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Evaluation of Patellofemoral Complications by Comparing the Medial Parapatellar and Subvastus Approaches

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Abstract

Introduction and Aim: The aim of this study was to investigate the relationship of the medial parapatellar (MPP) approach and the subvastus (SV) approach, which are frequently used in total knee arthroplasty, with patellofemoral complications and to compare patient satisfaction.

Material and Methods: In this study, we evaluated 488 patients who presented to our hospital between 2010 and 2020, were diagnosed with osteoarthritis, underwent total knee arthroplasty, and were followed up. The surgery was performed using the MPP approach in 242 of these patients (49.6%) and the SV approach in 246 (50.4%). The mean follow-up duration was 52 months for the MPP group (range 14-83 months) and 50 months (range 15-79 months) for the SV group. We compared these two patient groups in terms of anterior knee pain, patellar tilt, lateral retinacular release requirement, patella baja, and the WOMAC score.

Results: When the MPP and SV groups were compared in terms of the patients' demographic characteristics, no significant difference was found in age (p=0.186), gender (p=0.769), and body mass index (p=0.051). The incidences of lateral retinacular release requirement (p=0.001) and patellar tilt (p=0.001) were significantly lower in the SV approach than in the MPP approach. However, there was no significant difference between the two groups in terms of anterior knee pain (p=0.087), patella baja (p=0.136), and WOMAC score (p=0.052). In addition, it was observed that lateral retinacular release increased the incidence of patellar tilt (p=0.001) but did not affect the incidence of anterior knee pain (p=0.946) and the patella baja (p=0.523).

Conclusion: The SV approach is advantageous over the MPP approach in reducing patellofemoral complications. However, despite these advantages, no significant difference was found between the two approaches in relation to the WOMAC scores of the patients. Therefore, although the SV approach decreased patellofemoral complications, it may have increased other complications associated with total knee arthroplasty.

Introduction

Total knee arthroplasty (TKA) is considered to be the best method for treating advanced knee osteoarthritis in terms of reducing pain, improving joint functions, and increasing the patient's quality of life [1]. The most commonly used approach in TKA is the standard medial parapatellar (MPP) approach described by Insall [2]. The MPP approach provides a good view of the operating field [3]. However, it also has the potential to impair a large part of the extensor mechanism and the blood supply of the patella [4]. As an alternative, [5]. described the subvastus (SV) approach, which can preserve blood flow to the patella and result in better alignment of the patella by preserving muscle function [4]. Both surgical procedures have potential clinical advantages, and it is not yet clear which has better clinical outcomes [6].

The aim of this study is to compare the results of 488 patients with osteoarthritis who underwent TKA using the MPP and SV approaches in our clinic between 2010 and 2020 in terms of anterior knee pain, lateral retinacular release requirement, patella baja, patellar tilt, and the WOMAC score.

Materıal and Method

At the beginning of the study, ethics committee approval was obtained (date: July 27, 2020). In addition, each participant was informed about the study, and their informed consent was obtained. This trial was conducted as a single centre, single blinded, randomized controlled trial. In this study, 540 patients who underwent TKA due to osteoarthritis at the Orthopedics and Traumatology Clinic of Hatay Mustafa Kemal University Hospital between 2010 and 2020 were evaluated. TKA was applied to patients with stage 3 and 4 osteoarthritis according to the Kellgren and Lawrence classification, and the approach to be applied was randomly decided by the senior surgeon by applying the MPP and SV approaches, respectively, according to the patient's admission order. Patients with perioperative complications such as collateral ligament avulsion and peroneal nerve injury, those that developed postoperative infections, those with a previous history of TKA on the contralateral knee, those with a previous fracture around the knee, those with a knee flexion of less than 90 degrees, those with varus or valgus deformities greater than 15 degrees, those with a body mass index of >35, and those over 80 years of age were excluded from the study. Among the remaining 488 patients, TKA was performed using the MPP approach in 242 and SV approach in 246. The mean follow-up duration was 52 months for the MPP group (range 14-83 months) and 50 months (range 15-79 months) for the SV group. Age, gender and body mass index of the patients were recorded from the hospital system. The only difference between the two study groups concerned the approach (MPP or SV) used during TKA.

The Zimmer (Warsaw, IN, USA) cemented prosthesis sacrificing the posterior cruciate ligament was applied to all patients. Patella replacement was not performed in any of the patients. All surgical procedures were undertaken by a senior surgeon experienced in both the MPP and SV approaches undertaken in our clinic. The approach to all knees was started with an anterior midline skin incision. The SV approach was performed as described by Hofman et al. [5]. After passing the subcutaneous adipose tissue, the first facial layer was exposed. This layer was bluntly separated from the perimuscular fascia above the oblique fibers of the vastus medialis. The inferior edge of the vastus medialis was exposed, and the muscle was separated from the periosteum and intermuscular septum by blunt dissection at approximately 10 cm proximal to the

adductor tubercle. The muscle mass was lifted anteriorly, and the tendinous attachment site of the medial patellar retinaculum was exposed. When the muscle mass was tense, the transverse part of the capsular incision was performed. Arthrotomy was performed by cutting the capsule distally. While the knee was in full extension, the patella was everted and dislocated. To apply the MPP approach, the tendinous part of the extensor mechanism was cut 5 mm lateral to the junction of the vastus medialis and rectus femoris. The quadriceps tendon was cut at the junction of the lateral 2/3 of the tendon and the medial 1/3 of the tendon. The medial structures of the capsule and joint were opened along the medial edge of the patella. The incision ran distally, parallel to the patellar tendon, and ended 5 mm medial to the tuberositas tibia.

In the last follow-up of the participants, weight-bearing anterior-posterior, weight-bearing 30-degree lateral and 45-degree Merchant radiographs were taken. Using these radiographs, patellar tilt and the Insall Salvati index were determined to measure the patellar height. Patellar tilt was measured as the angle between a line joining the medial and lateral corners of the patella and another line joining the anterior apex of the medial and lateral femoral component condyles in the Merchant view. Pathological limits were considered for patellar assessment. Two subgroups were formed by accepting ≤ 5 degrees as normal and >5 degrees as abnormal for patellar tilt. Patellar height was measured using the Insall Salvati index with lateral radiography taken at 30 degrees of flexion. Accordingly, the patients with a patellar height of less than 0.8 were considered to have patella baja. Patellofemoral alignment was evaluated with the 'no thumb' test. After the components were placed in position, it was observed whether there was patellar tilt or subluxation, and if there was, lateral retinacular release (LRR) was performed. The patients that required LRR were noted. The Visual Analog Scale, a numerical rating, was used for pain evaluation. VAS is a scoring system based on patients' subjective expression of pain rated on a scale of 0 (no pain at all) to 10 (worst pain imaginable). According to the marking of the patients on the 100 mm VAS line, two subgroups were formed, consisting of those without anterior knee pain if the marked point was <50 mm and those with anterior knee pain if it was >50 mm.

Clinical evaluation was performed with the WOMAC score, which was determined by a physiotherapist blinded to the other study data, at the time of the patients' last follow-up. The WOMAC score consisted of three subgroups, namely pain, stiffness, and function. In order to determine a potential correlation between clinical and radiological factors, it was investigated whether the WOMAC score of the patient groups who underwent TKA with the MPP or SV approach was associated with radiological measurements.

The suitability of data to normal distribution was tested with the Shapiro-Wilk test. Student's t-test was used to compare normally distributed variables between two independent groups, and the Mann-Whitney U test to compare non-normally distributed variables between two independent groups. The relationships of categorical variables were examined using the Pearson chi-square test. As descriptive statistics, mean ± standard deviation were given for numerical variables, number and percentage values for categorical variables. SPSS for Windows, version 23.0 was used for statistical analyses, and p<0.05 was considered statistically significant.

Results

When the demographic characteristics were examined,

no significant difference was observed between the MPP and SV groups in relation to gender (female n= 205, male n = 37 and female n = 206, male n = 40, respectively; p = 0.769), age (66.5 ± 7.9 and 65.6 ± 7.7 years, respectively; p=0.186), and body mass index (27.2 ± 2.7 and 27.7 ± 2.4 kg/m², respectively; p =0.051).

There was no significant difference between the two groups in terms of anterior knee pain (p = 0.087). Patella baja was observed in five patients (2.7%) in the MPP group and 11 patients (4.5%) in the SV group, with no significant difference (p = 0.136). The incidence of patellar tilt was significantly higher in the MPP group compared to the SV group (p = 0.001) (Figure 1), (Table 1). When the patients with and without patellar tilt were compared in terms of anterior knee pain, there was a significantly higher rate of
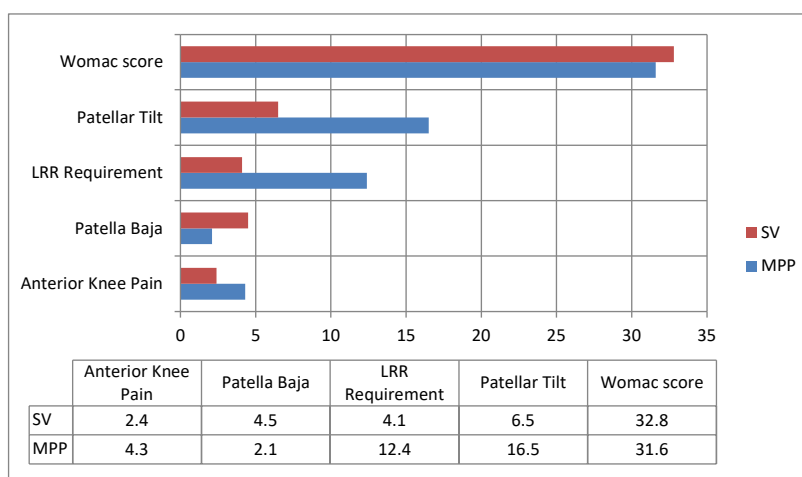

	Anterior Knee Pain	Patella Baja	LRR Requirement	Patellar Tilt	Womac score
SV	2.4	4.5	4.1	6.5	32.8
MPP	4.3	2.1	12.4	16.5	31.6

Figure 1: Anterior knee pain, patella baja, LRR requirement and patellar tilt percentages and WOMAC score averages in patients who underwent MPP or SV approach. Patellar tilt and LRR requirement are significantly higher in the MPP approach.

Table 1: Comparison of the MPP and SV groups in terms of patella baja, anterior knee pain, lateral retinacular release requirement, and patella baja.

		Group					
		MPP		SV			
		n	%	n	%	Chi-square	p
Patella baja	Present	5	2.1	11	4.5		0.136
	Absent	237	97.9	235	95.5		
Anterior knee pain	Present	44	18.2	31	12.6	2.921	0.087
	Absent	198	81.8	215	87.4		
Lateral retinacular release requirement	Present	30	12.4	10	4.1	11.254	0.001
	Absent	212	87.6	236	95.9		
Patellar tilt	Present	40	16.5	16	6.5	12.069	0.001
	Absent	202	83.5	230	93.5		
MPP: Medial Parapatellar; SV: Subvastus							

anterior knee pain in those with patellar tilt (p = 0.001).

LRR requirement was significantly higher among the cases in which the MPP approach was used compared to the SV group (p = 0,001) (Table 1). Anterior knee pain was present in six of the 40 patients (15%) that underwent lateral release and 69 of the 448 patients (15.4%) that did not require lateral release, indicating no significant difference between these two groups (p=0.946) (Table 2). When the patients with and without LRR requirement were compared, the incidences of patella baja and patellar tilt were found to be higher in the former (p=0.523 and p=0.001, respectively) (Table 3).

The mean WOMAC score of the 242 patients who underwent MPP approach was 31.6, while that of the 246 patients who underwent SV approach was 32.8. No significant difference was found between the two groups in terms of the WOMAC score (p=0.052) . When the WOMAC scores of the patients who underwent LRR were evaluated according to the incision groups, this score was 35.5 for the patients in the MPP group and 37.7 for those in the SV group. There was no significance between the two groups

(p = 0.077) (Table 4).

Discussion

The most important findings of our study are that there was no difference between the MPP and SV approaches in relation to anterior knee pain, patella baja, and WOMAC score, but LRR requirement and patellar tilt were detected at a higher rate in the MPP group compared to the SV group. In addition, we determined that the incidence of anterior knee pain and patella baja and WOMAC score were not affected by LRR requirement while the incidence of patellar tilt was increased in patients who underwent LRR.

Anterior knee pain is one of the most common causes of permanent problems after TKA [7]. In a study conducted by Sensi et al. [8], the incidence of anterior knee pain was reported to be 8%. In another study, the causes of anterior knee pain were divided into mechanical and functional, with the mechanical causes being listed as patellofemoral instability, patella baja, avascular necrosis, prosthetic design, chondrolysis, misplacement of components,

Table 2: Comparison of the patients with and without lateral retinacular release requirement in terms of anterior knee pain.

		Lateral retinacular release requirement					
		Present		Absent			
		Count	%	Count	%	Chi-square	p
Anterior knee pain	Present	6	15.0%	69	15.4%	0.005	0.946
	Absent	34	85.0%	379	84.6%		

Table 3: Comparison of the patients with and without lateral retinacular release requirement in terms of the incidence of patella baja and patellar tilt.

		Lateral retinacular release requirement				
		Present		Absent		
		Count	%	Count	%	P
Patella baja	Present	2	5.0%	14	3.1%	0.523
	Absent	38	95.0%	434	96.9%	
Patellar tilt	Present	11	27.5%	45	10.0%	0.001
	Absent	29	72.5%	403	90.0%	

Table 4: Comparison of the WOMAC score between the MPP and SV groups for the patients with lateral retinacular release requirement.

	Group	n	Mean	SD	z	p
WOMAC score	MPP	30	35.5333	3.29821	-1.788	0.077
	SV	10	37.7000	3.86005		
MPP: Medial Parapatellar; SV: Subvastus; SD: Standard Deviation						

tibiofemoral instability, and synovial hyperplasia [7]. Since MPP and SV are the most commonly used approaches in TKA and they can directly affect anterior knee pain and patellofemoral complications, we compared these two approaches in terms of patellofemoral complications. We also investigated how LRR affected anterior knee pain, patellar tilt, and patellar instability.

In the literature, the role of patellar avascular necrosis in the etiology of anterior knee pain is controversial [9-11]. It is known that the MPP approach disrupts the patellar blood supply more than the SV approach [12,13]. In particular, when LRR is added to the MPP approach, the main arteries that feed the patella will be cut in the superolateral genicular (SLG) artery; therefore, the patellar blood supply will be further disrupted. In the SV approach, arteries on the medial side are preserved, and even if LRR is performed, there will be no serious damage to the patellar blood supply [14]. Although the literature contains many studies that support this view, the effect of this impaired blood supply of the patella on the clinical state of the patient remains unclear. This is because, similar to our findings, many studies have reported no difference between the MPP and SV approaches in relation to anterior knee pain [9]. In our study, in agreement with the literature, we observed that the need for LRR was greater in cases where the MPP approach was used (p=0.001) [15,16]. However, the incidence of anterior knee pain was similar among the patients with and without LRR requirement (p=0.946). In addition, among the patients that underwent LRR, there was no significant difference between the WOMAC scores of the MPP and SV groups (p=0.077). Some researchers have argued that SLG, which remains intact in both the MPP and SV approaches, may be sufficient to maintain patellar vascularity; therefore, there may be no difference between the two approaches in terms of vascularity and anterior knee pain [17]. However, the incidence of anterior knee pain not increasing despite the dissection of SLG in patients undergoing LRR suggests that anterior knee pain may not be related to the blood supply of the patella.

In some studies, it has been argued that patellar tendon scar and contracture may occur due to the ischemia of the patellar tendon in patients that have undergone LRR, and this result in patella baja [7,18]. In patella baja, the patella is always in contact with the trochlea in extension, unlike a normal patella. This can cause compression that leads to anterior knee pain and joint stiffness. In addition, patella baja causes a reduction in the lever arm followed by extensor delay, resulting in a decrease in range of motion [18]. In our study, the incidence of patella baja was similar between the MPP and SV approaches (p=0.136). There was also no significant difference in the incidence of patella baja between the patients that did and did not undergo LRR (p=0.523).

Patellar tilt and lateral patellar shift are good indicators of patellar tracking. In our study, the incidence of patellar tilt was higher in the MPP group compared to the SV group (p=0.001). Similarly, the incidence of patellar tilt was higher in patients that underwent LRR compared to those that did not require this procedure (p=0.001). In addition, the incidence of patellar tilt was higher among the patients that did not undergo LRR in the MPP group compared to those in the SV group (p=0.006). In other words, regardless of LRR being performed, the MPP group had a higher rate of patellar tilt than the SV group, and LRR presented as a risk factor for patellar tilt. When the patients with and without patellar tilt were compared in terms of anterior knee pain, those with patellar tilt had significantly greater anterior knee pain (p=0.001). When patellar tilt is considered as a risk factor for anterior knee pain and in light of the finding that both MPP and LRR increase patellar tilt, it can be stated that MPP and LRR are indirect risk factors for anterior knee pain through increasing the patellar tilt incidence.

This study has several limitations. It had a retrospective nature, which resulted in a risk of bias, but this was minimized with the prospective collection of data. Other weaknesses of the study include the lack of preoperative data and the absence of an evaluation of component rotation that has the potential to affect patellofemoral complications. Although many studies suggest that patellofemoral complications are similar between patients that have and have not undergone patellar resurfacing, our study only included cases with knee prostheses without patellar resurfacing, which can be considered as another limitation.

Conclusion

According to our results, patellar tilt was more common in the MPP approach. However, there was no difference between the two approaches in terms of anterior knee pain, patella baja, and WOMAC score. From this point of view, it can be concluded that the risk of patellofemoral complications is higher in the MPP approach, but the lack of a difference in functional scores indicates that this approach may have more advantages.

Conflicts of Interest

There were no conflicts of interest regarding the submission and publication of this manuscript.

References

1. Gandhi R, Dhotar H, Razak F, Tso P, Davey JR, Mahomed NN. Predicting the longer term outcomes of total knee arthroplasty. The Knee. 2010 Jan 1;17(1):15-8.

2. INSALL J. A midline approach to the knee. JBJS. 1971 Dec 1;53(8):1584-6.

3. Pagnano MW. Patellar tendon and quadriceps tendon tears after total knee arthroplasty. The Journal of Knee Surgery. 2003 Oct 1;16(4):242-7.

4. Cila E, Güzel V, Özalay M, Tan J, Şimşek AS, Kanatlı U, et al. Subvastus versus medial parapatellar approach in total knee arthroplasty. Archives of Orthopaedic and Trauma Surgery. 2002 Feb;122(2):65-8.

5. Hofmann AA, Plaster RL, Murdock LE. Subvastus (Southern) approach for primary total knee arthroplasty. Clinical Orthopaedics and Related Research. 1991 Aug 1(269):70-7.

6. In Y, Kim JM, Choi NY, Kim SJ. Large thigh girth is a relative contraindication for the subvastus approach in primary total knee arthroplasty. The Journal of Arthroplasty. 2007 Jun 1;22(4):569-73.

7. Petersen W, Rembitzki IV, Brüggemann GP, Ellermann A, Best R, Gösele-Koppenburg A, et al. Anterior knee pain after total knee arthroplasty: a narrative review. International Orthopaedics. 2014 Feb;38(2):319-28.

8. Sensi L, Buzzi R, Giron F, De Luca L, Aglietti P. Patellofemoral function after total knee arthroplasty: gender-related differences. The Journal of Arthroplasty. 2011 Dec 1;26(8):1475-80.

9. Bourke MG, Sclavos EK, Jull GA, Buttrum PJ, Dalton PA, Russell TG. A comparison of patellar vascularity between the medial parapatellar and subvastus approaches in total knee arthroplasty. The Journal of Arthroplasty. 2012 Jun 1;27(6):1123-7.

10. Holtby RM, Grosso P. Osteonecrosis and resorption of the patella after total knee replacement: a case report. Clinical Orthopaedics and Related Research®. 1996 Jul 1;328:155-8.

11. Soucacos PN, Johnson EO, Soultanis K, Vekris MD, Theodorou SJ, Beris AE. Diagnosis and management of the osteonecrotic triad of the knee. Orthopedic Clinics. 2004 Jul 1;35(3):371-81.

12. Ogata KO, Shively RA, Shoenecker PL, Chang SL. Effects of standard surgical procedures on the patellar blood flow in monkeys. Clinical Orthopaedics and Related Research. 1987 Feb 1(215):254-9.

13. Scuderi G, Scharf SC, Meltzer LP, Scott WN. The relationship of lateral releases to patella viability in total knee arthroplasty. The Journal of Arthroplasty. 1987 Jan 1;2(3):209-14.

14. Jung YB, Lee YS, Lee EY, Jung HJ, Nam CH. Comparison of the modified subvastus and medial parapatellar approaches in total knee arthroplasty. International orthopaedics. 2009 Apr;33(2):419-23.

15. Hu X, Wang G, Pei F, Shen B, Yang J, Zhou Z, et al. A meta-analysis of the sub-vastus approach and medial parapatellar approach in total knee arthroplasty. Knee Surgery, Sports Traumatology, Arthroscopy. 2013 Oct 1;21(10):2398-404.

16. Teng Y, Du W, Jiang J, Gao X, Pan S, Wang J, et al. Subvastus versus medial parapatellar approach in total knee arthroplasty: meta-analysis. Orthopedics. 2012 Dec 1;35(12):e1722-31.

17. Kayler DE, Lyttle D. Surgical interruption of patellar blood supply by total knee arthroplasty. Clinical Orthopaedics and Related Research. 1988 Apr 1(229):221-7.d

18. Lum ZC, Saiz AM, Pereira GC, Meehan JP. Patella baja in total knee arthroplasty. JAAOS-Journal of the American Academy of Orthopaedic Surgeons. 2020 Apr 15;28(8):316-23.