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Cruciate retaining versus posterior-stabilized total knee arthroplasty: a short-term comparative study

Raghav K. Suthar[1]*, Dimple R. Parekh[2], Shaival B. Mistry[3]

[1]Department of Orthopedics, [2]Head of Orthopedics and Joint Replacement Surgery, Parekhs Hospital, Ahmedabad, Gujarat, India
[3]Department of Orthopedics, Ahmedabad Physiotherapy College, Ahmedabad, Gujarat, India

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***Correspondence:**
Dr. Raghav K. Suthar,
E-mail: raghav_suthar@hotmail.com

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ABSTRACT

Background: Total knee arthroplasty has got excellent results. Among the techniques (posterior-stabilized vs posterior cruciate retaining total knee arthroplasty) it is unclear whether one design has superior outcome over another. The purpose of the present study was to directly compare clinical and radiological outcomes of these two designs.
Methods: A prospective study involving 36 patients who received a cruciate-retaining implant were compared to 30 patients who received posterior-stabilized prosthesis. At 3 months follow-up time clinical and radiological evaluation done and results were analyzed.
Results: At 3 months follow-up time mean knee society scores improved from 49.9/46.9 (objective/subjective score) points to 80.9/82.5 points in the cruciate-retaining group and from 48.2/43 (objective/subjective score) points to 80.4/80.2 points in the posterior-stabilized group. The ranges of motion was 117.2° (range, 90° to 130°) and 125.3° (range, 100° to 140°) in the cruciate-retaining and posterior-stabilized group respectively, at 3 month follow-up. One patient had post-operatively periprosthetic fracture reported after 2 weeks (treated conservatively), one had superficial infection (treated with dressing) and one patient with superfical infection required debridement.
Conclusions: This study did not conclusively demonstrate the superiority of one knee design over the other, suggesting that the choice of implant should be based on surgeon preference, patients knee dimensions, pre-op knee deformity and existing pathology of the posterior cruciate ligament.

Keywords: Total knee arthroplasty, Cruciate retaining knees, Posterior-stabilized knees, Osteoarthritis of knee

INTRODUCTION

Total knee arthroplasty is final and effective available surgical treatment for arthritis of knee joint. Multiple studies shows that it has got excellent result and survival rates greater than 90% at follow-up times of 10 to 20 years.[1-6] Numerous implant designs have been developed to improve the durability and function of these procedures. However, there has been controversy regarding techniques.

Cruciate retaining techniques preserves posterior cruciate ligament. This design has advantages of bone preservation, increased proprioception, near normal knee kinematics and greater stabilization of the prosthesis (PCL preventing anterior translation of the femur on the tibia). Posterior-stabilized implants have got a polyethylene post and femoral cam to replace the role of the PCL. During extension post and cam interact to prevent anterior translation of the femur on the tibia, while allowing femoral rollback during flexion. Potential

advantages of these designs include a less technically demanding procedure, a more stable component interface, predicted femoral rollback and increased range of motion.[7,9-11]

Recent studies have shown high short- and midterm success rates of both designs, but there is no consensus about superiority of one design over another.[12-16] The purpose of the present study was to directly compare clinical and radiological outcomes, and complications of two groups of patients who received cruciate-retaining or posterior-stabilized implant and provide guidance to surgeon on selecting implant for particular patient.

METHODS

The prospective study carried out on 66 patients (71 Kness), who had been operated for primary total knee arthroplasty at our centre in October, 2017. From total 98 patients 66 patients were included in our study selected on basis on inclusion and exclusion criteria. Patients with osteoarthritis, rheumatoid arthritis and post traumatic arthritis of knee who required total knee arthroplasty, were included in study. Patients who underwent revision knee arthroplasty and who lost follow-up were excluded from study. Informed written consent was taken from all patients. Cases were divided in two groups depending upon type of implantation they received.

Pre-operatively, patients clinically and radiologically evaluated. Clinical evaluation involved history, thorough examination, BMI (Body mass index) calculation and knee society score.[17] Radiological evaluation done on standing weight bearing antero-posterior x-ray and lateral x-ray (knee 90 flexed). It includes alignment parameters like aLDFA (Anatomical Lateral Distal Femoral Angle), mMPTA (Mechanical Medial Proximal Tibial Angle), Tibial slope (Posterior Proximal Tibial Angle), Patella position and radiological Ahlback grading of arthritis (Figure 1 and Table 4).[18]

Patients were operated in standard arthroplasty operative setup. All Surgeries done using midline anterior skin incision followed by medial parapatellar arthrotomy. Patelloplasty done in each case patella resurfacing was not done.[19,20] Femoral and tibial cuts taken with help of intra-medullary and extra-medullary jig respectively. In CR group, we tried to keep tibial slope as normal as possible while in PS group we tried to keep tibial slope 5° ±1° (3° cutting tibial cutting block was used). Negative suction drain was kept for 24 hours in all patients. Full weight bearing walking with support started from 1st post- op day and stair climbing was allowed from 2nd post-op day. All patients were discharged on 3rd or 4th post op day. Physiotherapy was advised for 2-3 weeks. Stitches were removed on 18th post-op day. After that support gradually weaned off over period of 2 weeks. All patients re-evaluated clinically, radiologically (as it was done pre-operatively) and for complications after 3 months.

Data analyzed with help of SPSS software. Data was not following normal distribution curve so p value calculated using Wilcoxon index.

RESULTS

There were 66 cases included in study (71 knees) with mean age of 62.5±7 years (45–80 years) (Table 1). Male to female ratio was 1: 2.1 (21/45) (Table 2). Mean BMI (Body mass index) of patients was 33±4 kg/m^2. In 29 cases, left knee was operated, in 32 cases right knee was operated while in 5 cases B/L knee were operated (Table 3). 4 patients had associated rhematoid arthritis, 2 patients had Gout, in one case partial meniscectomy was done previously and one patient had operated patella. 59 cases had varus alignment in which predominantly medical compartment was involved. 3 cases had valgus alignment in which predominantly lateral compartment was involved and 4 cases had neutral coronal alignment in which both compartments were equally involved.

Table 1: Age distribution.

Age (in years)	Number of cases
<40	0
40-50	4
51-60	23
61-70	27
71-80	12
>80	0

Table 2: Sex distribution.

Sex	No. of patients
Female	45
Male	21

Table 3: Operated side.

B/L	5
Left	29
Right	32

About 40 patients had medical history of hypertension, 18 patients had history of diabetes mellitus, 4 patients had thyroid disorders and 1 patient had pancytopenia.

In CR group, pre-op mean objective and subjective knee society score was 49.9 and 46.9 respectively. Average ROM observed was 107.4°. According to Ahlback grading (based on radiograph) 2 cases had grade 1 changes, 11 patients had grade 2 changes 18 had grade 3 changes and 5 had grade 4 changes. In PS group, pre-op mean knee society score was 48.2 and 43.0 respectively. Observed mean ROM was 107°. On radiograph, according to Ahlback grading 5 cases had grade 2 changes, 14 had grade 3 changes, 9 had grade 4 changes and 2 had severe grade 5 changes (Table 4 and 5).

Average surgical time was 62±8 min and average hospital stay was 3.3 days. Pre-operatively and post-operatively in all cases patella position was normal. Rest of the alignment angles were as mentioned in Table 6.

Post-op 12 weeks follow-up, mean ROM in CR and PS joint was 117.2° and 125.3° respectively and objective/subjective knee society score corrected to 80.9/82.5 and 80.4/80.2 in CR and PS group respectively (Table 5).

Total 3 patients developed complications; one patient presented at 7th post op with superficial infection which was managed with removal of infected suture material followed by regular dressing along with oral antibiotic. Another patient presented on 6th postop day with superficial infection required superficial debridement and antibiotic treatment for a month; and one patient presented at 10th day with periprosthetic un-displaced supra-condylar femur fracture which was treated with above knee plaster.

Table 4: Radiological pre-op Ahlback grading.

Ahlback grading		Number of patients	
		CR group	PS group
1	Narrowing of the joint space (with or without subchondral sclerosis)	2	0
2	Obliteration of the joint space	11	5
3	Bone defect/loss <5 mm	18	14
4	Bone defect/loss 5-10 mm	5	9
5	Bone defect/loss >10 mm (with subluxation and arthritis of the other compartment)	0	2

Table 5: Clinical results.

Arthroplasty system	ROM		Knee society score (Mean)			
			Objective score		Subjective sore	
	Pre-op	3 months postop	Pre-op	3 months post-op	Pre-op	3 months post-op
CR knees	107.4°	117.2°	49.9	80.9	46.9	82.5
PS knees	107.0°	125.3°	48.2	80.4	43	80.2

Table 6: Radiological results.

Radiological parameteres	aLDFA		mMPTA		Tibial Slope	
	Pre-op	Post-op	Pre-op	Post-op	Pre-op	Post-op
CR knees	82.4°±2.8°	84.2°±1.2°	84.8°±4.1°	89.1°±1.9°	8.6°±3.4°	9.6°±1.6°
PS knees	81.9°±2.8°	84.3°±1.2°	82.5°±4.1°	89°±1.9°	9.1°±3.4°	6.1°±1.6°

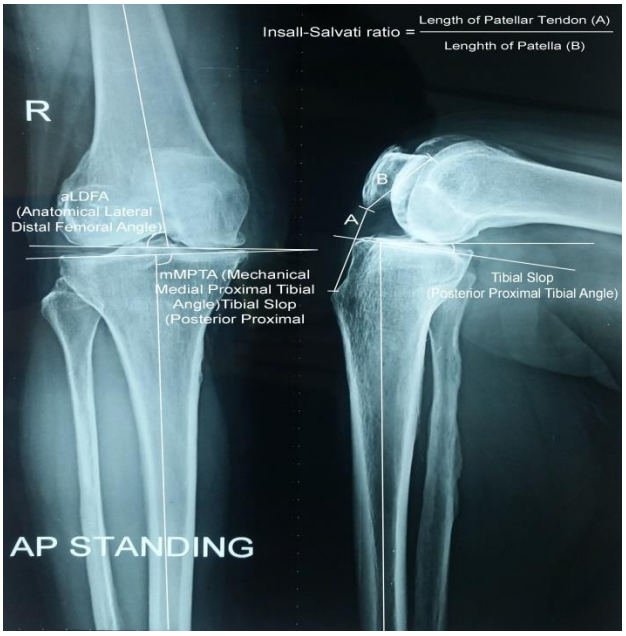

Figure 1: Pre-op radiological evaluation.

DISCUSSION

Our study was conducted on 66 patients (71 knees). Number of female patient was almost twice that of male patients. Major indication of the surgery was osteoarthritis of knee joint (60 patients) followed by rheumatoid arthritis (4 patients) and post traumatic arthritis (2 patietns). Majority of patient had medial compartmental arthritis with varus deformity (64 knees) while only 3 patients had lateral compartmental arthritis with valgus deformity (4 knees) in few patients with rheumatoid arthritis both compartments were more or less equally involved (3 knees). On radiological evaluation 96.9% of total cases had complete loss the joint space and total 71.2% cases had bony involvement (46.9% patient had <5mm defect, 21.2% patients had 5 mm-10 mm bony defect and 3% patients had >10 mm defect) (Table 4).

We have used medial parapatellar approach in all cases. Patella resurfacing was not done as we believe Indian knees are smaller and resurfacing patella increases risk for fractures. Because of better surgical technique, post

operative pain management and post-op rehabilitation training we could able to shorten hospital stay to less than 4 days. Complications were reported in 3 patients; one patient presented at 1 week with superficial infection which was treated with removal of infected Vicryl stitch and regular dressing along with oral antibiotic. Another patient with superficial infection required superficial debridement and antibiotic treatment for a month; so both cases required some local procedures with antibiotics to treat infection and one patient with severe osteoporotic bones had spontaneous periprosthetic un-displaced supra-condylar femur fracture which was treated conservatively with plaster.[21,22]

Evaluating post operative radiographs, femoral component and tibial component were almost perpendicular to mechanical axis of limb. Patella position was not altered. Posterior tibial slope in CR and PS joint was 9.6° and 6.1° respectively. In PS joint femoral rollback depend upon post cam mechanism so tibial slope is not regulatory factor while in CR joint it was kept (9.6°) as closer to original (8.9°) because rollback was done by intact PCL which requires native slope (Table 6).

Several other studies have directly compared the two prosthetic designs, with mixed results. Maruyama et al did prospective, randomized comparison of posterior cruciate-retaining (PCR) and posterior stabilized (PS) total knee arthroplasties (TKAs) conducted in 20 patients who underwent bilateral TKAs for osteoarthritis (One knee was implanted with a PCR TKA, and a contralateral knee with a PS TKA). Patients had a clinical and radiographic evaluation at a mean of 31.7 months for PCR TKAs and 30.6 months for PS TKAs postoperatively and there were no significant differences between the PCR and PS TKAs in postoperative knee scores. However, postoperative improvement in range of motion was significantly superior in the PS group (131° versus 122°, $p<0.05$).[23] Yoshiya et al performed in vivo kinematic analysis of a 20 patients who underwent bilateral total knee arthroplasties with a posterior-stabilized implant in one knee and a cruciate-retaining implant in the other. In the PCR TKA, an anterior femoral translation from 30 degrees to 60 degrees of flexion was observed in the weight-bearing condition indicating that the PCL might not be functioning while flexion kinematics for the PS TKA was more stable characterized by the maintenance of a constant contact position under weight-bearing conditions and posterior femoral rollback in passive flexion. They also found a greater range of motion of the knees that had posterior-stabilized implants (131°±12° versus 121°±16°).[24] Bolanos et al examined fourteen patients with a posterior-stabilized prosthesis in one knee and a posterior cruciate-retaining prosthesis in the contralateral knee at mean 98 months follow-up time Hospital for Special Surgery (HSS) knee scale were evaluated by isokinetic muscle testing and comprehensive gait analysis. At mean 98 months time no significant differences were found between the cruciate-retaining and the posterior-stabilized knees with regard to gait parameters, knee range of motion, and electromyographic waveforms during level walking and stair climbing. Both knee prosthesis performed equally well.[25] Tanzer et al examined two groups of 20 patients who were randomized to receive cruciate-retaining or posterior-stabilized implants, they found no differences in Knee Society or radiographic scores at the two-year follow-up.[26]

In our study mean knee society score (objective/ subjective) at 3 month follow-up was 86.5/ 81.4 for PS joint and 85.7/82.9 for CR joint. So there was no significant difference functional outcome as far as CR or PS knees concerned (p value 0.62 and 0.49 respectively) In 4 CR joint KSS was below 60 at 3 month follow-up, among them 2 had extremely low pre-op KSS, 1 patient had developed periprosthetic fracture and in one case post-op tibial slope was altered significantly (8.5°). In two PS knee KSS was below 60. One had low pre-op score and one had developed post-op infection.

All patients had good functional ROM at follow-up (125.3° in PS knee and 116.3° in CR knees) comparing both system PS joints had significant improvement in early ROM (18.3°) compare to CR joints (9.8°) ($p=0.01$).

CONCLUSION

The results of this study would suggest that, CR design offer normal knee kinematics and increased proprioception, preserves bone and greater stabilization of the prosthesis, with the PCL preventing anterior translation of the femur on the tibia. PS design does appear to support improved postoperative range of motion when compared with the CR design, while comparing in regards to clinical outcomes, there was no significant difference. Both designs give equal and good results. We preferred CR Knees in relatively young patients and patients with smaller knees as its bone conserving implant and PS knees in patients with Inflammatory arthritis, patient with severe varus or flexion deformity, when tibial cut is more than 10 mm and when intra-operatively findings suggestive of nonfunctional posterior cruciate ligament.

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