

Comparative Study Of Cruciate Retaining Vs Posterior Stabilized Prosthesis In Total Knee Replacement¹Rajkumar Aggarwal, ²Devinderpal Singh.¹Professor and head, ²Junior resident, Department of orthopaedics, Sri Guru Ramdas university of Health Sciences, Amritsar, Punjab, India.

Corresponding author: Dr. Devinderpal Singh, Junior resident Department of orthopaedics, Sri Guru Ramdas university of Health Sciences, Amritsar, Punjab, India.

Introduction : Although being debated for many years, the superiority of Posterior Cruciate-Retaining (CR) Total knee Arthroplasty (TKA) and Posterior Cruciate - Stabilizing (PS) TKA remains controversial. The primary objective of this study was to compare functional outcome in patients who underwent primary total knee arthroplasty surgery using posterior stabilized and cruciate retaining implants.

Material and method: Sixty diseased osteoarthritis knees in 42 patients were included in the study, with 30 cases operated with CR prosthesis and 30 cases with PS Prosthesis. The two groups were then compared using disease specific functional scores; 2011 knee society score. Pain, range of motion, any flexion, varus, valgus deformity, instability at knee joint was assessed preoperatively and postoperatively. Functional outcome (e.g. walking, climbing stairs) was assessed.

Result: Postoperative objective knee score and range of motion was significantly better in PS group than CR group, with significant p value. No significant difference in functional outcome between both the groups was seen.

Conclusion: No significant difference in the functional outcome is seen between both the groups.

Email of corresponding author : livelow.thinkhigh@gmail.com

Introduction

Total Knee arthroplasty, a surgical procedure to replace weight-bearing surfaces of knee joint to relieve pain and disability; is an end-of-line treatment for patients with severe pain and functional limitations. Although being debated for many years, the superiority of Posterior Cruciate-Retaining (CR) Total knee Arthroplasty (TKA) and Posterior Cruciate - Stabilizing (PS) TKA remains controversial. Proponents of Cruciate-Retaining; CR prosthesis assert that PCL retention preserves more normal knee kinematics¹, improved proprioception²⁻³, superior knee stability (PCL preventing anterior translation of the femur on the tibia) and is more of a bone conserving procedure whereas the proponents of PCL Stabilized; PS prosthesis assert that Posterior-stabilized implants with a polyethylene post and femoral cam to replace the role of the PCL, has controlled replication of the femoral rollback mechanism, resulting in reduced sliding shear stress on the polyethylene liner and providing superior range of motion⁵ in terminal knee flexion, a less technically

demanding procedure, a more stable component interface, Also PCL is diseased with various form of arthritis and contracture and is difficult to balance reproducibly⁶,so the significant deformity can be more reliably corrected with the use of PCL substituting designs .

Multiple studies have addressed differences in knee range of motion following cruciate retaining and posterior stabilized primary knee re placements. Most studies have shown a small gain in terminal flexion with posterior stabilized designs.⁷⁻⁹A number of studies have also reported on short- and medium-term functional results comparing these two implant designs.The current literature has not demonstrated any significant difference in early functional outcome between posterior stabilized and cruciate retaining knee replacements. This discrepancy between biomechanical and clinical results suggests that the differences in function between PS and CR knees are either nonexistent or that they are not detected with current outcome tools.

The primary objective of this study was to compare functional outcome in patients who underwent primary total knee arthroplasty surgery using posterior stabilized and cruciate retaining implants.

MATERIAL AND METHOD

Patient in age group 55 to 70 years with diseased osteoarthritic knees undergoing either unilateral or bilateral primary Total knee arthroplasty at our centre were selected for the study. The prospective study was conducted on 60 diseased osteoarthritis knee in 42 patients operated either with CR or PS Total knee arthroplasty for duration of One and half years from Dec 17 to May 15 with prospective analysis upto Oct 2019 with follow up for period of 6 months. Patients with age group 55 to 70 years, Osteoarthritis radiological grade III&IV, painful knees with inability to perform routine activities and willing to giving consent for both CR and PS were included in the study ; whereas patients with Patients with sepsis of the knee joint or inflammatory arthritis , Patients with local skin lesions, Revision Total knee arthroplasty and Patients with prior PCL injury were excluded From the the study. The two groups were then compared using disease specific functional scores; 2011 knee society score .Pain ,range of motion ,any flexion, varus , valgus deformity ,instability at knee joint was assessed preoperatively and postoperatively .Functional outcome (e.g. walking ,climbing stairs) was assessed ..

Patient expectation with the Total knee arthroplasty procedure and satisfaction postoperatively was noted .The following criteria were assessed preoperatively and postoperatively and further at follow up in the OPD and points were assigned as per “2011 knee society score “ and the results were compared for cruciate retaining and posterior stabilised prosthesis .

Patients were operated in standard arthroplasty operative setup. All Surgeries done using midline anterior skin incision followed by medial parapatellar arthrotomy. 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 $5^{\circ} \pm 1^{\circ}$ (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 for the period of 6 months.

RESULTS

BASELINE DEMOGRAPHICS;The mean age of the patients in the CR group was 61.53 years and for PS group was 62.03 years.Out of 30 knees Operated with CR knees ,25 knees were of female gender and 5 were of male gender .Similarly for PS knees;13 knees were Of female and 17 were of male.

12 patients were operated with unilateral CR arthroplasty and 7 patients with B/L CR arthroplasty 7 patients were operated with B/L PS arthroplasty and 12 with U/L PS arthroplasty .4 patients were mixed, treated with CR arthroplasty in one knee and PS in the other.

PRIMARY OUTCOME

The mean objective knee score of CR group improved from 33.17 to 71.17 and that for PS group, from 39.1 to 73.13 postoperatively; with p value of 0.018 which indicated significant difference in favour of PS group .The mean postoperative range of motion of CR Group preoperatively was 87.5 degree which got improved to 104.2 degree postoperatively and in PS group ,it got improved to 114.67 degree postoperatively from 92.33; with significant p value of 0.010 which indicated better

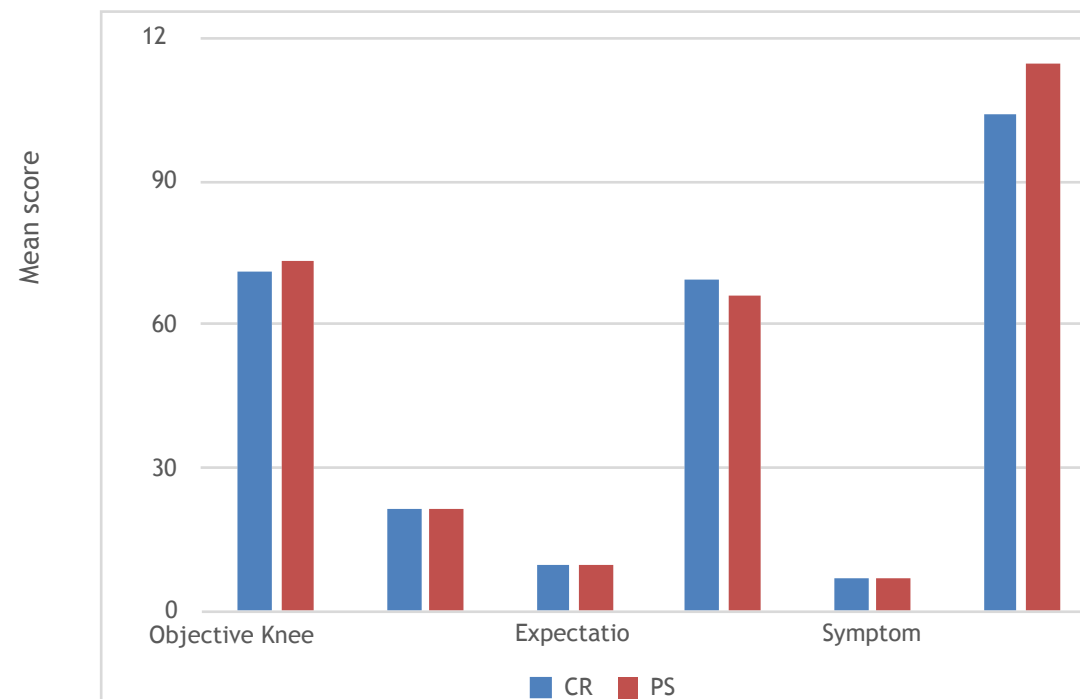
range of motion in PS group than CR group .The preoperative and postperative mean functional sore of CR group were 33.63 &69.23 respectively, compared to mean preoperative post operative functional score of PS group of 31.33 & 66.37) , indicated insignificant difference with p value of 0.101. The Postoperative symptoms score in CR group was mean 7.23 and that in PS group was 7.03; with p value of 0.654 which indicated insignificant difference between both the groups .The postoperative satifaction (mean of 21.6 in CR group and mean of 21.6 in PS group)and expectation scores(mean of 9.93 in CR group and mean of 9.57 in PS group) of both the groups were comparable with insignificant difference

Preoperative knee society score

The 2011 KSS categories	CR	PS	P Value
Objective Knee Indicators	33.17±4.12	39.1±12.3	0.372
Satisfaction	7.6±2.11	7.07±2.02	1.000
Expectation	9.5±0.86	9.07±0.74	0.192
Functional Activities	33.63±4.57	31.37±4.8	0.101
Symptoms	14.3±1.76	14.5±1.68	0.587
Range of Motion	87.5±6.92	92.33±6.26	0.316

The 2011 KSS categories	CR	PS	P Value
Objective Knee Indicators	71.17±3.78	73.13±2.29	0.018
Satisfaction	21.6±4.34	21.6±3.34	1.000
Expectation	9.93±1.17	9.57±0.97	0.192
Functional Activities	69.23±6.83	66.37±6.48	0.101
Symptoms	7.23±1.28	7.03±1.54	0.654
Range of Motion	104.2±19.58	114.67±8.9	0.010

POSTOPERATIVE KNEE SOCIETY SCORE







CASE OPETAED WITH B/L PS





CASE OPERATED WITH B/LCR

Discussion

As patient expectations following knee arthroplasty increases, knee arthroplasty research is increasingly focused on clinically important differences in patient functional outcomes but still there is controversy whether the Cruciate retaining or posterior stabilised prosthesis designs have superior outcomes over each other. 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.

After TKA treatment, ROM of the operated knee is a very important index when evaluating the effect. Most of the previous report found that post-operative Range of motion was better in PS TKA . In our study, mean ROM for CR prosthesis preoperatively and post operatively was 87.5 and 104.67 respectively whereas it was 92.33 and 114.67 for PS .These results are comparable with the studies done by N Li et al¹⁰, Matsumoto et al¹¹, Yagishita et al¹² Berick et al¹³; where they also indicated more significant improvement in ROM in PS TKA as compared to CR TKA. The mean objective knee score in the present study for CR and PS prosthesis was 33.17 and 39.1 respectively which got improved to 71.17 and 73.13 which indicated significant improvement but in contrast to Suthar RK et al¹⁴, Longo UG et al¹⁵ study ;favours PS prosthesis with better objective knee score results.

The mean knee society score for pain in our study was 14.3 and 7.23 preoperatively and postoperatively respectively for CR prosthesis whereas it was 14.5 and

7.03 pre and postoperatively for PS TKA .These results are comparable to N Li et al¹⁰, Wang CJ et al¹⁶, Verra et al¹⁷ study where they also indicated no statistically significant difference .

The question of function in cruciate retaining and posterior stabilized knee repla- cements has been addressed in several studies .. The study by Frank R.kolisek et al¹⁸, R chaudary et al¹⁹, EA unkar et al²⁰, Harato et al²¹ concluded insignificant difference in knee functional score between CR and PS TKA at follow up in patients operated with these two prosthetic types .In our study the mean postoperative knee function score for CR group was 69.23 and for PS group was 66.37 with p value of 0.101 which also concluded insignificant difference between both groups, despite the superior range of motion in PS TKA what still remains uncertain is whether these small increases in knee motion in PS prostheses represent clinically relevant improvements that are recognized by patients. Similarly there was insignificant difference between CR and PS Total knee arthroplasty regarding patient satisfaction and expectation .

The PCL has been shown to provide approximately 95% of the total restraint to posterior translation of the tibia on the femur, maximally taut at full flexion. Thus CR TKA is advantageous over PS TKA as it retain the PCL and also being the bone conserving technique as compared to PS TKA where more of intercondylar bone stock and femoral condyles are sacrificed for prosthesis. PCL, if found to be intact in an arthritic knee can be balanced . But many authors argue that the PCL is diseased with various form of arthritis and contracture⁵¹⁻⁵³ and is difficult to balance reproducibly and also PCL in some cases contributes to the flexion and varus deformity; PCL being the medial stabilising structure. When medial structures are subsequently released to balance lax lateral structures, the PCL is usually too tight relative to these structures and must be released to some extent to balance the knee but there exists the possibility for late anteroposterior instability if the PCL stretches over time. One of the biggest drawback of the CR prosthesis is late rupture of PCL, a issue which can be addressed by using deep dish insert in CR TKA.

The kinematic differences between CR and PS knee replacement designs have generally been borne out in the literature when knee range of motion is the primary outcome measure. Cruciate retaining implants rely on the intact PCL, which becomes taut in deep flexion, preventing anterior femoral translation and producing femoral rollback. However, recent kinematic studies have thrown doubt over this mechanism and have shown paradoxical anterior movement of the femoral condyles during high-flexion with higher peak femoro-tibial contact stress.²²⁻²³ This may be a result of difficulty in adequately balancing the PCL or of pathological

PCL function, as it may be involved in the degenerative disease process and no longer functions like a “normal” PCL, following knee replacement. In contrast, cruciate substituting knee replacement relies on replacement of the PCL with a tibial polyethylene post, which articulates with a CAM between the femoral condyles. This CAM/post articulation in deep flexion prevents anterior femoral translation and mechanically reproduces femoral rollback. Kinematic studies have demonstrated that this mechanical rollback creates a smoother flexion arc and also a superior range of deep flexion

conclusion

There are surgeons who exclusively do PS TKA in all the cases but we found that with PCL recession and soft tissue balancing and use of deep dish insert , CR TKA can be done even in cases with varus deformity .In the end ,we suggest that if the contractures are significant ,and the PCL is adding to the deformity ,it should be excised and posterior stabilized prosthesis should be used. On the other hand, if the PCL seems adequate and does not hinder the surgical procedure, and seems to be adding to the stability, it should preferably be retained, as it has significant stabilising function.

References

1. William M. Mihalko. Arthroplasty of the knee. In: Azar FM, editor. Campbell's operative orthopaedics , 13th ed. Philadelphia: Elsevier; 2017.p.397.
2. Andriacchi TP, Galante JO, Fermier RW. The influence of total knee replacement design on walking and stair climbing. J Bone Joint Surg Am. 1982 Dec;64:1328–35.
3. Kelman GJ, Biden EN, Wyatt MP, Ritter MA, Colwell CW Jr. Gait laboratory analysis of a posterior cruciate sparing total knee arthroplasty in stair ascent and descent. Clin Orthop Relat Res. 1989 Nov;248:21–5.
4. Schultz RA, Miller DC, Kerr CS, Micheli L. Mechanoreceptors in human cruciate ligaments. A histological study. J Bone Joint Surg Am 1984 Sep;66:1072–76.
5. Maloney WJ, Schurman EJ. The effects of implant design on range of motion after total knee arthroplasty. Clin Orthop Relat Res 1992;278:147-52.
6. Long WJ, Scuderi GR. Varus and Valgus deformities. In: Lotke PA, Lonner JH, editor. Knee Arthroplasty, 3rd ed. New York: Lippincott Williams & Wilkins; 2009.p.111
7. Maruyama S, Yoshiya S, Matsui N, et al. Functional comparison of posterior cruciate-retaining versus posterior stabilized total knee arthroplasty. J Arthroplasty 2004; 19(3): 349–353.
8. Jacobs WC, Clement DJ, and Wymenga AB. Retention versus sacrifice of the posterior cruciate ligament in total knee replacement for treatment of osteoarthritis and rheumatoid arthritis. Cochrane Database Syst Rev 2005; (4): CD004803
9. Seon JK, Park JK, Shin YJ, et al. Comparisons of kinematics and range of motion in high-flexion total knee arthroplasty: cruciate retaining vs. substituting designs. Knee Surg Sports Traumatol Arthrosc 2011; 19(12): 2016–2022.
10. Li N, Tan Y, Deng Y, et al. Posterior cruciate-retaining versus posterior stabilized total knee arthroplasty: a meta-analysis of randomized controlled trials. Knee Surg Sports Traumatol Arthrosc 2014; 22(3): 556–564.
11. Matsumoto T, Muratsu H, Kubo S, Matsushita T, Kurosaka M, Kroda R. Intraoperative soft tissue balance reflects minimum 5-year midterm outcomes in cruciate-retaining and posterior-stabilized total knee arthroplasty. The Journal of arthroplasty 2012; 27(9):1723–30.
12. Yagishita K, Muneta T, Ju YJ, Morito T, Yamazaki J, Sekiya I. High-flex posterior cruciate-retaining vs posterior cruciate-substituting designs in simultaneous bilateral total knee arthroplasty: a prospective, randomized study. The Journal of arthroplasty. 2012, 27(3): 368–374.
13. Bercik MJ, Joshi A, Parvizi J. Posterior cruciate -retaining versus posterior -stabilized total knee arthroplasty: A Meta analysis. J arthroplasty 2013;28:439-44
14. Suthar RK, Parekh DR, Mistry SB. Cruciate retaining versus posterior-stabilized total knee arthroplasty: a short-term comparative study. Int J Res Orthop. 2018 Sep;4(5):726-730
15. Longo UG, Ciuffreda M, Mannering N, Andrea VD, Locher J, Salvatore G, et al. Outcomes of Posterior-Stabilized Compared with Cruciate-Retaining Total Knee Arthroplasty. Knee Surg 2018;31:321-40.
16. Jiang C, Liu Z, Wang Y, Bian Y. Posterior Cruciate Ligament Retention versus Posterior Stabilization for Total Knee Arthroplasty: A Meta-Analysis 2016. PLOS / ONE TENTH ANNIVERSARY [INTERNET]. 2016 Jan 29 [cited on Dec 8]; 11(1). Available on <https://Journals.Plos.org/Plosone/article>. DOI.org/10.1371/ journal.pone.0147865.

- 17 Verra WC, Boom LG, Jacobs WC, Schoones JW, Wymenga AB, Nelissen RG. Similar outcome after retention or sacrifice of the posterior cruciate ligament in total knee arthroplasty: A systematic review and meta-analysis. *Acta orthopaedica* 2015;86(2):195–201.
- 18 Kolisek FR, Mcgrath MS, Marker DR, Jessup N, Seller TM, Mont MA et al. Posterior -stabilized versus posterior cruciate ligament -retaining Total knee Arthroplasty. *Iowa orthop J* 2009;29:23-37.
19. Chaudhary R, Beaupré LA, Johnston DW. Knee range of motion during the first two years after use of posterior cruciate-stabilizing or posterior cruciate-retaining total knee prostheses. A randomized clinical trial. *J Bone Joint Surg Am* 2008; 90(12):2579–2586.
20. Ünkar EA, Ozurken Y, Sukur E, Carkci E, Mert M. Posterior cruciate-retaining versus posterior-stabilized total knee arthroplasty for osteoarthritis with severe varus deformity. *Acta Orthop Traumatol Turc* 2017 Mar;51(2):95-99.
21. Harato K, Bourne RB, Victor J, et al. Midterm comparison of posterior cruciate-retaining versus -substituting total knee arthroplasty using the Genesis II prosthesis. A multicenter prospective randomized clinical trial. *Knee* 2008; 15(3):217–221.
22. Fantozzi S, Catani F, Ensini A, et al. Femoral rollback of cruciate-retaining and posterior-stabilized total knee replacements: in vivo fluoroscopic analysis during activities of daily living. *J Orthop Res* 2006; 24(12): 2222–2229.
23. Stiehl JB, Komistek RD, Cloutier JM, et al. The cruciate ligaments in total knee arthroplasty: a kinematic analysis of 2 total knee arthroplasties. *Arthroplasty* 2000; 15(5): 545–550.