to immobilization. Disruption of the extensor mechanism may require cerclage wiring or even extensor mechanism allografting if chronic. Conventional tension band wiring usually fails. Patellar fractures are controversial and problematic. **Key words:** knee, arthroplasty, complications, fracture.

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Periprosthetic fractures around total knee arthroplasties (TKAs) represent a challenging problem in joint arthroplasty. Cain et al [1] described the successful treatment of periprosthetic fractures about TKA as the absence of knee pain, fracture union in less than 6 months, range of motion from 0° to 90°, and a return to normal ambulatory status. Treatment options include conservative and operative methods. Both have advantages and disadvantages that must be considered before deciding the appropriate course of treatment. The risk of fracture around knee arthroplasties is a result of surgical technique and inherent uncontrollable patient

factors. In the following sections, we will discuss risk factors, the different types of periprosthetic fractures, and current treatment options.

Stress Fractures of the Pelvis and Femoral Neck After TKA

These fractures may be difficult to diagnose immediately after an otherwise successful knee arthroplasty and there may be concern as to whether the fracture resulted directly from the surgical technique or a fall after surgery. Both pubic rami fractures [2,3] and fractures of the femoral neck [4-6] have been described in association with knee arthroplasty and are attributed to profound osteopenic disease. Most of these patients are aged, have not been weight bearing normally for a considerable period before surgery, and have these insufficiency fractures because of becoming mobile again. Conventional treatment prevails and awareness of the possibility in these deconditioned patients will help avoid problems.

From the Department of Orthopedic Surgery, Keck School of Medicine, University of Southern California, Los Angeles, California.

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Reprint requests: Kelly G. Vince, MD, FRCS(C), Department of Orthopedic Surgery, Keck School of Medicine, University of Southern California, 1520 San Pablo Street, Los Angeles, California, 90033.

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Supracondylar Femur Fractures Above Total Knee Arthroplasty

Incidence and Classification

The incidence of supracondylar femur fractures above TKAs has been reported to be between 0.3% and 2.5% [7]. These fractures occur between the immediate postoperative period to more than a decade after surgery with a mean of 2 to 4 years [8]. Rorabeck and Taylor [9] described 3 types of periprosthetic femur fractures. Type 1 described nondisplaced fractures with a stable prosthesis. Type 2 included displaced fractures with a stable prosthesis and type 3 involved displaced or nondisplaced fractures associated with a loose prosthesis. The last type was first described by Hirsh et al [10] in 1981 and, since that time, has been the focus of much controversy regarding optimal treatment.

Risk Factors

Periprosthetic supracondylar fractures of the femur are likely the result of interaction between 3 major factors: osteopenia, femoral notching, and poor flexion. Experienced surgeons debate the significance of notches in the anterior femoral cortex resulting from the position of the femoral component.

Biomechanical studies show a 30% decrease in torsional strength of the femur when there is a 3-mm notch of the anterior cortex [11]. Aaron and Scott [11] reported that of 250 TKAs, 42% of femurs with a significantly deep resection of the trochlear groove (femoral notch) had a periprosthetic supracondylar fracture. None of the femurs without notches had fractures. They also noted that osteopenia was significant in patients that had fractures. Similarly, Culp et al [12] examined 61 periprosthetic supracondylar femur fractures in 58 patients. Of these 61 cases, 27 (44%) had notching of the anterior femoral cortex. By contrast, Ritter et al [13] published a report of 670 knee arthroplasties. Of these, 27% had identifiable notching greater than 3 mm. However, only 1 of these 180 cases led to fracture [13].

Poor flexion is discussed less frequently as a risk factor for supracondylar fracture. Patients with poor flexion from a stiff knee arthroplasty increase their risk of fracture in 2 ways. First, they are less mobile and agile, which increases their risk of falling. Secondly, when they fall, where a supple knee would flex and assist in energy dissipation in the accident, the stiff knee absorbs the energy and transfers it to host bone. The optimistic findings of Ritter et al [13] illustrate the fact that femoral

notching in isolation may not be terribly significant, but the combination of an anterior femoral stress riser, osteopenic bone, and poor mobility with a stiff knee unable to dissipate energy through flexion likely increases the risk of supracondylar fracture significantly.

Treatment

Conservative management includes closed reduction with immobilization or skeletal traction to maintain alignment [10,14,15]. The advantage of this approach is the avoidance of surgical risk, especially in patients with significant comorbidities that make surgical intervention unreasonably dangerous. Disadvantages include difficulty in achieving and maintaining fracture alignment. Prolonged immobilization may promote physical deconditioning, venous thromboembolism, muscle atrophy, and delayed healing.

Retrograde intramedullary (IM) nailing gained popularity in the mid-1990s. McLaren et al [16] and Rolston et al [17] both described good results after the use of a locked IM nail inserted retrograde through the femoral component. This allowed stable fixation of the fracture through a minimal approach with decreased operative time and blood loss. However, because of the poor supracondylar fit of an IM nail and difficulty achieving solid fixation in osteoporotic bone, varus malalignment became problematic. Nonunion, loosening of the locking screw with migration of the nail into the knee joint, and decreased range of motion have all been reported with this method of stabilization [18]. In addition, some femoral components do not allow access to the medullary canal. Other concerns have been metallosis and accelerated polyethylene wear due to interaction at the rod-prosthesis interface [19].

Flexible IM nails have also been used. Ritter et al [20] described 22 displaced supracondylar femur fractures above TKAs that were treated with Rush rods. All patients achieved union within 4 months. The average femoral anatomic valgus angulation before fracture was 7° with an average of 10° at final follow-up. Two patients healed with a valgus malunion of 15°. The authors recommended Rush rods as a reliable method of treatment not requiring extensive exposures. Hayakawa et al [7] reported on 5 patients treated with Ender's nails. All patients achieved union and were ambulatory at final follow-up. Knee flexion and extension were not significantly changed at final follow-up but malunions occurred. The authors reported adequate results with the use of Ender's nails. Reported

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