

POSTERIOR-STABILIZED VERSUS POSTERIOR CRUCIATE LIGAMENT-RETAINING TOTAL KNEE ARTHROPLASTY

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ABSTRACT

Posterior-stabilized and posterior cruciate retaining total knee arthroplasty prostheses have had high success rates, but it is unclear whether one design has superior outcomes. The purpose of the present study was to directly compare the outcomes of these two designs. Forty-five patients who received a posterior-stabilized prosthesis were compared to 46 consecutive patients who received a cruciate-retaining implant. At a mean follow-up time of 60 months (range, 49 to 69 months), the mean Knee Society knee scores improved from 42 points (range, 20 to 73 points) to 93 points (range, 39 to 100 points) for the cruciate-retaining group and from 38 points (range, 20 to 70 points) to 94 points (range, 60 to 100 points) for the posterior-stabilized group. The mean Knee Society functional scores improved from 36 points (range, 10 to 60 points) to 71 points (range, 15 to 100 points) for the cruciate-retaining group and from 32 points (range, 10 to 70 points) to 73 points (range, 32 to 100 points) for the posterior-stabilized group. The ranges of motion were 125° (range, 100 to 140°) and 118° (range, 87 to 135°) in the cruciate-retaining and posterior-stabilized groups, respectively, at final follow-up. Radiographic analysis revealed no radiolucencies that were progressive or were greater than 1 millimeter in length. There were no re-operations in either group. This study

did not conclusively demonstrate the superiority of one knee design over the other, suggesting that the choice of implant should be based on surgeon preference and existing pathology of the posterior cruciate ligament.

INTRODUCTION

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.¹⁻⁶ Numerous prostheses have been developed to improve the durability and function of these procedures. However, there has been controversy regarding whether the posterior cruciate ligament (PCL) should be retained or removed during the procedure. Some potential advantages of cruciate-retaining prosthetic designs include preservation of bone, more normal knee kinematics, increased proprioception, femoral rollback on the tibia during flexion, and greater stabilization of the prosthesis, with the PCL preventing anterior translation of the femur on the tibia. Posterior-stabilized 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. Potential advantages of these designs include a less technically demanding procedure, a more stable component interface,⁷⁻⁹ and increased range of motion.^{7,10,11}

Recent studies have shown high short- and mid-term success rates of both designs,¹²⁻¹⁶ but it is unclear whether one design has superior outcomes.¹⁷ The purpose of the present study was to directly compare the Knee Society knee as well as function scores, ranges of motion, radiographic outcomes, and complications of two larger cohorts of patients who received contemporary cruciate-retaining or posterior-stabilized prostheses.

METHODS

Fifty-four consecutive patients underwent total knee arthroplasty utilizing a posterior-stabilized prosthesis, and another group of fifty-three consecutive patients received a cruciate-retaining implant. All patients who had osteoarthritis, osteonecrosis, or rheumatoid arthritis and who were indicated for a total knee arthroplasty were invited to take part in a prospective study to follow their outcomes, and none of the patients declined. In the

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cruciate-retaining cohort, 1 patient passed away and 6 patients changed their addresses prior to the five-year follow-up visit, so their results were not included in the study. At the latest follow-up visit (mean follow-up time 17 months; range, 3 to 48 months), the patients who were lost to follow-up had mean Knee Society knee and function scores of 85 points (range, 52 to 100 points) and 78 points (range, 50 to 100 points), respectively. In the posterior-stabilized group, 3 patients passed away and 6 patients could not be reached at the five-year follow-up visit, so they were also excluded. At their last follow-up (mean follow-up time 29 months; range, 7 to 49 months), the mean Knee Society knee and function scores of the patients who were lost to follow-up were 85 points (range, 34 to 100 points) and 63 points (range, 45 to 100 points), respectively. No other patients were excluded. The patients were evaluated in the office one month after the procedure and annually thereafter. The ranges of motion, Knee Society scores,¹⁸ radiographic outcomes, and complications were assessed at each follow-up visit, and these were compared at the five year follow-up. This study received full institutional review board approval.

The patients who received cruciate-retaining arthroplasties consisted of 20 men and 26 women who had a mean age of 64 years (range, 40 to 77 years), a mean body mass index of 32 kilograms per meter squared (range, 26 to 43 kilograms per meter squared), a mean preoperative Knee Society knee score of 42 points (range, 20 to 73 points), and a mean preoperative Knee Society functional score of 36 points (range, 10 to 60 points). The patients who received posterior-stabilized arthroplasties consisted of 17 men and 28 women who had a mean age of 66 years (range, 45 to 81 years), a mean body mass index of 32 kilograms per meter squared (range, 23 to 47 kilograms per meter squared), a mean preoperative Knee Society knee score of 38 points (range, 20 to 70 points) and a mean preoperative Knee Society functional score of 32 points (range, 10 to 70 points).

All procedures were performed by two of the authors, who both used a standard median parapatellar approach. All surgeries utilized the Scorpio CR cruciate-retaining system or the Scorpio PS posterior-stabilized system (Stryker, Mahwah, New Jersey). Each author performed approximately half of the CR procedures and half of the PS procedures.

The patients were evaluated in the office one month, one year, and annually after the surgery. Knee Society scores,¹⁸ ranges of motion, and radiographs (weight-bearing anteroposterior and lateral views) were assessed at each follow-up visit. Radiolucencies were evaluated using the system of zonal analysis developed by the Knee Society.¹⁹

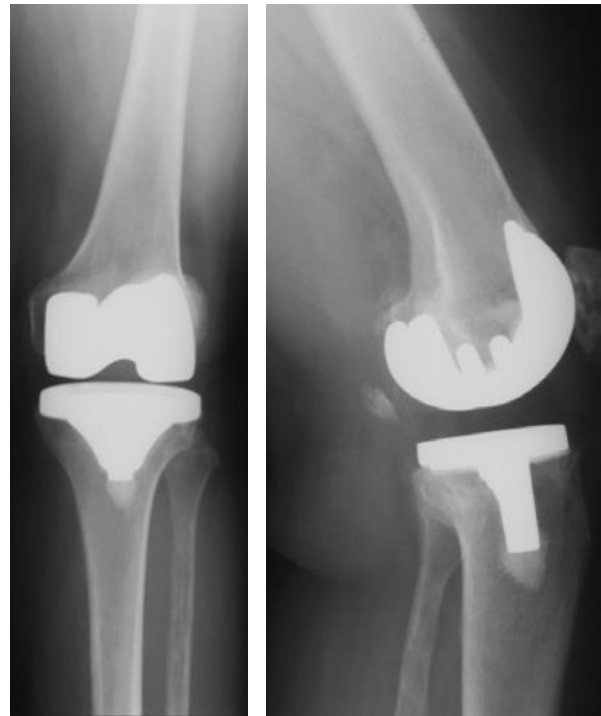


Figure 1. Anteroposterior (A) and lateral (B) radiographs of the knee of a 55 year old woman who received a cruciate-retaining prosthesis.

The Knee Society scores and ranges of motion of the two groups were compared with Student t-tests. All statistical analyses were performed using SigmaStat version 3.0 (SPSS, Chicago, Illinois).

RESULTS

At a mean follow-up time of 60 months (range, 54 to 69 months), the clinical scores of the two groups were similar, but the cruciate-retaining group had a higher mean range of motion. The mean Knee Society knee scores of the cruciate-retaining and posterior-stabilized groups were 93 points (range, 55 to 100 points) and 94 points (range, 60 to 100 points), respectively ($p=0.823$). The mean Knee Society functional scores were 71 points (range, 15 to 100 points) for the cruciate-retaining group and 73 points (range, 32 to 100 points) for the posterior-stabilized group ($p=0.565$). The mean ranges of motion were 125° (range, 100 to 140°) for the cruciate-retaining group and 118° (range, 87 to 135°) for the posterior-stabilized group. Figures 1 and 2 show examples of the two implants.

There were two incidents of postoperative knee pain in the cruciate-retaining group, but no revisions or re-operations in either group. Two 65 year old men who received cruciate-retaining prostheses began having per-

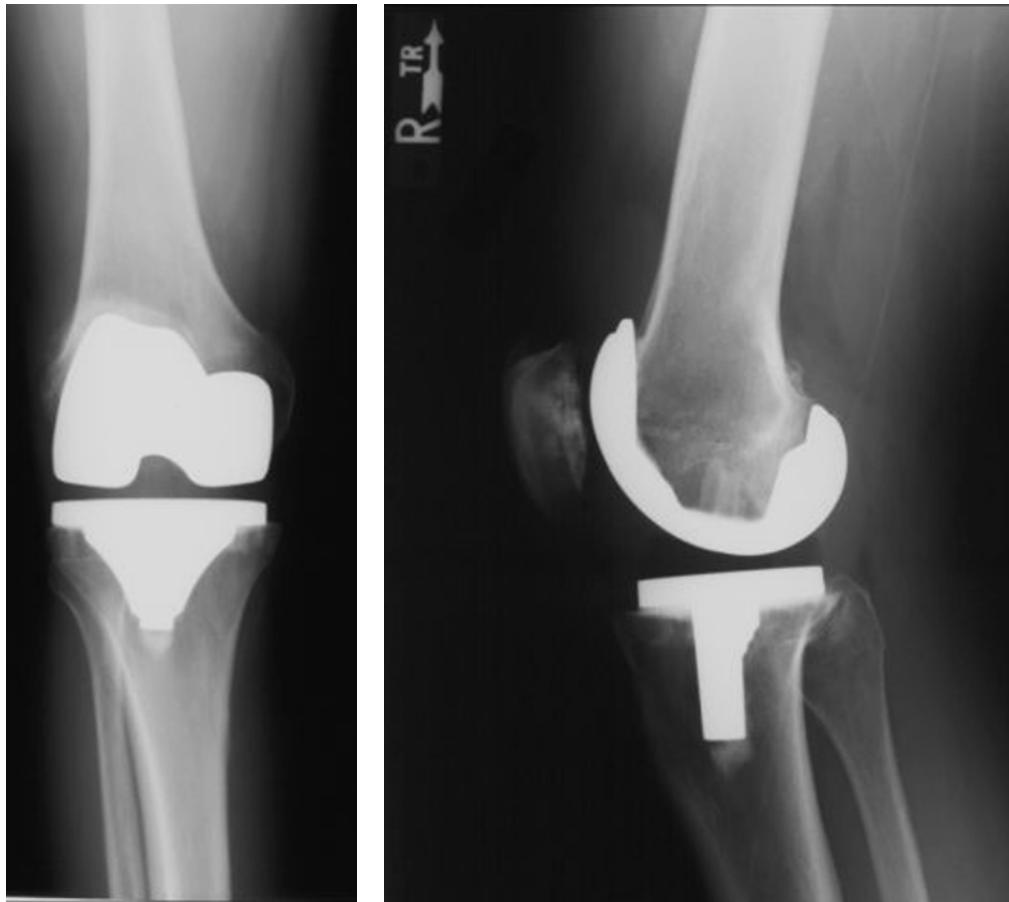


Figure 2. Anteroposterior (A) and lateral (B) radiographs of the knee of a 52 year old woman who received a posterior-stabilized prosthesis.

sistent pain in the operative knees, at one year and five years after the surgery, respectively, with no radiologic or physical abnormalities, and they have both received adequate pain relief with analgesic medications. The Knee Society knee scores of the three patients were 55 and 68 points, and the Knee Society functional scores were 80, and 65 points at follow-up times of 59 and 60 months, respectively.

Assessment of radiographs revealed no radiolucencies that were longer than one millimeter, and no progression of radiolucencies. There was one incidence of lateral patellar tilt in a 71 year old man who received a cruciate-retaining prosthesis, but he was doing well clinically, with Knee Society knee and functional scores of 100 and 80 points, respectively, and he did not desire any treatment. No other radiographic abnormalities were seen.

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 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.

Several other studies have directly compared the two prosthetic designs, with mixed results. Maruyama et al.¹⁰ examined 20 patients who underwent bilateral total knee arthroplasties, with a posterior-stabilized implant in one knee and a cruciate-retaining implant in the other, and found that the clinical scores of the two implants were similar at follow-up times of 30 months, with greater flexion in the posterior-stabilized knees (131° versus 122°, $p < 0.05$). Yoshiya et al.⁷ performed a kinematic analysis of a cohort of 20 patients who underwent bilateral total knee arthroplasties with a posterior-stabilized implant in one knee and a cruciate-retaining implant in the other. The posterior-stabilized implant was more stable, with no anterior translation under weight-bearing conditions and femoral rollback with passive flexion, whereas, the cruciate-retaining prostheses did experience anterior femoral translation between 30° and 60° under weight-bearing conditions, indicating that the PCL might not be functioning. They also found a greater range of motion of the knees that had posterior-stabilized implants (131° ± 12° versus 121° ± 16°). Bolanos et al.¹⁷ examined 14 patients who had bilateral total knee replacements, with posterior-stabilized prosthesis in one knee and a cruciate-retaining prosthesis in the other knee, and found that Knee Society scores, isokinetic strength of the quadriceps and hamstring muscles, gait parameters, knee ranges of motion, and electromyographic waveforms during stair-climbing were similar for the two prostheses at a mean follow-up time of 98 months (range, 72 to 134 months). Tanzer et al.²⁰ examined two groups of 20 patients who were randomized to receive cruciate-retaining or posterior-stabilized implants and found no differences in Knee Society or radiographic scores at the two-year follow-up. The results of the present study support the previously-published data, by finding similar clinical scores in two larger patient cohorts, but in contrast to previous studies, it found that the cruciate-retaining knees had a significantly higher mean range of motion by 7°.

The present study shows a 100% survival rate of both posterior-substituting and cruciate-retaining knees at a mean follow-up time of 60 months (range, 48 to 69 months). The cruciate-retaining group had a slightly higher mean range of motion, in contrast to previous studies, which showed higher ranges of motion in posterior-stabilized knees, but this difference is likely not clinically important. The published evidence regarding PCL retention or substitution remains inconclusive, especially as some studies have found that the PCL appears to be nonfunctional in many patients who have

cruciate-retaining designs,^{7,21} and one study found no difference between a PCL-sacrificing and a PCL-substituting design. Kinematic and anatomic studies to elucidate the reasons for any differences between the two groups are indicated, and further follow-up will be 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.

CONFLICT OF INTEREST STATEMENT

Three of the authors (FRK, MAM, CLB) are consultants for Stryker Orthopaedics. The other authors have no external sources of support. No company has had any role in the study design; the data collection, analysis, and interpretation; the manuscript preparation; or the manuscript submission.

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