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KNEE REVISION X-RAY CASE REVIEWS

January 2014

CASE REPORT

Revision Solutions

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REVISION OF A FAILED UNICOMPARTMENTAL KNEE REPLACEMENT TO A TKA

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ABSTRACT

Conversion of a failed unicondylar knee replacement to a successful total knee replacement (TKA) can often be more difficult than it seems. This case demonstrates the use of metaphyseal sleeves to overcome bone loss and less than ideal bone quality to provide solid, durable fixation of the tibial implant.

CASE REPORT

HOME

PRE-OPERATIVE

Initial pre-operative X-rays show a medial mobile bearing Oxford® partial knee replacement in an active 52-year-old male. His index procedure was performed four years prior. There were no post-operative complications and he was satisfied and very active up until the previous year. Over the last 12 months he experienced increased pain and swelling and noticed more bowing of his leg. X-rays demonstrated progressive tibial loosening and failure of the arthroplasty back into varus (Figure 1).

The pre-operative infection work-up was negative. As the patient was fairly symptomatic and delaying intervention would result in further tibial bone damage, a revision to a total knee replacement was planned. Pre-operative planning for these cases is essential. Prepare for implant removal with flexible and rigid osteotomes, implant specific extraction tools, and possibly a high speed burr. The availability of revision components must be assessed. As seen from the proposed perpendicular tibial cut in Figure 2, it would be easy to underestimate the amount of tibial bone damage and the size of the resection needed to remove it.

Figure 1: Initial pre-operative X-rays with tibial loosening and varus deformity

Figure 2: Perpendicular tibial cut and medial bone damage

INTRA-OPERATIVE

At the time of revision surgery, exposure proceeded in a fairly standard fashion incorporating the previous slightly medial incision. Careful attention was spent developing a plane along the medial tibia where there was a lot of tissue reaction from the loose implant. This was facilitated a bit by removing the polyethylene component which took some tension off of these tissues. Once this plane was established, to protect the MCL, the tibial component was easily removed by just lightly tapping it up with a punch. It was clearly loose. The femoral component was still well-fixed, and it took a little more work to remove it. A 1/2 inch rigid osteotome was used to work around the cement implant interface and once this was broken up the Oxford® component holding clamp was used to extract the component with essentially no bone loss. The key here is to be patient and break up the cement fixation before attempting extraction as it is easy to fracture off the medial side of the medial condyle. Once the implants are out and the cement and debris have been removed, the defects can be properly assessed. In this case there was little distal and posterior bone loss. These defects would be incorporated in standard distal and posterior bone cuts for a new femoral component. Loss of the posterior condyles poses a problem for posterior condylar referencing and could result in excessive external femoral rotation. An alternative method of determining femoral component rotation should be planned for. In this case we ultimately used soft-tissue balancing based on the cut surface of the tibia and collateral ligament tension to square up the flexion space.

The biggest obstacle in this case was the amount of tibial bone loss and damage. We began with a standard depth tibial resection which removed about half of the medial defect. An additional 2 mm resection eliminated a bit more of the defect and improved the quality of the bone at the cut surface but we were still left with between 30-40 percent of the tibial metaphyseal bone that was compromised. At this point we made the decision to proceed to an MBT revision tibial component and a metaphyseal sleeve to improve the surface area of tibial fixation and compensate for the bone loss. The tibial metaphysis was broached for a 37 mm sleeve. The cavitary bone defects were bone grafted with autograft from the tibial cut and the final tibial component was surface cemented with a porous-coated sleeve. Post-operatively, the patient was treated according to standard Total Knee Arthroplasty (TKA) protocol, weight bearing as tolerated and discharged to his home.

POST-OPERATIVE & DISCUSSION

One of the proposed benefits of unicompartmental knee replacements is their bone-sparing nature. It is attractive in theory to be able to convert partial knee replacements to total knee replacements using standard primary components and without much complexity. Recent reports, however, have demonstrated that the complexity of the reconstruction is often underestimated and revision components may be needed more often than previously thought. Likewise, reports on the clinical success of converting unis to totals have demonstrated clinical results closer to that of revision TKA and potentially higher failure rates than revision TKAs due to the underestimated compromised fixation and and weak soft tissues.[1,2] In this case even taking 2 mm additional bone off the tibia still left us with 40 percent compromised bone that would be our primary site of cement fixation. The decision to use an MBT revision tray significantly increased the available surface area for cement fixation into mechanically sound cancellous bone. Broaching the porous coated sleeve into solid, undamaged metaphyseal bone allowed us to compensate for the medial tibial deficiency and gave us the ability to achieve biologic fixation in the healthy remaining bone. Figure 3 shows initial follow-up X-rays and figure 4 is one year post-operative. Notice that the medial defect is still visible but there is a trabecular pattern extending onto the porous coating around the top of the sleeve (arrow). Clinically, the patient has done well and has returned to his very active lifestyle. Intra-operative assessment of the bone defect in these cases is paramount. Often it is not just the quantity of bone that is missing but also the quality of the bone that is remaining. Cement fixation relies on the mechanical interlock between the cancellous bone structure and the cement. If the integrity of the bone structure is damaged, mechanical fixation of the implant will be compromised. As the percentage of damaged bone involved in the primary fixation interface increases, the need to increase the surface area and stability of the fixation with revision components likewise increases.

Figures 3: Initial post-operative X-rays

Figure 4: One year post-operative with trabecular hypertrophy on porous coating

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MANAGING BONE LOSS IN REVISION TKA FOR ASEPTIC LOOSENING IN AN ELDERLY PATIENT

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ABSTRACT

Aseptic loosening is one of the most common causes for revision total knee arthroplasty (TKA). This case demonstrates how to manage and overcome the challenges which are encountered in revision TKA in an elderly patient. Several intra-operative decisions were made to overcome the challenges of bone loss due to osteolysis, osteoporosis, and ligamentous deficiency.

CASE REPORT

HISTORY

A 70-year-old patient presented complaining of severe left knee pain four and a half years status post bilateral total knee replacement performed at an outside institution. Upon physical examination her knee had an obvious varus deformity, with a range of motion of 5-100 degrees with moderate mediolateral instability. X-rays of her left knee (Figures 1 and 2) revealed a High-Flex knee implant with obvious loosening of the tibial component and what appeared to be a well-fixed femoral component. After ruling out infection, she was indicated for a revision of her tibial component for aseptic loosening. She was also made aware that her femoral component may be revised because of a clinical concern for instability.

Figure 1: A/P pre-operative X-ray

Figure 2: Lateral pre-operative X-ray

INTRA-OPERATIVE

The revision began by exposing the left knee through the prior incision. The incision was carried through the soft tissues to the capsule. A medial parapatellar arthrotomy was performed with a medial release and quadriceps snip. After the extensor mechanism and patella were retracted laterally, the polyethylene liner was removed.

Examination of the femoral component revealed significant osteolysis underneath the lateral aspect of the component. At this point, it was deemed that a revision of the femoral component would be indicated as well for both improved fixation and increased constraint.

Attention was then turned to the tibial component, which was noted to be grossly loose and subsequently removed. The medial tibial plateau was noted to be grossly deficient with a large central defect in the cancellous bone and deficient medial cortex. The decision was made to use a noncemented metaphyseal sleeve. The proximal tibia was then sequentially reamed to achieve endosteal fit. The proximal tibia was then broached for an appropriately sized metaphyseal sleeve. An appropriately sized trial implant provided a good press-fit of the sleeve with contact of the lateral tibial tray on the bone. There was no bone contact with the medial tibial tray.

The fixed femoral component was then freed from the cement mantle by using a saw medially and a small curved osteotome laterally. An extractor was then attached to the femoral component and a slaphammer was used to safely and easily remove the component. At this point a rongeur was used to clean up synovial proliferation and the bone cuts were cleaned up.

The distal femur was then prepared with sequential reaming and broaching.

A tenaculum clamp held the condyles to help prevent fracture. A trial implant was placed on the distal femur. It became evident that a 4 mm augment would be needed medially and a 12 mm augment laterally because of the extensive bone loss.

A trial 12.5 mm rotating platform posterior stabilized (PS) polythethylene insert was placed and the knee was ranged. Alignment was satisfactory; however the knee was found to be slightly loose in both flexion and extension. The insert was then replaced with a slightly larger 15 mm insert and taken through the same range of motion. Satisfied with the stability of this insert throughout the entire range of motion, all trials components were removed and the field was thoroughly irrigated.

The tibial components (size 2 MBT revision tray, 37 mm MBT metaphyseal sleeve, 75 mm x 14 mm Universal fluted stem) were assembled and malleted into position. Cement was deemed not necessary as the metaphyseal sleeve had a good press-fit fixation and the tibial tray contacted the cortex laterally. Similarly, the femoral components (34 mm Universal fully porous coated femoral sleeve, SIGMA® TC3 size 2 femoral component, 75 mm X 14 mm Universal fluted stem, 4 mm medial distal femoral augment, 12 mm lateral distal femoral augment) were assembled and malleted into position. A 15 mm PS trial polyethylene was then ranged and showed the flexion and extension gaps were well balanced. The trial was removed and an RP insert (15 mm TC3) was placed. Again the knee was ranged and showed well-balanced flexion and extension gaps. The knee was then appropriately closed.

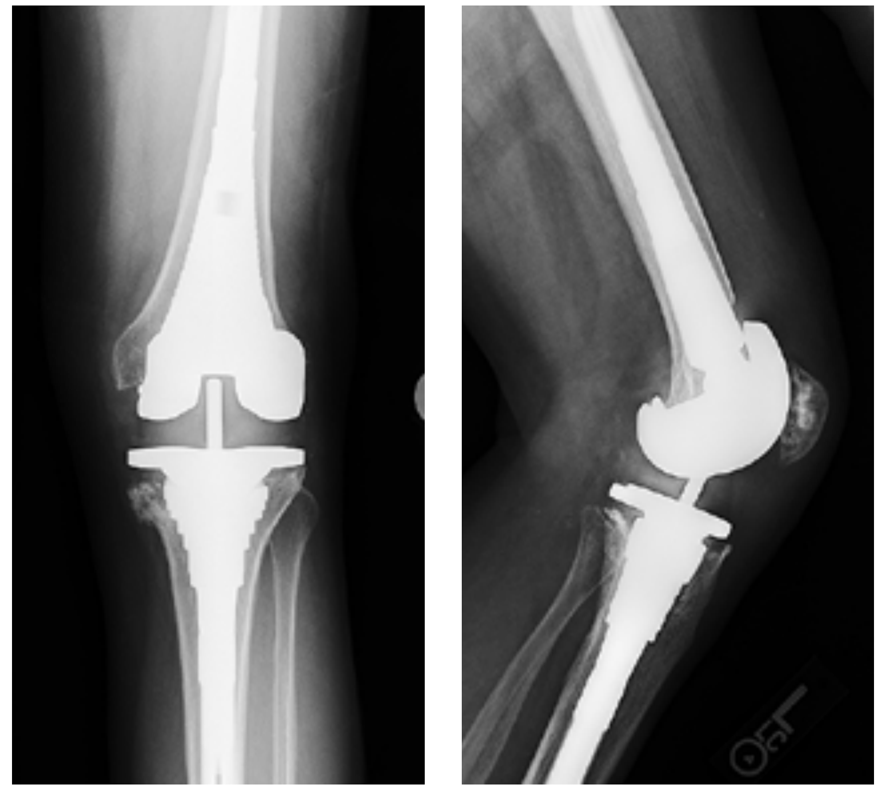

Figure 3: Post-operative X-rays

POST-OPERATIVE

The patient was discharged from the hospital on the third day, weight bearing as tolerated. At six week follow-up she was doing well, walking 5-10 blocks per day with only mild post-operative pain. On examination she was walking without a limp, had no instability, and had a range of motion of 0-125 degrees. X-rays revealed the components to have good alignment and were well-fixed (Figure 4). She was encouraged to use a cane and return for follow-up in six weeks. She returned at three months post-operatively with end-of-stem pain localized in the mid-tibial region. She was encouraged to use the cane and that her pain would resolve in time. At six months post-operatively, she had no complaints with her left knee. Her only complaint was her right knee which had similarly gone on to aseptic loosening. This knee was revised in exactly the same fashion.

Figure 4: X-ray at two year follow-up

DISCUSSION

Aseptic loosening is one of the most common causes for revision surgery. Often, revision surgery requires overcoming challenges such as bone defects due to osteolysis, osteoporosis, and instability in order to create a stable joint with well-fixed implants. One of the most useful tools in managing bone loss and bone defects is the use of porous coated non-cemented metaphyseal sleeves. Based on the Anderson Orthopaedic Research Institute (AORI) Bone Defect Classifications, patients that have bone defects in one or both condyles are classified as a type 2 defect. Metaphyseal sleeves are valuable in overcoming type 2 bone defects. Patients with type 2 defects often have cancellous bone in the proximal tibia that is not well-suited to support the load of an implant with cement alone. This system also makes use of fluted stems that change the load pattern to reduce the load on the condylar bone. Large metaphyseal sleeves also help to fill the void and bypass the proximal tibial defects left by implants and bone defects. They contain a large surface area with an osteoconductive porous coating, which creates a strong, non-cemented biologic bond. Non-cemented metaphyseal sleeves have shown good to excellent results with follow-up up to 2 years.[1]

In addition to the bone defects encountered in this case, the patient presented pre-operatively with moderate mediolateral instability with an implant that had drifted into varus. This instability called for the use of a constrained device. This rotating-platform constrained design (TC3 RP) offers a cam and post mechanism that provides more stability than a standard posterior stabilized implant, but less constraint than many constrained knee designs. RP inserts have been shown to decrease stresses on the cam and post mechanism thereby uncoupling the forces extended to the fixation surfaces. Overall, this implant design offers stability and solid fixation to overcome many of the challenges of revision surgery. It comes with the added benefit of easily being converted to a hinged device if needed either intra-operatively or for future procedures.

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1 Alexander, G. E., Bernasek, T. L., Crank, R. L., and Haidukewych, G. J. (2013). Cementless metaphyseal sleeves used for large tibial defects in revision total knee arthroplasty. *The Journal of Arthroplasty*, 604-7.

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TKA WITH RETAINED HARDWARE… TO REMOVE OR NOT TO REMOVE?

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ABSTRACT

There are several factors to consider in a patient with a prior injury and retained hardware that now requires a total knee arthroplasty (TKA). The previous surgery can leave multiple prior incisions prone to wound healing problems. Previous injuries can leave deformities secondary to malunions and ligament instability, and scar tissue can create stiffness. All of these factors lead to a more complex decision tree pre-operatively and less predictable outcomes.

CASE REPORT

HISTORY

The patient is a 54-year-old female, 3 years status post motor vehicle accident with multiple fractures including the left distal femur and proximal tibia. The fractures have healed with malunions leading to a significant varus deformity and progressive post-traumatic arthritis (Figure 1). The femur has an extension malunion and the tibia has a varus malunion. The patient has a midline incision over the proximal tibia, and a posterior-lateral incision over the distal femur.

Figure 1: X-rays at time of presentation

Three distinct treatment options come to mind for this case:

1) Two-stage revision - partial or complete hardware removal in the first stage, followed by a TKA at a later date.

Pros:

- Allows for a test of the medial parapatellar incision prior to TKA.
- Limits the amount of dissection at the time of TKA.

Cons:

- Two surgeries.
- Unprotected fractures with tenuous healing prior to TKA.

2) Osteotomies - corrective osteotomies of either the femur and/or tibia to correct malunions prior to TKA.

Pros:

- Recreates normal mechanical axis and allows for a more straightforward TKA with easier ligamentous balancing at the time of the surgery.

Cons:

- Two major surgeries with the associated risk of an osteotomy.

3) One-stage revision - complete or partial hardware removal with implantation of a TKA.

Pros:

- One surgery.
- No need for additional fracture healing.

Cons:

- Larger soft tissue dissection.
- Wound healing risks.

INTRA-OPERATIVE

For this case, I elected to go with a one-stage revision with partial femoral hardware removal and complete tibial hardware removal. I used a mid-line parapatellar incision because the lateral incision was too far posterior to achieve proper exposure. In general, the most lateral incision should be used to avoid devascularization of the skin. To help with ligamentous balance, I utilized a medial tibial reduction osteotomy.

To protect the prior tibial fracture, I stemmed the tibial component and used an offset tibial tray to maximize support of the tibial tray. Extramedullary guides were used for the tibia because of the varus deformity.

On the femoral side, I retained the femoral hardware to protect the distal femoral fracture. A short intramedullary guide was used on the femur because of the retained hardware, and an intra-operative X-ray was used to confirm the position and alignment of the trial components. No varus-valgus constraint was required to balance this knee, so a posterior stabilized femoral component was utilized. Stiffness associated with post-traumatiuc arthritis obviates the use of a cruciate retaining design.

Figure 2: Post-operative X-rays

POST-OPERATIVE

Post-operative motion exercises were delayed two days to help protect the incision. Otherwise, post-operative care was routine in this case.

DISCUSSION

When faced with post-traumatic arthritis cases:

- Always respect prior incisions and when possible use the most lateral incision, even if this requires raising a flap to obtain a medial parapatellar exposure.
- Minimize hardware removal and soft tissue dissection when possible.
- Anticipate stiffness and possible ligament insufficiency.
- Use a posterior cruciate substituting design and have constrained designs available.
- Pre-operative planning: Spend time thinking about the case pre-operatively… not just intra-operatively.

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TKA FAILURE SECONDARY TO INSTABILITY

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ABSTRACT

This patient was less than a year out from a left knee replacement performed at an outside institution. She presented to the surgeon's office for progressive pain and instability. Her early failure was due to poor soft tissue balancing resulting in instability and implant loosening. She received a revision SIGMA® TC3 knee with sleeves. One year after surgery the patient is doing well, ambulating independently, without pain.

CASE REPORT

HOME

HISTORY

A 66-year-old female presented to my office status post staged bilateral total knee replacements with the left knee being done most recently in April of 2012. At the time of presentation she had cemented posterior stabilized knees in place (Figure 1). Her main complaints upon initial evaluation were pain with weight bearing, knee instability, and a progressive deformity. She had essentially progressed to the point where she was unable to ambulate without a walker and was using a wheelchair for long distances.

The patient denied any history of drainage, complications with wound healing, or infection following her procedure. In addition, the patient had a normal sed rate and CRP during her pre-operative work up.

Figure 1: X-rays at time of presentation

INTRA-OPERATIVE

Based upon the patient's physical exam findings I had concerns about the integrity of the MCL based on the valgus deformity and difficulty obtaining a firm endpoint on ligamentous exam. From a pre-operative planning stand point we had an S-ROM® Knee hinge available for backup in case the MCL was truly incompetent.

When revising a knee with instability, the exposure is generally obtained with relative ease using standard techniques. For me this entails a thorough synovectomy, debulking the extensor mechanism, and reestablishing the medial and lateral gutters. After this is completed the polyethylene bearing is removed and the components are extracted. I tend to use a short, narrow oscillating saw to disrupt the cement-implant interface followed by the use of revision osteotomes. The key is to make sure the implant is loose prior to using a bone tamp or extractor to remove the implant. By doing this you are greatly able to minimize bone loss.

At the time of surgery the MCL was indeed intact but was severely attenuated. I suspect that the patient had a severe valgus deformity prior to her primary knee replacement resulting in attenuation of the MCL with contracture of the lateral ligament complex. The pre-operative instability that was observed in this case was a result of the MCL attenuation in combination with loosening and collapse of the tibial component laterallly. At the time of surgery, the lateral ligament structures both in flexion and extension were noted to be excessively tight.

Once the implants were removed we then assessed the flexion and extension gap balance. In extension, laminar spreaders were used and a pie crusting technique was performed releasing the posterolateral capsule and the subsequent tight structures from the popliteus to the IT band anteriorly. This was performed until the extension gap was balanced. Similarly, the flexion gap was tight laterally and this was balanced through a combination of femoral component rotation and ultimately required release of the popliteus tendon. In my experience this is an uncommon finding except in knees with a severe valgus deformity.

In regards to implant fixation, there was a significant amount of cavitary bone loss on the tibia, particularly on the lateral side. There was an intact cortical rim and thus the defect was bypassed with a cementless metaphyseal sleeve and stem. The defect was filled with cement given the patient's age. Often, the bone quality encountered at the time of revision surgery is not very receptive to cemented fixation. I have encountered several cases where a hybrid technique was used to cement the proximal portion of the component and press fit the stem. Many of these implants loosen particularly when a fixed bearing constrained polyethylene insert is used. Cement is unable to interdigitate in the densely sclerotic bone that is often encountered with implant loosening, and ultimately fails unless the entire construct is cemented in place. Porous coated metaphyseal sleeves have solved this issue for me by allowing biologic ingrowth, which provides durable fixation. In addition, with the use of a rotating platform bearing, constraint can be used without concern for increasing stress at the implant interface. As a result, most of the revision knees I perform are constrained.

Just like in primary total knee replacement, balancing the soft tissue sleeve and establishing equal flexion and extension gaps is of critical importance. In most revisions, the flexion gap is larger than the extension gap and thus care must be taken to balance the flexion gap

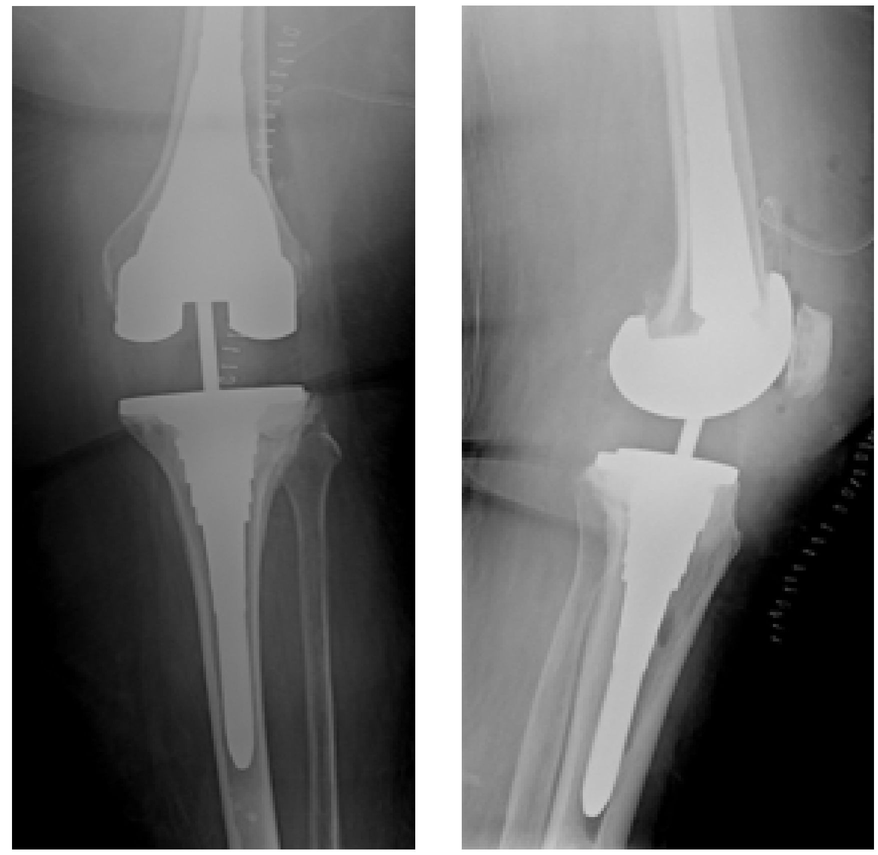

Figure 2: Post-operative X-rays

without elevating the joint line. My standard technique in revision knee surgery to ensure that the flexion gap is balanced is to use the largest femoral component that the femur will accept. This is based on the medial-lateral dimension and ensures the posterior offset is increased as much as possible from a sizing stand point. In addition, I generally always use the +2 mm offset option, which shifts the housing on the femoral component 2 mm posterior. An additional technique when using a metaphyseal sleeve is to preferentially broach the femur posteriorly to further close the flexion space. I have found that by using these concepts and balancing the flexion gap first, instability in flexion can be avoided. Once the flexion space is balanced, then the femur is augmented distally until full extension is obtained. This restores the joint line and thus decreases the risk of mid flexion instability and patella baja, which can limit range of motion. In severe cases where the flexion gap cannot be balanced without excessive elevation of the joint line, a hinged implant may be required.

POST-OPERATIVE

This patient's post-operative course was really quite unremarkable. She was allowed to weight bear as tolerated with a walker and able to advance off her ambulatory aids as she progressed. The metaphyseal sleeves provided good mechanical stability after surgery and thus I rarely protect the patient's weight bearing. Following completion of the procedure the knee was stable throughout a range of motion and thus there were no limitations to motion and no braces were utilized.

This patient is now about a year out from surgery and is doing well. The knee is stable, the sleeves have achieved biologic ingrowth, and she is back to baseline activities with no limitations (Figure 3).

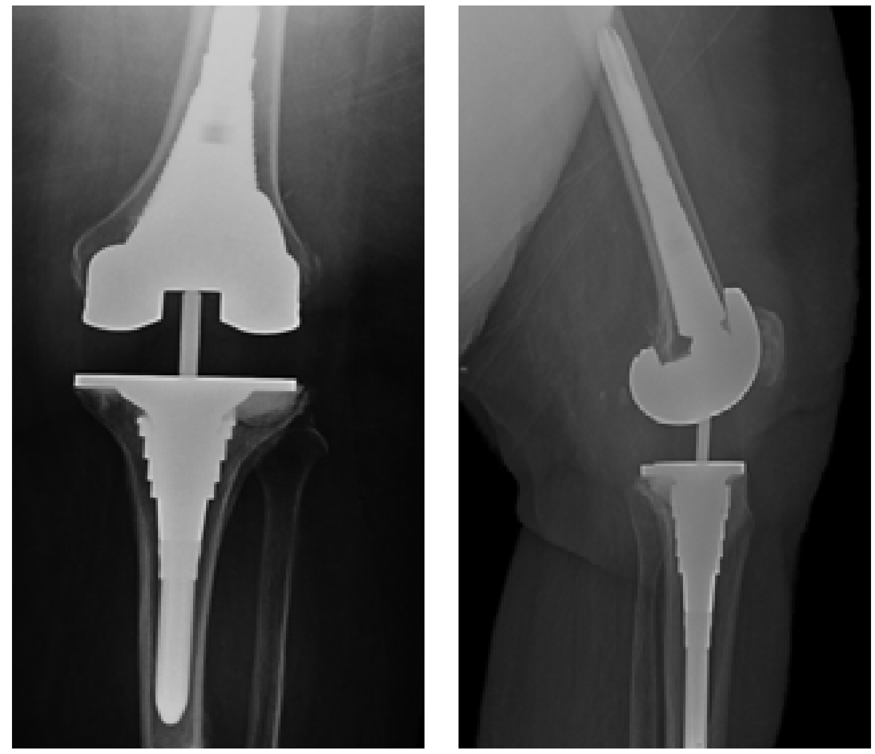

Figure 3: X-rays at one year follow-up

DISCUSSION

I think this case illustrates the importance of following the basic principles of knee replacement surgery. First, we must restore the mechanical alignment of the limb and then balance the soft tissue envelope so that the forces throughout the knee are symmetric. In this particular case, the lack of ligament balance resulted in an unstable painful knee that ultimately resulted in early implant loosening.

We must eliminate these early failures through surgeon education and strict attention to detail. Unfortunately, in my practice a fair number of the failed total knees that I see are related to instability, malalignment, and early implant loosening. This trend has also been reported in the literature and aside from infection represents the mode of failure in many of the revisions that are done today. Many of these failures can be eliminated by assuring at the time of surgery that these basic goals are attained. As the burden of knee revision surgery continues to increase, it will be important to develop strategies to prevent these early mechanical failures.

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SOLVING INSTABILITY IN THE DIFFICULT REVISION TKA

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ABSTRACT

This case describes a 67-year-old male with a second revision for loosening, bone loss, and instability. Patient has returned to an active life with a combination of a hinged component, stems, and sleeves.

CASE REPORT

HISTORY

A 67-year-old male with hypertension, diabetes, and coronary artery disease presents with a painful knee prosthesis eight years post-operative knee revision performed at another institution. Patient was retired but active and wished to resume playing golf, which his painful knee was preventing.

X-rays revealed a semi-constrained prosthesis with femoral and tibial stems (Figure 1). Lucency was apparent around the femoral stem suggesting prosthetic loosening. Workup including a bone scan, aspiration and blood studies confirmed aseptic loosening. The patient was scheduled for a knee revision. Due to a concern about extensive femoral bone loss, the plan was to revise using a mobile bearing component with stems, sleeves, and allograft bone available for fixation.

Figure 1: X-rays at time of presentation

INTRA-OPERATIVE

The knee was approached through a standard median parapatellar incision. Adequate exposure was obtained using standard medial and lateral ligamentous and capsular releases as well as an extensive synovectomy. The femoral component was clearly loose and came out easily. The tibial component was not loose but was damaged so it was removed utilizing flexible osteotomes.

Reconstruction of the tibia was performed using a size 4 mobile bearing tray, 18 mm x 75 mm press-fit stem and a 45 mm sleeve. There was extensive femoral bone loss so a size 4 SIGMA® TC3 femoral component was implanted using a 14 mm x 115 mm press-fit stem with a 40 mm sleeve and a medial 16 mm distal augment with an allograft femoral head cemented to the component to augment the lateral side. A 15 mm TC3 RP insert was utilized.

Unfortunately, at six weeks post-operative the patient dislocated his femur posteriorly (Figure 2). After a failed closed reduction, it was elected to convert to a hinged system. After a standard approach as above, the femoral component was tamped out along with the stem and sleeve. The stem was increased to a width of 16 mm and the sleeve size was increased to 46 mm. Utilizing the size small hinged S-ROM® Knee component, we were easily able to convert to a hinge and retain the original tibial components. Allograft cancellous bone was used to fill the voids in the femur.

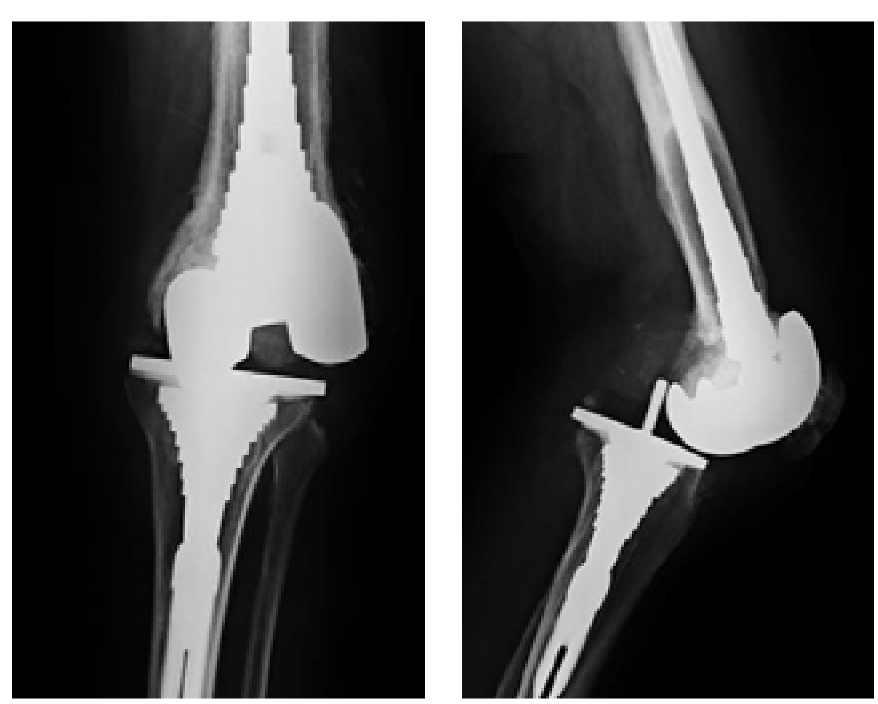

Figure 2: X-rays at six weeks

POST-OPERATIVE

Post-operative regimen consisted of full weight bearing in a hinged long leg brace. Pain management consisted of PCA narcotics for the first two days followed by oral oxycodone. Wound healing was uneventful and by six weeks post-operative he was removing his brace, although not advised to. After three months, a hinged knee brace was provided for activities such as golf.

At three years post-operative, he was doing well with no complaints of pain. His stability remains excellent and he continues to use his brace for activities such as golf. He has full extension and can flex beyond 110 degrees. He is very satisfied with his result. X-rays reveal good component position without signs of wear or loosening (Figure 3).

Figure 3: X-rays at three years post-operative

DISCUSSION

This particular case occurred five years ago, so management today would be somewhat different. Our emphasis is less on parenteral narcotics for pain control and more on multimodal pain therapy with scheduled oral medications. We are also tending to rely more on the sleeves and less on long stems and allograft bone as we have gained confidence with the system.

The ultimate revision to a hinged component in this case to solve an instability problem was made much easier by the compatibility of the existing tibial components as well as the stability of the sleeve and stem construct in order to overcome significant loss of bone from the distal femur.

Finally, the versatility of the system to have readily available multiple levels of constraint and fixation in a single system is much appreciated by surgeons dealing with difficult problems.

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INFECTED DISTAL FEMUR WITH PERIPROSTHETIC FRACTURE NONUNION

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ABSTRACT

Infection and periprosthetic fractures are two of the biggest reasons for failure in total knee arthroplasty (TKA. This is the case of a morbidly obese female who sustained a periprosthetic fracture. It was treated with an ORIF and presented with an infected nonunion of her distal femur periprosthetic fracture.

CASE REPORT

HISTORY

The patient is a 69-year-old female who had a previous total knee arthroplasty which was functioning well. She is morbidly obese, with medical comorbidities of diabetes, HTN, and coronary artery disease. She fell at home sustaining a distal femur periprosthetic fracture (Figure 1). The fracture was treated with an open reduction internal fixation of her fracture, with a lateral distal femoral locking plate at an outside institution. As she progressed through her post-operative course, she developed persistent drainage from her lateral incision. At four months out from her surgery, she had failed a washout and IV antibiotics. She had persistent copious drainage with significant erythema of her lateral incision. Lab markers for infection (ESR and CRP) were elevated. Wound cultures grew out MRSA. X-rays showed significant bony defects at the fracture site and a long lateral distal locking plate with delayed union and no significant progress to union (Figure 2). At this point she presented for evaluation.

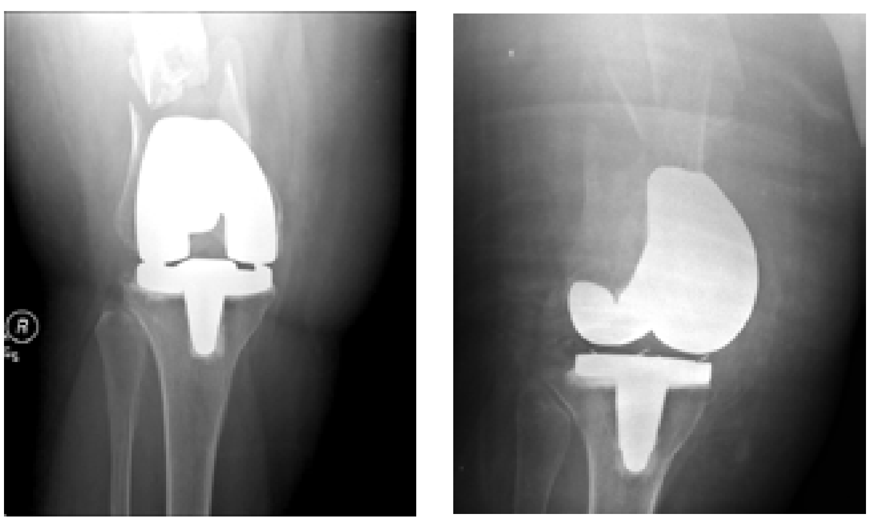

Figure 1: Post-fall X-rays of the distal femur fracture

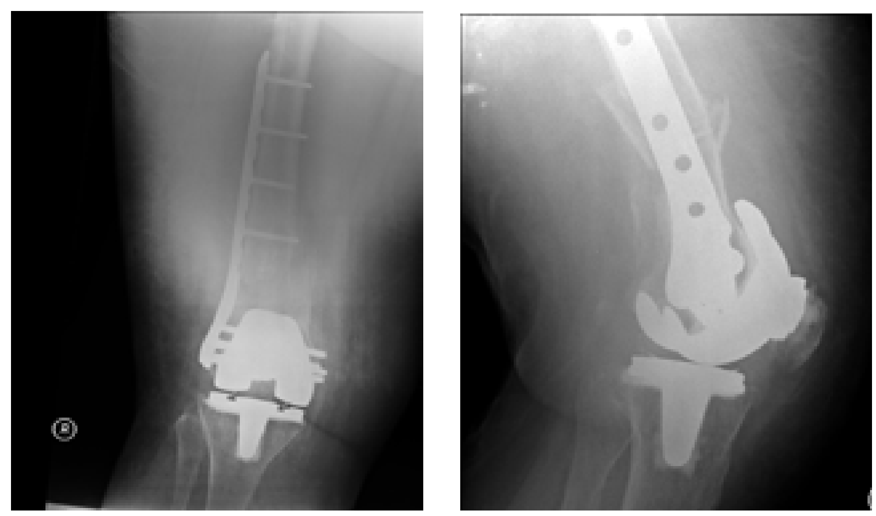

Figure 2: X-rays of the locking plate

INTRA-OPERATIVE

Taking into consideration the patient's age, weight, medical comorbidities, bony defects, organism, and now chronic course, the decision was made to perform a two-stage debridement and re-implantation. At the time of the initial debridement, the knee was opened through her previous midline incision with a medial parapatellar approach, as well as through her more fresh lateral incision. Her 10-hole locking plate and screws were removed through the lateral incision and the lateral tissue was thoroughly debrided. Then, through the midline incision, the distal femur fragment and the tibial component were excised as part of the debridement.

The decision to excise the distal fragment had to do with the poor success rates of eradicating MRSA infections. Removal of the distal fragment allowed for a more thorough debridement and gave full access to the femoral canal and screw holes for removing any questionable tissue. Further contributing factors to the more radical debridement were the patient's comorbidities and age. A distal femoral articulating spacer was made with cement rods placed up the canals of both the tibia and the femur (Figure 3). Vancomycin and Tobramicin were added to each dose of cement. The patient was placed in a knee immobilizer and kept touch down weight bearing (TDWB). for six weeks.

The patient was brought back to the OR six weeks later after treatment with IV antibiotics. Serum and local tissue markers showed

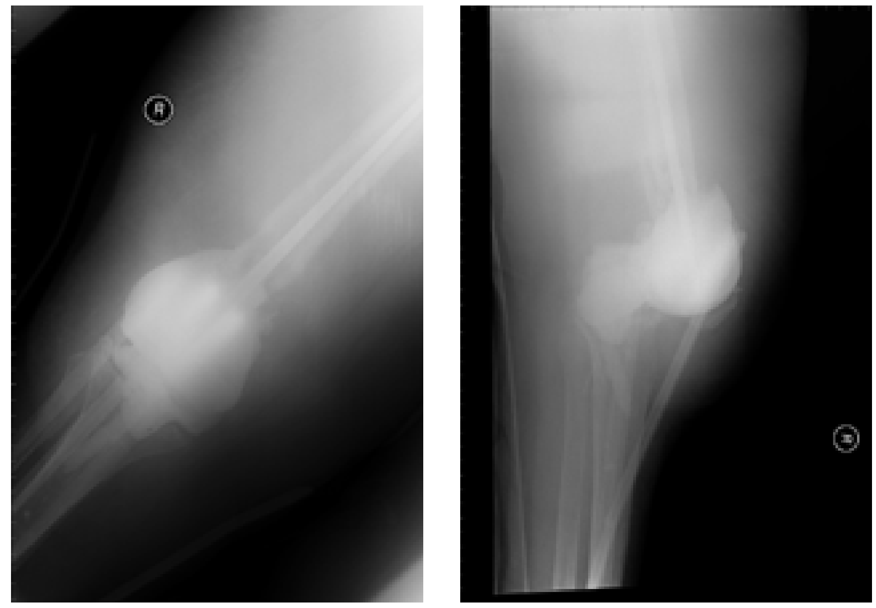

Figure 3: Articulating spacer

decreased inflammation and the decision was made to reimplant.

A second debridement was performed and then a distal femoral replacement was placed with cementless fixation. A fluted press-fit stem with a fully porous coated femoral sleeve was used with a distal femoral component. The tibia was prepared for a mobile bearing revision tray with a porous ingrowth sleeve as well (Figure 4).

Figure 4: LPS System distal femoral replacement with metaphyseal sleeve

POST-OPERATIVE

Post-operatively, the patient was kept TDWB for six weeks. She was maintained on IV antibiotics per the ID service for two weeks post-operative, until final cultures were back and her incisions had proven to be stable. The patient was allowed gentle active range of motion and quad strengthening. At six weeks, with stable X-rays, the patient was allowed to progress to weight bearing but was kept on a walker in a hinged knee brace until she had regained good quad strength in physical therapy. At three months, quad strength had returned enough to allow ambulation with a crutch out of the brace.

The patient was seen at one year follow-up with well healed incisions and normal labs (Figure 5). Her X-rays showed good fixation of her sleeves on both the femur and the tibia. The patient was able to ambulate pain free on her knee without the use of any assistive devices

Shortly after her one year follow-up, the patient took another fall sustaining bilateral ankle fractures. Her porous ingrowth distal femoral replacement survived this trauma without any ill effect.

Figure 5: X-rays at one year post-operative

DISCUSSION

Dealing with bone loss and fixation can be very challenging in revision knee surgery. The use of sleeve fixation has changed the way I manage these patients. Instead of cementing into sclerotic, cortical bone, porous coated sleeves provide a better long-term option. To gain adequate cemented fixation on this patient would require cementing with a gun two thirds of the way up the femur. The potential long term issues of a long cemented stem are loosening, stress shielding, or difficulty of revision should this patient ever re-infect.

Technical tips which help in placing a distal femoral sleeve include:

1) Do not internally rotate the distal femoral component. It is easy to be fooled by the patient's anatomy and the leg often sits in significant external rotation. If the landmarks of the femur are not identified, the femur can easily be internally rotated leading to significant patellar tracking issues.

2) Place a prophylactic cerclage wire around the distal femur before broaching. This will help absorb the hoop stresses to prevent a fracture while preparing the host bone.

3) When broaching, prepare up in size so as to leave the final broach sitting proud by at least 3 or 4 steps. This ensures that the final sleeve is significantly wider than the diameter of the femoral canal and prevents any chance for significant subsidence.

The treatment for this patient was a more radical debridement and treatment for a significant problem which has led to a successful outcome with now four year follow-up.

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TWO-STAGE REVISION FOR AN INFECTED TKA

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ABSTRACT

This case describes a 55-year-old male with constant pain since his initial total knee arthroplasty (TKA) two years ago. Lab tests revealed an infection which was treated with a two-stage revision procedure.

CASE REPORT

HISTORY

A 55-year-old gentleman presents with a history of a painful total knee arthroplasty. The TKA was performed two years ago, and has hurt diffusely since surgery. The pain is constant, and wakes the patient at night. He denies instability. He is otherwise healthy, other than some mild high blood pressure and high cholesterol. On examination, he has an antalgic gait and uses a cane for support. The knee is warm to the touch and has a moderate effusion. The knee is diffusely painful to the touch and the active range of motion is 10 to 100 degrees. The knee is stable and the limb is neurovascularly intact. The skin demonstrates a healed midline incision.

Pre-operative X-rays demonstrate a well fixed TKA in good alignment. (Figures 1 and 2)

Figure 1: Pre-operative lateral view

Figure 2: Pre-operative anteroposterior view

INTRA-OPERATIVE

Laboratory values include a Sedimentation rate of 50 and a C-reactive protein (CRP) of 2.5. Aspiration reveals 6,000 nucleated cells, 90 percent PMNs, and Staph Aureus on culture. A staged re-implantation is recommended to clear the infection.

The patient undergoes resection with removal of all components and residual cement.The knee is copiously irrigated, and an articulating spacer is made using molds sized to the patient's bone. Antibiotics are used in a ratio of 3 grams Vancomycin and 2.4 grams Tobramycin per 40 gram batch of cement.

The infectious disease service is consulted and recommends six weeks of intravenous antibiotics.

After completion of the antibiotic regimen, laboratory values are repeated and the knee is aspirated. The aspiration is dry. The Sedimentation rate returns to normal at 5, and the CRP returns to normal at 0.3.

Figure 3: Post-operative anteroposterior view of articulating spacer

Figure 4: Post-operative lateral view of articulating spacer

Re-implantation is performed. At re-implantation, the central cavitary tibial defect is managed with a porous metaphyseal sleeve. Distal and posterior femoral defects are managed with augments, and the metaphyseal defect is managed with a femoral sleeve. Press-fit stems are used in the femoral and tibial canals. The epiphysis is cemented with a ratio of 1 gram of Vancomycin per 40 gram batch of cement.

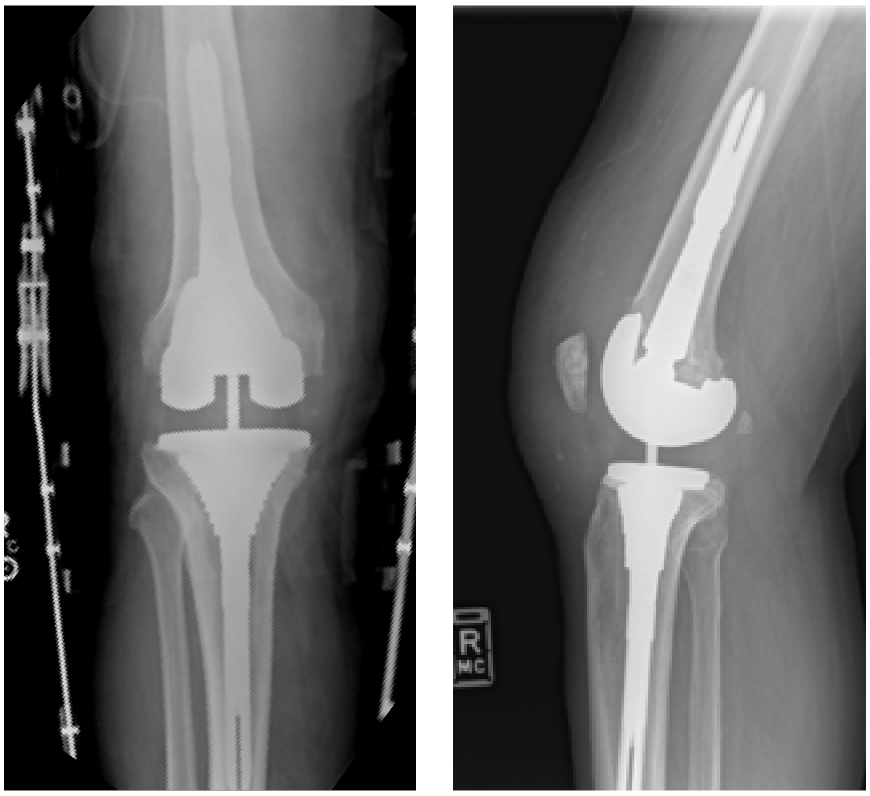

Figure 5: Post-operative anteroposterior view and lateral view of replanted TKA demonstrating use of press-fit stems, metaphyseal sleeves, and epiphyseal cementation technique

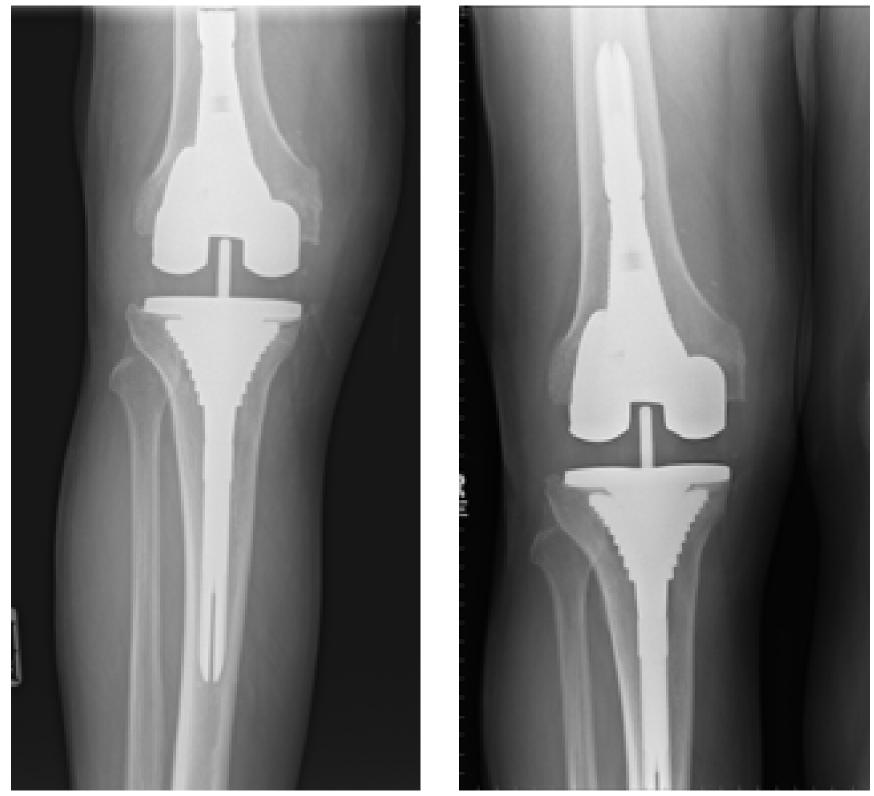

Figure 6: Post-operative anteroposterior view of the replanted TKA

Post-operatively, full weight bearing is allowed immediately. The soft tissues are healthy and the wound is healing well; therefore, range of motion is commenced on day three post-operative. The author prefers to allow a few days of rest for revision TKA incisions prior to starting range of motion.

At follow up, the patient is doing well; his pre-operative pain has markedly improved. He has some minor anterior discomfort but is pleased with his surgery. There are no clinical signs of infection. He walks well without gait aids and has range of motion from 3 to 118 degrees. His knee is stable and his radiographs show stable interfaces.

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USE OF FEMORAL POROUS SLEEVES FOR FEMORAL FIXATION IN DISTAL FEMORAL REPLACEMENT

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ABSTRACT

Patient presented with chronic infection of a revision total knee arthroplasty (TKA) requiring a two-stage reconstruction. Underwent explantation with placement of articulating antibiotic spacer and eventual re-implantation with an LPS™ System distal femoral replacement. Uncemented femoral fixation was achieved with the use of a femoral metaphyseal sleeve. Patient is presently functioning well with minimal pain, without need for a walking aid and no evidence of recurrence of infection.

CASE REPORT

HISTORY

The patient is a 67-year-old gentleman who had previously undergone revision for flexion instability in 2007 with a constrained TKA with cemented stem fixation. He required a polyethylene exchange at an outside institution in the early part of 2012 due to a broken locking mechanism. He developed infection with MRSA post-operatively. This was treated with I&D, polyethylene insert exchange, IV ABX, and suppression. Despite this treatment he continued to have pain and swelling and presented to our institution for care (Figure 1). ESR and CRP were noted to be markedly elevated and the knee had a large erythematous effusion, with a limited ROM of 15 to 80 degrees. The recommended treatment for the patient was a two-stage revision.

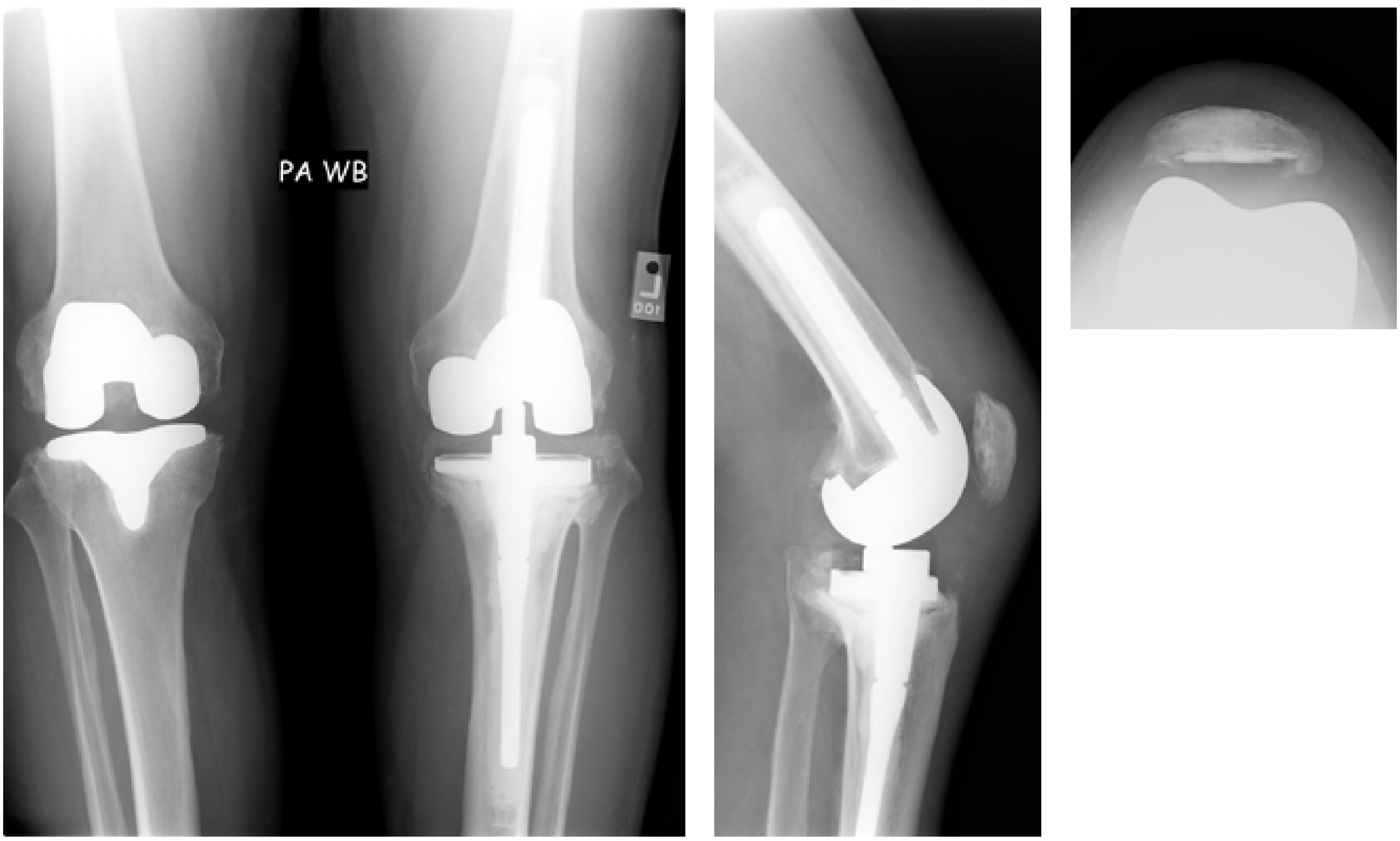

Figure 1: X-rays at time of presentation

INTRA-OPERATIVE

The initial stage of the revision involved explantation of the components and placement of a spacer in August of 2012. There was notable, significant bone loss due to prior cement, etc. An articulating spacer was used with a high dose of antibiotics (2 grams of Vancomycin and 2.4 grams of Tobramycin for every 40 grams of cement). The patient was treated with six weeks of IV ABX. Serologies trended to normal and he returned to the OR in November of 2012 for a planned re-implantation.

First Stage:

Extensile exposure was achieved with a large medial release and establishment of gutters. After the polyethylene was removed, the femoral and tibial components were removed with flexible osteotomes and a bone tamp without difficulty. The cement was well-fixed to the bone requiring the use of osteotomes and a high speed burr to remove all of the cement.

Second Stage:

Due to the continued joint mobility with the articulating spacer, exposure was not difficult. Once again, a large extensile approach was used proximally and distally with a large medial release and splitting of the quad proximally to sublux the extensor mechanism. The cement spacer was easily removed. Synovial fluid was checked for leukocyte esterase (negative) and a frozen section was also checked and was negative. Due to massive bone loss and a history of chronic infection, the decision was made to reconstruct the joint with the LPS System. This allowed for wide excision of any potential chronically infected bone (osteomyelitis) and also provided joint stability in an otherwise compromised soft tissue envelope. Both tibial and femoral fixation were achieved with porous sleeves. The largest sleeves possible were used to achieve axial and rotational stability and also to maximize porous material for biologic fixation. Femoral fixation was supported with a cable above the level of the sleeve due to

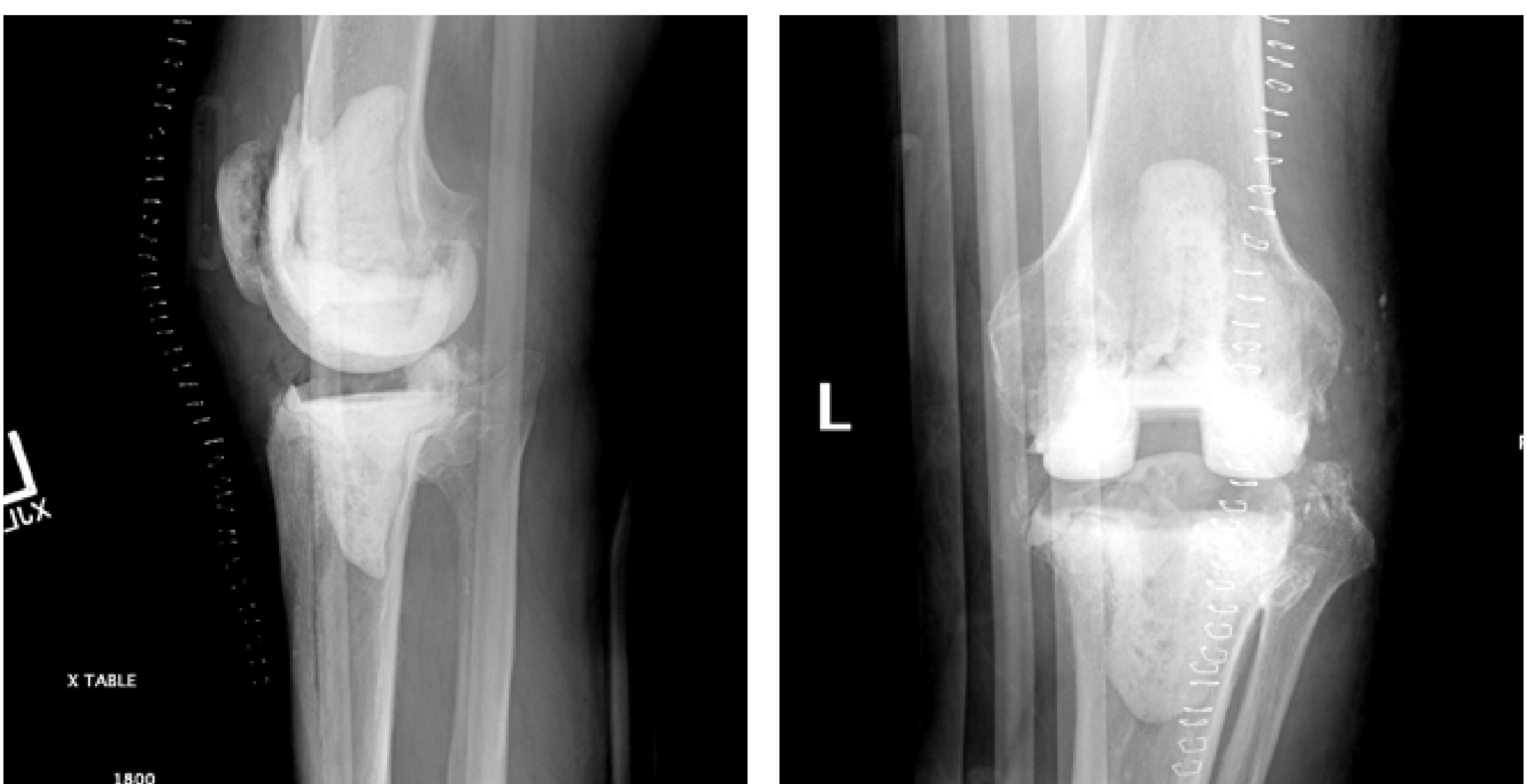

Figure 2: Articulating spacer

the general weak nature of this bone and the tremendous forces placed through this interface. A relatively long stem is used for both the femur and the tibia to help distribute stresses until osseous fixation is achieved. The patella is often not resurfaced in this setting due to its general poor bone stock and history of failure with similar cases in the past.

**Author's Note: When using a femoral metaphyseal sleeve with a DFR, it is usually recommended to leave the sleeve a bit proud of the host bone to allow the cortical bone to help distribute the weight bearing forces. In this particular case the host bone was larger than the largest femoral sleeve but it still achieved a tight fit.*

Figure 2: Post-operative X-rays

POST-OPERATIVE

My post-operative program is very conservative.

The soft tissue window in these patients has sub-optimal healing potential both in regards to the skin as well as the deeper tissues. Additionally, the stresses across the fixation interfaces are high. Therefore, patients are placed in a post-operative knee brace locked in extension. They are allowed to partially weight bear with a walker. After two weeks, the brace is unlocked from 0-30 degrees and increased by 30 degrees every two weeks. Weight bearing is partial until six weeks post-operative. X-rays are taken at six weeks post-operative. The brace is discontinued at six weeks. Weight bearing is then progressed to as tolerated with continued use of a walker or a pair of crutches for another six weeks. At twelve weeks post-operative, patients may transition to a cane and wean from the cane as comfortable. Currently this patient is mobilizing well at ten months post re-implantation. He has no limp, minimal pain, and his ROM is 0-95 degrees. There is no evidence of recurrence of infection. Please note patient was treated with six months of oral antibiotic after re-implantation based on our current protocol with our ID team.

DISCUSSION

Revision total knee arthroplasty after explanation can be a difficult endeavor with a myriad of potential pitfalls and challenges both in relation to optimal joint reconstruction as well as healing of soft tissues and avoidance of peri-operative complications.

The LPS System used in this case example provides a way for the surgeon to aggressively deal with the prior infected bed while providing the patient with a durable solution. When possible, an articulating spacer will allow the subsequent re-implantation to be performed in a more efficient manner.

The LPS System, in combination with the femoral and tibial porous sleeves, provides the surgeon with a fairly simple technique for joint reconstruction in a joint that would otherwise be quite difficult to reconstruct.

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LPS™ SYSTEM UTILIZED FOR PERIPROSTHETIC FRACTURE

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ABSTRACT

Periprosthetic fractures involving a total knee arthroplasty (TKA) often have compromised bone stock as well as loose TKA components that preclude traditional ORIF or retrograde nailing. The LPS™ System is used to treat the fracture as well as revise the TKA in a single stage, allowing the patient to begin immediate weight bearing and resumption of daily activities. Presented is the case of an 82-year-old female with multiple medical co-morbidities who sustained a fracture involving the distal femoral-implant interface. She was treated with an LPS System distal femoral replacement and began mobilization on post-operative day one.

CASE REPORT

HISTORY

An 82-year-old female with CAD, DM, HTN, and osteoporosis presented to my office with a periprosthetic distal femur fracture she sustained during a mechanical fall in December of 2010. She originally had a cruciate-retaining TKA performed at an outside hospital four years prior with some complaints of anterior knee pain prior to her fall. Her ambulatory status was a community ambulator with assistance. She lives alone.

Her pre-operative X-rays showed a displaced, comminuted, distal femur fracture involving the bone-implant interface with evidence of periosteal reaction of the anterior cortex and lucency of the anterior cortex of the implant (Figure 1). No prior outside X-rays were available for review. However, I suspect notching of the anterior cortex with aseptic loosening as the etiology of the facture.

A pre-operative workup for infection consisted of an aspiration showing >100,000 RBC's, 2400 nucleated cells with 65 percent segs. The knee joint was determined to not be infected.

Informed consent was obtained from the patient and family, discussing different treatment options including ORIF, retrograde nailing, and distal femoral replacement (LPS System) revision TKA. Because of her comminuted bone, osteopenia at the fracture site, and poor medical condition that precluded three months of non-weight bearing, a decision was made to perform a single-stage LPS System revision TKA.

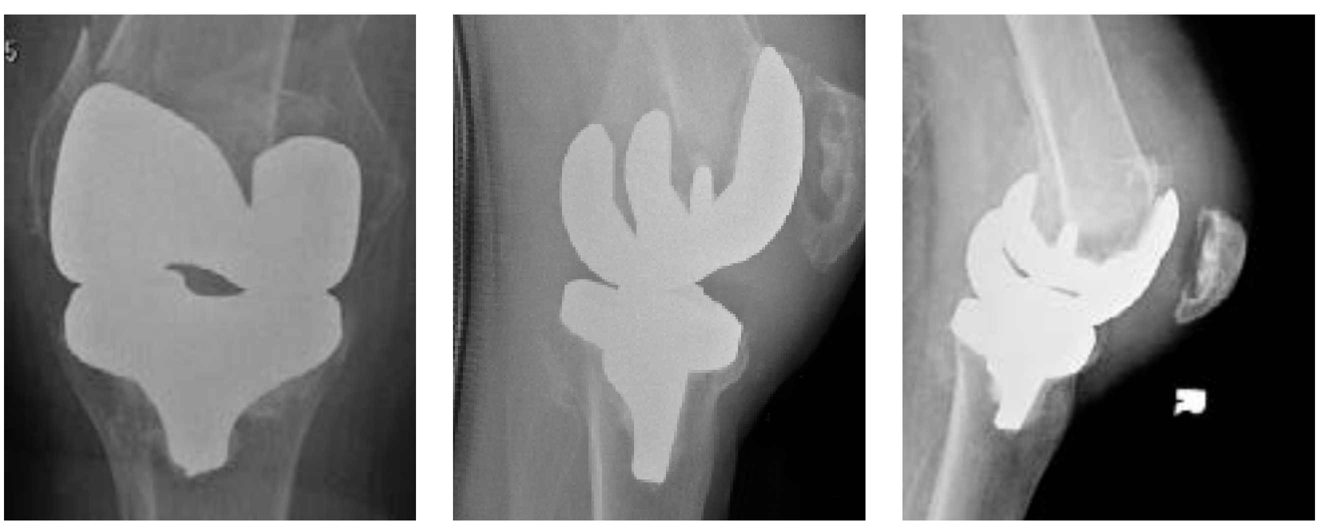

Figure 1: Pre-operative X-rays

INTRA-OPERATIVE

The patient was brought into the OR, placed supine, and the tourniquet was applied as proximal as possible to allow for adequate exposure of the distal thigh. Pre-operative antibiotics consisted of Ancef® and Vancomycin due to the patient's age and overall medical co-morbidities. After standard prep, drape, and surgical timeout, the tourniquet was inflated to 275 mm Hg.

A midline incision was made following her previous incision and a medial parapatellar approach was utilized. As is standard for my practice, the medial and lateral gutters were cleared and the tissue was sent to microbiology for routine cultures. If there was a greater concern for infection, I would have sent the synovial tissue to pathology to read WBC/HPF.

Following adequate exposure, I performed subperiosteal dissection around the distal femur, proximal to the fractured bone. Two blunt Bennett retractors were placed around the distal femur meta-diaphyseal junction and the bone was transected perpendicular to the shaft. Prior to doing this, a linear line was scored onto the anterior cortex with a bovie as a reference to the proper rotation of the femoral component (since additional reference points will be removed during the operation). The level of this resection was made based on the total length of the femur (including prosthesis) I wanted to resect. Following this, the entire distal femur and prosthesis were removed using a strict subperiosteal technique (Figure 2). I used a bovie and took care to stay on the bone so as not to damage the neurovascular structures. In my opinion, release of the collateral ligaments and posterior capsule are the most difficult areas of this resection.

Figure 2: Distal femoral component next to the patient's excised bone

Following this, the femoral canal was prepared to accept a cemented stem. Traditionally, I use cemented stems, but lately I have incorporated broaching a metaphyseal sleeve into the distal femur for rotational control.

Attention was then turned to the tibia. It is important during this portion to keep the distal femoral bone from displacing posteriorly and injuring neurovascular structures, and thus I usually have an assistant manually hold the femur up or hold it with Bennett retractors. The tibial component was removed in a standard fashion using a saw and an osteotome. A skim cut was made on the tibia and the metaphysis and tibial canal were prepared in a standard fashion. Because this patient was older and the overall bone quality was decent, I elected to not use a tibial sleeve or tibial augments.

If the patellar component is well fixed and does not exhibit wear, I will leave it to articulate with the LPS System distal femoral component trochlear groove. If there is a question, I will remove it and inspect the bone stock. If there is inadequate bone, I will leave the patella unresurfaced.

Trial LPS System components were placed after the prep was completed. The XX-Small femoral

INTRA-OPERATIVE (CONTINUED)

component was used to help with soft tissue closure. When performing distal femoral replacements, it is important to properly restore the leg length. I use the height of the patella in 20 degrees of flexion to assess the overall leg length. When the joint line is established properly, the patella should rest on the distal aspect of the trochlear groove. The knee was put through a range of motion and the patellar tracking was assessed. I tried to avoid lateral release of the patella to avoid avascular necrosis as the overall dissection disrupts most of the patellar blood supply

Once I was satisfied with the trial components, I assembled the implant components on the back table using the taper impactors. Next, I placed cement restrictors at the appropriate level and used a cement gun to insert the cement using a retrograde technique. I cemented the tibia first followed by the femur. I then placed an insert trial, removed excess cement, and allowed the cement to harden with the knee in full extension as I paid close attention to the rotation of the femoral component.

After the cement hardened, I dropped the tourniquet and bovied the bleeders. I then inserted the final polyethylene insert and locking pin. Closure was routine using a non-absorbable suture. Skin was closed with nylon. Drains were used and post-operative X-rays were obtained to ensure no proximal or distal fractures had occurred (Figure 3). A bulky dressing was used and motion was started on post-operative day two with full weight bearing on post-operative day one. Overall flexion was limited to 100 degrees so as not to disengage the tibial polyethylene post from the keel well.

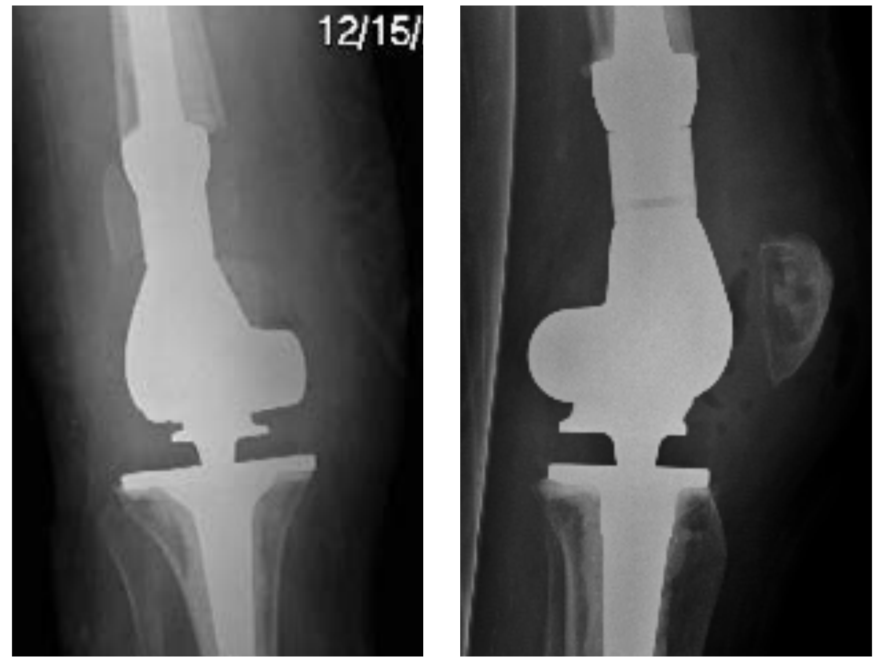

Figure 3: Post-operative X-rays

POST-OPERATIVE

Following this surgery, the patient did well and was able to begin immediate ambulation. The stable implants allow older patients, who often are compromised with respect to balance and strength, to resume their normal daily activities. Pain management is similar to primary total knee replacements.

Latest follow-up on this patient is from September of 2012 (21 months) and she is pain free and walking with a walker due to her additional medical co-morbidities. In my experience, the outcome of this type of patient is similar to those sustaining femoral neck fractures treated with cemented hip hemiarthroplasty.

POST-OPERATIVE CONTINUED

The X-rays shown are typical of most, with periosteal reaction and heterotopic bone forming at the level of the femoral resection. AVN of the patella is also common due to the overall dissection involved to remove the distal femoral bone and implant.

Figure 4: X-ray at one year follow-up

DISCUSSION

The LPS System for distal femoral replacement is a treatment option for problems in medically compromised patients.

Cost of the implant can be substantially more than other methods of treatment. The ability to revise this construct is also a deterrent, and if the patient develops an infection, the salvage is typically an above-the-knee amputation as there is inadequate bone stock for a fusion. It is important to rule out infection prior to revising patients to this construct.

In my practice, the majority of patients sustaining these injuries are treated with traditional locked side-plates and less frequently with retrograde nailing. However, for the patient who needs to mobilize quickly due to medical issues and who has compromised bone stock and/or a compromised TKA, this technique is optimal.

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