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Posterior cruciate ligament retaining versus sacrificing total knee replacement surgery: A comparison of the functional outcome

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Abstract

Background: Theoretically, the role of Posterior cruciate ligament in total knee replacement it has been suggested that PCL retaining knees can produce femoral rollback, which helps to increase the range of flexion and prevents posterior translation in the patients. However, this in effect, reduces loosening and excessive polyethylene wear by decreasing the shear stresses at the fixation surfaces. We conducted a prospective study to compare the retention of PCL using a standard PCL-retaining with cruciate sacrificing cemented total knee replacement and assessed the functional outcome of both using functional knee scores and WOMAC score during the period between December 2020 to December 2022.

Aim: The aim of the study is to prospectively compare the functional outcome of Primary Total Knee Replacement done in our hospital during the period of December 2020 to December 2022 between patients in whom Posterior cruciate ligament(PCL) was retained with those were it was sacrificed using Knee Society Knee Scoring and Functional Knee Score and WOMAC Questionnaire.

Methods: The study was done on 20 patients. Scoring systems such as WOMAC Score, Knee Society Knee Score and Functional Knee Score were used to evaluate the patients before and after surgery. Both knee scores and functional scores are calculated with each amounting to a total of 100 points and WOMAC Score with max of 96 points. Preoperative full length radiograph from the hip to ankle was taken in all the patients who underwent knee replacement surgery and pre op mechanical axis was drawn and the amount of varus or valgus deformity was quantified. Radiological grading as advocated by Kellegren and Lawrence was used to evaluate the severity of the arthritis. PCL was retained in five patients who had minimal deformities with no flexion contracture pre operatively and PCL was sacrificed in rest of the patients.

Results: Analysing the functional outcome it was found that all the patients in both the groups had significant improvement in their knee score and the functional knee score. Analysing the total Knee Scores, the average Knee Society Score for the PS group was 85.80 and that of CR group was 75.60 and statistical analysis revealed a significant difference in the p-value in favour of Cruciate Sacrificing Prosthesis signifying that Cruciate Sacrificing Prosthesis has better functional outcome. The functional knee society also showed a marked improvement in all patients, for CS group FKS was 99.6 and for CR group it was 91.6. Statistically there was no significant difference. The WOMAC Score also showed a marked improvement. In CS groups it was 24.6 and in CR it was 27.4. Statistical analysis showed a highly significant difference in favour of cruciate sacrificing prosthesis.

Conclusions: Total Knee Arthroplasty in patients in whom posterior cruciate ligament was sacrificed was found to have a better functional outcome as compared to the retaining group, which can be mainly attributed to the persistence of flexion deformity in cruciate retaining group. In Indian scenario where knee replacement is done at a late stage of osteoarthritis, sacrificing the contracted posterior cruciate ligament has better outcomes as compared to retaining it.

Keywords: Cruciate, posterior, retaining, sacrificing, knee

Introduction

Total knee joint replacement is the definitive treatment for end-stage knee arthritis including osteoarthritis and Rheumatoid arthritis for patients who have used up all nonoperative measures. Total knee arthroplasty surgery is a highly successful surgery modality to improve the functional outcomes in patients having severe knee pain and or deformity^[1].

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Several modifications and changes have been performed to improve the durability and function of this procedure. The most widely used designs for primary arthroplasty used nowadays is cruciate-retaining (CR) and posterior-stabilized (PS) or cruciate sacrificing (CS). Advantages of PCL sacrificing implants include replication of the femoral rollback mechanism which in turn results in reduced sliding shear stress on the polyethylene liner and providing superior range of motion in terminal knee flexion^[3]. On the other hand, cruciate retaining implants preserve the posterior cruciate ligament (PCL), which provides improved proprioception, superior knee stability, and replicates normal knee kinematics^[2]. Many studies have addressed differences in functional outcome after cruciate retaining and posterior stabilized primary knee replacements. However, the impact of the functional differences have at best, been controversial, and the superiority of one design over the other has not been established yet. The primary aim of our study was to compare functional outcome in patients who had undergone primary total knee arthroplasty surgery using cruciate sacrificing and cruciate retaining implants. We conducted a prospective study to compare resection with retention of PCL using a standard PCL-retaining cemented total knee replacement and assessed the functional outcome using functional knee scores and WOMAC score during the period between December 2020 to December 2022 at Government Medical College and Hospital, Kota.

Methods

Preoperative Planning

A standing full length AP (Anteroposterior), lateral x ray from the hip to ankle was done in all the patients who gave the consent for knee replacement surgery and pre op mechanical axis was drawn and the amount of varus or valgus deformity was quantified. Also, the amount of joint space narrowing, any bony deformity was assessed. Radiological grading as advocated by Kellegren and Lawrence was used to evaluate the severity of the arthritis and all the knees were graded from I to IV^[9]. Pre operatively a detailed history of the patients complaints is obtained regarding the duration of pain, the daily activities affected out of the disease. Presence of any skin ailments, infective focus, varicose vein and DVT ruled out. All the cases were investigated thoroughly and comorbid medical conditions brought under control before surgery. Pre-operative Haemoglobin level of 10 gms% was considered as cut off. Clinical evidence for any ligamentous instability was also checked. Written valid consent was obtained for all patients. All Baseline values (Preoperative diagnosis, age at time of surgery, operative side, gender) were recorded.

The operations were performed by our Head of the Department, according to the standardized protocol in our hospital. All procedures were performed in operation theatre with laminar flow. All the cases were done under tourniquet control using pneumatic tourniquet. Anaesthesia by either epidural or spinal as per the anaesthetist discretion. A standard anterior midline skin incision and medial parapatellar approach was used in all patients. The same standard set of modular TKA systems were used in all patients. The two designs (CR and CS) were identical except for the cam-post mechanism. Both the designs had cemented fixation of both femoral and tibial components. Femoral preparation was done first, and intramedullary alignments were used for femur and tibia in all patients. Care was taken to balance flexion and extension gaps while performing bone

resections. All patellae were routinely resurfaced.

Postoperative protocol

Post operatively all the patients were put on the same antibiotic (Inj. Ceftriaxone and Inj. Gentamycin), thromboembolic prophylaxis with low-molecular-weight heparin for 5 days. Suture removal done between tenth and twelfth post op day. All the patients were given a temporary immobilisation using knee brace for first 48 hours. First look of the wound and removal of the drain were done on the second post-operative day for all the patients. In the immediate post-operative period a bolster was kept under the ankle to prevent flexion. Quadriceps strengthening exercises were encouraged from the first post op day. Active knee mobilisation was started on the second or third post-operative day as per the patient compliance. Supportive ambulation using walker was allowed on the third post-operative day. All the patients were made to fully weight bear by the fifth to sixth post-operative day. Suture removal was done between 10 and 12 post-operative day and they were discharged between eleventh to twelfth post op day after satisfactory wound healing.

Inclusion Criteria

Adult patients having end-stage arthritis of both the medial and lateral compartments were eligible for inclusion and they had a functional status of ACL and PCL determined preoperatively and intraoperatively.

1. Osteoarthritis & Rheumatoid arthritis
2. Age > 50 years
3. Kellgren and Lawrence Grade 3 and 4

Exclusion Criteria

1. Age < 50 yrs
2. Minimal degenerative changes (Kellgren and Lawrence grade 1 & 2)
3. Poor skin conditions
4. Post traumatic arthritis
5. Varicose veins
6. Medically unfit patients

Criteria for retaining PCL

1. Structurally intact posterior cruciate ligament
2. Fixed flexion deformity of less than 150

Criteria for sacrificing PCL

1. Fixed flexion deformity of more than 150
2. Structurally contracted PCL
3. Technical inability to properly balance PCL.

The period of study is from December 2020 to December 2022. Cases operated before December 2020 with atleast 3 months of follow up were taken into study. During the study period 26 knees were replaced in 25 patients. Of them three patients with three total knee replacement lost follow-up one died due to medical(cardiac) cause and two did not turn up for follow up. Others had regular follow up and were taken into study. Final study was on 20 knees in 19 patients which includes 1 bilateral and 18 unilateral cases. The patients who did not turn for follow-up were excluded from the study. This included five patients with five knees. Scoring system formulated by the WOMAC Score and Functional Knee Score were used to evaluate the patients before and after performing the surgery. Both knee scores and functional scores were

calculated with each of them amounting to a total score of 100 points and WOMAC Score with maximum of 96 points (24questions). PCL was retained in five patients who had minimal deformities with no flexion contracture pre operatively and PCL was sacrificed in rest of the patients. PCL retaining prosthesis was applied for all the five in whom PCL was retained. Implants for all the twenty cases were of the same manufacturer. Bone cement was used in all the twenty cases.

Results

All the 20 cases which had regular follow up for taken into the study and the average follow up was from a minimum of 3 months to 18 months.

Age Group

Range 52 years to 73 years

Mean 58.1 years

We had the following observations: Among the 20 cases which received total knee replacement using a cruciate retaining prosthesis we retained Posterior cruciate ligament in 5 patients and in the rest it was sacrificed (15). The results were analysed statistically using SSPS -17 (Statistics Package for Social Sciences) software and using chi-square for discrete variables, 't' test for continuous variables, bivariate correlation to find out measure of agreement were done. The functional outcome between the posterior cruciate retaining and the cruciate sacrificing groups were compared using the American knee society scoring and the functional knee score and WOMAC Questionnaire and the following observations were made.

Table 1: Sex Ratio

Sex	Number
Male	12
Female	8

Table 2: Indication

Disease	Number
Osteoarthritis	19
Rheumatoid arthritis	1
Others	NIL

Table 3: Type of deformity

Deformity	Number
Varus	16
Valgus	4

Table 4: Side

Side	Number
Right	7
Left	11
Bilateral	1

1. Pain

Overall all the patients, in both the groups had great improvement in the knee scores. Stair climbing score was 11.3 (out of 15) and 9 in the PCL Sacrificing and Retaining groups respectively as compared to the preoperative score of 4.6 and 5. The pain score (including stair climbing) in the Posterior cruciate sacrificing was on average 42.6 (out of 50) and that of Cruciate Retained group was 37.

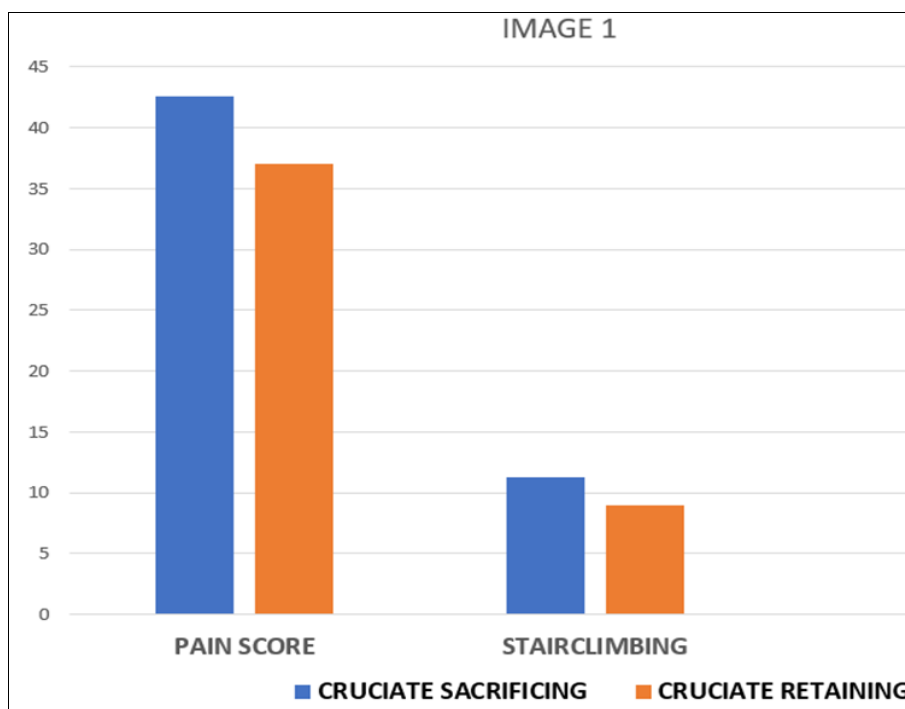


Fig 1: In both the groups had great improvement in the knee scores

Table 5: The pain score of knee society score were analysed statistically we got the following values:

Sl. No	Category	Group	No	Mean	SD	S.E of Mean	P value	Significance
1	Walk	CS	15	31.00	2.070	.535	.013	Significant
		CR	5	34.00	2.236	1.000		
2	Stairs	CS	15	11.30	2.070	.535	.013	Significant
		CR	5	9.00	2.236	1.000		
3	Total pain score	CS	15	42.60	4.140	1.069	.013	Significant
		CR	5	37.10	4.472	2.000		

2. Range of Motion

We were able to achieve a flexion of 100 to 110° in all our patients and statistically there was no much difference between CR and CS groups.

The mean range of motion in the CS and CR groups had a great improvement with postoperative scores 19.5 (max 25) and 18.4 in PCL sacrificing and retaining groups respectively.

Table 6: Range of Motion

Type	No	Mean	SD	S.E of Mean	P value	Significance
CS	15	18.47	.990	.256	.081	NS
CR	5	19.548	.548	.245		

3. Total Knee Scores: The overall average knee score was 85.8 for Posterior Cruciate Sacrificing and 75.6 for the Cruciate Retained patients as compared to the pre operative score of 43.4 and 38.

Table 7: Total Knee Scores

TKS	Type	N	Mean	S.D	S.E of Mean	P value	Significance
	CS	15	85.80	5.267	1.360	.004	HS
	CR	5	75.60	6.124	2.739		

Table 8: Functional Knee Score was 99.6 and 91.6 for CS and CR groups respectively. The preoperative Functional knee score was 37.8 and 38 in these groups

FKS	Type	N	Mean	S.D	S.E of Mean	P value	Significance
	CS	15	99.687	3.739	.965	.866	NS
	CR	5	91.640	3.578	1.600		

Table 9: The WOMAC Score also showed a marked improvement from 66.3 to 24.6 in cruciate sacrificing groups & 27.4 for CS and CR respectively.

Womac Score	Type	N	Mean	S.D	S.E of Mean	P value	Significance
	CS	15	24.60	.737	.190	.000	HS
	CR	5	27.40	.548	.245		

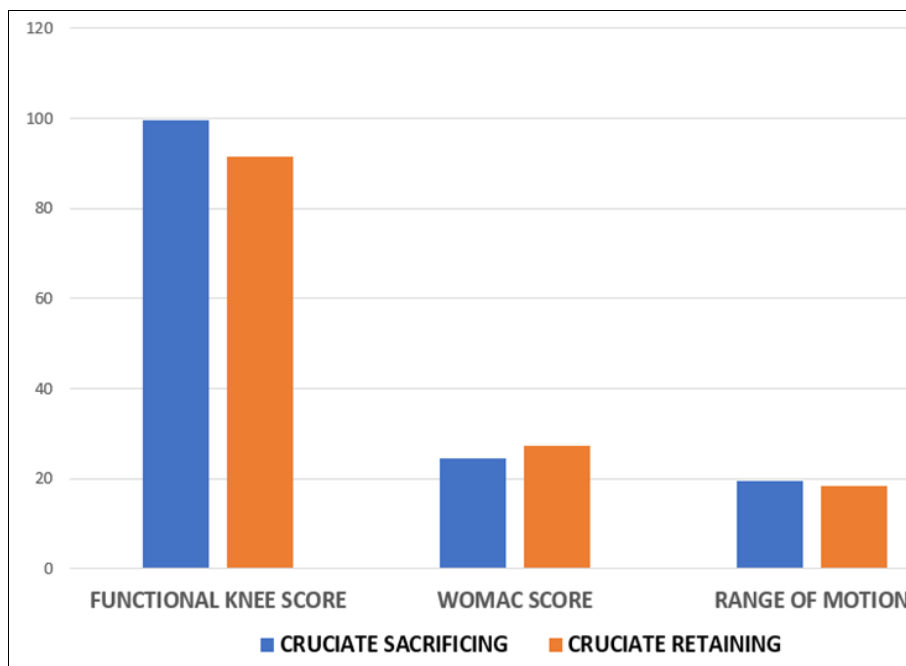


Fig 2: Functional Knee Score was 99.6 and 91.6 for CS and CR groups respectively. The preoperative Functional knee score was 37.8 and 38 in these groups

Table 10: Correlation between KSS (Knee Society Score), FKS (Functional Knee Score) & WOMAC

		Total KS	Func KS	WOMAC
KSS	Pearson	-.102	.670	-.511*
	P value			
Func KS	Pearson	-.102	.670	.041
	P value			
WOMAC	Pearson	-.511*	.041	.863
	P value			

*Correlation is significant at .05 level.

- All patients had marked improvement in their knee society score and the increase was attributed to pain score and stair climbing.
- Functional knee score showed an excellent improvement in all the patients.
- Womac score also showed marked improvement with a significant improvement in patients in whom posterior cruciate ligament was sacrificed.
- There exists a good degree of agreement between the knee society score, functional knee score and WOMAC

score.

Discussion

Total knee replacement, is a surgical procedure which is done to replace the weight-bearing surfaces of the knee joint to relieve the patients of their knee pain and disability [4]. Although done for various diseases around the knee joint, it is most commonly performed for osteoarthritis, rheumatoid arthritis and psoriatic arthritis. The pioneer of knee replacement surgery, as mentioned in literature was Leslie Gordon Percival Shiers; whose original papers were published in the Journal of Bone and Joint Surgery in 1954 [5]. There is continued innovation in designs and methods to try to limit the problems of wear of implants, implant loosening and loss of range of motion post the surgery. The mean age of our patients who had osteoarthritis and got TKR done was 58.1 years. It is much higher than the data available from the western population [6]. 50% of our patients were well within the normal range of body mass index of <25 kg/m2. The earlier onset of osteoarthritis in individuals with normal range of BMI is explained by the habit of kneeling, squatting, cross

legged sitting practiced by the population in this part of the world. 58% of our patients had Grade IV osteoarthritis with complete obliteration of joint space at the time of initial presentation. Various scoring system are in vogue to assess the outcome of Total Knee Arthroplasty namely The American Knee Society Score, Function Knee Society Scoring, Western Ontario and McMaster OA index (WOMAC), The Hospital for Special Surgery Rating System Knee injury and Osteoarthritis Outcome Score (KOOS), Oxford 12-item Knee Questionnaire [7]. All the 20 patients in our study were evaluated both preoperatively and post operatively. The Functional outcome in our study was evaluated using the Knee Society Score, the Functional Knee Score and WOMAC questionnaire score.

1. Functional outcome

Analysing the functional outcome it was found that all the patients in both the groups had significant improvement in their knee score and the functional knee score. On comparison between the two groups, in those patients in whom the cruciate ligament was sacrificed had a average knee score of 85.8 and a Functional Knee Score of 99.6, whereas in whom the posterior cruciate ligament was retained the knee score was 75.6 and functional score was 91.6 which was in concordance with studies done by Laskin RS *et al.* [8] in which he had functional scores of 98.7 and 90.4 for CS and CR knees respectively.

2. Pain

The pain score showed a marked improvement in all the patients with a average of 42.6 in CS group as compared to 37 in CR group. Statistical analysis conducted by Bolanos AA *et al.* [10] also revealed a significant difference in p value for all the variables of pain score (walking, climbing) which was in favour of the cruciate sacrificing group signifying that they had a better improvement in pain score. Analysing the total Knee Scores, the average Knee Society Score for the PS group was 85.80 and that of CR group was 75.60 and studies conducted by Incavo SJ *et al.* [11] also revealed a significant difference in the the p-value in favour of Cruciate Sacrificing Prosthesis signifying that Cruciate Sacrificing Prosthesis has better functional outcome as seen in our study. The functional knee society also showed a marked improvement in all patients, for CS group FKS was 99.6 and for CR group it was 91.6. Statistically there was no significant difference. The WOMAC Score also showed a marked improvement. In CS groups it was 24.6 and in CR it was 27.4. Our Statistical analysis showed a highly significant difference in favour of cruciate sacrificing prosthesis which was in line with the studies conducted by Straw R *et al.* [12]. And when the three scoring systems were evaluated in our study we found a good agreement between each scoring system with one other.

3. Range of movements

We were able to achieve a flexion of 100 to 1100 in all our patients and statistically there was no much difference between CR and CS groups which was also reported in studies conducted by Pagnano MW *et al.* [13] in which he had conducted his studies on 64 knees.

Conclusions

1. Total Knee Arthroplasty in patients in whom posterior cruciate ligament was sacrificed was found to have a

better functional outcome as compared to the retaining group, which can be mainly attributed to the persistence of flexion deformity in cruciate retaining group.

2. In Indian scenario where knee replacement is done at a late stage of osteoarthritis, sacrificing the contracted posterior cruciate ligament has better outcomes as compared to retaining it.
3. A limitation of our study was that we have used deep dishd cruciate retaining prosthesis (which was the only implant available to us in scheme) for all the 20 patients.
4. Finally our study is in a small number of cases with short duration and further follow up is necessitated.

Conflict of Interest

Not available

Financial Support

Not available

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