Case Report
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SIMULTANEOUS FEMORAL OSTEOTOMY AND PRIMARY TOTAL KNEE ARTHROPLASTY IN PATIENT WITH SEVERE EXTRA-ARTICULAR DEFORMITY: A CASE REPORT

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ABSTRACT

Correction of an extra-articular deformity of the femur and tibia during Total Knee Arthroplasty (TKA) in advanced knee osteoarthritis (OA) is a technically demanding procedure. The challenge is in the implications of the femoral and tibial realignment osteotomy in both coronal and sagittal planes either as a step-by-step or simultaneous procedure. We herein describe an unusual case of knee OA characterized by fixed severe varus knee deformity, tibiofemoral bowing, and lower limb internal rotation. The patient underwent distal femoral osteotomy correction accompanied by TKA to restore mechanical and rotational alignment at the same time. A standard primary Posterior Stabilized (PS) implant was used. The procedure successfully provided stability, restored alignment, and delivered a good functional outcome. This case highlights the arthroplasty surgeon's challenges, especially those who work in limited facilities.

Keywords: Corrective Femoral Osteotomy, Knee Osteoarthritis, Total Knee Arthroplasty, Varus Knee Deformity.

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INTRODUCTION

Most knee osteoarthritis (OA) cases are related to deformities, both intra-articular and extra-articular. The deformity produces abnormal knee alignment which affects the development and progression of the disease (1). The extra- articular deformity can be caused by a previous fracture, skeletal developmental abnormality, metabolic bone diseases, congenital malformation, and previous osteotomies (2). This deformity appears in the coronal, sagittal, and axial planes or combination (3). It can be corrected by osteotomy alone, arthroplasty with intra- articular correction, or in conjunction with an extra-articular procedure (4). Management of knee OA in conjunction with extra-articular deformity needs a comprehensive approach.

Total Knee Arthroplasty (TKA) is a frequently administered and effective procedure to relieve pain and restore function in patients suffering from severe OA (5). This procedure is aimed to correct knee mechanical alignment. Proper mechanical alignment is difficult to obtain in patients with extra-articular deformity because the sclerotic canal, crocked canal, or retained hardware potentially obstruct the use of an intramedullary guide (6). Intra-articular bone cuts TKA in 20° of femoral and 30° of tibial deformity, which will jeopardize the insertion of the medial and lateral collateral ligaments leading to complex instability. In this circumstance, distal femoral and or proximal tibial realignment osteotomy in both coronal and sagittal planes is needed either as a step-by-step or simultaneous procedure.

When corrective osteotomy is necessary, a decision must be made either to perform step-by- step or simultaneous osteotomy before TKA. Optimal deformity correction can be easily achieved by staged means as there is no concern with interfering with the arthroplasty implant and procedure. Once the osteotomized bone is fully healed, the plate and screw can be removed so that they will not obstruct the intramedullary guide during TKA. The simultaneous approach provides benefits that are one surgical procedure and one recovery period. Nevertheless, blood loss management and potential cement leakage in the osteotomy site are obstacles that must be overcome (2).

Arthroplasty procedure can be achieved with conventional, or Computer-Assisted Navigation (CAN) system or Patient-Specific Instrument (PSI)6. Both CAN system and PSI are expensive and necessitate a complicated instrument. Completing corrective osteotomy before TKA provides opportunities for using a primary standard arthroplasty implant.

PRESENTATION OF CASE

A 52 years-old woman presented with severe bilateral knee pain. The right knee wasmore painful, and she complained of difficulty in walking. The patient confessed that both of her knees had been bowed since a young age for an unknown reason because of a very limited health care facility. Physical examination revealed varus deformity, joint crepitation, mild swelling, and tender right knee. The preoperative range of motion was 6° - 84°. The Antero-posterior (AP) and lateral knee

radiograph illustrated grade IV Kellgren-Lawrence classification OA. Normal patellar tracking can be seen on the skyline view (Figure 1.).

Anterior posterior long leg standing radiographs of both knees were obtained and revealed a deformity of 36° varus, 72° of lateral distal femoral angle (LDFA), 34° of extra-articular femoral deformity, 82° medial proximal tibial angle (MPTA), 8° of extra-articular tibia deformity,6° of joint line convergence angle (JLCA), 18° varus, and 160 mm deviation from the mechanicalaxis of the limb in the coronal plane. Apex deformity is situated at the junction between the distal and the medial third of the femur (Figure 2.).

Figure 1. Knee radiograph, A) AP, B) Lateral, C) Skyline view.

The femur was exposed through lateral approach. Closed-wedge osteotomy was performed at the apex deformity of the femur. Alignment and rotation were corrected under image intensifier control. A 4.5-mm locking broad plate (Synthes, West Chester, USA) was placed with a bicortical screw at the proximal fragment and a unicortical screw at the distal fragment so as not to interfere with the intramedullary guide during distal femoral cutting while temporarily maintaining the correction (Figure 2).

The medial parapatellar approach was done to the knee. Distal femoral bone cut with 6° valgus correction was accomplished using the conventional intramedullary guide. The proximal tibia bone cut was performed perpendicular to the tibia mechanical axis using the extramedullary guide, followed by soft tissue balancing. We found a medial defect approximately 8 mm in depth type T1 Anderson Orthopedic Research Institute (AORI) Classification on the proximal tibia. Cement and screw augmentation was performed to treat the defect along with tibial deformity correction. A standard posterior-stabilized (PS) TKA prosthesis (DePuy Orthopaedic Inc., Warsaw, IN, USA) was fixed with antibiotic-loaded polymethyl- methacrylate in standard fashion and assembled with 10-mm-thick polyethylene insertion. After TKA had been finished, the unicortical screws were changed to bicortical screws (Figure 2).

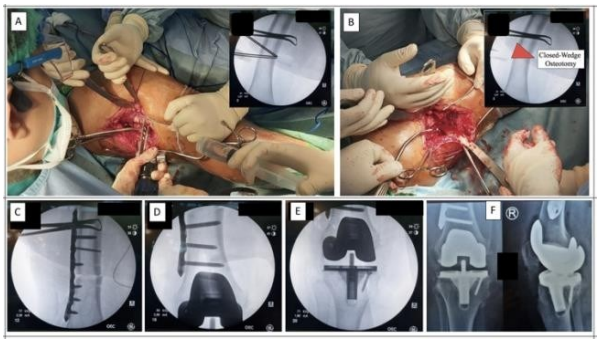

Figure 2. (A) Apex deformity identification, (B) Closed-wedge osteotomy, (C) Deformity correction and temporary fixation, (D) Unicortical screws were changed to bicortical screws after TKA finished (E) Prosthesis evaluation, (F) Postoperative knee AP and lateral view.

Based on the postoperative evaluation, we achieved 1° valgus, 87° lateral distal femoral angle(LDFA), 89° medial proximal tibial angle (MPTA), parallel to joint line convergence angle (JLCA), and 20 mm deviation from the mechanical axis of the limb in the coronal plane. The extra-articular femoral deformity was corrected (figure 3). The Western Ontario and McMaster Universities Arthritis Index (WOMAC) Score was improved from 37.1 to 76.5 (table 1)

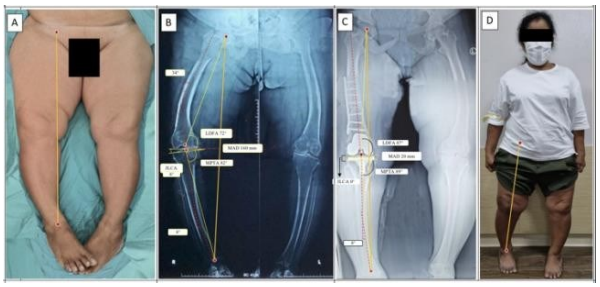

Figure 3. (A) Preoperative clinical picture, long- standing AP radiograph (B) preoperative, (C) postoperative, (D) postoperative clinical picture.

Table 1. Pre and postoperative measurement.

No	Measurement	Normal Range	Result	
			Pre-OP	Post-Op
1	Mechanical Axis Deviation (MAD)	0-8 mm	160 mm	20 mm
2	Lateral Distal Femoral Angle(LDFA)	85° - 90°	72°	87°
3	Medial Proximal Tibial Angle (MPTA)	85° - 90°	82°	89°
4	Joint Line Convergence Angle (JLCA)	0° - 2°	6°	0°
5	Western Ontario and McMaster UniversitiesArthritis Index (WOMAC)		37.1	76.5

DISCUSSION

The success of TKA is highly dependent on mechanical axis correction, soft tissue balancing around the knee, good patellar tracking, and precise placement of the implants. Femoral or tibial extra-articular deformity makes the surgery very challenging (7). In this case, the measurement result of abnormal LDFA and MPTA indicates that deformity originates from both the femur and tibia. Deformity of femur approximately 34° and 8° for tibia deformity. The apex of femoral deformity is located 20 cm proximal from the joint line and 14 cm from the joint line for the tibia. Based on these data we can conclude that deformity is extra-articular. The extra-articular deformity is defined as the deformity located proximal to the femoral epicondyles for the femur or distal to the fibular neck for the tibia (3).

In our case, the extra-articular femoral deformity was >20° (34°) and >30° (8°) for the tibia. We performed corrective closed-wedge osteotomy of the femur before TKA in one-step surgery. According to Wang et al, the intra-articular bone resection-only technique during TKA can be accomplished for extra-articular deformity of the femur <20° and of the tibia <30° in the coronal plane8. So in this situation, femoral osteotomy was needed before TKA but not for the tibia. Extra- articular femoral osteotomy doesn't need to perform in a series study of knee arthrosis by Mann et al on 11 patients with an average of 14° on femoral coronal plane deformity (9). Contrary to the study by Rajgopal et al, corrective resection extra-articular of the femur is required if >10° deformity in the coronal plane (7).

Distal femoral resection with proper orientation to the mechanical axis in a

femoral coronal deformity that >10° is challenging. There will be at risk of oblique orientation bone cut to the epicondylar axis in extension leading to an imbalance ligament. The relationship between the posterior aspect of femoral condyles and proximal tibia in flexion produces asymmetrical gaps which are troublesome to balance (7).

If the femoral deformity >20°, soft tissue balancing will be hard to achieve after the bone is cut by only intraarticular correction. The possibility of bone resection and ligament balancing is determined by the degree of deformity and distance of deformity from the joint line. The larger of deformity and closer to the joint line, the greater impact on soft tissue imbalance (10). We performed a corrective femoral osteotomy at the apex before TKA. Wolff et al said that extra-articular deformity can only be adjusted at the apex of deformity before TKA (10). The apex of femoral bowing was located approximately 20 cm proximal to the knee joint. Realignment osteotomy femur and fixation with plate and screw firstly were done. No obstacle was found during insertion of intramedullary guide femur because the distance between joint the line and corrected apex was far enough.

Preoperative surgical planning has been done in detail. Based on practical methodology by Wang and Wang11, we found a line drawn perpendicular to the mechanical axis femur at the proposed resection, passing to proximal insertion of collateral ligaments. It means that if we do cut the distal femur before femoral osteotomy correction, we will damage the collaterals ligaments at femoral insertion. Therefore, extra-articular correction must be done before TKA to avoid the damage and difficulties mentioned above.

One-stage surgery is technically demanding but it delivers long-term implant survival, corrects both anatomical and mechanical axis in a single surgical procedure, avoids two anesthesia, decreases recovery time, and diminishes the total cost of the procedure (12). Apart from these advantages, bleeding control, operation time, and soft tissue handling due to multiple surgical incisions must be taken care of.

CONCLUSIONS

In conclusion, OA of the knee in conjunction with the femur and or tibia extra- articular deformity is rare but challenging. Preoperative surgical planning is mandatory in such of condition. Further investigation, more cases, and longer series are needed to prove its advantages.

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