European Journal of Molecular & Clinical Medicine (EJMCM)
ISSN: 2515-8260 Volume 09, Issue 04, 2022

Original research article

Posterior Cruciate Ligament Retention Versus Posterior Stabilization Implants for total Knee Replacement: A Hospital based Study

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Abstract

Introduction: The posterior cruciate ligament (PCL) in total knee arthroplasty (TKA), so-called cruciate-retaining (CR), or to substitute for it, so-called posterior stabilized (PS), continues to engage orthopaedists. The many reasons for retaining the posterior cruciate ligament (PCL) during total knee replacement (TKR) include improved stability, reduced shear stresses at the fixation interface, improved proprioception, and more efficient gait patterns during level walking and stair climbing;
Material and Method: This is prospective study design was at Gadag Institute of Medical Sciences ,Gadag, Karnataka. The studyperiod was from October 2021 to March 2022.
Results: There were many prospective studies with the evidence level 1–2 to compare the CR and PS TKAs using contemporary prostheses. Most studies reported no difference in clinical scores, ROM, midterm survival rate, and quadriceps muscle recovery; two studies reported only the better ROM in PS TKAs. In our preliminary prospective study using the recently introduced prosthesis of Persona, all the clinical results did not differ at 1 year postoperatively.
Conclusion: CT TKA may not be feasible in certain conditions; PCL insufficiency, severe deformity, and the history of previous traumas or operations should be carefully examined for appropriate selection of the prosthesis type. The surgeon should have a clear idea on the technical differences between CR and PS TKAs. The extent of distal femoral resection, selection of femoral component size, and adjustment of tibial slope are particularly crucial for successful TKA.
Keywords: Posterior cruciate ligament retention, Posterior stabilization implants, Total knee replacement.

Introduction

The posterior cruciate ligament (PCL) in total knee arthroplasty (TKA), so-called cruciate-retaining (CR), or to substitute for it, so-called posterior stabilized (PS), continues to engage orthopaedists. [1] The many reasons for retaining the posterior cruciate ligament (PCL) during total knee replacement (TKR) include improved stability, reduced shear stresses at the fixation interface, improved proprioception, and more efficient gait patterns during level walking and

stair climbing; moreover, one of the most commonly cited motives for retaining the PCL is to preserve femoral rollback, which improves extensor efficiency by lengthening the moment arm and improves the range of flexion by minimizing the potential for impingement of the femur on the tibial component, reducing loosening and excessive polyethylene wear. [2] Posterior-stabilized (PS) implants attempt to replace the role of the PCL with a polyethylene post and femoral cam that interact to prevent anterior translation of the femur on the tibia, while allowing femoral rollback during flexion. [3] Potential advantages of these designs include a less technically demanding procedure, a more stable component interface, and increased range of motion. [4] Potential advantages of PS Total knee arthroplasties include the possibility of easier balancing of severe coronal and sagittal deformities (i.e., varus/valgus or recurvatum), better controlled flexion kinematics, less polyethylene sliding wear, greater weight-bearing maximal flexion, and greater posterior femoral rollback than cruciate retaining (CR) high-flexion TKA. [5] A decrement in patello-femoral contact pressure in PS TKA designs when compared to CR designs is another potential advantage. [6] There are several potential disadvantages in the use of PS designs with respect to other CR implants, including tibial post wear and breakage, increased incidence of anterior knee pain, and implant instability especially during the midflexion phase. [7] Total knee arthroplasties have had excellent results, with multiple studies showing survival rates greater than 90% at follow-up times of 10 to 20 years. [8] Numerous prostheses have been developed to improve the durability and function of these procedures. Despite the high success rates of total knee arthroplasties, there is still controversy regarding removal versus retention of the PCL. [9] Proponents of cruciate-retaining designs believe that it is important to retain as much of the original anatomy as possible, and that the PCL can continue to stabilize the knee during flexion. The posterior-stabilized designs utilize a tibial post and femoral cam to substitute for the PCL, which allows femoral rollback and attempts to prevent anterior movement of the femur. Many studies have compared the two types of prostheses, with mixed results. [10] The present study was performed systematic review of outcome of compare the clinical results of both designs.

A secondary objective was to identify factors that influence the results, such as disease severity, polyethylene bearing mobility, patella resurfacing, age, and sex.

Material and Method

This is prospective study design was at Gadag Institute of Medical Sciences ,Gadag, Karnataka. The studyperiod was from October 2021 to March 2022. The outcome measurement in the studies had to be a functional, clinical or radiological measure. Primary outcome measures were pain, impairment (anterior-posterior stability, range of motion) or disability/handicap. The minimal follow-up had to be 12 months. For study type, randomization technique, allocation concealment, and blinding was recorded. For population, the affiliation, the period of inclusion, the inclusion and exclusion criteria, and the age, sex, work status, and race of the patients were recorded. For sample size, the number of patients who met the inclusion criteria, who was randomized and who was followed up were recorded. For all outcome variables, quantitative results were recorded as well as complications encountered in the treatment groups.

Analysis

Statistical analyses were conducted using SPSS. Continuous data (e.g. visual analog scales of pain, patient global assessment) was entered as means and standard deviations, and dichotomous outcomes (e.g. response, improvement) as number of events. Standard deviations were used when available. When not provided, standard deviations were imputed from comparable studies or from original scores when calculating change scores. In the absence of significant heterogeneity, and given sufficient included trials, results were combined using

weighted mean difference or standardized mean difference (depending on comparability of scales) for continuous data, and relative risk for dichotomous data (given that the event is not rare). A random-effects model was used for all analyses in this review. A test of heterogeneity of the data was performed and if significant ($p < 0.05$ using the X2 statistic), the source of heterogeneity was investigated by performing a sensitivity analysis and considering clinical reasons for potential clinical heterogeneity.

Results

There were many prospective studies with the evidence level 1–2 to compare the CR and PS TKAs using contemporary prostheses (Table 1).[11-17] Most studies reported no difference in clinical scores, ROM, midterm survival rate, and quadriceps muscle recovery; two studies reported only the better ROM in PS TKAs.[12, 14] In our preliminary prospective study using the recently introduced prosthesis of Persona, all the clinical results did not differ at 1 year postoperatively (Table 2).

Table 1: Comparing the Outcomes of CR and PS Total Knee Arthroplasty

Study	Level	Number (CR/PS)	Prosthesis	FU (yr)	Clinical evaluation
Seon et al.[11]	I	48/47	NexGen CR flex vs Legacy knee PS flex	2.3	HSS, WOMAC, ROM non-weight bearing & weight bearing
Thomsen et al.[12]	I	36/36	AGC vs. NexGen Legacy knee PS flex	1	VAS (pain, satisfaction, feel), SF-36, ROM active & passive
Kim et al.[13]	I	250/250	NexGen CR flex vs. Legacy knee PS flex	2.3	KS and FS, HSS, WOMAC, ROM non-weight bearing & weight bearing
Yagishita et al.[14]	II	29/29	NexGen CR flex vs. Legacy knee PS flex	5	KS and FS, VAS, patient satisfaction score, ROM, radiolucency
Cho et al.[15]	II	51/51	Triathlon & PFC Sigma	0.5	KS and FS, ROM, quadriceps force in dynamometer
Harato et al.[16]	II	99/93	Genesis II CR vs. PS	5–7.3	KS and FS, WOMAC, SF-12, ROM, radiolucency, complication
Matsumoto et al.[17]	II	19/22	NexGen CR flex vs. Legacy knee PS flex	5	KS and FS, laxity, ROM

CR: cruciate-retaining, PS: posterior-stabilized, FU: follow-up, KS: Knee Society Knee Score, FS: Knee Society Function Score, HSS: Hospital for Special Surgery score, WOMAC: Western Ontario and McMaster Universities

Osteoarthritis Index, ROM: range of motion, VAS: visual analog scale, SF-36: 36- Item Short Form Health Survey, SF-12: 12-Item Short Form Health Survey.

Table 2: Comparison of Preliminary Results of Cruciate-Retaining and Posterior-Stabilized TKAs

Variable	Cruciate-retaining	Posterior-stabilized	p-value
Knee score			
Preoperative	44.4 ± 5.8	42.8 ± 6.7	0.101
Last follow-up	85.2 ± 10.1	86.9 ± 8.3	0.284
Function score			
Preoperative	43.8 ± 4.7	42.4 ± 5.5	0.077
Last follow-up	68.9 ± 13.4	71.5 ± 16.2	0.280
WOMAC			
Preoperative	67.2 ± 3.6	68.5 ± 4.7	0.071
Last follow-up	23.1 ± 7.5	22.6 ± 7.6	0.688
ROM (°)			
Preoperative	119.9 ± 17.1	110.3 ± 21.4	0.004
Last follow-up	127.2 ± 10.1	128.8 ± 10.3	0.322

Values are presented as mean ± standard deviation. The preliminary prospective study was conducted from April 2015 to June 2017. The mean follow-up period was 1 year for both groups.
TKA: total knee arthroplasty, WOMAC: Western Ontario and McMaster Universities Osteoarthritis Index, ROM: range of motion.

Discussion

Despite the high success rates of total knee arthroplasties, there is still controversy regarding removal versus retention of the PCL. Proponents of cruciate-retaining designs believe that it is important to retain as much of the original anatomy as possible, and that the PCL can continue to stabilize the knee during flexion. The posterior-stabilized designs utilize a tibial post and femoral cam to substitute for the PCL, which allows femoral rollback and attempts to prevent anterior movement of the femur. Many studies have compared the two types of prostheses, with mixed results. The present study was performed to directly compare the clinical results of both designs, made by the same manufacturer, at the 5-year follow-up to determine whether either prosthesis had a distinct advantage. There have been several studies that analyze the kinematics in CR and PS TKAs. A prospective study with bilateral paired CR and PS TKAs compared three- dimensional kinematics using a computer model fitting technique.[18] In the weight bearing condition, the CR TKA showed an anterior femoral translation from 30° to 60°of flexion, but the PS TKA showed the maintenance of a constant contact point. The tendency of the anterior femoral translation of the CR TKAs also existed in the non- weight bearing situation without statistical significance; PS TKA showed posterior femoral roll back between 60° and 90° of flexion in non-weight bearing. However, recent two studies using the same evaluation technique reported that paradoxical femoral anterior translation at low flexion angles was seen in both CR and PS TKAs.[19,20] On *in vivo* kinematics of stair climbing using radiographic-based image matching techniques, CR TKA was more sagittally stable in mid-flexion.[21] Four studies compared the long-term (10–20 years) survivorship between CR and PS TKAs. Two studies showed no difference, but the other two studies reported better survival rate in CR TKA.[18,19] But, it seems that the use of a specific brand of prosthesis with poor locking mechanism could increase the revision of tibial component due to backside wear and

loosening.[22] In a previous study comparing the long-term results at our institution, there was no difference in functional outcome, ROM, and 15-year survival rate between CR and PS TKAs.[23] The first-generation PS femoral component was known to increase the risk of postoperative patellofemoral crepitus or clunk. The contemporary femoral components with patellofemoral conformity has been shown to decrease the risk of such postoperative noise.[24] Nevertheless, Nam et al.[25] recently reported that the likelihood of noise generation was greater in PS TKA than in CR TKA (odds ratio, 2.5; 95% confidence interval, 1.8 to 3.7; $p < 0.001$). It is noteworthy that patient-perceived noise generation was associated with residual symptoms, including difficulty getting in and out of a chair, limping, swelling, and stiffness compared with those who did not report noise generation after TKA in their study. The surgeon should inform the patients of the possibility of noise preoperatively, especially when performing PS TKA. In addition, it is important to make efforts to avoid surgical errors and to use modern prostheses with improved design. Kinematic and anatomic studies to elucidate the reasons for any differences between the two groups are indicated, and further follow-up was necessary to evaluate long-term differences between the two groups. At this time, the choice of implant can be based upon surgeon preference and training, as well as the presence of any existing PCL pathology. There were some limitations to this study. The patients were not randomized, although they were followed prospectively. Also, several patients in each cohort were deceased or could not be contacted for the five-year follow-up visit, although almost all of them were doing well one to four years after the procedure. Despite these limitations, this report demonstrates that both designs had excellent clinical outcomes at a follow-up time of five years, with few differences between the two types of prostheses.

Conclusion

Our data shows a statistically significant trend of greater flexion and range of motion achieved with posterior stabilized total knee prostheses. However, the advantage is not great and may fall in a range that is not clinically significant. Since both total knee designs have shown excellent long-term results, there may not be much point in arguing for one design over the other. Rather, the surgeon should use the knee replacement with which he or she is most comfortable and which most consistently provides good results for his or her patients. In addition, more high quality, randomized controlled trials need to be performed that report comparable data on clinical features of knee replacements such as stair-climbing ability, stability, proprioception, and pain relief.

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