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Medial pivot total knee arthroplasty: Mid-term results

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This study aims to evaluate the mid-term results of patients who underwent medial pivot total knee arthroplasty at a single center. A total of 304 knees of 236 patients (40 males, 196 females; mean operation age and standard deviation : 66,64 ±7,09 years; range, 45 to 82 years) treated with medial pivot total knee prosthesis in our center between January 2010 and December 2014 were retrospectively analyzed. The American Knee Society Score, Oxford Knee Score, and especially flexion angles were recorded during pre- and postoperative follow-up. Of the operated knees, 71.2% were unilateral and 28.8% were bilateral. The mean follow-up was 79.30±14.76 months. The postoperative results with the Functional Score, Knee Score, Oxford Score, Total Knee Society Score, and flexion angles were significantly higher compared to baseline ($p<0.01$). All postoperative scores were significantly lower inpatients aged ≥65years, compared to those aged <65 years ($p<0.01$). In patients who underwent resection of anterior and posterior the cruciate ligaments, only the mean flexion angles were found to increase ($p<0.01$). Our study results suggest that medial pivot knee prostheses are reliable in the mid-term and provide favorable results in terms of function and patient satisfaction.

Keywords: medial pivot total knee prosthesis, maximum flexion angle, knee osteoarthritis.

Level of Evidence: Level IV retrospective study

INTRODUCTION

Total knee arthroplasty (TKA) is frequently used in advanced gonarthrosis that cannot be managed with non-invasive treatment options. Medial pivot knee prosthesis (MPTKP) is a type of knee prosthesis that simulates normal knee kinematics[1-2]. In previous studies investigating the kinematic features of the knee joint after TKA, paradoxical anterior-posterior translation was noticed in the femoral component[3,4]. This situation may cause instability in patients with TKA. In the light of literature data, MPTKP designs with better anterior-posterior stability have been introduced over time[5]. Unlike conventional prostheses, the femoral rollback mechanism is not visible in these designs. High anterior and posterior lips restrict the paradoxical anterior-posterior translation of the medial condyleand also enable better fitting with the medial condyle. Because of this design, it is thought that MPTKP designs can provide better stability which can increase range of motion (ROM)[5,6]. Increased stability leads to homogenous weight distribution, thereby reducing the wear on polyethylene materials[7]. The results of MPTKP are quite satisfactory[8], and many studies have reported rather high degrees of patient and physician satisfaction compared to other designs. In addition, the results reported with the use of radiological and functional scales and prosthesis survival rates underline the advantages of MPTKP compared to other prostheses[9-11].

The main goal of prosthesis application is to ensure normal kinematics and ROM of the joint. No consensus has been reached upon the type of prosthesis that completely fulfills these features, yet. Although initial results seem to be promising, the number of studies using MPTKP designs is quite limited and, therefore, mid- to long-term results are scarce. In the present study, we aimed to evaluate the mid-term results of patients who underwent surgery with MPTKP (Wright – MicroPort Advance®; Wright Medical Technology, Arlington, Tennessee, USA).

MATERIALS AND METHODS

This single-center, retrospective study was conducted at XXX Training and Research Hospital, Orthopedics and Traumatology outpatient clinic between January 2010 and December 2014. MPTKP was applied to a total of 328 patients during the study period. Among these, 32 were lost-to-follow-up for various reasons and 55 patients had missing data, as they did not attend to postoperative follow-up on a regular basis. The records of a total of 241 patients were examined. Five patients were excluded from the study, as revision was required due to the development of infective and aseptic loosening. Finally, a total of 304 knees of 236 patients (40 males, 196 females; mean operation age and standard deviation : 66,64 ±7,09 years; range, 45 to 82 years) were included in the study. The study flow chart is shown in Fig 1. A written informed consent was obtained from each patient. The study protocol was approved by the XXX Ethics Committee (Approval no:2019-23 Date: 11.04.2019) (MK's thesis). The study was conducted in accordance with the principles of the Declaration of Helsinki.

All operations were performed by a single surgeon (AG). Arthrotomy was carried out through the medial parapatellar approach following an anterior midline incision. Osteophytes were removed and medial tissues of the varus knees (deep medial collateral ligament, pes anserinus) and lateral tissues of the valgus knees (lateral collateral ligament, lateral capsules, popliteus, iliotibial band) were released depending on the severity of deformity to maintain soft tissue architecture. Subsequently, under the guidance of sawing blocks for femur and tibia, respectively, flexion and extension gaps were checked and incisions were performed. After testing, original cemented femoral and tibial components and inserts were placed. Patella resurfacing was not performed in the patients. A Hemovac drain was also placed and closure was done accordingly.

On the day of surgery, cold application and compression were done. All patients were given respiratory and ankle pump exercises. On postoperative Day 1, drain was removed and patients were mobilized with a walker. Straight leg raise and quadriceps exercises were initiated. On postoperative Day 4, all patients were discharged and stair climbing up and down, hip and knee strengthening and stretching exercises were instructed. As of the second postoperative week, strengthening and stretching exercises, squat exercises, stair climbing up and down, and spinning exercises were initiated.

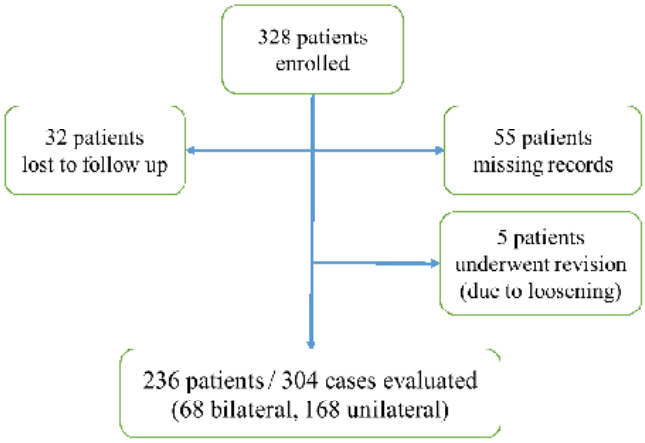

Figure 1. — Study flow chart.

Data including age and sex of the patient, age at time of surgery, operation site, postoperative follow-up duration, and posterior cruciate ligament (PCL) integrity were recorded. In terms of clinical results, the following variables were recorded in the pre- and postoperative periods: Oxford Knee score, Functional Score, Knee Score, Total Knee Society Score, and flexion angle. All patients were followed for five to nine years.

Oxford Knee Score

This scale consists of 12 questions that result in a maximal score of 48 points. It is used to evaluate the pain status and functional capacity of patients. The higher the score obtained from the scale, the better the result[12].

American Knee Society Score

This scale, known also known as Total Knee Society Score, consists of two subscores, knee score, and functional score.

Knee Score: Direct evaluation of pain, mobility, and stability. Flexion, extension, and adjustment problems negatively affect the knee score[13].

Functional Score

This subscore examines stair climbing up and down and walking distance. The need for auxiliary tools while walking lowers the total score. It is scored ranging from a total of 100 points, and higher scores indicate better function[13].

Statistical analysis

Statistical analysis was performed using the SPSS version 21.0 software (IBM Corp., Armonk, NY, USA). Descriptive data were expressed in mean ± standard

deviation (SD) or median (-min-max) for continuous variables and in number and frequency for categorical variables. For the normality check, the Shapiro-Wilk test was used. Categorical variables were compared using the chi-square test. The pairedsamples*t*-test was used to compare continuous variables between dependent groups and the independent samples *t*-test was used to compare continuous variables between independent groups. A two-tailed *p* value of <0.05 was considered statistically significant.

RESULTS

Of all operations, 71.2% (n=168) were unilateral and 28.8% (n=68) were bilateral. The mean follow-up was 79.30±14.76 (range, 48 to 111) months (Table I).

Table I. — Baseline characteristics of patients

Age of surgery (years)	66.64 ± 7.09 (45-82)
Sex	
Male	40 (16.95%)
Female	196 (83.05%)
Operation site	
Left	88 (37.29%)
Right	80 (33.90%)
Bilateral	68 (28.81%)
Follow-up duration (months)	79.30 ± 14.76 (48-111)

Data are given in mean ± standard deviation, median (min-max) or number and frequency, unless otherwise stated.

Table II. — Summary of preoperative and postoperative measurements of patients.

	Preoperative	Postoperative	p
Oxford knee score	25,05±4,22	43,24±4,35	**<0,001**
Knee Society functional score	53,98±13,11	85,39±14,31	**<0,001**
Knee Society knee score	44,81±7,13	85,27±7,95	**<0,001**
Knee Society total score	99,39±19,28	170,51±21,25	**<0,001**
Knee flexion angle	93,48±10,00	106,01±11,26	**<0,001**

Data are given in mean ± standard deviation, unless otherwise stated.

Table III. — Variables affecting patients' postoperative measurements.

	Oxford knee score	Society functional score	Society knee score	Society total score	Knee flexion angle
Sex					
Male (n=56)	44,32±4,00	87,13±15,93	86,81±11,12	174,56±25,15	107,68±12,36
Female (n=248)	43,47±4,37	85,44±13,18	85,33±8,27	170,02±20,32	106,10±11,35
p	0,218	0,067	0,342	0,103	0,297
Age (years)					
< 65 (n=127)	44,04±3,19	92,00±10,31	88,91±5,90	181,32±13,78	110,04±9,32
≥ 65 (n=177)	41,51±4,41	80,61±14,30	83,04±8,71	163,46±22,19	104,77±11,19
p	**0,020**	**<0,001**	**0,011**	**0,003**	**0,015**
PCL					
Retained (n=227)	43,47±4,50	86,12±14,25	85,07±9,88	171,38±22,41	105,40±10,13
Resected (n=77)	43,19±3,47	85,43±13,10	85,90±8,16	171,30±18,45	110,72±12,30
p	0,634	0,831	0,468	0,876	**0,009**

PCL: posterior cruciate ligament. Data are given in mean ± standard deviation, unless otherwise stated.

In the early postoperative period, seven patients developed superficial infection which was treated succesfully with antibiotherapy. In the late postoperative period, prosthesis infection developed in four patients. Bilateral aseptic loosening was observed in one patient with rheumatoid arthritis. Five of these six patients underwent revision surgery and, therefore, were excluded from the analysis. Compared to baseline, the mean postoperative Functional Score, Knee Score, Total Knee Society Score, Oxford Knee Score, and flexion angles were significantly higher after surgery (p<0.01) (Table II).

There was no statistically significant difference between males and females in terms ofpostoperative

Oxford Knee Score, Functional Score, Knee Score, Total Knee Society Score, and flexion angles measurements ($p>0.05$). However, postoperative Oxford Knee Score, Functional Score, Knee Score, Total Knee Society Score, and flexion angles were significantly lower in the patients aged ≥65 years than those aged <65 years($p<0.01$) (Table III). Compared to PCL-retained surgeries, the mean flexion angle was significantly higher in the patients who underwent PCL resection ($p<0.01$). Furthermore, there was no statistically significant difference between PCL resected and retained cases in terms of sex, age, and operation site ($p>0.05$).

DISCUSSION

In the present study, we evaluated the mid-term results of MPTKP patients. Our study results showed that there was a significant improvement in all variables after the surgery. Compared to preoperative results, pain, mobility, stability, functionality, and knee flexion joint angle demonstrated an improvement in the mid-term after MPTKP operation. In addition, all postoperative variables significantly improved in the patients aged <65 years than those aged ≥65 years.

The American Knee Society Scoreis one of the scores frequently used in the evaluation of the results of prosthetic surgeries. In our study, the functional score (from 54 to 85), knee score (from 45 to 85), and total score (from 99 to 171) significantly increased. Macheras et al.[14] reported a significant improvement in the knee score (from 32 to 92) and functional score (from 42 to 82) after MPTKP. Several studies have also shown a statistically significant improvement in these scores after MPTKP: Bae et al.[15,16], in two different studies reported an increased knee score (60 to 90) and functional score (54 to 85); Schimdt et al.[17] found increased knee scores (67 to 95); Chinzei et al.[18] showed an increase in the knee score (36 to 92) and functional score (31 to 73);and Vecchini et al.[19] reported higher knee scores (28 to 73) and functional scores (49 to 78).The results of our study are consistent with previous studies in the literature. Compared to the preoperative period, the American Knee Society Scores, which assesses pain, mobility, stability and function, improved significantly in the mid-term in patients who underwent MPTKP.

Although studies demonstrate a significant success with physician-measured patient characteristics after TKA, patient-reported results are usually less satisfactory[20]. Some studies have reported relatively low levels of patient satisfaction after TKA[20-22]. In our study, the Oxford Knee Score was used to evaluate patients' perceptions related to knee pain and functions. Similarly, several studies have utilized Oxford Knee Score as a patient-based assessment after MPTKP. Karachalios et al.[11] reported that the Oxford Knee Score improvedsignificantly in the long-term MPTKP results (11 to 15years). Sabatini et al.[23] found that the Oxford Knee Score increased from 19.5 to 41.2 on average during one-year follow-up after the MPTKP operation, indicating a statistically significant increase. In consistent with the aforementioned study, the mean Oxford Knee Score, which was 25 before the operation, increased to 43 after the operation in our study. Previous studies have suggested that the reliability of this scale for treatment success is rather questionable, as it shows subjective data based on the patients' interpretations and expectations[14]. Many factors, such as age, pain, active function, patient compliance, ROM,and knee joint kinematics have been shown to be associated with patient satisfaction[20,24,25]. In our study, there were statistically significant improvements in all scores among patients younger than 65 years. This can be attributed to both physiological and social characteristics of young patients. Younger individuals have a higher level of tissue healing and treatment compliance. Additionally, the fact that younger patients' muscle strength would contribute to the stability of the knee joint is another factor that may increase compliance with physical therapy and exercise programs, thereby increasing postoperative healing process.

The positive results of MPTKP have also been shown in several studies evaluating ROM. Dehland et al.[26] reported that ROM increased from 98° to 110°at 10 years after the application of MPKP. Karachalios et al.[11] reported that the ROM value of 284 MPTKP patients increased from 101° to 117° during 13-year follow-up. Nakamura et al.[27] showed that patients who underwent MPTKP had a statistically significant improvement in the postoperative functional score, knee score, and ROM, with a minimum of 10-year follow-up results. In a few number of studies, knee flexion anglereached above 120° after the MPTKP operation[14,16]. Although Bae et al.[16] reported a knee flexion angle of 124° after the MPTKP operation, the results were considered normal, since the average was 120° before the opera-tion. In the light of studies investigating ROM after MPTKP,it is evident that MPTKP significantly increases ROM, since almost all studies have reported increased values: Fan et al.[28] (103° to 115°), Vecchini et al.[19] (114° to 122°), Chinzei et al.[18] (97° to 112°), and Schmidt et al.[17] (115° from

119°). In our study, consistent with the literature, the ROM increased from 93.5° to 106°in the mid-term.

Cates et al.[29] reported a higher degree of tibial internal rotation, when PCL-retained cases had a high degree of flexion. In contrast to these studies, Fantozzi et al.[30] reported that PCL-retained TKA operations adversely affect knee kinematics. In our study, postoperative flexion angles of PCL-resected cases were found to be significantly higher. Consistent with our study, Bae et al.[15] reported that the increase in ROM among PCL-resected cases was significantly better compared to PCL-retained cases (7.9°*vs.* 8.5°, respectively).On the other hand, Karachalios et al.[11] reported that there was no significant difference between the measurements according to the status of PCL in TKA operations.

Nonetheless, this study has several limitations. First, the study has a single-center, retrospective design that may produce bias. All data were obtained from the patient records and, therefore, we were unable to evaluate any characteristics that could influence rehabilitation or healing processes. Second, the presence of other conditions that may affect the results of the operation and recovery, such as comorbidities, surgery-related alterations, and postoperative physical therapy and exercise compliance were unable to be assessed. It is also possible that patients who attended postoperative follow-ups may have consisted of individuals who had significantly better improvement. Thus, the results among the included patients may have been skewed. The lack of a control group (*i.e.*, untreated, or those treated with other methods) is also an important limitation that prevents comparative assessment. On the other hand, we believe that thereliability of our hospital records was very high, and the number of patients who underwent treatment with MPTKP was relatively large.

CONCLUSION

MPTKP operations have favorable mid-term results in terms of function and patient satisfaction. Younger patients have significantly better outcomes in all measures, and flexion angle is better in PCL-resected cases. In the future, prospective studies examining various other variables that may affect the results of TKA are needed to identify detailed patient characteristics and to explain the differences between various groups. Furthermore, by incorporating different techniques into the studies as control groups, the specific advantages of MPTKPs should be elucidated. We believe that these results can guide clinicians in choosing the optimal treatment while planning TKA.

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