

Case Report

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Total Knee Arthroplasty in Patients with Distal Femoral Malunion: A Case Report

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ABSTRACT

Background: Post-traumatic arthrosis can occur subsequent to fracture of the distal femur related to residual malalignment or direct intraarticular injury. The presence of extra articular deformities either in the femur or the tibia with arthritis of the knee makes total knee arthroplasty (TKA) technically demanding. We report our initial experience on such complex knee arthroplasty

Case Presentation: A 69-year-old female complained of progressive right knee pain, limited range of motion and obvious varus deformity of the right knee. She had a trauma history 13 years ago on femur side, operated and subsequent removal of implant 2 years after. Preoperative radiographs showed severe osteoarthritis on medial side and patellofemoral joint and malunion supracondylar and varus deformity. Total knee arthroplasty (TKA) was done using standard jig and equipment

Conclusion: Correction could be possible to perform in majority of TKA for extraarticular deformities with good preoperative planning and templating, intraarticular bone resection and good soft tissue balancing both in flexion and extension.

Keywords: *Total knee Arthroplasty, Extra-articular deformity, intraarticular resection*

Level of Evidence: IV



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Introductions

Distal femoral fractures are a relatively common Orthopaedic injury.¹ Post-traumatic arthrosis can occur subsequent to fracture of the distal femur related to residual malalignment or direct intraarticular injury. In advanced disabling osteoarthritis of the knee, total knee replacement (TKR) appears to be the only effective attitude.³

Distal femoral fractures may exert an adverse effect in several ways. First, because of the proximity of the fracture to the knee joint, and possible intraarticular extension of the fracture, these patients are at higher risk of developing arthritis early in younger age.^{1,2,13} In addition, presence of a malunion in the vicinity of the knee, following these fractures, and disruption of the mechanics of joint function, may also accelerate the subsequent development of arthritis and create reconstructive challenges at the time of arthroplasty. Furthermore, poor bone stock, prior surgical procedures with retained hardware, and a compromised soft tissue envelope around the knee may also adversely affect the result of TKA in some patients with a prior distal femoral fracture.¹

With this understanding in our mind, we describe specific complications and technical issues on our initial experience in this complex total knee arthroplasty.

Case Presentation

A 69 years old female presented to us with 8 years history of right knee pain. Pain gradually increased in severity over few years and worse on movements. She had a history of distal femoral fracture on 2008 ORIF was done and removal of implant on 2010 treated elsewhere. Medical treatment with non-steroidal anti-inflammatory analgesics did not relief her pain. The patient had moderate to severe pain, obvious varus knee, antalgic gait and restriction extension and flexion of the right knee due to pain. ROM under anaesthesia measured 0-90°. Distal femur shape like trapezoid on axial view. There is a previous surgical scar on lateral side of distal femur but had healed and does not look compromised. The lower limbs X-ray showed severe osteoarthritis with

some residual deformity extraarticular in knee that suggested a TKA



Figure 1: preoperative Xray with scannogram for templating, it shows malunited fracture of the right supracondylar femur with advanced osteoarthritis of the right knee, a deformity of 9° varus in the coronal plane, CT scan used to determine the deformity in detail for planned correction

was appropriate. And CT scan with 3D reconstruction is helpful for the preoperative plan on the right knee to determine the deformity.

We do preoperative templating to determine the corrective osteotomy, cutting line so as not to endanger the collateral ligament attachment, amount of bone cut, and the need for expanding stems or augments on scanogram. Emphasis was laid on proper positioning of limb (in 10° internal rotation) during execution of the radiographs as external rotation accentuated the varus deformity due to the anterior bowing of the femur. The varus deformity measured 9 degrees, no recurvatum and shortening deformity preoperatively. Rotational deformity difficult to be determined preoperatively, however we note clinically and intraoperatively. A line is drawn from the center of the femoral head to the center of the knee. Another line is drawn from the middle of the talus to the center of the knee. Perpendiculars from these lines at the level of the joint line will help determine the relative difference between the medial and lateral resection of the distal femur. The planned resection seems not to compromise the integrity of the collateral ligament. Considering her age and the degree of medial arthritis, a TKA was ordered for both sides.

The surgery was performed by one experienced surgeon under Combined Spinal Epidural Anesthesia (CSEA) using conventional instruments and a fixed bearing, posterior-

stabilised prosthesis (U2 primary-PS system, CMA™; United Inc). More constrained knee system and augments prepared as back up. Standard midline incision, medial parapatellar approach was done. The lateral bump seen preoperatively was osteophyte and removed intraoperatively. First the tibial proximal cut was made 90° to the mechanical axis on coronal plane and 0° posterior slope on sagittal plane. A 9 mm resection below the highest point of the lateral plateau was made. The insertion point for femoral jig was measured from notch according to preop template and was found 17mm on lateral condyle from intercondylar notch. Then 9 mm distal femoral cut was made perpendicular to the mechanical line [hip knee stem (HKS) 6 degrees. Collateral ligament was found to be not violated with the planned distal cut.

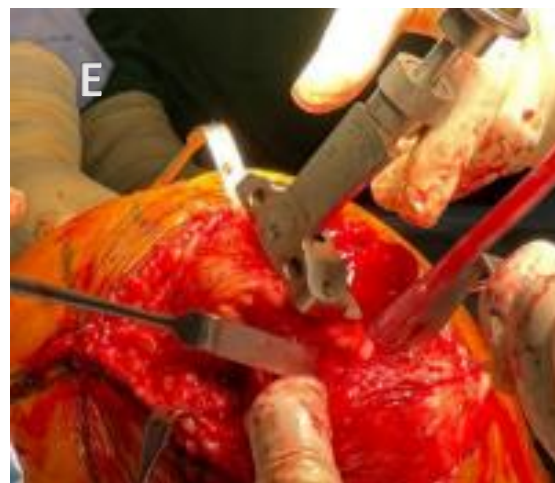


Figure 2: intraoperative picture A. advance OA with osteochondral defect, notice the shape of lateral femoral condyle(trapezoid) B. external tibial jig was use to cut tibia perpendicular C. insertion of femoral jig assisted with a rod aligned to femoral head D. intramedullary guide wire inserted, notice the insertion was on lateral condyle E. Distal femoral jig set to 6°

After distal femoral cut, the extension gap was found to be balance in extension. The subsequence femoral cutting block was applied and dependant femoral rotational cut was made according



Figure 3. Post operative radiograph shows good alignment and restoration of mechanical alignment, HKA angle was 178° post operatively, good tibial slope and implant position on lateral view, centre position of patella on skyline view

to tibial proximal cut. We use transepicondylar axis and whiteside's line for rotational guide. Rotational malunion location found near the attachments of the collateral ligaments. We do not change the rotational position of either the tibial or femoral component in the knee. Femoral was measured size 3 with this system.

Soft tissue balancing was done after bone resection. Patellar tracking was assessed at this stage by the thumbs off sign. Knee flexion beyond 90° and no anterior lift of the tibial tray. The final components were fixed using cement (Palacos®), patella was not resurfaced and wound closed with water tight suture by layer. The contralateral knee TKR was done in usual manner at the same sitting, left femur measured size 2 with the system. Local infiltration analgesia was done postoperatively. Post-operative regiment was similar to routine TKR.

Patient hospitalized for 3days, started to walk using walker after 24hours. She had obvious pain relief and alignment correction at the time of follow up. Range of motion was 0 to 125 degree and no infection and thrombolism was found. She started to walk using walker for the first 2 weeks in 3 months follow up The preoperative hip knee ankle (HKA) angle was 163° and the postoperative HKA angle was 178°

Discussion

Total knee arthroplasty (TKA) is an extremely successful operation. Surgical techniques are standardized and outcomes are consistently good. The long-term success of TKA depends on recreating the mechanical axis, balancing the soft tissues appropriately, and equalizing the flexion and extension gap.^{1,9,12} Most arthritic knees have some degree of bony and soft-tissue deformity preoperatively. These deformities can usually be handled by asymmetric intra-articular bony resection and soft-tissue release.¹³ However, bony deformity above or below the joint makes restoration of the mechanical axis difficult. Wolff et al.³ reported that the feasibility of joint line resection and soft-tissue balancing is determined by the degree of the deformity and the distance of the deformity from the knee.

Our goal of treatment in such deformity is to obtain proper mechanical alignment to ensure a successful result. Proper axial alignment obtained through the use of intramedullary

instruments on the femoral side can be hindered when extraarticular deformity present. In these situations, the use of computer-assisted surgery (CAS), which has reported been used successfully is appropriate.⁴ However, the use of this expensive and advanced technology is very limited on our setting in Indonesia. Coronal plane deformity, sagittal plane deformity, and rotational deformities can occur in isolation or in combination to make surgical planning and surgical execution much more difficult. Extramedullary techniques are difficult on the femoral side, requiring radiographic identification of the femoral head and free hand pinning of the distal femur. We found careful preoperative planning and measurement is the key to dealing with extra-articular deformity and arthritis of the knee is preoperative planning.⁶ Moreover, bowing of the femur or tibia as well as previous fractures that may have gone unnoticed since childhood can be identified on the scanogram and thus should always be done to guide and ensure recreation of mechanical axis. The closer the deformity is to the joint, the greater impact the deformity has on the orientation of resection thus the farther deformity from the knee joint may be less in need of corrective osteotomy than those that are closer to the knee joint.^{7,12}

For TKR with extraarticular deformity, options include two- stage osteotomy, one-stage osteotomy, and one-stage intra-articular correction.⁸ A two-stage osteotomy can be performed for extra-articular deformities that are thought to be too severe for intra-articular correction. The osteotomy is usually done at the apex of the deformity and fixed with either intramedullary or, in most cases, extramedullary hardware following wedge resection.^{9,13} A TKA is then performed once the osteotomy has healed. Extra-articular osteotomies allow a larger correction but bring about the possibilities of osteotomy non-union and decreased weight-bearing status that may interfere with rehabilitation after TKA.

One-stage osteotomy uses an extensile-incision, through which either a wedge osteotomy

with plating or a wedge osteotomy fixed with a long-stemmed, uncemented fluted implant is performed. Lonner¹⁰ described 11 knees in which this one-stage extra-articular osteotomy combined with a TKA was performed. The average range of motion preoperatively was 56°, and the average range of motion postoperatively was only 84°. Booth (Instructional Course Lecture presented at the American Academy of Orthopaedic Surgeons annual meeting, 2001) described an oblique osteotomy technique that allows for correction primarily by rotation through an oblique osteotomy¹³

The effect of intra-articular correction of extraarticular deformities on ligamentous stability remains a concern. In the presence of large extraarticular deformities, significant imbalance of the collateral ligaments may result if intraarticular correction is used.¹¹ In the presence of extraarticular deformity of 10° or more in the coronal plane or 20° or more in the sagittal plane, Lonner¹⁰ recommends simultaneous or staged osteotomy to reduce the need for constrained implant. Extraarticular osteotomy has the advantage of maintaining the normal relationship of the collateral and posterior cruciate ligaments to the joint, however it involves an additional procedure requiring the use of adjunct internal fixation. The amount of bone resection and the possibility of collateral compromise were determined as described by Wolff et al.³ and Wang et al.² Wang et al.² also reported no complication in their series of 13 cases where TKA was done in conjunction with intraarticular bone resection. In their series intraarticular bone resection with soft tissue balancing with TKA achieved satisfactory outcomes in patients with arthritis of the knee and an extraarticular varus deformity of <20° in the femur and ≤30° in the coronal plane of the tibia. A corrective extra articular femoral osteotomy is indicated if the anticipated femoral condylar resection violated the integrity of the insertion of either the medial or the lateral collateral ligament if not then TKA following intraarticular bone resection could be done.^{1,13} Extra-articular rotational malunions can be difficult to understand, predict, or correct at primary

arthroplasty except by corrective osteotomy at the site of the malunion. In general, rotation malunions that are located beyond the attachments of the collateral ligaments should not be corrected by changing the rotational position of either the tibial or femoral component in the knee.¹²

The vast majority of these deformities can be managed by intra-articular resection and careful ligamentous balancing.^{7,9} Any planned resection that would compromise the integrity of the collateral ligament must be dealt with either by an osteotomy or by using metallic augmentation on the deficient side and limiting the resection on the prominent side to preserve the collateral ligament. Resection much greater than 10 mm may jeopardize the origin of the collateral ligaments on the femoral side or affect the strength of the tibial bone stock on the tibial side.

Our study goal was to evaluate our early experience whether TKA alone was able to correct extra-articular deformities in patients with knee OA, and this was accomplished successfully. In the presence of multiple plane deformity, it would be harder to re-establish mechanical axis with standard jig and instrument, thus the role of navigation/computer assisted surgery.⁴ Fortunately, in the present era where there is more and more inclination toward internal fixation it is more unlikely that deformities of very high degree would be seen.

Total knee arthroplasty in conjunction with intra-articular bone resection is an effective procedure for patients with arthritis of the knee and extra-articular varus deformity. A good preoperative planning and templating, intraarticular bone resection and good soft tissue balancing both in flexion and extension, correction would be possible in majority of extraarticular deformities.

Conclusion

Correction could be possible to perform in majority of TKA for extraarticular deformities with good preoperative planning and templating, intraarticular bone resection and good soft tissue balancing both in flexion and extension.

Conflict of interest

None

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