



Midterm outcomes of posterior cruciate ligament substituting total knee arthroplasty

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Abstract

Aim: In the present study, it is aimed to retrospectively investigate and present the midterm results of the cases with posterior cruciate ligament (PCL) substituting total knee arthroplasty.

Materials and Methods: In this study, we included a total of 61 patients with 80 knees who underwent PCL-substituting total knee arthroplasty between July 2006 and June 2012.

Results: 52 patients were female and 9 were male. The mean age of patients was 65.4 (42-85) years and the mean follow up period was 32.6 (12-72) months. Patients were evaluated according to the American Knee Society Score for knee score and knee functional score. Radiological evaluation was performed according to Total Knee Arthroplasty Radiological Evaluation criteria. Knee score was 38-71 (mean 43.7) prior to the surgery and 78-100 (mean 95) subsequently. 69 knee (86,25%) had perfect knee scores and 11 knee (13,75%) had good scores. Functional score was 10-60 (mean 35,08) prior to the surgery and 60-100 (mean 82,2) subsequently. In the evaluation according to the functional knee score, we obtained perfect results in 45 knee (56,25%) and good results in 29 knees (36,25%) and moderate results in 6 knees (7,5%). Patients had a mean 9,7o varus (8o valgus – 20o varus) prior to the surgery and mean 4,75o valgus (2o varus – 10o valgus) alignment was obtained subsequently to surgery. In 1 case revision arthroplasty was performed due to late deep infection. In 1 case insert replacement was performed due to insert fracture due to trauma. As a result of our PCL substituting total knee arthroplasty applications, we obtained 86,25%perfect knee score and 56,25%perfect functional score.

Conclusion: PCL substituting total knee arthroplasty is a favorable orthopedic surgical intervention when performed with adequate preoperative preparations and cautious surgical techniques with appropriate patient choice.



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Introduction

Degenerative changes that occur in the knee joint due to various reasons cause pain and limitation of movement, resulting in a decrease in quality of life. In cases where other treatment options are inadequate, arthroplasty is a procedure frequently preferred and successfully performed by orthopedic surgeons. Total knee arthroplasty, which has a historical development of more than a century, is one of the most satisfactory results among orthopedic surgical procedures when performed in accordance with basic surgical principles. With advancements in prosthesis design and further improvements in surgical techniques, the number of applications is steadily increasing both worldwide and in our country [1, 2]. Due to the complex anatomical

structure and biomechanical characteristics of the knee, the development of knee prostheses has been slower and more challenging compared to hip prostheses. The long-term success of arthroplasty relies on achieving the normal longitudinal and rotational alignment of the lower extremity, thereby making the knee's transverse axis parallel to the ground. This ensures the normal distribution of forces across the joint [3]. An ideal prosthesis should allow for a range of motion close to normal, should not alter joint kinematics, and should maintain anatomical integrity. In addition to providing normal joint function, ensuring joint stability, which includes maintaining ligament balance, is essential for normal joint function [4, 5]. Accordingly in the present study, the aim of the study was to retrospectively examine cases that underwent posterior cruciate ligament-substituting total knee arthroplasty and present the intermediate-term results.

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Materials and Methods

A total number of 80 knees of 61 patients who referred to Gaziantep University Faculty of Medicine Orthopedics and Traumatology Clinic with the PCL – substituting total knee arthroplasty indications were enrolled. All surgeries were performed by the same surgeon. The sample size was determined through a Power analysis. Using G Power analysis, an effect size of 0.3 and a power of 0.87 were assumed, resulting in a calculated sample size of 80 for the study. A posterior cruciate ligament (PCL)- substituting type of prosthesis was used in all knees. Patellar joint surface replacement was not applied to any of the knees; however, in all cases, the patella was denervated using electrocautery. Approval for the study was obtained from Institutional Review Board of Gaziantep University in accordance with the Helsinki declarations (Protocol Number: 19.02.2013/70).

Scoring

The patients were evaluated according to the American Knee Society criteria. Pain, function, motion range of joint, flexion deformity, and instability were assessed using scoring systems. Preoperative and postoperative assessments were conducted using the same criteria. The Knee Society Score consists of two components: the knee score and the knee functional score. In the Knee Score, pain, motion range of joint, and stability in the anteroposterior and mediolateral planes are evaluated. Flexion contracture, extension deficit, and alignment deformity are parameters that negatively impact the knee score. In the Knee Functional Score, walking distance and stair climbing are evaluated. Using a cane, walker, or crutch are parameters that lower the functional score. The scoring results are evaluated as follows: below 60 points is considered poor, 60-69 points is moderate, 70-84 points is good, and 85-100 points is excellent.

Radiological evaluation

Radiological evaluation was conducted by measuring the alignment angles of the femoral and tibial components in the coronal and sagittal planes. In the AP radiograph, the β angle is measured, which is the angle between a line drawn parallel to the tibial component and the tibial axis (considered as 90°). In the lateral radiograph, the γ angle is measured, which is the angle between a line drawn perpendicular to the contact line of the distal femoral component and the cement and the femoral axis (midmedullary axis, considered as 0°). In the tibia lateral radiograph, the σ angle is measured, which is the angle between the anatomical medullary axis of the tibia and a line drawn parallel to the tibial component (considered as 90°). The Ω angle, representing the total valgus of the prosthesis in the AP radiograph, is calculated as the sum of β and α angles ($\Omega = \beta + \alpha$, where $\alpha = 180^\circ$). Radiolucent lines are examined in millimeters to assess the relationship between bone and the prosthesis, fixation quality, and signs of loosening. For the radiolucent area assessment, the tibial component is evaluated using both AP and lateral views, the femur is assessed only in the lateral view, and the patella is evaluated in the tangential position with radiographs. When evaluating radiolucent lines, ≤ 4 mm is considered

insignificant, 5-9 mm suggests progressive changes, and the possibility of loosening should be closely monitored, while ≥ 10 mm indicates an existing or potential deficiency, and progressive criteria for loosening should be considered.

Statistical analysis

In this study, SPSS and GraphPad Prism programs were used to analyze the data. The data of the patients are stated with descriptive statistics such as mean, standard deviation, median and frequency. P values lower than 0.05 was accepted statistically significant.

Results

Fifty-two of the patients were female, and 9 were male. Ages of the patients ranged from 42 to 85 years (mean 65.4 years). The average follow-up period was 32.6 months (12-72 months). Fifty-nine patients were operated on due to primary osteoarthritis, 1 patient due to rheumatoid arthritis, and 1 patient due to secondary osteoarthritis resulting from knee trauma. Out of 61 patients who underwent total knee arthroplasty, 19 of them were bilateral, 39 were on the left side, and 41 were on the right side. The second operation of bilateral procedures was performed in 4 patients 12 months later and in 15 patients during the same session. The prostheses used in patients who underwent total knee arthroplasty were as follows: Twenty-four knees with Smith Nephew® TDP, 20 knees with Evolutis® TDP, 16 knees with Omniapex® TDP, 16 knees

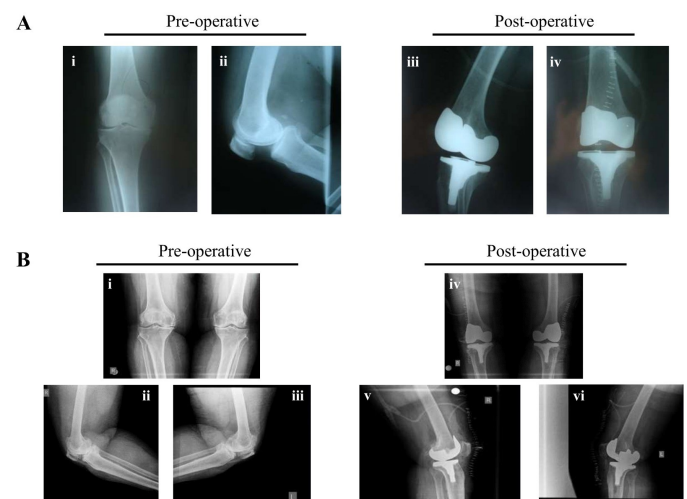


Figure 1. A 69-year-old female patient was diagnosed with bilateral gonarthrosis, and TKA was applied to her left knee in 2008. Her knee and functional score were found to be excellent in her 53-month follow-up. i-ii preoperative left knee radiographs, iii-iv postoperative left knee radiographs. B) A 60-year-old female patient was diagnosed with bilateral gonarthrosis and underwent bilateral FFP in the same session in 2009. At the 40-month follow-up, right and left knee and functional scores were found to be excellent. i-ii-iii preoperative right and left knee radiographs, iv-v-vi postoperative right and left knee radiographs.

Table 1. Evaluation characteristics of the patients in our study.

Evaluation criteria	Preoperative	Postoperative
Range of motion	40 ⁰ –105 ⁰	90 ⁰ –125 ⁰
Mean range of motion	77.1 ⁰	117.04 ⁰
Knee score	38–71	78–100
Mean knee score	43.7	95
Knee function score	10–60	60–100
Mean knee function score	35.08	82.2
Flexion contracture	0 ⁰ –35 ⁰	0 ⁰
Average flexion contracture	14.9 ⁰	0 ⁰
Alignment	20 ⁰ varus–8 ⁰ valgus	2 ⁰ varus–10 ⁰ valgus
Mean alignment	9.7 ⁰ varus	4.75valgus
Alfa (α) angle	–	89 ⁰ –99 ⁰
Beta (β) angle	–	86 ⁰ –92 ⁰
Sagittal femoral angle (γ)	–	0 ⁰ –11 ⁰
Sagittal tibial angle (δ)	–	84 ⁰ –92 ⁰
Femorotibial angle (Ω)	–	-1 ⁰ –11 ⁰

with Striker[®] TDP, and 4 knees with Baumer TDP. According to the evaluation conducted based on the Knee Society Total Knee Arthroplasty Evaluation Criteria, the knee score improved from a preoperative range of 38–71 (with an average of 43.7) to a postoperative range of 78–100 (with an average of 95). In the evaluation based on the knee score, excellent results were achieved in 69 knees (86.25%), while 11 knees (13.75%) had good outcomes. In the evaluation based on the knee function score, the knee function score improved from a preoperative range of 10–60 (with an average of 35.08) to a postoperative range of 60–100 (with an average of 82.2). In the evaluation based on the knee functional score, the results were as follows: 45 knees (56.25%) achieved excellent outcomes, 29 knees (36.25%) had good outcomes, and 6 knees (7.5%) had fair outcomes. The preoperative range of knee motion for the patients in our study varied between 40⁰ and 105⁰, with an average range of motion of 77.1⁰. After surgery, the range knee motion improved to a range of 90⁰–125⁰, with an average of 117.04⁰. In all our patients, the range of motion improved after surgery. The minimum postoperative joint range of motion was determined to be 90⁰, with a total of 3 patients exhibiting this level of improvement. Moreover, in the preoperative evaluations of our patients, flexion contracture was found to be between 0⁰ and 35⁰, with an average of 14.9⁰. There were no residual flexion contractures after surgery (Table 1). The radiological evaluation of our total knee arthroplasty procedures was conducted according to the Total Knee Arthroplasty Radiological Evaluation criteria. In the preoperative period, an average of 9.7⁰ varus (ranging from 8⁰ valgus to 20⁰ varus) alignment was identified. After surgery, an average of 4.75⁰ valgus alignment (ranging from 2⁰ varus to 10⁰ valgus) was achieved (Table 1). The compatibility of components was evaluated by measuring the alpha and beta alignment angles in the frontal plane and the sagittal femoral (gamma) and sagittal tibial (theta) angles in the sagittal plane. The average alpha angle was 93.4⁰ (ranging from 89⁰ to 99⁰), the average beta angle was 89.2⁰ (rang-

ing from 86⁰ to 92⁰), the average gamma angle was 4.3⁰ (ranging from 0⁰ to 11⁰), and the average theta angle was 88.3⁰ (ranging from 84⁰ to 92⁰) (Table 1). No lysis in the femoral component was observed in any of our patients. In two cases, a 2mm radiolucent area was detected at the medial corner of the tibial component. However, during follow-up, it was observed that these radiolucent areas did not progress. When evaluating prosthesis survival, after an average follow-up of 32.6 months (ranging from 12 to 72 months), the prosthesis survival rate was determined to be 98.75%.

Discussion

Degenerative disorders can lead to pain and restricted mobility, and in the management of these conditions, both conservative and surgical treatment methods can be employed [6]. Conservative treatment options for degenerative disorders may include anti-inflammatory therapy, physical therapy, and intra-articular injections. On the other hand, surgical interventions such as arthroscopic joint debridement, synovectomy, distal femoral osteotomy, and high tibial osteotomy can be considered as treatment options [7]. If these treatments fail, total knee arthroplasty is the most effective treatment modality to choose. The treatment modalities other than arthroplasty for alleviating complaints related to osteoarthritis still remain a subject of debate. Aichroth et al. [8] conducted a prospective randomized study in which they examined 254 patients with an average age of 49. Arthroscopic debridement was performed on these patients due to the presence of degenerative knee joint. They performed partial meniscectomy, cartilage abrasion arthroplasty, osteophyte, and loose body excision on selected knees as they deemed appropriate. After a 4-year follow-up, it was observed that 85% of the patients were satisfied with the treatment. Waciakowski et al. [9] evaluated 92 cases of high tibial osteotomy with an average age of 59.8 in their study. All patients had primary osteoarthritis. During surgery, they identified unicompartmental arthritis in 59 patients and multicompartamental arthritis in 66 patients. They observed that 80.4% of the patients had no complaints 10 years after osteotomy, while 30.4% had no complaints 15 years later. In today's world, with the increase in average life expectancy, the prosthetic survival after arthroplasty has become a matter of significant importance. In the study by Gill and Joshi [10], they reported a prosthesis survival rate of 96.3% at 15 years and 82% at 23 years for total knee arthroplasty with cement and preservation of the posterior cruciate ligament. Back et al. [11] reported a prosthesis survival rate of 99.05% in the average 5-year follow-up results of 369 patients. Abdel MP and colleagues [10] reported a prosthesis survival rate of 77% at 15 years in total knee arthroplasty with posterior cruciate ligament (PCL)- substitution in 2728 cases. Remarkably, in our study, following a 32.6-month follow-up period, prosthesis survival rate was determined to be 98.75% in patients subjected to the PCL-substituting total knee arthroplasty. Although our follow-up period may not be as long as in the extensive series mentioned here, in our case with the longest follow-up duration of 72 months, no issues related to the prosthesis were identified. Total knee arthroplasty

(TKA) due to primary osteoarthritis is predominantly performed in the elderly population, whereas patients operated on for secondary osteoarthritis related to conditions like traumatic arthritis and rheumatoid arthritis tend to comprise a relatively younger patient group. Total knee prostheses can be applied through unilateral, bilateral, or simultaneous bilateral surgery. The indications for simultaneous bilateral arthroplasty are widely documented in the literature and are the subject of ongoing discussion. Urban et al. [12] conducted a study on 462 patients with degenerative arthritis to investigate whether complications in simultaneous bilateral knee arthroplasty were more or less frequent than in unilateral knee prosthesis. They performed simultaneous knee replacement on 169 patients and unilateral knee replacement on 293 patients. From both groups, 122 individuals were matched for age, weight, and a history of ischemic heart disease and hypertension. As a result, they found that in the group undergoing simultaneous arthroplasty, there was a higher risk of fat embolism syndrome and cardiac arrhythmia. They also noted that there were no postoperative deaths in either group, and the incidence of serious complications was low and similar in both groups. Trojani et al. [13] conducted a study on single-stage bilateral knee prostheses. They evaluated 30 patients in the study group who had bilateral non-infectious gonarthropathy, a preoperative hemoglobin value of at least 13 mg/dl, and met the criteria for ASA-1 and ASA-2. The patients were followed up for an average of 18 months. They reported 3 cases of deep vein thrombosis, 1 case of a cardiopulmonary attack, and 3 cases of confusion. They reported that none of the patients experienced postoperative death, pulmonary embolism, nosocomial infection, or revision procedures. In conclusion, they stated that simultaneous bilateral knee arthroplasty is a reliable alternative to two-stage arthroplasty in ASA-1 and ASA-2 patients.

Conclusion

Consequently, in our study, simultaneous bilateral total knee arthroplasty surgery was performed. Since all of these patients were carefully selected with good medical conditions, and necessary precautions were taken against potential complications, there were no postoperative serious complications in our cases. Considering that the patient receives a single anesthesia, the total hospital stay is shorter, the overall cost is lower, and there is a shorter duration of physical therapy, we believe that simultaneous bi-

lateral knee prosthesis should be applied in selected cases. To address issues such as pain and limited motion range of joint resulting from degenerative disorders in the knee joint, Total Knee Arthroplasty (TKA) should be considered when conservative and certain surgical methods have proven unsuccessful.

Ethical approval

Approval for the study was obtained from Institutional Review Board of Gaziantep University in accordance with the Helsinki declarations (Protocol Number: 19.02.2013/70).

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