Knee Flexion and Clinical Outcomes in Total Knee Arthroplasty: A Comparative Analysis of Two Types of Bearings

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INTRODUCTION: In total knee arthroplasty (TKA), the posterior stabilized (PS) tibial bearing has been widely used for decades, constituting over 50% of all TKA surgeries in the United States from 2012 to 2018 [1]. In recent years, cruciate retaining (CR) type bearings (including different constraint levels) have gained prominence and become the most widely used bearings in the US since 2019 [1]. Compared to the PS implant, the CR-type implant offers benefits of less bone resection and a more efficient surgical flow. Moreover, modern TKA implant systems often provide multiple CR bearing options with varying levels of anterior-posterior (AP) constraint to accommodate patient needs. A more constrained CR bearing could provide increased AP stability when the patient has a compromised posterior cruciate ligament (PCL), presenting as an alternative solution to the traditional PS implant. However, because CR-type implants lack the cam/spine mechanism present in the PS implant, which enforces femoral rollback during knee flexion, there is a perception that CR-type implants may not achieve the same degree of maximum knee flexion as PS implants. By utilizing a manufacturer-operated clinical database which contains the same TKA system with multiple bearings, this analysis aims to answer two questions: 1) Does a CR constrained bearing provide comparable maximum knee flexion to a PS bearing? 2) Does the difference in maximum knee flexion, if any, translate to a meaningful clinical outcome difference?

METHODS: Data collected as part of Exactech's Post Market Clinical Follow-up (PMCF) study were reviewed to conduct this retrospective analysis. Two types of bearings used in the Truliant® knee system were evaluated: the PS bearing and the CRC (CR Constrained) bearing. Aside from the tibial inserts (and the additional cam feature on the PS femoral component), the two types of TKA implant constructs share the same tibial tray components, patellar components, and articulating geometries of the femoral components. In comparison to the traditional CR bearing, the CRC bearing features an elevated anterior lip to provide increased AP stability of the TKA knee. For each patient, both maximum knee flexion and the Oxford Knee Score (OKS) were measured pre-operatively and at the 2-year post-operative follow-up. The OKS is a widely used measurement for assessing TKA patients' pain and joint function, with proven validity, reproducibility, and sensitivity [2]. Additionally, a visual analog scale (VAS) patient satisfaction score was measured at the 2-year post-op follow-up by asking the patient a single question: "*On a scale of 0 to 10, how satisfied are you with the results of your surgery? (0 being least satisfied, and 10 being most satisfied)".* All Truliant PS and CRC patients in Exactech's PMCF database with complete data points (knee flexion and OKS score at pre-op, knee flexion, OKS score, and VAS satisfaction score at 2-year post-op) were included in this analysis. A total of 147 qualified patients were identified (73 PS and 74 CRC). No statistical differences were observed between the two patient groups concerning age at surgery (PS: 66.7±6.4 yrs, CRC: 66.1±8.4 yrs, p=0.50), gender (PS: 70% females, CRC: 57% females, p=0.10), and BMI (32.3±5.5 kg/m^2, CRC: 34.5±7.0 kg/m^2, p=0.06). Pre- and post-op maximum knee flexion, OKS scores, and VAS satisfaction scores were compared between the two groups using the Mann-Whitney U test; within-group pre- and post-op improvements in maximum knee flexion and OKS score were assessed using the Wilcoxon Matched-Pairs test (R Core Team).

RESULTS: At the 2-year mark following TKA surgery, the PS group exhibited statistically greater maximum knee flexion compared to the CRC group (127.0°±7.5° vs. 118.6° ± 10.7°, p<0.01). However, a pre-op disparity in maximum knee flexion was also observed between the two groups (PS: 120.1°±6.2°, CRC: 114.4°±13.6°, p=0.01). Both patient groups experienced an increase in flexion from pre- to post-TKA surgery, with an average increase of 6.8° for the PS group and 4.2° for the CRC group; but this difference in increase did not reach statistical significance (p=0.17). Both cohorts demonstrated significantly improved knee joint function after TKA surgery, as indicated by the OKS. The pre-op OKS, 2-year post-op OKS, and net improvement were 21, 42, and 21 points for PS patients and 19, 43, and 24 points for CRC patients. There was a significant statistical difference between pre- and post-op OKS scores for each group (p<0.01), while none of the pre-op, post-op and net improvement OKS scores showed statistical significance between patient groups. At the 2-year post-op assessment, both patient groups reported high VAS satisfaction scores, with no statistical difference between groups (8.7±2.6 for PS and 9.2±1.5 for CRC, p=0.85). (See Figure 1).

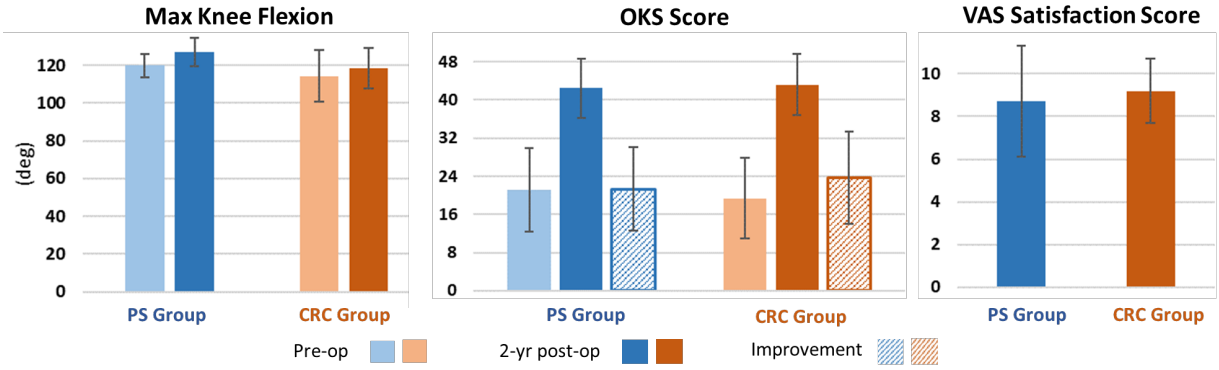

Figure 1: Left to right: comparison of max knee flexion (pre-op and 2-year post-op), OKS scores (pre-op, 2-year post-op, and net improvement), and VAS satisfaction score (2-year post-op) between PS and CRC patient groups.

DISCUSSION: In this analysis, our findings at the 2-year post-op assessment revealed a slightly smaller flexion in the CRC patient group compared to the PS patient group. However, this post-op disparity could be attributed in part to the pre-op difference in maximum knee flexion between the two patient groups. Both cohorts exhibited an increase in knee flexion following TKA, and no statistical difference in the net improvement was observed between them. Therefore, our first question remains inconclusive. The analysis showed that the modest difference in knee flexion did not translate into any discernible variations in clinical outcomes, as evidenced by OKS and VAS patient satisfaction scores. TKA surgery significantly improved knee joint functions in both groups, with OKS scores increasing by more than 20 points for each. At the 2-year mark post-TKA surgery, both patient groups reported high overall satisfaction, reflected by VAS patient satisfaction scores of 8.7 and 9.2 in the PS and CRC groups, respectively.

SIGNIFICANCE/CLINICAL RELEVANCE: This analysis indicated that PS implants may potentially afford patients higher knee flexion than CRC implants, albeit the difference is likely modest and does not translate into meaningful variations in clinical outcomes. When chosen appropriately, both types of implants can provide significantly improved knee joint function and high satisfaction for patients undergoing TKA surgery.

REFERENCES: 1: *AJRR 2023 Annual Report*. 2: Dawson et al. *JBJS Br. 1998*.