Case Challenges in Hip and Knee Surgery

KNEE CHALLENGES:
WHAT WOULD YOU DO?

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Panelists: Lawrence D. Dorr, MD; David S. Hungerford, MD;
John N. Insall, MD; Richard D. Scott, MD; Leo A. Whiteside, MD

CASE 1
A very active woman had sustained a supracondylar fracture of her left femur 20 years prior to being examined in 1981, at which time she was 62 years of age, 5'11", and weighed 220 lbs. She had been treated with a cast, and the fracture healed in the position shown on the first set of radiographs (Figs 1A-B). She had returned to a very active lifestyle until 1981, by which time she had become incapacitated by her pain and deformity.

S. David Stulberg, MD: Dr Insall, how would you treat this situation?

John Insall, MD: I would do a total knee replacement (TKR). I would disregard the angulation that is in the femur. This would probably mean that you need to use a degree of eyeballing for the placement of the femur. You have to use external references rather than intramedullary instrumentation. I do not think that you have to correct the extraarticular deformity in this case to do a TKR. You can obtain the appropriate correction within the knee by orienting the resections correctly.

Stulberg: How far would you push the principle of correcting an extraarticular femoral deformity with an intraarticular TKR? Is there a degree of angular or rotational deformity beyond which you cannot gain correction through the knee?

Insall: I would push the principle pretty far.

Stulberg: So when the fracture is close to the knee joint, you would be willing to allow a substantial amount of deformity to be corrected by the TKR?

Insall: Yes.

David Hungerford, MD: In this case, in order to determine the distal resection angles on the femur, one draws a line from the center of the femoral head to the center of the knee. The distal femoral cut is either perpendicular to this line or 3 degrees of valgus to the perpendicular. If these lines are drawn, one can determine, preoperatively, roughly how much distal femur must be resected to restore proper alignment. It goes without saying that the procedure must restore the correct alignment of the extremity. In this case, a laterally based wedge of whatever the degree of deformity will have to be removed. It appears that the degree of deformity is roughly 15 degrees. This means an over-resection, relative to the normal-sized resection, of the lateral distal femur will have to be performed. I would be concerned that this relative over-resection will produce instability on the lateral side. However, a relative over-resection of the posterior portion of the lateral condyle does not appear necessary in this case. Therefore, an instability would exist in extension, but not in flexion. Therefore, this instability could not be treated simply by doing medial release and putting in a thicker tibial plateau. Correction of the deformity, therefore, with a TKR may lead to a complex instability. My question for Dr Insall is, do you feel that a CCK-type prosthesis should be used in this case? Lateral instability is often relatively well-tolerated because it is dynamically stabilized by the popliteus tendon and the iliotibial track and the biceps femoris.

Therefore, what I would do in this case is a laterally based, wedge supra-condylar osteo-
Figs 1A-B: AP radiographs of a 62-year-old woman who sustained a supracondylar fracture of her left femur 20 years ago. She now has severe pain secondary to degenerative arthritis of her left knee.

Figs 1C-D: A TKR was performed in 1981. A cemented, cruciate-retaining implant system was used. The patient returned to a very active lifestyle.

Figs 1E-F: By 1988, 7 years after the TKR, the implants were subluxating and the patient was very symptomatic.

To correct the deformity to neutral, internally fix the osteotomy, and then see how she does. I suspect that the osteotomy alone would provide her with 5 to 7 years of relatively comfortable function. Correcting an extraarticular deformity that, over a long period of time, has caused secondary arthritis often produces the same pain-relieving effect as an osteotomy done for primary arthritis.

Stulberg: Is it true that the younger and more active the patient, the more inclined you would be to treat the symptoms with a corrective osteotomy?

Insall: Absolutely.

Richard Scott, MD: I would do both the TKR and an osteotomy. I would prepare the femur first with symmetrical femoral condylar resections. Then I would enter the intramedullary canal, do a closing wedge osteotomy based on the lateral side, and skewer that with a press-fit rod or cemented stem, whichever I needed for adequate fixation.

Lawrence Dorr, MD: I agree with Dr Insall. I think that, to avoid instability, it is critical that a flat prosthesis not be used. I would carry out a TKR, and I would take more off of the distal lateral femoral condyle. I would elevate the superficial medial collateral ligament. The morbidity is much less if you do not add an osteotomy to the TKR procedure.

Scott: I absolutely disagree with Dr Dorr. The ligaments are built for a knee in normal alignment, not a knee in relative varus. A large lateral resection will require too extensive a medial release.

Stulberg: In 1981, the TKR in Figures 1C-D was performed. The prosthesis used was a cruciate-sparing, flat-on-flat prosthesis. Dr Insall, how do you feel about the alignment achieved and prosthesis type chosen?

Insall: The alignment is fine. However, a dished, condylar-type prostheses provides the surgeon with more flexibility to carry out large bone resections or more extensive ligament releases.

Stulberg: The patient did very well for 7 years. She returned to a very active lifestyle. She then developed the radiographic findings you see in Figures 1E-F. Dr Whiteside, would you please comment on the current situation and what you would do now?

Leo Whiteside, MD: It is not clear to me why the procedure failed. I, too, would have done a TKR. The rule of thumb that I use is that if I can project the intramedullary canal of the femur somewhere on the lateral surface of the joint, then I use that location as an entry point for the intramedullary rod. I then resect the thickness of the implant from the lateral side. That leaves a defect on the medial side, which can be corrected by inserting the implant and releasing the medial ligaments. At this point, I would probably revise the primary TKR, use a thicker tibial component, and balance the ligaments. The lateral ligaments may need to be tightened.

Stulberg: How about you, Dr Insall?

Insall: I would revise the TKR using a semi-constrained prosthesis and the resection principles I discussed earlier.

Stulberg: A revision was performed using a cruciate-sacrificing, semi-constrained prosthesis with augmentation blocks to treat the bone...
deficiencies distally and posteriorly (Figs 1G-H). She returned to her previous level of activity. Any comments?

Insall: The alignment looks satisfactory.

Scott: It looks to me as if the femoral alignment is still in slight varus. That might result in trouble.

Stulberg: In fact, it did. One year after the revision procedure she sustained a fatigue fracture of her distal femur, almost at the level of her original deformity. The fracture was treated closed, with a long-leg cast, and healed (Figs 11-J). As you can see in Figures 1K-L, the overall leg alignment is now, finally, correct. It is, I guess, better to be lucky than good.

CASE 2

A very active, 50-year-old man underwent an uncemented TKR. He returned to his former lifestyle and was functioning very well when he slipped, fell, and sustained a femoral fracture (Figs 2A-B).

Stulberg: Dr Whiteside, how would you treat this fracture?

Whiteside: I would perform a reduction and internal fixation, perhaps using the Rush rod technique that Dr Merrill Ritter has advocated.

Hungerford: Although some minimally displaced supracondylar fractures following TKR can be treated non-surgically, I believe that this case should be treated surgically. Dr Booth summarized the surgical options available in a talk given earlier today. In addition to the Rush rod technique, the compression-screw and side-plate technique, and the compression-plate technique, one should be aware of the technique in which an interlocking nail is passed, percutaneously, through the intercondylar notch and up the femur. This is usable with prostheses that allow access up the intramedullary canal through the intercondylar notch.

Stulberg: Would anyone treat this fracture non-operatively?

Panel: No.

Stulberg: The fracture was treated initially with skeletal traction applied through a tibial wire. The leg was then placed in a cast that incorporated the pin (Figs 2C-D). A nonunion developed. I first saw the patient 1 year after the fracture with the radiographs you see in Figures 2E-F. At this point, would everyone on the panel treat this surgically with one of the methods mentioned by Dr Hungerford?

Panel: Yes.

Stulberg: Would everyone place bone graft around the reduced, fixed fracture?

Panel: Yes.

Stulberg: An open reduction and internal fixation using a compression screw and long side plate was used. Bone graft was used in addition to the fixation device (Figs 2G-H). In my experience, these fractures, particularly those that are nonunions, may take quite some time to heal. I protect these patients until signs of union occur. The patient has now returned to his previous level of activity.

CASE 3

A 58-year-old woman with multi-articular rheumatoid arthritis underwent a right TKR in 1978. Cruciate-retaining implants, with an all-polyethylene tibia, were cemented in place. In
Figs 2A-B: A 51-year-old man who had undergone an un cemented TKR 1 year ago fell and sustained a supracondylar fracture of the left femur. He had been doing very well prior to the fracture.

Figs 2C-D: The fracture was treated with skeletal traction applied through a tibial wire. A long leg cast was then applied which incorporated the wire.

Figs 2E-F: A non-union was present 1 year following the fracture. The implants appeared well fixed.

Figs 2G-H: A nonunion was treated with an open reduction and internal fixation using a compression screw and side plate. Cancellous graft was applied to the nonunion. After a 2- to 3-week period of cast immobilization, the knee was mobilized in a cast brace. The patient now has 110 degrees of flexion and is very active and pain-free.

1981, when the patient was 61, she underwent a left TKR with the same implant system, except that a metal-backed tibia was used (Figs 3A-B). She did very well until 1990, when she was mugged and sustained the left tibial fracture you see in Figures 3C-D.

Stulberg: How would you treat this fracture, Dr Insall?

Insall: I would probably treat this fracture non-surgically. I might use traction followed by immobilization. I think that, in general, it is unwise to revise a total knee component in the presence of a fresh fracture. If the implant was well-fixed prior to the fracture, I would allow the fracture to heal and then determine if a revision was necessary.

Hungerford: I agree with this approach.

Dorr: I would also treat this fracture closed. However, I would not use traction. I would use a fracture brace and try to mobilize the knee. Incidentally, Dr Scott, notice that it was the tibia with the metal-backed implant that fractured.

Scott: A patient who has had a total knee replacement for 8 or 9 years which has functioned well and has had good motion does not lose motion when put in a cast for awhile. Therefore, I would treat her with a solid cast for several weeks and then a cast brace.

Stulberg: That is exactly how this fracture was treated. As you can see on the radiographs (Figs 3E-F), the fracture healed and she regained her preinjury range of motion.

CASE 4

A 34-year-old woman sustained a closed lateral tibial plateau fracture in 1988. The fracture healed, but the patient was having a substantial amount of pain (Figs 4A-B). The treating orthopedic surgeon felt that a femoral, varus supracondylar osteotomy would align her leg and relieve her pain. This procedure was performed in 1990. The osteotomy was fixed with a supracondylar nail and side plate (Figs 4C-D). The osteotomy did not unite (Figs 4E-F), so the internal fixation device was exchanged for an external fixator (Figs 4G-H). The non-union persisted (Figs 4I-J), the bone of the distal femur resorbed, and the patient had a substantial amount of pain.

Stulberg: Dr Whiteside, how would you proceed at this point? She was 38 years old at the time these radiographs in Figs 4I-J were taken.
Figs 3A-B: In 1978, at the age of 58, this patient with multi-articular rheumatoid arthritis underwent a right TKR. In 1981, at the age of 61, she underwent a left TKR. The implants functioned very well.

Fig 3A.

Fig 3B.

Whiteside: Once I had established that there was no infection present, I would carry out a TKR and use a femoral component with a long stem.

Scott: I would do the same thing.

Dorr: I believe that the joint is bad for three reasons, and, therefore, needs a TKR. Firstly, the tibial plateau fracture resulted in an uneven joint surface. Secondly, the supracondylar osteotomy extended into the intercondylar notch and produced a displaced intraarticular fracture. Thirdly, the joint has been immobilized for a long time. The immobilization itself would have resulted in deterioration of the articular cartilage. I would also use a femoral component with an intramedullary rod if the fracture is not united. An offset rod may be necessary. If the fracture is actually united, I would use a femoral component without an intramedullary rod.

Hungerford: I do not have very much experience with the Ilizarov device, but I would send this patient for a consultation to our Ilizarov people and see whether or not they could treat the nonunion and, simultaneously, realign the fracture. It then would be much easier to perform a TKR, if it were needed.

Insall: I would probably do a TKR with an offset rod. I would, however, be worried about the presence of infection. Therefore, if at the time of surgery I was at all concerned about the presence of infection, I would perform the TKR in two stages. In the first stage, I would make the bone cuts for a TKR, get cultures, biopsy the fracture site, and close the wound. If the cultures were negative, I would proceed with the TKR 2 weeks later.

Stulberg: The nonunion was not infected. A TKR was performed. A femoral component with an intramedullary rod was used. The femoral component was press fit. The tibial and patellar components were cemented (Figs 4K-L). She did very well following the arthroplasty. She was pain-free for the first time in years, stopped using narcotics, and walked without

Figs 3C-D: In 1990, 9 years after the left TKR, she was injured and sustained a comminuted fracture of her left tibia, just below the well-fixed prosthesis.

Fig 3C.

Fig 3D.

Figs 3E-F: The fracture was treated with a long leg cast for 8 weeks, followed by a cast brace. The fracture united and the patient returned to her pre-injury level of function.

Fig 3E.

Fig 3F.
Figs 4A-B: This 34-year-old woman sustained a closed lateral, depressed tibial plateau fracture which healed well, but was associated with a noticeable, troublesome valgus deformity and pain.

Figs 4C-D: A femoral, supracondylar varus osteotomy was performed 2 years after the original injury. The osteotomy was fixed with a blade-plate device.

Figs 4E-F: The fracture developed a nonunion.

Figs 4G-H: An attempt was made to immobilize the fracture with an external fixator.

Figs 4I-J: A frank nonunion developed. The condylar fragments migrated proximally.

Figs 4K-L: The established nonunion was treated with a cruciate-sparing TKR and a long intramedullary femoral rod.

support (Figs 4M-N). Then, in July 1994, 2 years after the TKR, she slipped and fell and sustained the tibial fracture that you see in Figures 4Q-P. How would the panel treat this? Panel (unanimous): Closed: casting immobilization and progressive weight bearing.

Stulberg: She was treated with a long-leg cast, knee in almost full extension for 16 weeks. Although the position of the fracture did not change, a mobile, non-union was clearly developing (Figs 4Q-R). How would the panel treat the fracture now?

Insall: I would take out the tibial component and fix the fracture with a long intramedullary rod placed on a new tibial component. I would
Figs 4M-N: The patient became pain-free. She regained over 100% of flexion.

Fig 4M.

Fig 4N.

Figs 4O-P: Two years after the TKR, the patient fell and sustained a comminuted tibia fracture, minimally displaced below the well-fixed tibial implant.

Fig 4O.

Fig 4P.

Hungerford: I would try to fix the fracture with an internal fixation device and resist removing the tibial component for fear of losing bone stock. I would also use bone graft.

Dorr: I would do the same as Dr Hungerford.

Scott: I would also do the same before proceeding with the procedure described by Dr Insall.

Stulberg: An open reduction and internal fixation with buttress plate was performed. I was prepared to do as Dr Insall suggested if the bone stock proved to be very poor. In fact, the bone in the proximal fragment was reasonable enough to hold fixation screws. A large amount of bone graft was impacted around the fracture site. She was then placed in a long-leg cast for 3 months, followed by a cast brace for 3 months. The fracture took 6 months to show radiographic signs of union (Figs 4S-T). She is now pain-free, and has regained her pre-fracture range of motion. She is walking with cane protection.

Figs 4Q-R: The fracture was treated with 16 weeks of cast immobilization and failed to unite.

Fig 4Q.

Fig 4R.

Figs 4S-T: An open reduction/ internal fixation (ORIF) of the tibial fracture with a buttress plate and cancellous graft was performed. The leg was placed in a long leg cast for 6 weeks and then placed into a cast brace. Four months after the ORIF, the fracture appeared to be uniting. The patient has more than 100 degrees of motion and is ambulating, with a cane, without pain.