

Innovations

Evaluation of Clinical Results and Outcome of Total Knee Arthroplasty in Valgus Knee: A Comparative Clinical Study

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Abstract: Total knee arthroplasty (TKA) has become a standard operative procedure to relieve pain and restore function in patients with arthritis. The correction of valgus deformity has posed technical challenges and has produced variable clinical results in the correction of the deformity, instability, and overall results. The valgus knee either presents as a fixed valgus deformity with a decreased range of movement or often as a mobile but highly unstable valgus knee with subluxation. Both of these present a significant challenge to the arthroplasty surgeon, **Aim and Objectives:** The aim of the present study was to evaluate the outcome of primary knee replacement for valgus knees, to analyze the technical challenges posed by valgus knees, and to identify an ideal implant for valgus TKA with a better outcome.. **Material and Methods:** Twenty-four patients aged between 45-80 years old, with valgus knees who underwent primary total knee replacements were included in the study. All the patients were evaluated preoperatively for joint line tenderness, range of movement of the joint, Instability (lateral and anteroposterior), and fixed deformity. The Clinical and Functional Knee Society score chart was assessed. The Width and extent of any radiolucency at the cement bone interface, Femorotibial alignment and alignment of prosthetic components, Condition and integrity of underlying bone, and migration or shifts in prosthetic components were assessed post-operatively. **Results:** In the cruciate substituting group, the overall mean increase in the arc of active motion was 29°. The mean Knee Society score increased from 35 points (range of 13 to 58 points) before arthroplasty to 90 points (range, of 63 to 100) after TKA. In the cruciate retaining group, the mean arc of motion improved from 82° (79° to 86°) to 95° (range 90° to 98°). The

overall mean increase in the arc of active motion was 13°. The mean Knee Society increased from 35 points (range 30 to 40) before arthroplasty to 84 points (range 71 to 93 points). Among 14 patients with cruciate substituting implant, 11 patients had excellent results and 3 had good results, while out of 8 patients with cruciate retaining implant, 5 patients had excellent, one patient had a good result, one had fair and one with poor result. Among two patients with HPPS one with excellent results and one with good results. **Conclusion:** Cruciate substituting may be an ideal prosthesis for valgus deformity, but it should associate with suitable patient selection with well performed ligamentous balance and soft tissue releases.

Introduction

Total knee arthroplasty (TKA) has become a standard operative procedure to relieve pain and restore function in patients with arthritis. Replacement surgeries have also been tried for valgus knee, which remains a rarity. A primary total knee arthroplasty for a knee with valgus deformity remains a formidable surgical challenge even for an experienced practitioner.

A valgus knee is defined as an anatomical valgus of more than ten degrees. A valgus knee has both bone and soft tissue abnormalities, including contracted lateral capsular and ligamentous structures with or without medial laxity, contracted or lax posterior soft tissues, osseous deficiency of lateral femoral condyle and/or tibial plateaus, external rotation deformity of the distal part of the femur, secondary remodeling of the femoral and tibialmetadiaphyseal region, patellar maltracking. (1-4)

The correction of valgus deformity has posed technical challenges and has produced variable clinical results in the correction of the deformity, instability, and overall results. The valgus knee either presents as a fixed valgus deformity with a decreased range of movement or often as a mobile but highly unstable valgus knee with subluxation. Both of these present a significant challenge to the arthroplasty surgeon. (2)

The absence of well-conducted studies on the results of valgus knees in the Indian scenario needs to be addressed. The peculiarity of the needs and demands of Indian patients is a topic left untouched in Western literature and direct results cannot be extrapolated. The aim of the present study was to evaluate the outcome of primary knee replacement for valgus knees, to analyze the technical challenges posed by valgus knees, and to identify an ideal implant for valgus TKA with a better outcome.

Material and Methods

The present clinical study was done in Twenty-four patients with valgus knees who underwent primary total knee replacements. The study was performed in the Department of Orthopaedics, Shri Sathya Sai medical College and research institute, Sri BalajiVidyapeeth deemed University; Ammapettai from 2022 January to 2023 June. The study was performed as both retrospective and prospective. The study sample included patients of the age group between 45-80 years old, with surgical demand due to pain with disability.

Patients with a Valgus angle of >10 degrees were included in the study. Moreover, patients who were medically fit for surgery were only included. Patients who are Medically not fit for surgery and with a Valgus angle of <10 degrees were excluded from the study.

Out of these twenty-four patients 15 patients were diagnosed as osteoarthritis, 6 patients were rheumatoid arthritis and 3 patients underwent high tibial osteotomy for varus deformity correction previously. All the patients were evaluated preoperatively for joint line tenderness, range of movement of the joint, Instability (lateral and anteroposterior), and fixed deformity. The Clinical and Functional Knee Society score chart was assessed. Basic pre-operative hematological and urine investigations were done.

The primary total knee replacements for all the patients were done under combined spinal and epidural anesthesia electively and in a few patients general anesthesia was given. Modular total condylar total knee implant and high post posterior stabilized Knee system were used. Pre-preoperative and post-operative radiological evaluation was done with standing radiographs of the knee in the AP projection, as well as lateral and patellofemoral views. Computed tomography (CT) scanning and Magnetic resonance imaging (MRI) were also done if necessary.

TheWidth and extent of any radiolucency at the cement bone interface, Femorotibial alignment and alignment of prosthetic components, Condition and integrity of underlying bone, and migration or shifts in prosthetic components were assessed post-operatively

In the present study, 20 patients underwent the median par-patellar approach and 4 patients underwent lateral parapatellar approach. From the surgical point of view, valgus deformities can be classified into three major variants (I, II, and III) ^(37,38). In Variant, I (7-15⁰) mild deficiency of lateral femoral condyle and tibialeplatue, Mild asymmetry of the soft tissue sleeve, with Intact medial collateral ligament is seen. In

Variant II (15-35°) the degree of deformity and bone loss are more than in Variant I with moderate asymmetry of the soft tissue sleeve and intact medial soft tissues. Variant III (>35°) has marked osseous deficiency of both lateral femoral condyle and tibial plateau, marked lateral soft tissue contracture, and marked attenuation of medial capsular ligament complex.

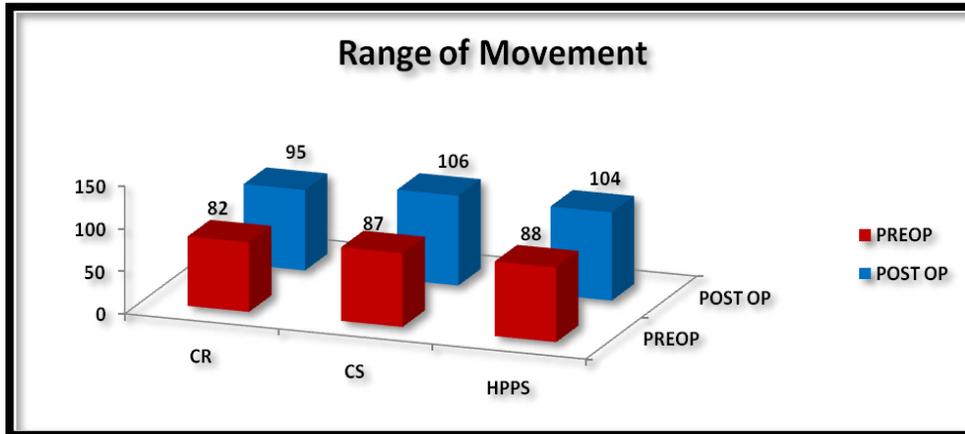
Postoperatively patients were evaluated closely for any signs of peroneal nerve palsy/compromise. On the first post-operative day, radiography of the knee joint, Quadriceps strengthening exercises, Hamstring strengthening exercises, and Passive knee mobilization with the aid of a CPM machine was done. The wound drainage tube and the epidural catheter were removed, Mobilization with the long knee brace, Full weight-bearing walking with walker support, and Passive knee mobilization with the aid of a CPM machine was done on the second postoperative day. Range of movement of the knee joint both active and passive, was assessed on the third postoperative day. After discharge, the patients were regularly examined in our outpatient clinic. Postoperative follow-up with roentgenograms and clinical assessment were assessed at regular intervals.

Results and Discussion

In the present study, 24 consecutive patients with valgus knees were studied. The cruciate retaining, cruciate substituting, and high post posterior stabilized implants were used according to preoperative valgus deformity and level of patient expectations. The cruciate retaining was used in 8 patients, cruciate substituting was used in 14 patients, and high post posterior stabilized in 2 patients. Based on the radiological assessment, 14 belonged to the mild variety (7-15), 8 were in the moderate variety (15-35) and 2 were in the severe variety (>35) preoperatively. After surgical correction 23 patients were in only mild variety and 1 patient in moderate variety.

The range of movement of the knee joint was measured and assessed both preoperatively and postoperatively. The difference in the range of movement of those patients who underwent CS implants is higher than those with CR implants. (Graph:1)

Graph 1; Range of motion in patients with CS and CR implants



In the cruciate substituting group, the mean arc of motion improved from 87° (79° to 100°) to 106° (range 99° to 112°). The overall mean increase in the arc of active motion was 29°. Preoperatively two knees had a flexion contracture of 5° to 15°, which was corrected by soft tissue procedure. None of the patients had medial and lateral instability upon examination. The mean Knee Society score increased from 35 points (range of 13 to 58 points) before arthroplasty to 90 points (range, of 63 to 100) after TKA. (Table-1) The mean Knee Society functional score increased from 49 points (range, 30 to 65 points) preoperatively to 75 (35 to 100) postoperatively. The mean overall Knee Society score increased from 84 points preoperatively to 165 points postoperatively. Eleven (89.2 %) patients had excellent outcomes; three (10.7 %) patients had good results. Similar results were yielded in the studies conducted by Ranawat CS et al and Lu HS et al study on valgus knee TKAs.

Table 1: Cruciate substituting group

	Pre-Operatively	Post-Operatively	Overall improvement
Mean arc of motion	87° (79° To 100°)	106° (99° To 112°)	29°
Mean knee society score	35 points (13 to 58 points)	90 points (63 to 100)	55 points

In the cruciate retaining group, the mean arc of motion improved from 82° (79° to 86°) to 95° (range 90° to 98°). The overall mean increase in the arc of active motion was 13°. Preoperative flexion deformity was corrected by soft tissue release. Four patients had medial instability upon

examination. The mean Knee Society increased from 35 points (range 30 to 40) before arthroplasty to 84 points (range 71 to 93 points).(Table-2) The mean Knee Society functional score increased from 44 points (28 to 66 points) to 68 points (range 50 to 90 points). The mean overall functional Knee score increased from 74 points to 152 points postoperatively. Five (62.5 %) patients had excellent results, one (12.5%) had good results, one (12.5 %) had fair results and one (12.5 %) had poor results. The reasons for the fair results included pain and misalignment, and the reason for poor results was pain and instability.

Table 2: Cruciate retaining group

	Pre-Operatively	Post-Operatively	Overall improvement
Mean arc of motion	82 ⁰ (79 ⁰ to 86 ⁰)	95 ⁰ (range 90 ⁰ to 98 ⁰)	13 ⁰
Mean knee society score	35 points (30 to 40 points)	84 points (71 to 93)	49 points

Cloutier JM et al conducted a study of total knee replacements in valgus knees with cruciate retaining prosthesis. Similar to the present study, Inthis study, the average knee score was 91+/-8.4 points (range, 54 to 100 points), and the average functional score was 82+/-21 (range, 10 to 100 points), comparatively in our study average KSS was 82 points(range,71 to 93 points) and average KSF score was 70 (range,50 to 90 points).

In two patients who underwent high post posterior stabilized the mean arc of motion improved from 88⁰ to 104⁰. The Knee Society score increased from 28 points to 86 points and the Functional Knee score improved from 44 points to 82 points. The mean overall functional Knee society score improved from 72 points to 168 points. One (50%) patient had excellent results; one (50%) had good results.

The mean radiographic alignment was 14⁰(range 7⁰ to 25⁰ valgus) before the total knee arthroplasty and improved to 3⁰- 5⁰ valgus postoperatively in the cruciate substituting group and to a range of about 3⁰ – 7⁰ in the cruciate retaining group and to a range of about 3⁰ – 6⁰ in the TC3 designs and 3⁰- 4⁰ in the constrained knee

Complications: Two patients in the cruciate retaining group developed peroneal nerve palsy, which recovered during subsequent follow-up. One patient had a mild infection in the cruciate retaining group, which subsided with antibiotics.

Overall Results: Among 14 patients with cruciate substituting implant, 11 patients had excellent results and 3 had good results, while out of 8 patients with cruciate retaining implant, 5 patients had excellent, one patient had a good result, one had fair and one with poor result. Among two patients with HPPS one with excellent results and one with good results.

Discussion

Valgus deformity causes defect in both femur and tibia and also exerts more stress to the soft tissues. Hence soft tissue procedure is mandatory in all valgus knees. Fixed valgus deformity is more likely to require special surgical techniques than are other deformities. As the principal lateral stabilizers of the knee are muscles like the popliteus, the tensor fascia lata and the biceps femoris, the deformity is more likely to become fixed at an early stage. The more severe valgus deformity or deformity of long standing is likely to be associated with attenuation of medial capsular stabilizers.

Because the principal medial stabilizers are not attached to muscles, residual static medial instability is likely to create functional instability. For these reasons, fixed valgus deformity is one of the more difficult problems to be addressed at total knee arthroplasty. As with other fixed deformities, the goal is to appropriately align the lower extremity and properly position the individual prosthetic components. However, since there is a basic ligamentous imbalance, this will usually have to be addressed as an independent problem and the implant selection also plays a very vital role in longevity of the total knee replacement.

In the present study, the overall mean increase in the arc of active motion in cruciate substituting group was 29° . The mean Knee Society score increased from 35 points (range of 13 to 58 points) before arthroplasty to 90 points (range, of 63 to 100) after TKA. In the cruciate retaining group, the mean arc of motion improved from 82° (79° to 86°) to 95° (range 90° to 98°). The overall mean increase in the arc of active motion was 13° . The mean Knee Society increased from 35 points (range 30 to 40) before arthroplasty to 84 points (range 71 to 93 points). Among 14 patients with cruciate substituting implant, 11 patients had excellent results and 3 had good results, while out of 8 patients with cruciate retaining implant, 5 patients had excellent, one patient had a good result, one had fair and one with poor result. Among two patients with HPPS one with excellent results and one with good results. Similar results were yielded in the studies conducted by Ranawat CS et al and Lu HS et al study on valgus knee TKAs. ^(6,7)

Jeff Pierson, MD ⁽⁸⁾ conducted a study on comparison of effectiveness of PCL retention with PCL substitution in December 8, 2000. In patients with severe deformities, the PCL is often a contributory factor in the soft tissue contractures, which must be released to correct the deformity and restore the correct mechanical axis. Once PCL is sacrificed, it is appropriate to provide a mechanical PCL in the form of a PS TKA. PCL retaining is a technically demanding procedure as leaving the PCL too tight, can cause major problems for the patient, including stiffness, excessive femoral rollback, and severe polyethylene wear, and late rupture. PCL retaining TKA does not result in posterior femoral rollback with knee flexion and typically results in paradoxical anterior translation in an unpredictable, jerky, cogwheel-type motion. These kinematic findings are extremely undesirable and much inferior to those demonstrated with PS TKA. As many PCL retaining knee designs were highly unconstrained and resulted in edge loading with resultant low-contact areas, high-surface stresses, and, often, delamination of polyethylene in conditions of condylar lift-off or unsatisfactory alignment.

Cruciate retaining designs offers preservation of the joint line, forces you to stay close to the anatomy, requires flatter polyethylene insert and smaller contract area which explains shorter survivorship and less Range of motion. Cruciate retaining rely on the PCL and flat polyethylene surface for the roll back, flat surfaces are reported to produce inferior results.⁽¹²⁾

As per the current study Cruciate substituting prosthesis gives better range of motion, higher scoring in both clinical and functional knee society scoring than cruciate retaining implant. Thus, Cruciate substituting prosthesis biomechanically is an option in valgus knees because of the lesser resection of tibia when compared to cruciate retaining which requires additional resection for a tight posterior cruciate ligament. The joint level changes but is more forgiving to adequate ligament and mechanics with correction of alignment and joint line orientation. Greater conformity is achievable in sagittal plane as the roll back is facilitated by cam and spine mechanism, and better range of motion is achieved because of dish insert, which allows better contact area. In knees with deformities cruciate substituting is an alternative to cruciate retaining. However Cruciate-substituting prosthesis is not an excuse for quick, less well-performed ligament balance.

Conclusion

Since there are various options available in prosthetic designs for correction of deformity in valgus knee, there is no single prosthetic design proven to be best for valgus knee. Cruciate substituting may be an ideal prosthesis for valgus deformity, but it should associate with suitable patient selection with well performed ligamentous balance and soft tissue releases. One has to be prepared well with good pre-operative planning and availability of all the prosthetic designs during the intraoperative period, so that one could avoid various complications anticipated in valgus knee.

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