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No Difference in Recovery of Patient-Reported Outcome and Range of Motion between Cruciate Retaining and Posterior Stabilized Total Knee Arthroplasty: A Double-Blind Randomized Controlled Trial

Lennard G.H. van den Boom, MD[1] Reinoud W. Brouwer, MD, PhD[2] Inge van den Akker-Scheek, PhD[3] Inge H.F. Reininga, PhD[4] Astrid J. de Vries, PhD[2] Sita M.A. Bierma-Zeinstra, PhD[5,6] Jos J.A.M. van Raay, MD, PhD[2]

[1] Department of Orthopaedic Surgery, ETZ Hospital, Tilburg, the Netherlands
[2] Department of Orthopaedic Surgery, Martini Hospital, Groningen, the Netherlands
[3] Department of Orthopaedic Surgery, University Medical Centre Groningen, University of Groningen, Groningen, the Netherlands
[4] Department of Trauma Surgery, University Medical Centre Groningen, University of Groningen, Groningen, the Netherlands
[5] Department of Orthopaedic Surgery, Erasmus University Medical Centre, Rotterdam, the Netherlands
[6] Department of General Practice, Erasmus University Medical Centre, Rotterdam, the Netherlands

Address for correspondence Lennard G.H. van den Boom, MD, Department of Orthopaedic Surgery, ETZ Hospital, Dr Deelenlaan 5, 5042 AD Tilburg, the Netherlands (e-mail: lvdboom@hotmail.com).

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Abstract

Both from the perspective of the individual and from a socioeconomic point of view (e.g., return to work), it is important to have an insight into the potential differences in recovery between posterior cruciate ligament retaining (PCR) and posterior stabilized (PS) total knee arthroplasty (TKA) implants. The primary aim of this study was to compare the speed of recovery of patient-reported outcome between patients with a PCR and PS TKA during the first postoperative year. The secondary aim was to compare the effect on range of motion (ROM). In a randomized, double-blind, controlled, single-center trial, 120 adults diagnosed with osteoarthritis of the knee were randomized into either the PCR or PS group. Primary outcome was speed of recovery of patient-reported pain and function, measured with the Western Ontario and McMaster Universities osteoarthritis index (WOMAC), with a follow-up of 1 year. Main secondary outcome measure was ROM. A generalized estimating equations (GEE) analysis was used to assess whether there was a difference over time between groups ("*p*-value for interaction"). Between 2008 and 2011, 59 participants received a PCR TKA (mean age, 70.3 years [SD = 7.7]; mean body mass index [BMI], 30.5 kg/m^2 [SD = 5.4]) and 55 participants a PS TKA (mean age, 73.5 years [SD = 7.0]; mean BMI, 29.2 kg/m^2 [SD = 4.4]). Six patients (two PCR and four PS) were excluded because of early drop-out, so 114 patients (95%) were available for analysis. In between group difference for

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total WOMAC score was −1.3 (95% confidence interval [CI]: −5.6 to 3.1); *p*-value for interaction was 0.698. For ROM, in between group difference was 1.1 (95% CI: −2.6 to 4.7); *p*-value for interaction was 0.379. These results demonstrated that there are no differences in speed of recovery of WOMAC or ROM during the first postoperative year after PCR or PS TKA.

Total knee arthroplasty (TKA) is the end-stage treatment for knee osteoarthritis (OA) and has become one of the most commonly performed surgical procedures in the United States.[1] In Sweden, in 2015, among women and men between 80 and 85 years old, 9% of the women and almost 7% of the men had at least one knee arthroplasty.[2] The recovery for a significant proportion of patients remains difficult and prolonged, and many never gain optimal functionality postoperatively.[3,4] This might have socioeconomic consequences like influence on self-reliance in older patients and on return to work in younger patients. Moreover, a substantial number of patients have unfulfilled expectations. These need more attention in preoperative patient information and education.[5] Nevertheless, also different surgery techniques might have influence on outcome.

The native knee has two cruciate ligaments. During TKA surgery, the anterior cruciate ligament (ACL) usually is routinely sacrificed. The posterior cruciate ligament (PCL) can either be retained or sacrificed by the surgeon. When the PCL is retained (PCR), natural movements of the knee are maintained, while preserving stability from extension to flexion.[6,7] When sacrificed, the posterior stabilized (PS) design is most commonly used to secure anteroposterior (AP) stability.

The debate among orthopaedic surgeons whether to retain or sacrifice the PCL during TKA surgery is ongoing. An updated systematic Cochrane review and a recent meta-analysis showed a statistically significant difference in range of motion (ROM) of the knee and in the Knee Society functional score in favor of a PCL-sacrificing TKA.[8,9] Those differences were clinically not relevant and it would be more interesting to see whether patients experience differences during activities of daily life (ADL) after implantation of a posterior cruciate ligament retaining (PCR) or a PS TKA. Moreover, none of the studies examined the speed of recovery after TKA surgery. In more recent years this has led to the use of patient-reported outcome measures (PROMs), such as the Western Ontario and McMaster Universities osteoarthritis index (WOMAC). As most studies only report on preoperative and final postoperative results (e.g., after 1 year), we were specifically interested in whether there are differences in speed of recovery of PROMs between patients receiving a PCR TKA versus PS TKA. The secondary aim was to investigate possible differences in ROM during the first postoperative year between the PCR and PS groups. Both from the perspective of the individual, as well as from a socioeconomic point of view (e.g., return to work), it is important to have insights into which TKA implant leads to a quicker recovery.

We, therefore, conducted a prospective, randomized study to compare patients implanted with a PCR TKA or a PS TKA for speed of recovery of patient-reported pain and function as measured with the WOMAC during the first postoperative year. We also examined whether there were differences in speed of recovery of ROM, health-related quality of life measured with the Short Form-36-Item Health Survey (SF-36) and functional outcome measured by the Knee Society score (KSS). As mentioned before, Cochrane review and recent meta-analysis both found a significant, though not clinically relevant, difference in functional score and ROM in favor of the PCL sacrificing TKA group; we hypothesized that speed of recovery would also be in favor of the PS group.

Materials and Methods

Study Design

A randomized controlled (RCT) trial was conducted in which patients received either a PCR or a PS TKA. The randomization procedure was based on sequentially numbered opaque sealed envelopes produced by an external institution. J.J.A.M.v.R. and R.W.B. performed the surgical procedure and block randomization took place 1 week before surgery. This study was approved by the local Medical Ethical Committee (registration number: 2007–23). The trial was registered in the Netherlands Trial Registry (NTR1673).

Study Population

The study was conducted at the Department of Orthopaedic Surgery of a large teaching hospital. Patients were included when the following inclusion criteria were met: nonfixed varus or valgus deformity less than 10 degrees, age between 55 and 85 years, body mass index (BMI) less than 37 kg/m^2 and American Society of Anesthesiologists (ASA) score I or II. Patients with secondary OA of the knee, rheumatic disease, flexion under 90 degrees, peripheral neuropathy, or a history of a cerebrovascular accident were excluded. Informed consent was obtained from all individual participants included in the study.

Intervention

The Anatomic Graduated Component (AGC; Biomet, Inc., Warsaw, IN) was used in the study; both the PCR and PS design have a fixed polyethylene (PE) tibial component with a durable cobalt chrome femoral component. Differences between the two designs are shown and further explained in ►**Fig. 1A** and **B**.

The patella was resurfaced when there was moderate to severe patellofemoral osteoarthritis present intraoperatively. In all other patients the patella was retained.

Before surgery, antibiotic prophylaxis with a first-generation cephalosporin was given and continued during the first 24 hours intravenously. The surgical procedure consisted of a midline skin-incision followed by an anteromedial arthrotomy of the joint capsule. All patients were treated with the same standardized protocol postoperatively in terms of analgesia, mobilization, physiotherapy, and prophylaxis against thrombosis.

Objectives and Measurements

Outcome assessments took place preoperatively and at 6 weeks, 3 months, 6 months, and 1 year postoperatively.

Primary outcome parameter was the patient-reported outcome, which was assessed with the WOMAC (0–100, higher score indicating less symptoms). The WOMAC is the most frequently used and recommended questionnaire to determine outcome after TKA.[10] The Dutch version has proven to be reliable and valid.[11]

Secondary outcome parameters are as follows: ROM was measured by two blinded outcome assessors (I.v.d.A.S., I.H.R.), skilled in the use of a goniometer and using standardized patient positioning to measure ROM of the knee. Physician-reported functional status was measured by the blinded outcome assessors with the validated Knee Society clinical rating system (KSS; 0–100, higher score indicating better functioning).[12] The SF-36 Health Survey Dutch-language version was used to assess the health-related quality of life (0–100, higher score indicating better health).[13]

Complications were registered. Both patient and outcomes assessors were blinded for the allocated intervention.

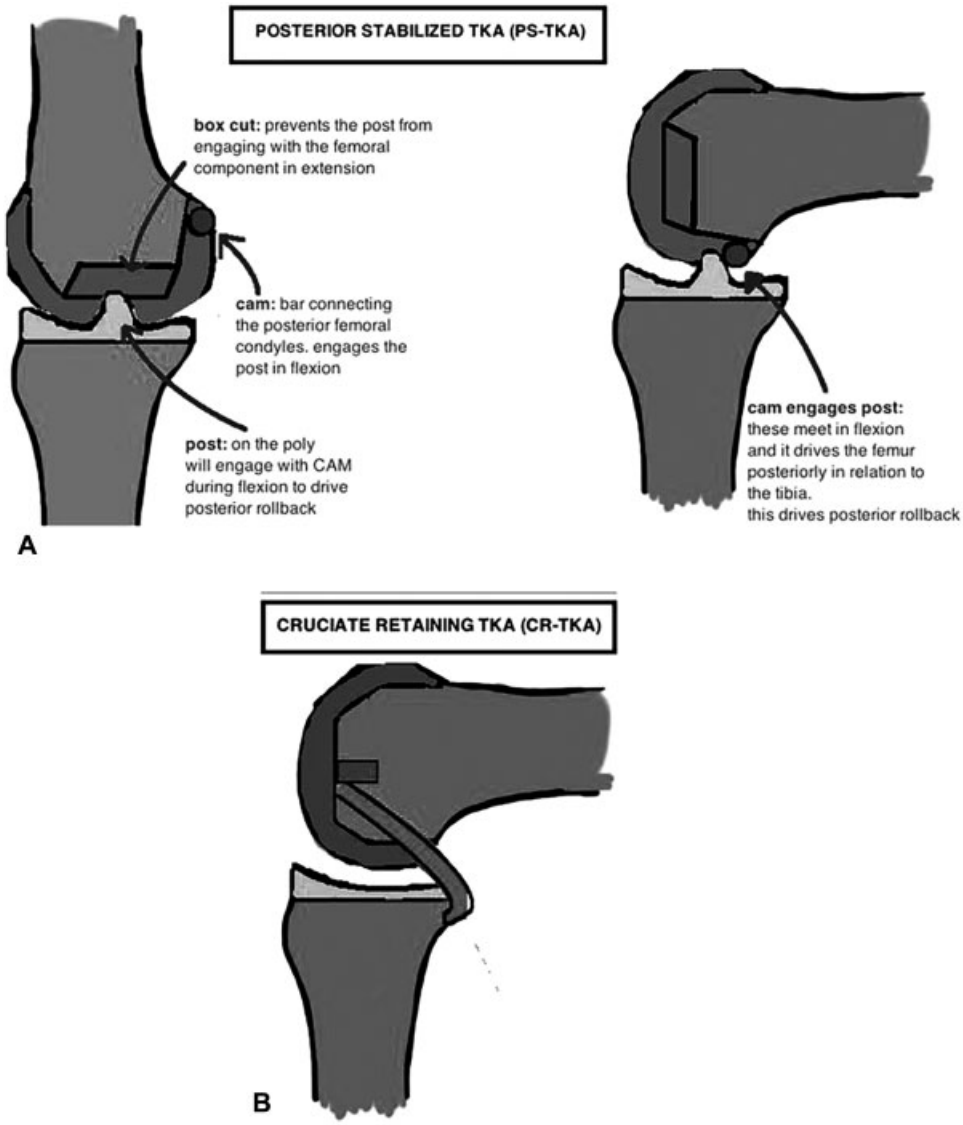

Fig. 1 The tibial component in the PS design consists of a high polyethylene "post" that connects with a cam in the femoral component: the PS TKA theoretically replaces the function of the PCL (**A**), the PCR design has a posterior cut-out for the PCL, and a relatively flat topography, using the native PCL to induce anteroposterior stabilization (**B**). PCL, posterior cruciate ligament; PCR, posterior cruciate ligament retaining; PS, posterior stabilized; TKA, total knee arthroplasty.

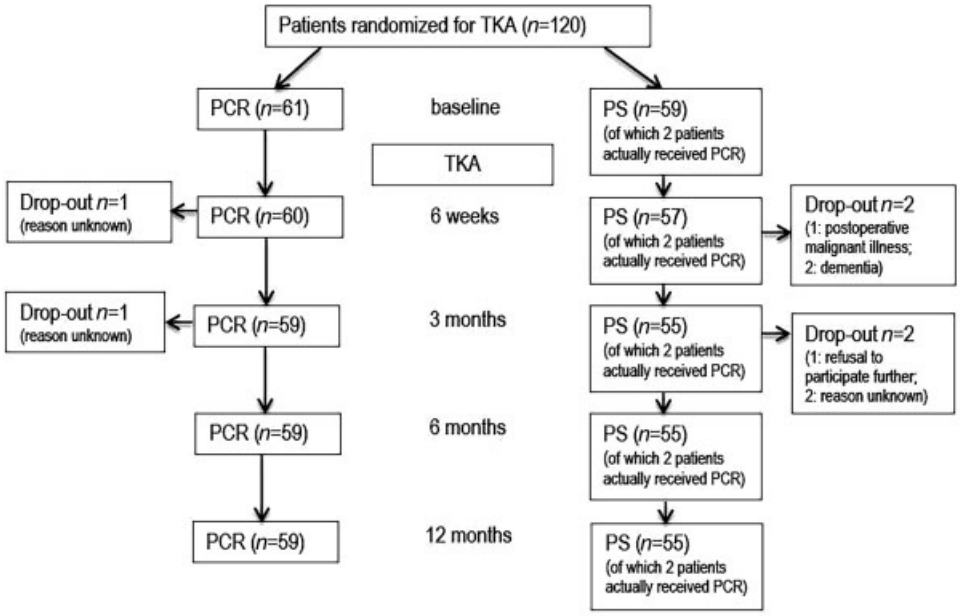

Fig. 2 Flow diagram of 120 TKAs. PCR, posterior cruciate ligament retaining; PS, posterior stabilized; TKA, total knee arthroplasty.

Sample Size

Sample size calculation was based on the primary outcome measure (WOMAC). A difference between the two groups of 15% of total WOMAC score in favor of the PS TKA was considered clinically relevant.[14] To detect such a difference with two-sided testing (standard deviation of 19.0 points, $\alpha = 0.05$, and power of 80%), 55 patients were needed in each group. With an estimated dropout of 10%, a total of 120 patients were needed. The design of this study was published before.[15]

Statistical Analysis

Descriptive statistics were used to present the patient characteristics and outcome variables of both groups at the five outcome assessments. To assess whether there was a difference between the PS and PCR groups on the primary and secondary outcome variables over time, generalized estimating equations (GEE) repeated-measures analyses were conducted. Structure of correlation was exchangeable. Time, group, and interaction (time × group) effects were reported; using this analysis, we were able to detect possible differences between the measured intervals irrespective of type of prosthesis (time effect) or time (group effect). To detect any differences in reported scores and data between the two groups over time, interaction was reported.

All analyses were conducted on an intention-to-treat basis, whereby patients are analyzed in the group to which they were originally allocated regardless of the treatment received. Analyses were conducted using SPSS version 22. A *p*-value of 0.05 was considered statistically significant.

Results

A total of 120 patients were randomized for the study, of which six patients dropped out. A flowchart can be found in ►**Fig. 2**. Baseline characteristics of 114 patients undergoing primary TKA are shown in ►**Table 1**. Two patients received a PCR TKA after being allocated to the PS group; for one patient, there was no appropriate component size available and for the other patient, the surgeon found the size of the knee too small to safely create a box for the PS-designed TKA. Those patients were analyzed in the allocated (PS) group. All other patients received the allocated treatment.

Primary Outcome Measure

As can be seen in ►**Table 2**, a significant difference in total WOMAC score was detected between the measured intervals over time, irrespective of type of prosthesis ($p < 0.001$ for time effect). No significant differences between the two groups were detected, irrespective of time ($p > 0.05$ for group effect). For interaction, $p > 0.05$, we found no significant difference between the two groups in WOMAC score

Table 1 Baseline characteristics of 114 patients undergoing primary TKA

	PCR ($n = 59$)	PS ($n = 55$)
Demographics		
Age (y)	70.3 (7.7)	73.5 (7.0)
BMI (kg/m^2)	30.5 (5.4)	29.2 (4.4)
Female/male	39 (66)/20 (34)	39 (71)/16 (29)
Surgical characteristics		
Resurfaced patella	10 (17)	12 (21)
Operating time (min)	52.3 (9.3)	62.9 (14.2)

Abbreviations: BMI, body mass index; PCR, posterior cruciate ligament retaining; PS, posterior stabilized; TKA, total knee arthroplasty.
Note: Values are given as means with standard deviation in parentheses except for resurfaced patella and gender (frequencies and percentages).

over time. In both groups, most of the improvement occurred within the first 6 postoperative weeks.

Secondary Outcome Measures

The results of the secondary outcome measures are presented in ►**Table 3**. A significant difference in ROM (including flexion and extension), SF-36 health dimensions and KSS score was detected between the measured intervals over time, irrespective of type of prosthesis ($p < 0.001$ for time effect). No significant differences between the two groups were detected, irrespective of time ($p > 0.05$ for group effect). For interaction, $p > 0.05$, there were no differences found between the two groups in either of the outcome measures over time. In both groups, there was a decrease in ROM compared with baseline at 6 weeks and an increase from 6 weeks to 1 year postoperatively. No statistically significant differences were seen between the preoperative and postoperative ROM in both groups. Extension deficits recovered after 1 year in both groups. For the SF-36 scores in both groups, the most improvement occurred within the first 3 postoperative months. The same holds for the KSS score, in both groups, the most improvement occurred within the first 3 postoperative months.

Side Effects and Complications

Postoperative complications occurred in 12 cases, eight cases from the PCR group and four from the PS group. Nine patients (seven from the PCR group and two from the PS group) had postoperative complications that required additional operations or treatments. The PCR group had four stiff knees (flexion under 90 degrees): one knee with severe or moderate anterior pain (AKP), one postoperative hemarthrosis, one superficial wound infection, and one that developed a fistula of the wound needing surgical excision. The PS group had one stiff knee and two knees with severe or moderate AKP. In one case, there was a posterior luxation of a PS TKA that needed surgical reduction. All stiff knees required manipulation under anesthesia. The PCR knee with AKP was required patellar resurfacing after the follow-up period of 1 year. No knees were excluded from our final analysis due to these complications.

Discussion

The present study primarily compared speed of recovery during the first postoperative year after PCR and PS TKA in terms of patient-reported pain and function, as measured with the WOMAC. No difference was found between the two designs in development of total WOMAC score over time, implying a similar speed of recovery of WOMAC score in both groups. ROM, KSS, and SF-36 scores showed no differences in development over time between the two groups either. Most studies only report on results in terms of real or possible differences in final outcome after TKA. To our knowledge, this study is the first RCT comparing the trajectory of patients

Table 2 Results of GEE-analyses of the WOMAC total, pain, and function score development over time between the PCR and PS groups

	PCR mean (95% CI)	PS mean (95% CI)	In between group differences (95% CI)	*p*-Value
WOMAC total (overall)	72.6 (69.2–76.0)	73.9 (71.0–76.6)	−1.3 (−5.6 to 3.1)	< 0.001 for time, 0.6 for group, 0.7 for interaction (group × time)
Preoperatively	49.4 (44.0–54.8)	49.8 (45.4–54.3)	−0.4 (−12.0 to 11.1)	
6 wk	73.5 (69.6–77.4)	75.1 (71.3–78.8)	−1.6 (−10.6 to 7.4)	
3 mo	78.2 (74.0–82.4)	77.5 (72.9–52.1)	0.7 (−9.6 to 11.1)	
6 mo	81.3 (77.1–85.5)	82.7 (79.2–86.3)	−1.4 (−10.6 to 7.7)	
1 y	80.6 (75.5–85.7)	84.2 (80.2–88.1)	−3.6 (−14.3 to 7.1)	
WOMAC pain (overall)	74.0 (70.4–77.6)	75.2 (72.5–78.0)	−1.2 (−5.8 to 3.3)	< 0.001 for time, 0.6 for group, 0.2 for interaction (group × time)
Preoperatively	47.9 (42.1–53.8)	49.5 (44.8–54.3)	−1.6 (−14.1 to 10.9)	
6 wk	72.4 (67.8–77.0)	74.3 (69.4–79.2)	−1.9 (−13.1 to 9.3)	
3 mo	81.6 (77.0–86.3)	77.2 (72.0–82.5)	4.4 (−7.2 to 16.0	
6 mo	84.2 (79.8–88.5)	86.9 (83.1–90.6)	−2.7 (−12.2 to 6.9)	
1 y	83.9 (78.7–89.2)	88.2 (84.6–91.9)	−4.1 (−13.5 to 5.4)	
WOMAC function (overall)	73.2 (69.7–76.6)	74.7 (71.9–77.5)	−1.5 (−6.0 to 2.9)	< 0.001 for time, 0.5 for group, 0.7 for interaction (group × time)
Preoperatively	50.5 (45.2–55.9)	50.1 (45.5–54.7)	0.4 (−11.4 to 12.2)	
6 wk	75.2 (71.3–79.0)	77.0 (73.4–80.6)	−1.8 (−10.6 to 7.0)	
3 mo	78.3 (74.0–82.5)	79.2 (74.8–83.6)	−0.9 (−11.1 to 9.2)	
6 mo	81.4 (77.1–85.7)	82.6 (79.0–86.1)	−1.2 (−10.5 to 8.1)	
1 y	80.4 (75.2–85.7)	84.6 (80.6–88.6)	−4.2 (−15.1 to 6.8)	

Abbreviations: CI, confidence interval; GEE, generalized estimating equations; PCR, posterior cruciate ligament retaining; PS, posterior stabilized; WOMAC, Western Ontario and McMaster Universities osteoarthritis questionnaire (range 0–100).

Table 3 Results of GEE-analyses of ROM development, including flexion and extension, the health dimensions of the SF-36 score and KSS score over time between the PCR and PS groups

	PCR mean (95% CI)	PS mean (95% CI)	In between group differences (95% CI)	*p*-Value
ROM (overall)	109.6 (106.9–112.2)	110.6 (108.1–113.1)	1.1 (−2.6 to 4.7)	< 0.001 for time, 0.6 for group, 0.4 for interaction (group × time)
Preoperatively	112.4 (108.1–116.7)	115.2 (111.1–119.3)	2.8 (−7.1 to 12.6)	
6 wk	99.5 (95.1–103.9)	99.3 (95.0–103.6)	−0.2 (−10.4 to 10.0)	
3 mo	108.3 (104.7–112.0)	106.9 (103.3–110.5)	−1.4 (−1.0 to 7.1)	
6 mo	112.1 (109.0–115.3)	114.7 (111.7–117.8)	2.6 (−4.6 to 9.8)	
1 y	115.4 (112.7–118.1)	117.0 (114.8–119.1)	1.5 (−4.2 to 7.3)	
Flexion (overall)	113.1 (110.6–115.6)	115.0 (112.7–117.3)	1.9 (−1.5 to 5.3)	< 0.001 for time, 0.3 for group, 0.4 for interaction (group × time)
Preoperatively	116.8 (113.2–120.4)	118.1 (114.4–121.8)	1.3 (−7.3 to 10.0)	
6 wk	105.6 (101.8–109.4)	106.8 (103.2–110.4)	1.2 (−7.6 to 10.0)	
3 mo	112.1 (108.6–115.5)	113.1 (109–8–116.3)	1.0 (−6.9 to 9.0)	
6 mo	114.2 (111.2–117.2)	118.2 (115.5–120.9)	4.0 (−2.7 to 10.7)	
1 y	116.8 (114.5–119.2)	118.9 (116.8–120.9)	2.0 (−3.1 to 7.2)	
Extension (overall)	−3.6 (−4.5 to −2.6)	−4.4 (−5.4 to −3.4)	−0.9 (−2.2 to 0.5)	< 0.001 for time, 0.2 for group, 0.1 for interaction (group × time)
Preoperatively	−4.5 (−6.1 to −2.8)	−3.0 (−4.5 to −1.5)	1.5 (-2.2 to 5.2)	
6 wk	−6.1 (−8.0 to −4.2)	−7.4 (−9.2 to − 5.7)	−1.3 (−5.6 to 3.0)	
3 mo	−3.8 (−5.2 to −2.3)	−6.2 (−7.9 to −4.4)	−2.4 (−6.2 to 1.4)	
6 mo	−2.1 (−3.1 to −1.0)	−3.5 (−4.8 to − 2.2)	−1.4 (-4.2 to 1.4)	
1 y	−1.4 (−2.4 to −0.5)	−1.9 (−3.0 to −0.9)	−0.5 (−2.9 to 1.8)	
SF-36				
Physical function (overall)	54.6 (50.3–58.9)	52.7 (48.8–56.5)	1.9 (−3.9 to 7.7)	< 0.001 for time, 0.5 for group, 0.4 for interaction (group × time)
Preoperatively	37.5 (30.7–44.2)	33.2 (27.6–38.9)	4.2 (−10.4 to 18.8)	
6 wk	49.1 (43.5–54.8)	48.4 (43.7–53.1)	0.8 (−11.5 to 13.0)	
3 mo	60.4 (54.9–65.9)	54.8 (48.7–60.9)	5.5 (−8.1 to 19.2)	
6 mo	63.4 (56.7–70.0)	61.0 (54.7–67.3)	2.4 (−12.8 to 17.5)	
1 y	62.7 (55.3–70.0)	65.8 (59.6–72.0)	−3.1 (−19.1 to 12.8)	
Role-physical (overall)	44.6 (37.4–51.8)	43.4 (36.2–50.6)	1.2 (−9.0 to 11.4)	< 0.001 for time, 0.8 for group, 0.3 for interaction (group × time)
Preoperatively	24.1 (12.1–36.0)	20.0 (10.0–30.1)	4.0 (−21.9 to 30.0)	
6 wk	25.9 (16.0–35.7)	15.8 (7.3–24.2)	10.1 (−11.5 to 31.7)	
3 mo	61.6 (50.1–73.0)	72.0 (61.0–82.9)	1.6 (−28.3 to 31.5)	
6 mo	61.6 (50.1–73.0)	72.0 (61.0–82.9)	−10.4 (−36.8 to 16.0)	
1 y	67.3 (55.1–79.5)	66.7 (54.5–78.8)	0.6 (−28.1 to 29.3)	
Bodily pain (overall)	64.5 (60.2–68.8)	63.8 (59.6–67.9)	0.7 (−5.3 to 6.8)	< 0.001 for time, 0.8 for group, 0.1 for interaction (group × time)
Preoperatively	45.1 (38.2–52.0)	43.2 (37.8–48.5)	1.9 (−12.6 to 16.5)	
6 wk	56.0 (50.1–61.9)	51.4 (45.5–57.1)	4.7 (−9.1 to 18.5)	
3 months	70.6 (64.9–76.3)	65.4 (59.4–71.3)	5.2 (−8.5 to 18.9)	
6 mo	75.8 (69.8–81.8)	78.4 (73.3–83.6)	−2.6 (−15.8 to 10.5)	
1 y	75.1 (68.0–82.1)	80.5 (74.9–86.0)	−5.4 (−20.4 to 9.6)	
General health (overall)	69.4 (65.9–73.0)	68.4 (63.9–72.9)	1.0 (−4.7 to 6.7)	0.5 for time, 0.7 for group, 1.0 for interaction (group × time)
Preoperatively	68.7 (64.7–72.8)	68.0 (62.7–73.3)	0.7 (−10.4 to 11.9)	
6 wk	68.8 (63.8–73.7)	67.2 (62.1–72.3)	1.6 (−10.3 to 13.4)	
3 mo	70.6 (66.3–75.0)	70.6 (65.1–76.2)	0.0 (−11.7 to 11.7)	
6 mo	70.1 (65.1–75.1)	67.7 (61.9–73.6)	2.4 (−10.4 to 15.2)	
1 y	68.9 (64.0–73.8)	68.4 (63.0–73.8)	0.5 (−11.6 to 12.6)	

Table 3 (*Continued*)

	PCR mean (95% CI)	PS mean (95% CI)	In between group differences (95% CI)	*p*-Value
KSS total (overall)	69.5 (66.8–72.1)	67.5 (64.7–70.3)	2.0 (−1.9 to 5.9)	< 0.001 for time, 0.3 for group, 0.1 for interaction (group × time)
Preoperatively	51.5 (47.5–55.6)	46.1 (41.6–50.6)	5.4 (−4.6 to 15.5)	
6 wk	63.8 (60.0–67.6)	62.5 (58.5–66.4)	1.3 (−7.7 to 10.4)	
3 mo	75.3 (72.4–78.3)	71.6 (67.8–75.4)	3.8 (−4.2 to 11.8)	
6 mo	78.1 (74.7–81.5)	77.6 (74.5–80.7)	0.5 (−7.2 to 8.2)	
1 y	78.5 (74.1–83.0)	79.8 (76.0–83.6)	−1.2 (−11.0 to 8.5)	

Abbreviations: CI, confidence interval; KSS, Knee Society clinical rating system (0–100); PCR, posterior cruciate ligament retaining; PS, posterior stabilized; ROM, range of motion; SF-36, Short Form Health Survey questionnaire (0–100).

over time and the speed at which they recover during the 1st year after implantation of a PCR or PS TKA.

Strengths of the present study are the blinded patient and blinded examiners, who were not involved in the clinical care of the patient and was not aware of group allocation. We adequately described study participants, surgical interventions (e.g., patellar resurfacing), and postoperative practice. In the present study, one AGC design is compared with another design of the same implant, thus minimizing the variables between the two groups of patients and enhancing reproducibility, especially with respect to surgical technique and materials used. In our hospital, this prosthesis has good results by 13 to 20 years after surgery.[16,17] This implant has been in use since 1983, with 95 to 98% survivorship worldwide, at 15 years. Several AGC studies have demonstrated these results.[18,19]

In the present study, mean KSS indicated good overall results in both groups. These results are in agreement with similar studies comparing PCR with PS TKA designs.[20,21] However, our results do not support the suggestion described in an updated systematic Cochrane review and a recent meta-analysis that ROM of the knee is improved by the use of a cruciate-substituting TKA design.[8,9] Criticisms addressed by the latter reviews are that the study findings were heterogeneous and the included studies lacked methodological quality. In the current study, we believed to have anticipated on these issues because of the clear description of randomization, blinded assessment of outcomes, and a priori sample size calculation based on the primary outcome measure (WOMAC). Moreover, several RCTs comparing PCR with PS TKA and having the WOMAC score as outcome variable focused mainly on final outcome instead of determining speed of recovery of ROM at several postoperative assessment points.[20–23] In this respect, it is interesting to observe that in the present study, WOMAC scores showed the most improvement at 6 weeks postoperatively, and SF-36 and KSS both at 3 months postoperatively, whereas ROM decreased during the first 6 postoperative weeks and was only higher compared with baseline at 1-year postoperatively in both groups. No statistically significant differences were seen between the preoperative and postoperative ROM in both groups, suggesting that preoperative ROM is an important predictor for postoperative ROM, supporting results of previous studies.[24]

In the present study, all SF-36 health dimensions showed a significant difference over time, irrespective of prosthesis type, except for general health. A reason for this observation might be that preoperative scores for general health perception were already high in both groups compared with the scores 1-year postoperatively. Moreover, equally high-preoperative scores in both groups show that our patients score well on general health perception despite symptomatic osteoarthritis of the knee. This latter finding might be related to the strict inclusion criteria; only ASA score I and II patients, patients who are relatively healthy, were included.

Complications were evaluated to assess implant safety. There were four stiff knees in the PCR group and one in the PS group. All required manipulation. The reason for this difference is not clear, but one study reporting similar findings suggests that a possible explanation may be related to differentiate in knee kinematics between the two types of implants. They state that, because of the design modification in the PS TKA, knee kinematics are preserved by replication of the PCL function.[18] On the contrary, Pandit et al raised the question whether substituting the PCL by a PS design really is such a strong determinant of knee joint kinematics. They suggested that surface geometry of the implant is a stronger determinant than the presence or absence of a PS design.[25] As already stated in the introduction, it is important to have insights into which TKA implant leads to a quicker recovery. Therefore, future research might focus on patients who are younger, more active, and demanding, that is, loading the knee implant more and heavier. Design changes that might be in favor of ROM by mimicking native knee mechanics better, might be noticed earlier by those more active patients, and subsequently lead to different results in this specific patient category.

Conclusion

In conclusion, the present study showed no differences in speed of recovery as reported by the patient (WOMAC) or in ROM between the two designs during the 1st year after TKA. The same was observed for health-related quality of life (SF-36) and

functional outcome (KSS). In both groups, the most improvement occurred in the first 6 postoperative weeks for WOMAC and in the first 3 postoperative months for SF-36 and KSS.

Conflict of Interest

S.M.A.B.Z. reports personal fees from Osteoarthritis and Cartilage, personal fees from Infirst Healthcare, grants from European union, the Netherlands Organisation for Health Research and Development, Dutch Arthritis Foundation, CZ, Nuts Ohra, Stichting Coolsingel, outside the submitted work.

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