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Original Article

PCL-retaining versus PCL-substituting TKR – Outcome assessment based on the “forgotten joint score”

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ABSTRACT

Background: Posterior cruciate ligament (PCL) retention or sacrifice figures prominently among the current controversies in total knee arthroplasty (TKA). Even though biomechanical advantages and disadvantages have been claimed for each type of TKA, clinical studies have not shown significant differences in the outcomes.

Methods: In this retrospective study, the recently introduced “forgotten joint score” (FJS) was used to assess whether any differences exist between the two types of total knee replacement (TKR). FJ scores of 169 patients with PCL-retaining TKA and 178 patients with PCL sacrificing were obtained. The mean follow-up period was 3.5 years and the minimum follow-up period was 2.5 years.

Results: Both groups showed high FJ scores indicating that majority of the patients were oblivious to the presence of the artificial joint during daily activities. There was no statistically significant difference between the mean FJ scores of the two groups. Scores of subsets based on gender, age and unilateral and bilateral TKR also did not show significant differences.

Conclusions: Since there are no clinically important differences between the two types of TKR, the choice of the TKA should be based on surgeon preferences and training and local conditions of the knee. Patient-reported outcomes appear to be similar regardless of the choice of TKA. Further prospective studies and validation of FJS outcomes with those of other questionnaires are essential to confirm the absence of differences between PCL retention and sacrifice.

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1. Introduction

Total knee arthroplasty (TKA) is one of the most widely performed joint replacement operations, and seems to have overtaken total hip replacement in terms of volumes of procedures performed.¹ Controversies that figure prominently in the total knee arthroplasty debate are the issues of retention/sacrifice of the posterior cruciate ligament and resurfacing/non re-surfacing of the patella.² The body of evidence available in the current literature does not support the superiority of one option over the other. The choice is therefore dependent on the preference of the surgeon and the individual conviction of the surgeon towards these issues.

PCL-retaining designs have been shown to be associated with a limited increase in the range of flexion (in comparison with PCL-substituting designs) in certain studies,^{3–6} while no such increase in flexion has been found by others.^{7–9} Studies which have found increase in flexion have attributed it to higher femoral roll back in PCL-retaining designs. The increased roll back is also said to increase the quadriceps lever arm and the power of extension.¹⁰ Proprioceptive function is said to be better with PCL retention. However, these so-called biomechanical advantages have not translated into observable improvements in clinical outcomes.⁶ One of the problems of PCL retention is that the retained PCL is of improper tension and is often too attenuated to be considered functional.^{3,11} It also restricts access to the posterior knee, especially with higher degrees of flexion deformity. If the PCL is tight, contact stresses on the polyethylene insert are more and thus, the wear of the PE is also increased.¹² A tight PCL may cause a paradoxical roll forward instead of roll back of the femoral condyle.¹³ Problems reported with PCL-substituting designs include the need for additional bone resection to accommodate the cam-post design, and also higher degree of wear at the cam-post interface.^{2,14}

The “forgotten joint score” (FJS) was published by Behrend et al. in 2012, as a method of assessing the “patient’s ability to forget the artificial joint in everyday life”.¹⁵ It includes 12 questions that test the patient’s forgetfulness of the joint during the following activities of daily living – in bed at night; sitting in a chair (>1 hr); walking (>15 min); taking bath; travelling in a car; climbing stairs; walking on uneven ground; standing up from a low-sitting position; standing for long periods of time; doing housework or gardening; taking a walk or hiking; and involving in sporting activity. It has been claimed to have high internal consistency and low ceiling effects and good ability to discriminate between various degrees of good outcomes. Higher degree of forgetfulness means that the patient ceases to think about the presence of artificial knee during activities of daily living. A computer adaptive test (CAT) version of the FJS has also been developed.¹⁶ The aim of the present study was to assess which of the two techniques (PCL-retaining and PCL-sacrificing) was associated with higher degree of forgetfulness of the implant. Unlike other patient-reported outcome measures, FJS provides insight into the degree of “acceptance” of the prosthesis in the mind of the recipient. It rests on the premise that a well-functioning, trouble-free prosthesis is “internalized” as a natural and healthy part of the body, whose existence is

“forgotten” in the minds of the recipients during their activities of daily living. It is thus relevant when differences between PCL-retaining and PCL-sacrificing designs of TKR implants are assessed (to assess whether the presence or absence of PCL affects the perception of these implants by the patients).

2. Patients and methods

This was a retrospective study that compared the outcomes of two different types of total knee arthroplasties using the FJS questionnaire. A total of 213 patients underwent primary total knee arthroplasty using PCL-retaining technique (group 1). During the same period of time, 255 patients underwent primary total knee arthroplasty using the posterior-stabilized (PCL-sacrificing) technique (group 2). The patients were operated during the period from January 2010 to November 2012. Patients with degenerative osteoarthritis of the knee joint, who underwent primary total knee replacement were included in the study. Patients with rheumatoid arthritis, post-traumatic arthritis and other uncommon causes of arthritis of the knee, and patients undergoing revision knee arthroplasties, were excluded from the study. Following exclusion of these patients, there were 191 patients in the PCL-retaining group and 221 patients in the posterior-stabilized/patella-resurfacing group. Both groups of patients underwent cemented total knee arthroplasty using the PFC[®] prostheses (DePuy Inc., USA). The post-operative protocol was similar in both groups of patients. The mean follow-up period was 3.5 years and the minimum follow-up period was 2.8 years.

Patients were assessed using the FJS questionnaire. The FJS consists of a set of 12 items that question the patient regarding the awareness of the artificial joint during various daily activities. The responses are scored from 0 to 4 points. The final scores of the FJS were calculated according to the method described by Behrend et al.¹⁵ Higher scores indicate higher degrees of lack of awareness of the presence of the artificial joint. The questionnaire was mailed to the patients who were also contacted over the telephone to explain the questionnaire. A total of 169 patients in the PCL-retention group and 178 patients in the PS group returned the questionnaire.

Data analysis was done with the help of a computer using “Epidemiological Information Package” (EPI 2010) developed by Centre for Disease Control, Atlanta. Paired ‘t’ test was used to test the significance of difference between quantitative variables and Yate’s and Fisher’s chi-square tests for qualitative variables. A “p” value less than 0.05 is taken to denote a significant relationship. Post hoc power analysis was performed to ascertain the effect of type 2 error. The analysis determined that at least 136 patients are required in each group for the post hoc power analysis to approximate the value of 0.8. The number of patients in both groups were higher than 136 (169 in group 1 and 178 in group 2).

3. Results

There were 50 male (29.6%) and 119 female (70.4%) patients in group 1 compared with 66 male (37.07%) and 112 female

Table 1 – Forgotten joint scores of the two groups.

Forgotten joint score	Group 1 (n = 162) (PCL retaining)		Group 2 (n = 174) (PCL substituting)		p
	Mean	S.D.	Mean	S.D.	
Whole group	94.2	3.6	91.4	9.4	0.14
Male patients	94.7	2.5	90.7	11.7	0.12
Female patients	92.7	4.1	92.4	7.5	0.69
Less than 65 years	93.3	2.8	91.6	9.6	0.13
More than 65 years	93.8	5.3	94.8	6.6	0.44
Unilateral TKR	94.4	2.6	92.2	5.8	0.27
Bilateral TKR	92.3	5.9	91.6	7.9	0.75

(62.93%) patients in group 2. The mean age was 64.5 years in group 1 patients and 62.3 years in group 2 patients. A total of 118 patients (69.8%) had unilateral TKR and 51 patients (30.2%) had bilateral TKR in group 1 compared with 114 (64%) unilateral and 64 (36%) bilateral TKR in group 2. There was no statistically significant difference between the two groups with respect to age ($p = 0.14$) and sex ($p = 0.13$) distribution, and unilaterality or bilaterality of the procedures ($p = 0.21$).

The mean FJS in group 1 patients was 94.3 and the mean FJS in group 2 patients was 92.5, and the difference was not statistically significant ($p = 0.14$). The FJ scores were analysed separately for male and female patients in the two groups and no statistically significant difference was found between the FJS of males and females in the two groups (Table 1). The FJ scores were also analysed in the age groups below 65 years and above 65 years in the groups 1 and 2. There was no statistically significant difference between the FJ scores in patients below the age of 65 years and above the age of 65 years in the two groups. The FJ scores were analysed separately for unilateral and bilateral TKRs in the two groups and once again, there was no statistically significant difference between patients with unilateral TKR and bilateral TKR in the two groups.

4. Discussion

PCL-retaining TKA is said to be more physiological in terms of the range of flexion and femoral roll back. However, proponents of PCL-substitution design of TKA claim that these so-called advantages are not always realized in practice due to the excessive tightness or looseness of the retained PCL and loss of 4-bar linkage following removal of Anterior cruciate ligament (ACL) (PCL cannot function well in isolation). Criticisms against posterior-stabilized implants used following PCL sacrifice include excessive bone removal for implanting these implants and the polyethylene wear due to cam-post impingement. Certain studies have cast doubts on the need for posterior-stabilized implant designs. Misra et al. and Ritter et al. have studied patients who underwent inadvertent partial or full release of the PCL followed by posterior cruciate ligament-retaining TKA (the prosthesis was not changed to posterior-stabilized implant even after the PCL recession). The clinical outcomes in these patients have also been good with no major adverse consequences.^{8,17} Surface geometry of the TKR design is perhaps more important for range of movement than PCL retention or sacrifice.^{18,19} Presently no difference has

been detected between the cruciate-retaining and cruciate-substituting designs in terms of stair climbing, proprioception, range of flexion and gait.^{20,21} A 10-year survival of both posterior-substituting and PCL-retaining designs used for primary TKA is more than 90%.²²

The FJS has been shown to have high discriminatory power, especially in patients with high scores on performance tests. Independent assessments by other authors have confirmed that FJS has high construct validity and test-retest reliability. It has been shown to have better test-retest reliability than the Oxford Knee Score and lesser ceiling effects than WOMAC and KOOS scores.^{23,24} The FJS has been used earlier to evaluate different types of knee arthroplasty – unicompartmental, patello-femoral and total knee arthroplasty.²⁵ Evaluation of patients undergoing cruciate-retaining and cruciate-sacrificing TKR using the FJS has not been reported earlier. We have compared the "forgetfulness" of the joint when these variations of TKR were employed. In our study there were no statistically significant differences between the mean FJS of patients who had cruciate retaining and cruciate sacrificing TKR. Even when the results were further analysed according to the gender of the patients, age group (above or below 65 years) and laterality of the TKA (unilateral or bilateral), there were no significant differences between the two groups.

Even though proprioceptive function, range of flexion and quadriceps moment are claimed to be better with PCL retention, the impact of these advantages has not been demonstrated clinically and our study using the FJS confirms the results of earlier comparisons that showed no significant functional differences between PCL-retaining and PCL-sacrificing TKA. The FJS is high in both PCL-retaining and PCL-sacrificing TKA and the similarity of the FJS in the two groups is maintained even when the results are analysed with respect to the gender, age group and laterality of TKA. Since a variety of outcome measurement instruments, including the FJS in the present study, have shown no significant differences in the outcomes between PCL retention and PCL sacrifice, the choice of the procedure should be based on considerations other than functional improvement. These include preference and training of the surgeon and local conditions in the individual joint. The PCL may be sacrificed without hesitation in the presence of significant deformity and tight joint space.

There are certain limitations to this study. It is retrospective in nature and comparison of pre-operative and post-operative scores in each subgroup was not possible. The dropout rate from the study was 11.5% in the PCL-retention group and 19.5% in the PCL-sacrifice group. However, the number of patients who responded in each group was more than the numbers required in the power analysis. There are confounding factors present, such as surgical experience and training with the type of implant used. Prospective studies that include these factors are required for further validation of these outcomes. In the recently published systematic review by Verra et al., around 20 studies that compared PCL retention and sacrifice have been analysed and these studies utilized previously validated questionnaires such as the WOMAC, KSS (Knee Society Score), HSS (Hospital for Special Surgery) score and SF-12. The authors found no significant clinically relevant differences between PCL retention and sacrifice. The present study that utilized the FJS substantiates the outcomes of earlier studies. It also shows

that in addition to lack of differences in functional outcomes shown by earlier studies, there are also no differences in the "perception" or "feel" of the replaced joint in the minds of the recipients (regardless of PCL retention or sacrifice).

5. Conclusions

Our study using the recently developed FJS confirms the findings of earlier studies that there is no significant difference in the patient-reported outcome measures between PCL-retaining and PCL-substituting TKA. Patients seem to be oblivious to the presence of the replaced joint regardless of PCL retention or sacrifice. Thus, the choice of the procedure depends more on the preferences and training of the surgeon and local conditions of the diseased joint and not on the outcomes in the patients.

Conflicts of interest

All authors have none to declare.

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