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Grand Rounds from HSS

MANAGEMENT OF COMPLEX CASES

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FROM THE EDITOR

Our focus in this volume is knee replacement periprosthetic injury.

We have become inured with the remarkable increase in knee and hip replacement surgery. Advances in technology and improvements in surgical technique have rendered the outcomes of this surgery unrivaled in successfully relieving pain, improving function and quality of life, with ever increasing anticipated durability. With documented, widely acclaimed patient satisfaction, the demographics are also dramatically changing. Increased volume and demand are due to the improved general health and increased levels of activity of older patients combined with the higher expectations of younger patients electing to undergo joint replacement.

More than 4.5 million Americans currently live with total knee replacement in at least one knee, nearly 5 percent of the population age 50 and older. As a result, the inevitable challenge of managing an increased incidence of periprosthetic soft tissue injury and fracture.

Charles N. Cornell, MD discusses three cases of periprosthetic knee injury. The first is a 77-year-old male with supracondylar fracture above a total knee prosthesis repaired using a lateral distal femoral locking plate; the second a supracondylar fracture in a 54-year-old female with such extensive metaphyseal comminution that it was necessary to revise the arthroplasty to a distal femoral replacement. The final case demonstrates the challenge of patellar tendon rupture in a 54-year-old male resulting from a fall following revision total knee arthroplasty.

This and past volumes of *Grand Rounds from Hospital for Special Surgery/Management of Complex Cases* are available on the HSS Web site, **www.hss.edu/complexcases,** where you will find additional images and references as well as links to related articles. We hope you find these cases to be of interest and the principles presented informative. Comments may be emailed to **complexcases@hss.edu** and are always welcome.

— Edward C. Jones, MD, MA, Assistant Attending Orthopaedic Surgeon

In this issue

CASE 1

Supracondylar Periprosthetic Fracture Above a Total Knee Replacement Repaired Using a Lateral Distal Femoral Locking Plate

Case presented by Charles N. Cornell, MD and Peter K. Sculco, MD

CASE REPORT: A 77-year-old male in good general health presented with painful osteoarthritis of the left knee of several years duration. Conservative measures including oral anti-inflammatory medications, intraarticular steroids and hyaluronic acid injections as well as physical therapy had failed to adequately control the painful symptoms. The patient elected left total knee replacement (TKR), which was performed with posteriorly stabilized components. An uneventful post-operative course was achieved and the patient was discharged on the fourth post-op day with a home care physical therapy program. Two weeks following discharge, the patient slipped and fell while entering a coffee shop and suffered a displaced supracondylar fracture above the femoral component at the diaphyseal-metaphyseal junction (Figures 1A and 1B). The femoral component fixation was undisturbed.

With adequate bone stock available for fixation of the distal component of the fracture, ORIF using a condylar locking plate was planned. The patient was placed in the lateral decubitus position and lateral approach to the femoral shaft, fracture site and distal aspect of the femur was performed through a subvastus approach. The fracture was reduced and preliminary fixation with 4.5mm cortical lag screws was performed. A 14 hole supracondylar locking plate was applied using a combination of locking and conventional screws securing stable fixation of both the proximal and distal fragments (Figure 2).

Post-operatively, immediate partial weight bearing was allowed with active and active assisted range of motion training for the knee replacement. The post-operative course was complicated by significant lower extremity swelling which was treated by compressive stockings and limb elevation. At 4 months after repair of the fracture, radiographs revealed abundant callus formation and the patient was advanced to full weight bearing (Figure 3). At one year following fracture repair the lower extremity swelling had resolved, full ambulation was restored and the patient had full extension with flexion to 120 degrees.

DISCUSSION: Periprosthetic fractures around total knee replacements are relatively uncommon but are being encountered more frequently as the population of patients with TKR has grown. These fractures often occur in the elderly and may be associated with osteoporosis, making fracture fixation difficult. The presence of the femoral TKR component can restrict the options for surgical repair of the fracture. Nonsurgical management has been less successful than surgical repair especially in cases of displaced fractures (1,2). Traditional approaches to fixation using conventional buttress plates and even blades plates were often unsuccessful due to varus collapse of the fractures. Although retrograde intramedullary nails have been successful in stabilizing supracondylar fractures, they have been less successful in periprosthetic fractures due to the frequently wide metadiaphyseal canal, osteopenia and comminution of the supracondylar area (1,2). Nonunion as well as malalignment were common with intramedullary nails which led to poor recovery of function of the TKR. Since their introduction, plates designed for fixation of supracondylar fractures with the capacity for locking screws have been used with better success.

Continued on page 5

FIGURE 1A

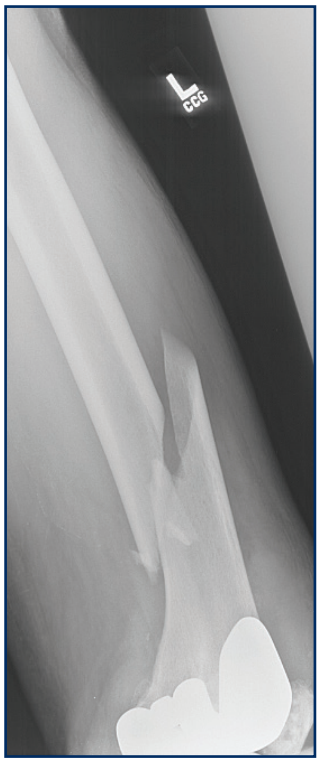

FIGURE 1B

FIGURE 2

FIGURE 3

FIGURES 1A and 1B: Radiographs showing displaced unstable supracondylar fracture above the total knee prosthesis; (1A) AP view, (1B) lateral view.

FIGURE 2: Radiograph showing AP view after open reduction internal fixation of the supracondylar fracture using a 14 hole supracondylar locking plate.

FIGURE 3: Radiograph, AP view, at 4 months after supracondylar locking plate fixation, showing abundant callus formation permitting full weight bearing.

CASE 2

Supracondylar Periprosthetic Fracture Above a Total Knee Replacement Revised to a Distal Femoral Replacement

Case presented by Charles N. Cornell, MD and Jason Blevins, MD

CASE REPORT: A 54-year-old female with a complex medical history presented with a painful deformed right knee. As a child she suffered an intracranial bleed from a cerebral aneurysm that resulted in a left-sided spastic hemiparesis and a seizure disorder. As a young adult she developed Hodgkin's Lymphoma requiring aggressive treatment with chemotherapy and an eventual bone marrow transplant to achieve a cure. As a result of the aggressive chemotherapy, marrow transplant and the need for anti-seizure medication, she developed osteoporosis.

Upon presentation the patient had disabling right knee pain rendering her unable to ambulate without assistance. The knee was aligned in 20 degrees of valgus; with a 20 degree flexion contracture and loss of the lateral joint space documented by conventional radiographs (Figure 1). The right lower extremity exhibited normal muscle strength and tone.

Right total knee replacement (TKR) was performed using posterior stabilized components (Figure 2). The patient made an uneventful recovery with restoration of normal right lower extremity alignment and recovery of full extension and 120 degrees of motion. Four months following the TKR the patient fell in her home and sustained a grossly displaced supracondylar fracture at the level of the femoral prosthesis with considerable metaphyseal comminution (Figure 3).

At surgery an attempt was made to perform ORIF using a lateral locking plate. The femoral component was well fixed. However, the severe osteopenia and poor bone stock prevented secure distal fixation. The metaphyseal comminution made restoration of the proper length and coronal and sagittal alignment of the distal femur difficult. The plan for ORIF was abandoned and the distal femur was excised. A modular, hinged distal femoral replacement was performed. The intramedullary canals were reamed to accept cemented intramedullary stems and a prosthesis was assembled using trial components. Careful trialing was performed with additional resection of proximal tibia to recreate the level of the natural joint line. This was essential to restore extensor mechanism function and to ensure proper patellar tracking. A lateral retinacular release was also required to establish stable patellar tracking. The trial components were then removed. The intramedullary stems were cemented using a cement plug for the femoral canal for aggressive cement pressurization and the entire tibial stem was cemented as well. Meticulous wound closure over a drain was performed (Figures 4A and 4B).

Post-operatively the patient recovered without complication. She regained 105 degrees of flexion with full extension and good extensor strength.

DISCUSSION: The decision to perform distal femoral replacement in the reconstruction of the knee following periprosthetic supracondylar fracture is indicated only after abandoning a plan for ORIF. The reported experience of rotating hinge prostheses implanted for non-tumor reconstruction is limited and concerns regarding the long term durability of these implants must be considered. Furthermore, the immense complexity of dealing with infection and failure of these implants

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FIGURES 1: Pre-operative nonweight-bearing AP radiograph of the right knee, with valgus deformity and tricompartmental degenerative changes.

FIGURE 2: Post-operative AP radiograph of the right knee after posterior stabilized total knee replacement.

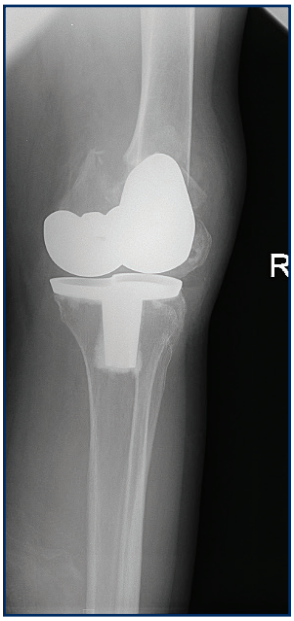
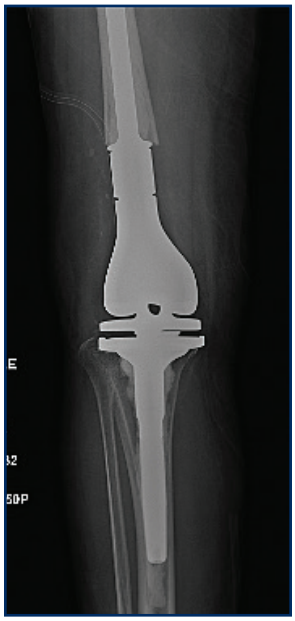


FIGURE 3: Radiograph four months after total knee replacement demonstrates a displaced supracondylar fracture at the level of the femoral prosthesis with considerable metaphyseal comminution.



FIGURES 4A and 4B: AP (4A) and lateral (4B) radiographs demonstrate the modular, hinged distal femoral replacement with cemented intramedullary stems with restoration of the level of the natural joint line (4B).

CASE 3

Patellar Tendon Rupture Resulting From a Fall Following Revision Total Knee Arthroplasty

Case presented by Charles N. Cornell, MD and Sravisht Iyer, MD

FIGURE 1: Photograph showing dehiscence of the surgical wound and distal rupture of the patellar ligament.

FIGURE 2: Post-operative lateral radiograph of the right total knee replacement after reconstruction of the patellar ligament demonstrating restored patellar position and the bone tunnel in the anterior tibial cortex, site of passage of the allograft distally.

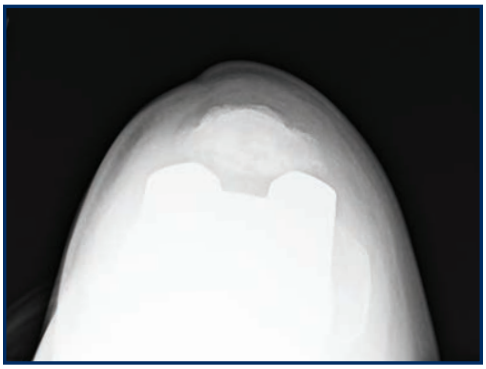


FIGURE 3: Merchant view radiograph showing proper alignment of the patella after patellar ligament repair.

CASE REPORT: A 54-year-old male presented with a painful right total knee arthroplasty following multiple prior surgeries. Most recently, the patient had undergone a 2-staged revision for treatment of deep infection. He was 12 months following the re-implantation and presented complaining of constant pain, swelling and a sense of instability in the knee. On examination the right knee had a moderate effusion but no signs of infection. The knee exhibited approximately 10 degrees of recurvatum and flexed to 140 degrees. There was both coronal and sagittal plane laxity at 90 degrees of flexion with an anterior draw subluxation of 10mm with no firm endpoint. Work-up for recurrent infection was negative and radiographic examination documented stable bone cement interfaces with no evidence of component loosening. Review of the patient's operative records indicated that the patient had a 13mm constrained condylar (CCK) tibial insert. The patient was advised to undergo revision surgery, inserting a thicker tibial component to stabilize the knee.

At the time of surgery the tibial component was revised to a 22mm CCK plastic tibial insert. Post-operatively the patient experienced immediate improvement in the sense of knee stability, uncomplicated early wound healing and recovery of both walking and functional range of motion.

Three weeks following revision surgery the patient slipped and fell backwards when walking on an icy sidewalk. The knee was hyperflexed during the fall resulting in a dehiscence of the surgical wound and distal rupture of the patellar ligament (Figure 1). The patient was taken emergently to the OR for irrigation and debridement of the open wound with repair of the ruptured patellar ligament. At surgery the patellar ligament was ruptured just above the tibial tubercle leaving a very small distal stump of ligament. The wound was meticulously debrided of any foreign and necrotic material. Thorough irrigation was performed. Direct suture of the patellar ligament would have likely resulted in shortening of the ligament with creation of patella baja. A #5 polyester suture was placed using a modified Kessler technique. A 3-5mm discontinuity in the ligament resulted. To reinforce this repair and provide ligament continuity an allograft semitendinosus tendon was obtained from our tissue bank. The allograft was tubed using a #5 polyester Bunnell-type suture. A tunnel was drilled from lateral to medial just posterior to the tibial tubercle and the allograft was passed through this tunnel. The graft was then woven through the patellar ligament in figure 8 fashion, bridging the small defect and reinforcing the repair. It was sutured to itself and the surrounding ligament using a #2 polyester suture. A careful, tension-free closure of the skin was performed over a suction drain and a vacuum assisted dressing was applied for 4 days following surgery until the wound appeared sealed without drainage.

Post-operatively, the knee was maintained in full extension in a brace for 6 weeks. Quadriceps isometric exercises were started at 4 weeks post-op with the brace in place. At 6 weeks the patient could maintain full extension with palpable continuity of the patellar ligament repair. Passive flexion extension exercises were then allowed advancing to 90 degrees of flexion over 4 weeks. Active exercises and quadriceps strengthening were then begun and slowly advanced. At four months post-op there was complete wound healing without evidence of infection. The patient had full active extension with 120 degrees of knee flexion and proper patellar alignment (Figures 2 and 3).

DISCUSSION: Falls resulting in extensor mechanism disruptions, unless repaired, will lead to disabling loss of knee function. Although these disruptions can occur anywhere along the extensor mechanism, patellar ligament disruptions are likely due to the compromise of the patellar ligament insertion that follows revision surgery. Direct primary suture of the ruptured tendon is often impossible due to the poor quality of the injured ligament and care must be taken not to fix the patella in a baja position. Many techniques for reconstruction using adjacent hamstring tendons to complete autograft reconstruction have been described (1). For modest deficiencies, use of an allograft semitendinosus tendon can provide sufficient reinforcement to

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CASE 1 CONTINUED

More stable fixation, better restoration of the mechanical axis and sufficient stability to permit earlier weight bearing have been reported. In many cases when conventional and locking screws are used the plate can be a reduction aid. Several authors have reported successful application of these plates with minimally invasive, indirect approaches (2,3,4). In this case the adequate bone stock of the distal fragment, the well-fixed femoral component and the relatively normal bone quality of this patient made the supracondylar locking plate an ideal choice for management of this fracture. ■

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CASE 2 CONTINUED

must also be factored into the decision to undertake this approach. However, when facing severe comminution and poor bone stock often encountered with these fractures, distal femoral replacement often provides the best approach if only for the short term. A useful classification system has been proposed to help make this decision (1,2).

In most cases we favor use of cemented intramedullary stems for these cases. Younger patients with relatively normal appearing diaphyseal cortices can be treated with press-fit on-growth stems but we have encountered several cases of poor fixation of uncemented stems in elderly and osteoporotic patients. Furthermore, attempts to press fit stems into widened medullary canals often results in periprosthetic fracture. In most cases we favor cement fixation of both the femoral and tibial stem extensions using up to date technique for achieving excellent pressurization of the cement.

Additionally, use of a modular system that provides flexibility in re-establishing the joint line is critical for recovery of post-op range of motion, muscle strength and stable patellar tracking. Use of trials to confirm the accuracy of the joint line reconstruction is essential prior to assembly and implantation of the final prosthesis (3).

The advantage of the distal femoral replacement is that it allows immediate weight bearing and rehabilitation following surgery. Care must be taken to ensure that the rehab program is tailored to the successful healing of the wound, but once primary healing is achieved, aggressive rehabilitative exercises can be started. The reported short term results of distal femoral replacements are excellent but only intermediate term follow-ups are reported. Many patients experience early complications and often require additional surgery but usually at 5 years following surgery excellent functional outcomes and durable fixation are reported in over 80% of cases (3,4). ■

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CASE 3 CONTINUED

achieve reconstitution of the ligament with avoidance of added morbidity of autograft harvest. For more substantial loss of the ligament, complete allograft extensor mechanism reconstruction is necessary (2,3). If the injury makes primary wound closure difficult then a medial gastrocnemius flap should be rotated to achieve secure wound closure. Some authors have found that the medial gastrocnemius flap itself can be adequate to restore extensor function (4). It is imperative that the knee be maintained in extension to allow healing of the repair for 6 weeks with gradual progression of flexion over 4-6 weeks thereafter. Failure to maintain this period of extension will lead to incomplete healing or stretching of the repair resulting in a prolonged or permanent extensor lag. Functional flexion is predictably achieved in spite of this immobilization as reported in most series (2,3). Aggressive quadriceps muscle strengthening is permissible 12 weeks following the repair. ■

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