

Total knee arthroplasty in extra articular deformities: A series of 36 knees

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ABSTRACT

Background: 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. The purpose of this study is to report outcomes with Total Knee Arthroplasty in patients with arthritis of the knee associated with extra articular deformity by intraarticular resection and soft tissue balancing.

Materials and Methods: Thirty six knees (32 patients) who had arthritis of the knee associated with extra articular deformity, underwent total knee arthroplasty between 1999 and 2006 were included in this retrospective analysis. All patients had intraarticular resection with soft tissue balancing to correct the deformity. Full length weight bearing anteroposterior X-rays, Knee society scores, and Knee range of motion was recorded pre- and postoperatively.

Results: The mean period of followup was 85 months (range 42-120 months). The deformities amenable to correction by intraarticular resection in our series were Femur- Coronal plane 11°-18° (mean 16.2°) Saggital plane 0°-15° (mean 10.1°) Tibia - Coronal plane 12°-24° (mean 21°). There was an improvement in the range of motion from mean of 54° preoperatively to 114° postoperatively (*P* value < 0.05). The Knee Society- Knee Score improved from 37 points to 85 points postoperatively (*P* value < 0.05). The functional score improved from a mean value of 19 to a mean of 69.5 at followup (*P* < 0.01). The preoperative hip knee ankle angle in the coronal plane improved from a mean of 14° ± 2° varus (26° varus to 4° valgus) to a mean of 2° ± 0.6° varus (6° varus to 2° valgus).

Conclusion: With 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.

Key words: Extra articular deformity, intraarticular resection, templating, total knee arthroplasty

INTRODUCTION

Lotke and Eckar¹ established the importance of alignment in 1977. John Insall² confirmed this observation with a 10 to 12 year followup. Most arthritic knees have some degree of associated deformity and soft tissue imbalance which can be addressed by soft tissue balancing and restoration of the mechanical axis and good patellar tracking. The presence of extra articular deformities either in the femur or the tibia with arthritis of

the knee is technically demanding. While extra articular deformities less than 10° in the coronal plane and 20° in the saggital plane can be managed mainly by modified intraarticular bone resection and soft tissue release, greater deformities^{3,4} in addition requires corrective osteotomy with total knee arthroplasty (simultaneous or two stage). In such situation, intraarticular bone resection and soft tissue release alone may jeopardise the insertion of collaterals^{3,4} and lead to collateral imbalance. Deformities may be either in the coronal (varus or valgus), in the sagittal (flexion or extension) plane or rotationale.

Such situations may be encountered following malunions or stress fractures, previous surgical interventions like the high tibial osteotomy in metabolic bone disease, e.g., Pagets disease, rickets, osteomalacia and in congenital or developmental dysplasias.^{3,4}

This study reports clinical and radiological outcomes following total knee arthroplasty in patients with arthritis of the knee associated with extra articular deformities, with intraarticular resection, and soft tissue balancing.

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MATERIALS AND METHODS

We retrospectively reviewed 2400 knees (1400 patients) those underwent primary TKA between 1999 and 2006. 42 knees in 38 patients fulfilled our criterion of having arthritis of the knee associated with an ipsilateral extra articular deformity. Six patients (6 knees) were lost to followup and thus not included in the analysis. There were 30 male and 2 female patients. All patients included in the study (32 patients/36 knees) had intraarticular resection with soft tissue balancing to correct the deformity. Hospital ethics committee approval was obtained for the study.

The inclusion criteria were as follows:

(A) Angular deformity in the femur present in the middle third or distal part of the femur (including intraarticular involvement) [Figure 1a]. B) Angular deformity in the tibia present in the proximal part (including intraarticular involvement) or middle third of tibia associated with arthritic changes in the knee [Figures 2 and 3a].

The criteria for inclusion were in accordance with that suggested by Wang *et al.*⁴ where intraarticular bone resection was indicated on the basis of line drawing on full length weight bearing X-rays preoperatively. Only those deformities which confirmed to this were included in our study.

The average age was 66.6 years (range 58-78 years) at the time of surgery. Thirty patients had osteoarthritis. Rheumatoid arthritis accounted for the remaining two patients. Malunited fractures accounted for 20 patients, osteotomies 06 patients, metabolic diseases 4 patients, and developmental deformities 2 patients. Sixteen knees had associated deformities in the femur and twenty had involvement of the tibia. The preoperative knee society scores and range of motion for all patients were recorded.

Preoperatively all patients underwent a scannogram (full length standing X-rays). Deformities of the femur in both coronal and the sagittal plane and of the tibia in the coronal plane were measured on the anteroposterior and lateral radiographs. 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 preoperative Hip Knee Ankle angle was measured in all patients on the full length standing X-rays. Templating⁵ was done for all patient's X-rays preoperatively to determine the possible size and also to look for any possible collateral compromise and if the deformity would in any manner obstruct the placement of the components. Assessment was done to determine the need for any augments in the form of

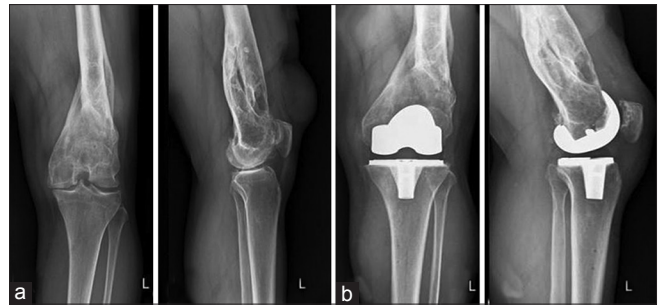


Figure 1: Preoperative x-ray of the knee (antero posterior and lateral views) showing (a) angular deformity in the distal part of the femur (including intraarticular involvement) (b) Post operative x-rays showing implant *in situ*



Figure 2: X-ray of the knee joint (anteroposterior view) showing angular deformity in the proximal part of tibia (including intraarticular involvement)



Figure 3: (a) Preoperative x-ray of the knee joint with leg bones (anteroposterior view) (a) showing angular deformity in proximal part of tibia (b,c) postoperative x-rays in anteroposterior and lateral views showing implant *in situ*

grafts, wedges or any stem extensions. The amount of bone resection and the possibility of collateral compromise were determined as described by Wolff *et al.*⁶ and Wang *et al.*⁴

According to Wang *et al.*⁴ the amount of bone to be resected from the knee could be determined using preoperative full length hip to ankle weight bearing X-rays of the lower limbs. A line was drawn from the center of the femoral head to the center of the knee and a second line perpendicular to the first line at the femoral condyle. 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. Similarly, for knees with extra articular deformity of the tibia, a line drawn from the medullary canal of the distal part of the tibia to the knee joint passing within the tibial plateau was an indication for TKA with intraarticular bone resection. If the line passed outside of the tibial plateau a corrective osteotomy was indicated.⁴

Preoperatively patients were clinically assessed for any ligament laxity, flexion deformity hyperextension, and evidence of any instability ($n=3$). In the presence of any instability a more constrained implant was used.

All TKAs were performed under epidural anesthesia using either an anterior midline incision with a medial parapatellar arthrotomy except one in which lateral most incision was used to include scar of previously operated patient. An attempt was made to achieve good intraoperative flexion by excising all the scar tissue and if required a quadriceps snip ($n = 3$) was done. An intramedullary device was used in the femur for resection of the condyles except in situations where the intramedullary rod failed to bypass the deformity (4 knees). The entry point for the intramedullary device was placed in lateral femoral condyle in case of varus and in the medial femoral condyle in case of valgus deformities. All tibia's were resected using the extra medullary jig at right angles to the mechanical axis of the tibia (line drawn from the PCL to the tibial tubercle proximally and just lateral to the tibialis anterior distally). Computer navigation was considered only in severe multiplaner or rotational deformities or in knees where intramedullary instrumentation could not be used ($n = 4$). Rotational alignment of the femur was rechecked at this stage by referring to the cut proximal end of the tibia. Final soft tissue balancing was done after bone resection and often required extensive soft tissue release as described by Clayton *et al.*⁷ On achieving soft tissue balance and confirming no compromise of the collaterals trial reduction was done. Patellar tracking was assessed at this stage by the thumbs off sign. Knee flexion beyond 90° and no anterior lift of the tibial tray, indicated a well balanced PCL in cruciate retaining knees. The final components were fixed using antibiotic (Gentamicin) impregnated cement in all cases.

Cruciate retaining implants were used in 19 knees [Figure 1a and b]. Cruciate sacrificing in 11 Knees. Minikeel tibia (minimal invasive knee implant-Zimmer, Warsaw) was used [Figure 3b and c] in 3 knees, while 3 knees underwent a LCKK (Legacy Constrained Condylar Knee-Zimmer, Warsaw) type of implant.

Epidural analgesia was used for 48 h postoperatively. Active knee mobilization started at 24 h and patients made to mobilize with a walker at 72 h.

All patients were followed at 3 weeks (for stitch removal), 3 months, 6 months, and yearly thereafter. Postoperatively all patients were evaluated for the Knee Society Score, Range of motion by independent assessor. Full length standing X-rays were taken of both lower limbs and assessed by a radiologist [Figure 4]. Statistical analysis was done using the SSPSv13 statistical software (SSPS Inc, Chicago, Illinois).

RESULTS

The mean period of followup was 85 months (range 42-120 months). The deformities amenable to correction by intraarticular resection in our series were:

Femur- Coronal plane 11°-18° (mean 16.2°)

Saggital plane 0°-15° (mean 10.1°)

Tibia - Coronal plane 12°-24° (mean 21°)

There was an improvement in the range of motion from mean of 54° preoperatively (range 10-100 deg) to 114° postoperatively (range 70-130 deg) (P value < 0.05). The Knee Society-Knee Score improved from 37 points preoperatively (range 10-80) to 85 points postoperatively (range 35-95) (P value < 0.05). The Knee Society-Functional score improved from mean value of 19 (0-40) to a mean of 69.5 (0-90) at followup (P < 0.01). The hip knee ankle angle in the coronal plane improved from a



Figure 4: Ortho scannogram showing postoperative alignment.

mean of $14^{\circ} \pm 2^{\circ}$ varus (26° varus to 4° valgus) to a mean of $2^{\circ} \pm 0.6^{\circ}$ varus (6° varus to 2° valgus) ($P < 0.001$).

No complications were seen at last followup. Complications such as arthrofibrosis, wound break down, ligamentous instability, and patellar malalignment as described in literature were not encountered in our series.^{3,8}

DISCUSSION

The success of TKA is largely dependant upon restoration of the mechanical axis, perfect balancing of the periarticular soft tissues, good patellar tracking, and accurate placement of the prosthetic components. While most often this is possible, the presence of extraarticular deformities either in the femur or the tibia makes this task very challenging. This may be corrected using different procedures such as, doing a corrective osteotomy as the first stage followed by a subsequent TKA as the second stage or combining both stages together. Alternately, correction and arthroplasty can be done simultaneously using intraoperative corrective bone resection with soft tissue balancing. This is usually considered adequate when the collaterals function and balance is not compromised during bone resections. This is often so when the deformities are less than 10 deg in the coronal plane and 20 deg in the sagittal plane. In the presence of deformities more than this resection of distal femur with proper orientation to the mechanical axis will result in resection which is oblique to the epicondylar axis in extension leading to ligamentous imbalance in extension. At the same time the posterior aspect of the femoral condyles maintain their relationship with the proximal tibia in flexion leading to large asymmetrical gaps which are difficult to balance.

Mann *et al.*⁹ reported results of technique preferred by Insall in a series of 11 patients with deformities in the femur associated with arthrosis of the knee. The average deformity of the femur was 14° in the coronal plane (range 5° - 22°) and 12° in the sagittal plane (range 0° - 38°). According to the authors such a deformity could be managed adequately by modified intraarticular bone resection and ligament balancing with no need for an additional osteotomy.

The feasibility of joint line resection and soft tissue balancing by determining the degree of deformity and distance of the deformity from the knee was reported by Wolff *et al.*⁶ They reported that larger the deformity and closer to the knee joint, the greater the impact on the knee joint. If the deformity was 20° or more, soft tissue balancing would be difficult after bone resection.

Though Wolff *et al.*⁶ reported some cases of instability after intraarticular correction and TKA due to asymmetric bone

resection, Koenig *et al.*¹⁰ believed this could be compensated with soft tissue balancing and a stabilized prosthesis. According to them extraarticular deformities were always correctable intraarticularly. The word “always” was debated by Hungerford¹¹ who stated that in his opinion “there are some cases better served by extraarticular correction.” The question then becomes which ones, and how does the surgeon determine? There are four considerations: the magnitude of the deformity, the relationship of the deformity to the knee, the side of the deformity (varus or valgus), and whether the femur or the tibia is affected by the deformity. A larger deformity is more important, but just as important is its relationship to the knee. Large deformities distant to the knee have little impact on the knee. Varus deformities require lateral intraarticular over resection, which produces lateral instability. Valgus deformities require medial over resection, which produces medial instability. Lateral instability is stabilized by the dynamic lateral stabilizers (popliteus, lateral head of the gastrocnemius, biceps femoris, and iliotibial tract) and is better tolerated than medial instability. The best way to determine the consequence of the malalignment in question is to template the knee by drawing the mechanical axis from the femoral head or ankle to the center of the knee, and then the resection level that will be required. This will demonstrate the amount of over resection required to correct the extraarticular deformity, and in some cases will indicate the advantage of an extraarticular correction.”

Similarly Ritter and Faris¹² believed that with proper attention to ligamentous instability any deformity could be intraarticularly corrected and found that outcomes following extraarticular osteotomy (staged or simultaneous) were worse in relation to alignment with a poor range of motion.

Wang *et al.*³ 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 $<20^{\circ}$ in the femur and $\leq 30^{\circ}$ in the coronal plane of the tibia.

Advantages of single stage procedure include an avoidance of any additional incision for a corrective osteotomy, and also rules out complications associated with osteotomies such as nonunion or delayed union, failure of internal fixation, infection at osteotomy site, and any wound break down at the osteotomy site.

The limitations of our study are that we have not used computer navigation¹³⁻¹⁶ in all cases whereas various studies have shown that it is of great help in such cases. However, the tendency to rely purely on navigation can lead to wrong

placement of femoral component especially in rotational deformities of the femur as the trans-epicondylar axis here would not be in the normal anatomical site and lead to an unbalanced flexion gap. We also did not take into account any bowing of the femur or the tibia which may have some bearing on the bone cut with the use of intramedullary alignment system alone.¹⁷ CT scannograms were not done due to non availability of the CT scans in house in the initial phase of the study. CT scannograms in contrast to the X-ray scannograms would have provided a more accurate three dimensional assessment of the deformity which could have some bearing on the final outcome.

Our data suggest that intraarticular resection of bone, soft tissue balancing, and primary TKA showed good results in patients with arthritis of the knee with extraarticular deformity of less than 18 deg in the coronal plane and 15 deg in the saggital plane in the femur and up to 24 deg in the coronal plane in the tibia, as measured on the ortho scannograms, similar to studies by Wang⁴ and Koenig.¹⁰ In the present era where there is more and more inclination toward internal fixation it is unlikely that deformities of very high degree would be seen. 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. However, beyond the parameters mentioned in our study, the possibility of compromising the collaterals increases and one should resort to extraarticular correction either as a staged or a single procedure.

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