

## Original Research Article

# Early outcomes of posterior cruciate retaining primary total knee arthroplasty in patients of osteoarthritis in Indian population

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## ABSTRACT

**Background:** Total knee replacement arthroplasty today has become the final treatment option for patients with unsalvageable, severely arthritic, painful and deformed knees. In India the numbers of such surgeries are steadily on the rise with bulk of the patients being relatively younger group. Amongst several factors affecting the kinematics of knee, variations in surface geometry and the retention or sacrificing the posterior cruciate ligament is considered especially important. The role of the retaining a PCL on the demographic, clinical and functional parameters of a patient undergoing TKA remains controversial. The aim of the study was to evaluate the outcomes of cruciate retaining primary total knee arthroplasty in patients of osteoarthritis in relation to demographic, clinical and functional parameters.

**Methods:** 20 knees from 12 patients of osteoarthritis including 8 females and 4 males in age group 45-80 years were operated with cruciate retaining implants. The pre and postoperative evaluations were done radiologically and clinically using new knee society score. Patients were followed up for minimum 1 year.

**Results:** evaluations of patients revealed good postoperative improvements at subsequent follow up in comparison to preoperative scores. The average range of movement improved by 43.3 degree. The objective, patients satisfaction and functional score improved with scores of 89, 34 and 89.7 at 1 year follow up. The walking distance and staircase climbing, squatting scores also did well. Age did not seem to affect overall outcomes with males having slightly better postoperative scoring overall.

**Conclusions:** In Indian population when the patient is young, high demanding, the retention of cruciate ligaments gives excellent postoperative functionality and objectivity and should be always considered as first choice surgery.

**Keywords:** Cruciate retaining, New knee score, Total knee arthroplasty

## INTRODUCTION

Osteoarthritis is accepted as the most prevalent chronic joint disease and the leading cause of primary arthritis worldwide. The incidence of osteoarthritis is rising because of the increase in ageing population and the epidemic of obesity. Pain, loss of function and deformity are the main clinical features that lead to treatment,

including non-pharmacological, pharmacological, and surgical approaches.<sup>1</sup>

Surgical intervention revolves around the concept of modifying the articular surface of femoro-tibial and femoro-patellar joints by various methods including the first method of resection arthroplasty by Fergusson in 1860 and interposition arthroplasty by Verneuil in

1863.<sup>2,3</sup> Over the course of time as the surgical knowledge increased, implants continue to evolve when in 1971 Gunston gave the concept of geomedic knee.<sup>4</sup> The whole concept of knee arthroplasty was revolutionized by the discovery of total condylar prosthesis by Inshall in 1973.<sup>5</sup> This prosthesis concentrated on mechanics and did not try to reproduce normal knee motion.

As our understanding of knee biomechanics increased it was universally accepted that the best knee replacement is one in which the kinematics of the normal knee can be reproduced.<sup>6</sup> Amongst several factors affecting the kinematics, variations in surface geometry and the retention or sacrificing the posterior cruciate ligament is considered especially important with increased attention being given to the beneficial role of PCL and its importance in altering knee biomechanics postsurgery.<sup>7</sup> Cruciate retaining total knee arthroplasty is having equal success rate and clinical outcomes as compared to posterior stabilized knee.

Unlike the posterior stabilized knee, cruciate retaining knees retains the posterior cruciate ligament which maintains its anatomy, strength, and integrity even in Grade IV osteoarthritis cases. Different long term studies shows, close to 90% implant survival in CR knees at the end of 20 years. The retention of PCL allows more normal knee function, closely matches the normal and improved femoral rollback.<sup>8,9</sup> The proprioceptive abilities, maintenance of load transfer by PCL, less load transfer to implant bone interface and improved anterior-posterior stability drives many surgeon for a cruciate retaining knee. But PCL retaining knees are widely considered technically demanding, difficult to balance the collaterals.<sup>10</sup>

With the advent of these varied types of prosthesis it became necessary to conduct studies for assessing the outcome of different prosthesis to test their clinical and functional efficacy. Hence different scoring systems were devised for assessing the outcome of total knee replacement.

Out of various scoring systems described in literature, the Knee Society Score System (KSS) is most widely used. It was subdivided into objective and functional component with each component having specific parameters which are scored by a separate and specific sets of questioner meant for the patient and clinician. The KSS was modified in 2011 and became more comprehensive with special attention being given to patient satisfaction and patient expectation from proposed surgery. The functional scoring became more detailed and precise with score that rates the patient's ability to walk, climb stairs, squat and stand. The addition of discretionary category helped to expand the horizon for varied needs of young patients.<sup>11</sup> The multispectral rating system eliminates the problem of declining knee scores associated with patient infirmity.<sup>12</sup>

The aim of our study is to know the early functional outcome based on selection of cases, surgical technique, postoperative rehabilitation and pre and postoperative clinical, radiological and functional evaluation.

## **METHODS**

Our study, was carried out at Care Hospital, Bhubaneswar between May 2016 till September 2016, where 20 knees from 12 patients with 8 females and 4 males suffering from various grades of osteoarthritis were operated with Cruciate retaining primary Total Knee arthroplasty. All the operations were performed by the senior author at various times of day.

A written consent for participation in this prospective study was obtained from all patients involved in the study.

Preoperative radiographs were obtained and grading of osteoarthritis was done using the Kellgren-Lawrence grading. Preoperative demographic parameters and range of movements and new KSS scores of patients were noted for each patients in details and tabulated. Similarly postoperative range of movements and new KSS scores were calculated for each at every follow up of 7 postoperative day, 6 weeks, 6 months and 1 year. Each patient was followed up for a minimum period of 1 year by the senior author post-surgery.

### **Analysis**

The pre and post-operative new Knee society objective, patient expectation, patient satisfaction and Functional Score was compared using Paired t-test and for correlation Pearson correlation co-efficient formula was used with p value <0.05 deemed significant.

### **Inclusion criteria**

Inclusion criteria were patients with primary osteoarthritis who accepted to undergo total knee arthroplasty and gave written informed consent for the same; both bilateral and unilateral primary osteoarthritis patients; skeletally matured patients; both sexes are eligible.

### **Exclusion criteria**

Exclusion criteria were patients having gross ligamentous imbalance and requiring constrained implants; active infection in the proposed knee; severe obesity with BMI >30 kg/m<sup>2</sup>; intraoperative and Postoperative fractures. (Periprosthetic fractures); valgus or varus deformity >15 degree.

### **Radiographic assessment**

1. Standard guidelines were used to obtain knee radiographs-standing anteroposterior view, a lateral

view and all osteophytes noted and OA grading done, bone quality determined. Full length lower limb orthoscanograms done to aid in templating.

2. Any collateral ligament laxity, subluxation of tibia, presence of osteophytes, any bone defects in the tibia and femur and the quality of bone was assessed.
3. Preoperative templating and sizing of the femoral and tibial components was also attempted.

### Operative procedure

All our cases were operated under spinal anesthesia augmented with regional block (adductor canal block) and intraoperative analgesic cocktail injection. All cases were operated in supine position with tourniquet. A bolster was arranged to maintain knee flexion at various stages of surgery. Standard midline skin incision was used in all cases and joint opened by medial parapatellar approach. Patella was everted and all marginal osteophytes removed. Joint debulking was done and both meniscus, extra fat, hypertrophied synovium, osteophytes removed. Next the tibial and femoral surfaces are prepared in stages taking care to protect the PCL at its tibial attachment. Extramedullary jig for tibia and intramedullary jig for femur was used. The tibial cut had a 5 degree posterior slope and femur had 3 to 5 degree of external rotation. All posterior and marginal osteophytes were meticulously removed. All the knees were balanced by measured resection technique as it reconstructs the distal and posterior dimension of femur accurately with intact PCL and balancing of soft tissue with minimal joint line elevation. The tibial and distal femoral cuts were taken independently of each other unlike gap balancing technique. The rotation of femoral component is determined from Whiteside line and interepicondylar line. The distal and anterior femoral cuts are done by using anterior referencing system because of having a less risk of notching the anterior femoral cortex and it places the anterior flange of the femoral component more reliably against the anterior surface of distal femur. After taking both the chamfer cuts, trial reduction was done starting from the thinnest tibial component and intraoperative balancing of PCL is assessed by doing POLO test (pull out lift off test). The pull out test is to test flexion laxity. With trial components in place, the knee is flexed to 90 degree. The surgeon then tries to pull out the tibial component from under the femur. In case of gross laxity thicker tibial component are tried till stability is achieved. Once the knee has proved not to loose or tight. The knee is flexed to 80 to 100 degrees to see the lift off of tibial component which suggest PCL tightening. If the lift off test is positive, then the PCL is resected sequentially. This should be done after posterior condylar clearance and checking patellar tracking over the femoral component. After resecting the PCL if in some cases where PCL integrity was doubtful, a constrained polyethylene liner (Curve Plus) was used.

All our cases received intraoperative analgesic cocktail consisting of combination of morphine, bupivacaine and

depomedrol in fixed proportion for immediate post-operative analgesia. Postoperative analgesia was augmented by adductor canal blocks with catheters placed intraop. All cases received DVT prophylaxis with 0.6 cc of LMW (low molecular heparin) for 5 postop days followed by aspirin 150 for 4 weeks. Naproxen 500 once or twice daily was used for pain management after discharge. All cases received gait and weight training on subsequent follow up as per physiotherapy protocol.

### RESULTS

All our unilateral cases are mobilised from post-op day 1. While bilateral cases were mobilized from day 2. Drain was removed on 2nd post-op day. Intensive physiotherapy under supervision was given to all patients according to predecided physiotherapy protocol in collaboration with Department of physiotherapy. Unilateral operated patients were discharged after 5 days on an average while bilateral patients are discharged after 7<sup>th</sup> day. Patients were evaluated clinically and radiologically at an interval of 1month, 6 months and 1 year, in Orthopaedics OPD.

Ours is a consecutive study of 12 patients with 20 knees who underwent total knee arthroplasty using posterior cruciate retaining design.

The majority of the patients were from the age group of 61-65 years which accounts for 40% of patients in our study. The youngest patient was 45 years of age and the oldest patient was 82 years. The mean age was 60.35 (Figure 1).

The weight of our patients varied from 60 kg to 80 kg with a mean of 68.4 kg (Figure 2).

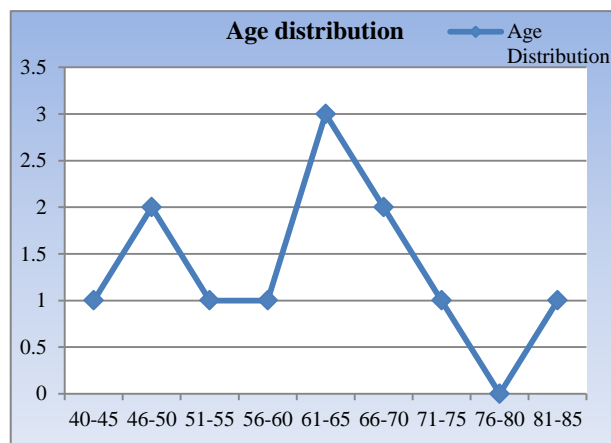


Figure 1: Age distribution graph.

There was a female predominance in our study, accounting for 60% of the patients (Figure 3).

Left and right sides were equally involved among the patients with 10 knees each.

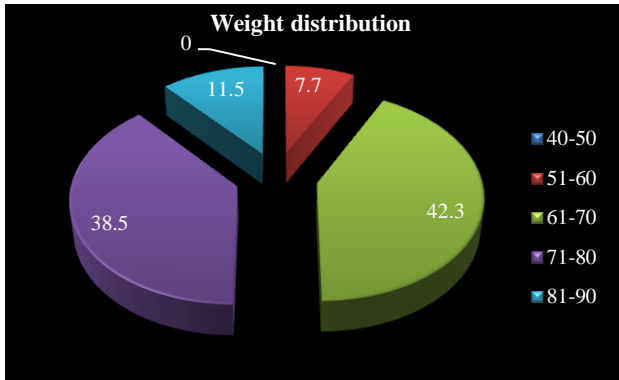


Figure 2: Weight distribution chart among patients.

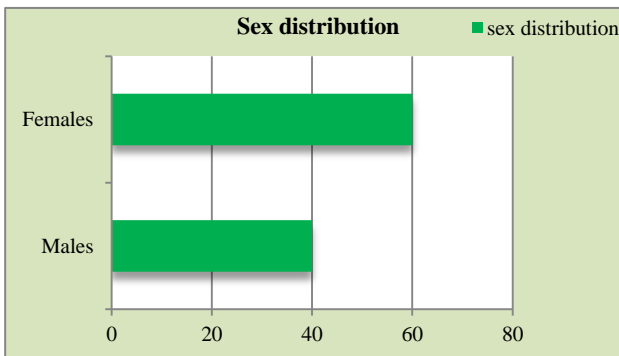


Figure 3: Sex distribution chart among patients.

Varus was the more common deformity seen in 60% cases with an average of 15 degree, while valgus was on an average of 14 degree (Table 1).

Table 1: Distribution of valgus and varus deformities among patients.

	Valgus		Varus	
	No	Avg degrees	No	Avg degrees
Male	3	10	4	14
Female	5	18	8	16

The diagnosis was primary osteoarthritis of knee in all the cases.

**Range of movement (Rom)**

There was significant improvement in range of movement after operation, with a mean rom being 110 degrees with a mean gain of 43.3 degrees at 1 year follow up which was statistically significant (p<0.001) (Table 2).

Table 2: Range of movement.

Type of surgery	ROM pre op	Mean ROM post op	Gain in ROM	P value
Cruciate retaining	66.7 deg	110 deg	43.3 deg	<0.0001

**New knee society scoring**

The knee society score which was revised in 2011 was used for patient evaluation. Under the new KSS, patient assessment was done under 4 headings:

- Objective score
- Patient satisfaction score
- Patient expectation score
- Functional score

**Objective score (OBS)**

Objective score measures the alignment, stability, joint motion and symptoms of the patient. The OBS score preoperative was 19 which increased to 89 at end of 1 year, a good improvement which was statistically significant (p<0.0001) (Table 3).

**Patient satisfaction score (PSS)**

It is a 40 score questionnaire which assess pain while at rest, sleeping, walking, daily and recreational activities both pre and post op. in our study the pre-op satisfaction score was 10 which improved to 34, which was statistically significant (p<0.0001) (Table 3).

**Patient expectation score (PES)**

It is a three-question fifteen-point scale that is collected pre-operatively and post-operatively reflecting the patient’s opinion and expectation from proposed surgery. In our study, the expectation score decreased from 12 to 11 at end of 1 year. This decrease was not significant (p=0.13) (Table 3).

**Functional knee score (FKS)**

The functional score evaluated how comfortable the patient is standing and walking, doing her standard activities like walking, getting up from chair, etc, advanced activities like climbing stairs, squatting, etc. and discretionary activities like riding bicycle, swimming etc. In our study functional score increased from 35 pre op to 90 at the end of 6 months, a gain which was significant (p<0.0001) (Table 3).

**Essential daily activities**

Out of many parameters evaluated in the functional scoring, significant improvements were seen in walking duration, climbing staircase and squatting in cruciate retained group. While parameter like standing duration, running, swimming did not produce significant changes possibly because it did not form a part of regular activity of every patient (Table 4).

**Table 3: Detailed revised knee society score (KSS).**

Type of KSS	Pre-op	Post-op score			P value
		6 weeks	6 month	1 year	
<b>OBS</b>	19	79	86	89	<0.001
<b>PSS</b>	10	32	33	34	<0.0001
<b>PES</b>	12	12	12	11	0.13
<b>FKS</b>	35	80	86	90	<0.0001

**Table 4: Average improvement in most essential and common daily activities.**

	Walking duration (in min)		Staircase climbing score		Squatting score	
	Pre-op	Avg post-op	Pre op	Avg post-op	Pre-op	Avg Post op
<b>Cruciate retaining</b>	5.8	38.2	1.2	4.2	1.3	4.6

**Table 5: Complications seen among patients of the study.**

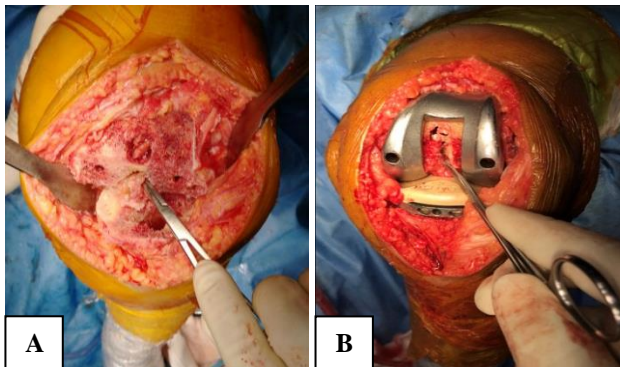
Complications	Percentage (%)
<b>DVT</b>	1 (8)
<b>Pulmonary embolism</b>	0
<b>Compartment syndrome</b>	1 (8)
<b>Superficial wound infection</b>	3 (25)
<b>Deep wound infection</b>	0
<b>Death</b>	0



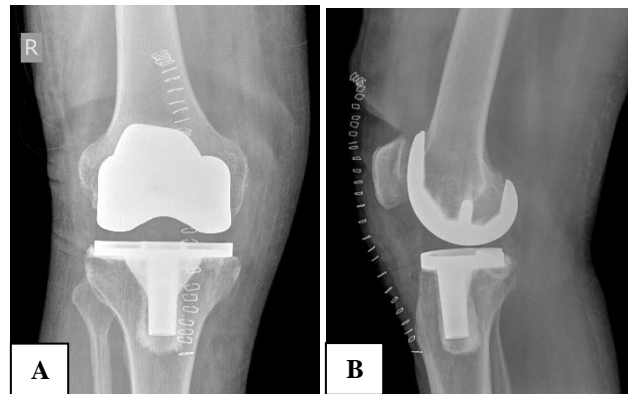
**Figure 4: A=AP view showing medial compartment OA; B=Lateral view showing patellofemoral arthritis.**



**Figure 6: Good patellar tracking.**



**Figure 5: A=Femoral and tibia cuts with intact PCL; B=Trail implants in place with intact PCL.**



**Figure 7: A=Postoperative AP view; B=Postoperative lateral view.**

## Complications

Common complications seen in our study included Deep vein thrombosis (DVT) in 1 patients, compartment syndrome in 1 patient, superficial wound infection in 3 patients. No incidences of pulmonary embolism, deep infection and deaths were seen in our study. Most of the infections were seen with patients having comorbidities like type 2 DM (Table 5).

## DISCUSSION

Total knee arthroplasty is generally an effective procedure and is associated with substantial functional improvement. Elderly patients having difficulty mobilizing because of degenerative arthritis found good relief after total knee arthroplasty. There was a substantial relief of joint pain, increased mobility, correction of deformity and an improvement in the quality of life of the patients following posterior cruciate retaining total knee arthroplasty.

Souza et al showed that mean age of patients with Osteoarthritis requiring surgery was 64 year in South America and most of them were females (79%).<sup>13</sup> However the mean age of patients of our study was 60.3 years which was significantly lower than western data indicating earlier onset of OA in our population. The earlier onset of osteoarthritis in individuals could be attributed to obesity, premature osteoporosis with incomplete nutrition, occupation and habits of kneeling, squatting, cross-legged sitting practiced by the population in this part of the world. Our study also demonstrated a female preponderance among OA patients needing surgery. We had 60% females requiring surgery in our study group.

Joshi et al in his study in Canadian population showed significant more varus deformity in Indian born Canadian population in comparison to native Canadian while Portuguese born Canadian population had more valgus deformity.<sup>14</sup> Our study also showed increased incidence of varus deformity among the study population with 60% with mean varus deformity of 15 degree.

The role of the PCL in primary TKA has been debated for several years. The PCL is the strongest ligament in the knee and can be responsible for absorbing a significant amount of force. Role of PCL has been advocated for causing femoral roll back phenomenon. Its postulated that in cruciate retaining surgeries, the prosthetic knee can achieve greater flexion as the implanted prosthesis allows the femur to glide posteriorly on the tibia due to intact PCL posteriorly. Moreover, this posterior roll back enhances postoperative flexion and efficiency of the quadriceps muscles by lengthening the lever arm from the point of joint contact to the quadriceps tendon. Retention of posterior cruciate ligament also results in a central contact area of the femur on the tibia

that helps to distribute load evenly on the tibial component.

Júnior et al also demonstrated in his study on 32 knees of Brazilian population a statistical significant difference in mean percentage rollback of the femur which was 13.24% in the cases in which the PCL was sacrificed and 5.75% in the cases in which it was preserved.<sup>15</sup> Ephrat Most et al demonstrated similar degree of translations in both CR and CS knee from 0-30 degree of flexion, increased roll back in CR knees between 30-90 degree and more roll back in CS knees beyond 90 degree of knee flexion.<sup>16</sup> In our study flexion view radiographs at various degrees of flexion were taken postoperatively for all patients. There was no significant difference in femoral roll back in PCL retained knees.

Kolisek et al in his comparative study found a much higher postoperative range of flexion of mean 125 degrees in a cruciate retaining knee in comparison to 118 degree in a cruciate substituting knee.<sup>17</sup> Similar observations were also made by Steihl et al and Pasquier et al, who all demonstrated increased flexion in Cruciate retained knees in comparison to CS knees.<sup>18,19</sup> Dennis et al however demonstrated higher gain in range of flexion post operatively in cruciate substituting surgeries with a mean of 127 degree of postop flexion in CS knees in comparison to 123 degree in CR knees.<sup>20</sup> In our study the mean postoperative flexion was 110 degrees in CR knees with an average gain of 43.3 degrees of flexion which is comparable to previous literature.

Many authors argue that the PCL is diseased and degenerated with various forms of arthritis and contracture and is difficult to balance reproducibly. But Scott, Richard D et al showed that PCL is always intact and is a strong biological stabilizer and if properly balanced can produce on an average 10 degree better flexion than cruciate stabilized knee.<sup>8</sup> In our study we found that PCL was intact and functional in all the cases of our study group and was able to be neatly balanced intraop using measured resection technique.

In our study we used the revised knee society score (KSS) to evaluate our patients based on 4 categories objective knee score, patient satisfaction score, patient expectation score and functional knee score.

Kawakami et al in his study in Japanese population showed a improvement in preoperative objective, patient satisfaction, patient expectation and functional scores in both CS and CR surgeries.<sup>21</sup> Though the differences between both the groups are statistically insignificant but overall improvement was better in CR knees.

Wang et al and Vinchiguerra et al all demonstrated significant increase in clinical and functional knee score in comparison to preoperative values which was statistically significant.<sup>22,23</sup> In all cases CR knees had

better postoperative parameters although it was statistically insignificant in comparison to CS knees.

Our study showed greatly improved postoperative scores under all the 4 subcategories of new KSS score. While the objective score improved from 19 to 89, patient satisfaction score improved from 10 to 34. Functional score also improved from 35 to 90. All the improvements were statistically significant ( $p < 0.001$ ). However patient expectation scored decreased from 12 to 11. This change was statistically insignificant ( $p = 0.13$ ).

Gait analysis by Andriacchi et al, and others found that individuals with PCL-retaining prostheses have a more symmetrical gait, especially during stair climbing, than do individuals with either PCL sacrificing/PCL substituting designs.<sup>24</sup> In our study also walking distance of patients significantly improved from 5.8 min to 38.2 min and staircase climbing score and squatting score improved to 4.2 and 4.6 respectively.

In our study we had 8% of patients had DVT, 25% had superficial wound infection, and 8% had compartment syndrome while no deep infection or deaths were seen in our study.

## CONCLUSION

Results from our study proves that cruciate retaining total knee arthroplasty has excellent postoperative scores based on early follow up experience. If the indications for CR surgery are properly taken into consideration and patients are properly selected cruciate retaining surgeries can result in excellent functional and clinical recovery in Indian population.

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