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Effect of patellar denervation by circumpatellar electrocautery on clinical outcomes of patients with total knee arthroplasty

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Abstract

Aim: Anterior knee pain may lead to worse outcomes after total knee arthroplasty. The effect of patellar denervation (PD) by electrocautery on postoperative pain and function in patellar nonresurfacing TKA were assessed in this study.

Materials and Methods: This retrospective study included patients with a minimum of 24 months follow-up who were operated for TKA between January 2014 and January 2018. Patellar Denervation (PD) group; patients who underwent circumpatellar electrocautery around the patella, and Control (C) group; who did not undergo. Patient demographics, preoperative patellofemoral osteoarthritis grades, Knee Society System (KSS) scores, Feller patella score (PS), Short Form-36 (SF-36) and visual analogue scale (VAS) scores at preoperative, postoperative 3. Month and last follow-up examination were noted.

Results: There was no difference between groups in terms of gender distribution and age ($p > 0.05$). At 3rdpostoperative month, KSS-Knee was significantly higher and VAS score was significantly lower in the PD patients compared to C group ($p=0.026$, $p=0.023$ respectively). At the final follow-up, KSS-Function and PS scores were significantly higher ($p=0.031$, 0.012 respectively). Some of the QoL scores were better at late follow-up in PD group. However, there was no statistical difference between these two groups in other follow-up examinations ($p > 0.05$).

Conclusion: Circumpatellar electrocautery denervation can be advantageous in reducing early postoperative knee pain. Clinical, functional and some of the QoL scores were better in the midterm postoperative period of patients with gonarthrosis treated by TKA with PD.

Introduction

Total knee arthroplasty (TKA) is a successful procedure to alleviate knee pain and improve knee function and quality of life in patients with symptomatic knee arthrosis [1]. However, anterior knee pain (AKP) may persist in up to 49% of the patients following primary TKA despite appropriate postoperative rehabilitation [2, 3]. AKP has been the source of patient dissatisfaction, poor clinical outcomes, and reoperation after TKAs [2, 4]. Degenerative changes, maltracking, overstuffing of the patellofemoral joint, prosthesis design, and preoperative gait patterns were reported as potential sources of AKP after TKA [5]. Although the exact cause is not yet well understood, the presence of substance-P nociceptive afferent fibres in peripatellar soft tissues and the infra-patellar fat pad is associated with the perception of pain in the anterior part of knee [6, 7]. The patella is innervated by the medial and lateral patellar nerves [8]. Thus, it is suggested that desensitization of peripatellar tissues by an electrocautery may be beneficial to reduce AKP [9].

The role of circumferential patella denervation (PD) during TKA remains controversial. Some surgeons recommend this technique as a reliable, cost effective and time-saving method to avoid AKP [10, 11] and they reported that PD is beneficial only for the first 3 months postoperatively with or without patellar resurfacing [12, 13]. However, several recent studies compared the clinical outcomes and pain status of patients who received primary TKA with or without PD and no differences were reported [14, 15]. Additionally, it was suggested that PD can be harmful to articular cartilage too [16].

Therefore, this study aimed to compare clinical, functional and quality of life (QoL) scores, and complication rates in patients who received primary TKA with and without PD.

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We hypothesized that patients who received PD would report reduced AKP with improved clinical and functional outcomes.

Materials and Methods

This study was conducted between January 2014 and January 2018, after obtaining institutional research committee and ethics committee approval (approval date-number: 10/06/2020-2020-10/14). This is a retrospective study which includes the patients of two different surgeons.

Study population

The inclusion criteria for the study were (1) patients who received primary TKA for end-stage gonarthrosis, (2) a minimum of 24 months of follow-up period, and (3) adequate pre and postoperative clinical and radiological records. The exclusion criteria were (1) history of rheumatologic diseases affecting the knee joint, (2) previous surgery or fracture around the knee, (3) valgus or (4) varus deformity >15°, and (5) incomplete medical records.

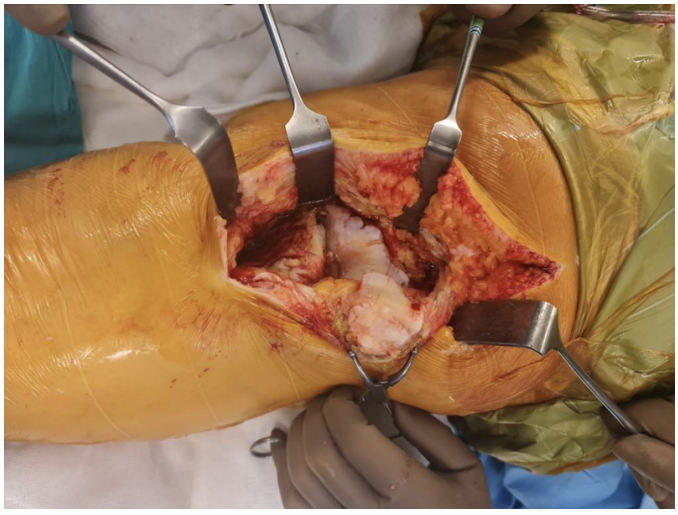

Figure 1. Patellar view of a patient in group PD – before the patellar denervation.

Figure 2. Patellar view of a patient in group PD – after the patellar denervation.

Based on these inclusion and exclusion criteria, 278 of the 334 patients were included in the study. The patients who underwent circumpatellar denervation were classified as Group PD (n=131) and the remaining patients as the control group (Group C, n=147).

Preoperative patellofemoral osteoarthritis was assessed radiologically. The Kellgren-Lawrence classification was used and patients were classified as grade 0 (no radiological findings of osteoarthritis), grade 1 (doubtful narrowing of joint space and possible osteophytic lipping), grade 2 (definite osteophytes and possible narrowing of joint space), grade 3 (moderate multiple osteophytes, definite narrowing of joint space, small pseudocystic areas with sclerotic walls and possible deformity of bone contour), or grade 4 (large osteophytes, marked narrowing of joint space, severe sclerosis and definite deformity of bone contour).

Surgical procedure

Two senior surgeons operated on all patients. One of them performed PD in the experimental group (group PD) and the other performed surgery on the control group (group C), based on their clinical experience. All surgical procedures were performed under epidural or spinal anaesthesia, unless it was contraindicated. A tourniquet was applied during the procedure. Midpatellar incision was followed by medial parapatellar arthrotomy. Retropatellar fat and suprapatellar synovium was excised and the patella was everted; osteophytes were excised as well. Tibial and femoral cuts were performed with respect to the mechanical axis. The femur was sized with the matched resection method; if the femoral component was in between sizes, the larger component was chosen. The cuts were confirmed by trial components. A similar posterior stabilized cemented primary total knee prosthesis (Maxim, Biomet, Inc., Warsaw, IN, USA) was used in all cases. Circumpatellar electrocauterization with 1–2 mm depth was performed in patients in group PD. Two pictures of a sample patient were shown before the patellar denervation in Figure 1, and after the patellar denervation Figure 2. All patients received the same postoperative rehabilitation protocol. Patellar resurfacing with a patellar component was applied to none of the patients.

Clinical assessment

Preoperative data regarding age, gender, affected side, body mass index (BMI) values, and the grade of patellofemoral osteoarthritis according to the Kellgren-Lawrence (KL) grading system [17] were recorded. Postoperative blood loss was assessed by measuring the amount of blood obtained from the hemovac drain. Clinical scores were obtained preoperatively, in the third month postoperatively and at last follow-up. Knee pain and functional status were evaluated using the Knee Society Clinical Rating System (KSS; knee and function score) [18], Feller patella score (PS) [19], Short Form – 36 (SF-36) score and a visual analogue scale (VAS) [20]. Two independent blinded physiotherapists assessed the patients. Complications such as patellar fractures, infection, and implant failures were recorded.

Table 1. Patient characteristics in group PD and Group C.

Variables	Total n=278 (Mean ± SD) / N (%)	Group PD n=131 (Mean ± SD) / N (%)	Group C n=147 (Mean ± SD) / N (%)	P value
Age (years)	65.2 ± 7.5	67.3 ± 11.2	64.1 ± 10.9	0.674
Gender				
Female	237 (85.3)	112 (85.6)	125 (84.8)	0.458
Male	41 (14.7)	19 (14.4)	22 (15.2)	
Affected side				
Right	198 (71.2)	101 (77.1)	97 (66)	0.067
Left	80 (28.8)	30 (22.9)	50 (34)	
Follow-up period (months)	32.2 ± 7.5	31.5 ± 3.1	33.9 ± 6.5	0.453
BMI (kg/m^2)	35.2 ± 5.1	32.4 ± 3.2	37.1 ± 4.1	0.232
Patellofemoral osteoarthritis				
Grade 1-2	77 (27.7)	41 (31.3)	36 (24.5)	0.587
Grade 3-4	201 (72.3)	90 (68.7)	111 (75.5)	

Values are presented as mean ± SD. P≤0.05 considered significantly different and defined bold. SD: Standard deviation.

Statistical analysis

Statistical analysis was performed using SPSS 24 software (SPSS® 24.0, Chicago, IL, USA). Continuous variables were expressed as mean ± standard deviation (SD). Normality of distribution was assessed by one sample Kolmogorov–Smirnov test. The comparisons between the two groups were performed by independent-samples t-test and Mann–Whitney U test. Qualitative and quantitative data were also analysed. Pre- and postoperative variables were compared by a paired-samples t-test. A p-value of <0.05 was considered significant. The power of the study was calculated as 74%.

Results

The mean follow-up period was 32.2 ± 7.5 (range, 24-68) months and it was not significantly different between the groups (p=0.453). Demographic variables were presented and compared between the two groups as shown in Table 1. Mean age, BMI, distribution of gender, patellofemoral osteoarthritis grade and affected side were all not significantly different between both groups (p=0.674, p=0.232, p=0.458, p=0.587, p=0.067, respectively) (Table 1).

Clinical results

AKP was detected in 23 (8%) patients at postoperative follow-up examinations. Mean postoperative blood loss in the hemovac drain was 542 ± 76 mL and 546 ± 76 mL in group PD C, respectively. (p=0.875). Preoperative and postoperative clinical scores are presented in Table 2. In the third month postoperatively (early postoperative period), the KSS-Knee score was significantly higher and VAS score was significantly lower in patients in group PD than those in group C. (p=0.026, p=0.023, respectively). The KSS-Function and PS scores were significantly higher in PD group at the late postoperative examination. (p=0.031, p=0.012 respectively) (Table 2). Nevertheless, physical functioning and role limitations due to physical health subscales were significantly better at the late postoperative examination in group PD compared with group C (p=0.032, p=0.026, respectively). Only pain subscale of SF-36 was significantly better in group PD at the early postoperative examination (p=0.023). All clinical scores were significantly better at the last postoperative examination compared with preoperative values (p<0.05) (Table 3).

There was one (0.68%) case of an acute superficial infection in group C; the patient was treated by surgical debridement and IV antibiotics were administered for four weeks. No other complications were observed.

Discussion

We hypothesized that AKP after TKA can be reduced by circumpatellar denervation with electrocautery. By decreasing AKP, clinical outcomes could also be improved. Our results showed that postoperative KSS knee score and VAS were significantly higher in the denervation group at the third month postoperatively. However, these outcomes did not statistically differ between the groups at the last follow-up. Postoperative KSS function and PS scores were similar at the third month, however significantly higher in the denervation group at the last follow-up. These findings indicate that patellar denervation by electrocautery can decrease AKP in the early postoperative period and improve clinical outcomes in the late postoperative period after TKA without patellar resurfacing. Moreover, SF-36 results showed that pain score was better in the early postoperative period, and physical functioning and role limitations due to physical health subscales were significantly better in the late postoperative period in the denervation group.

Several studies have advocated the use of patellar resurfacing to relieve AKP and improve functional outcomes and have reported similar clinical outcomes with either resurfaced or non-resurfaced patella in TKA [21, 22]. A less invasive and simpler technique is patellar denervation, where circumpatellar electrocautery is performed to

Table 2. Clinical and Quality of Life scores of both groups.

Pain and Functional Outcomes	Group PD	Group C	p
KSS – Knee			
Preoperative	55.15 ± 2.82	56.41 ± 4.42	0.813
Early Postoperative	73.60 ± 4.32	70.73 ± 3.63	0.026
Late Postoperative	74.65 ± 4.12	76.45 ± 1.44	0.515
KSS - Function			
Preoperative	59.34 ± 1.42	61.12 ± 3.82	0.678
Early Postoperative	78.41 ± 2.98	76.56 ± 2.16	0.667
Late Postoperative	84.31 ± 5.98	80.56 ± 6.56	0.031
PS			
Preoperative	19.34 ± 4.62	18.98 ± 3.22	0.557
Early Postoperative	20.10 ± 2.40	18.22 ± 2.84	0.642
Late Postoperative	28.23 ± 3.63	22.41 ± 4.53	0.012
VAS			
Preoperative	6.40 ± 2.52	6.52 ± 3.27	0.223
Early Postoperative	4.20 ± 1.12	5.62 ± 1.21	0.023
Late Postoperative	5.64 ± 0.95	5.71 ± 1.12	0.740
SF-36			
Physical functioning			
Preoperative	17.3 ± 2.4	18.1 ± 2.7	0.342
Early Postoperative	61.2 ± 22.2	59.2 ± 12.2	0.478
Late Postoperative	65.6 ± 13.3	61.6 ± 11.3	0.032
Role limitations due to physical health			
Preoperative	11.3 ± 3.1	12.1 ± 5.4	0.872
Early Postoperative	51.2 ± 11.9	50.2 ± 9.7	0.591
Late Postoperative	55.6 ± 13.2	51.2 ± 14.2	0.036
Role limitations due to emotional problems			
Preoperative	33.1 ± 9.4	32.8 ± 6.7	0.211
Early Postoperative	66.9 ± 12.9	64.7 ± 11.1	0.076
Late Postoperative	68.2 ± 11.2	66.2 ± 10.2	0.088
Energy/fatigue			
Preoperative	50.8 ± 9.1	51.3 ± 8.9	0.899
Early Postoperative	55.2 ± 10.6	54.9 ± 9.7	0.098
Late Postoperative	59.3 ± 12.7	57.3 ± 3.4	0.091
Emotional well-being			
Preoperative	61.2 ± 19.2	60.9 ± 18.7	0.122
Early Postoperative	69.1 ± 18.3	69.4 ± 17.9	0.564
Late Postoperative	71.9 ± 21.1	72.2 ± 16.4	0.877
Social functioning			
Preoperative	26.4 ± 3.2	25.9 ± 4.5	0.344
Early Postoperative	64.3 ± 12.9	65.4 ± 23.1	0.286
Late Postoperative	69. 9 ± 28.1	70.1 ± 21.1	0.418
Pain			
Preoperative	23.2 ± 6.5	24.1 ± 5.4	0.966
Early Postoperative	78.1 ± 23.7	72.6 ± 21.6	0.023
Late Postoperative	81.5 ± 18.7	80.6 ± 20.3	0.087
General health			
Preoperative	45.6 ± 14.6	44.3 ± 12.1	0.443
Early Postoperative	66.7 ± 12.9	68.1 ± 9.8	0.912
Late Postoperative	70.3 ± 15.6	71.2 ± 14.5	0.432

Values are presented as mean ± SD. P≤0.05 considered significantly different and defined bold. KSS: Knee Society Score, PS: Patellar score, VAS: Visual analogue scale, SF-36: Short Form 36.

a depth of 1–2 mm around the patella to deactivate pain receptors [11, 23]. Despite the controversial reports on the efficacy of this procedure, many surgeons prefer denervation to relieve AKP and to improve knee function [10, 15, 24, 25]. Pulavarti et al. reported that the effect of PD in alleviating anterior knee pain was significant in the early postoperative period (3rd month postoperatively) but diminished postoperatively at 12 and 24 months [12]. In another study by Altay et al., it was shown that PD can reduce AKP with satisfactory clinical and radiological outcomes for up to a mean of thirty-six months [10]. However, Kwon et al. reported no improvement in clinical outcomes with patellar denervation at the 5-year follow-up [26]. Our results showed that PD yielded significantly lower postoperative pain and improved functional outcomes 3 months after the surgery as compared to patients without denervation. We did not observe any difference between the control group and the PD group at longer follow-up periods. Thus, our results report the efficacy of PD in the early postoperative period. Despite PD not being a new technique, patellar innervation and PD are not well studied. The limited descriptions available often differ between studies, which could affect the results. Thus, a standard description of the patellar procedures is needed. Although effects of patellar denervation do not last in the long term, lower pain levels in the early postoperative period are desirable for both the patient and the surgeon.

Better results at the early post-operative term may show us the benefit of removal of the osteoarthritic parts of the patella. Later new osteoarthritic regions may increase and because of that long term results were similar between both groups.

The pathophysiology of AKP following total knee arthroplasty is not well understood; however, patellar cartilage degeneration and surface incongruities such as patellar maltracking probably contribute to AKP in many patients [27]. The presence of patellar-related complications such as loosening, component wear, fracture and maltracking, patellar retention or selective resurfacing of the patella has been discussed [28]. Witonski et al. reported that substance-P-positive fibres appear to be more prevalent in the medial retinaculum and fat pad than in the other soft tissue around the knee [29]. These findings may explain the ineffectiveness of lateral retinacular release for AKP. However, we did not need to perform any lateral retinacular release during surgery.

The possible harmful consequences of using electrocautery around the patella rim are of great concern to some clinicians. It was suggested that, disturbances in proprioception may cause abnormal lower extremity load bearing and aggravate knee pain [24]. Rand et al. reported that electrocautery has potentially harmful effects on the articular cartilage and that it must be handled carefully when utilised in an intra-articular location to avoid cartilage damage [30]. Some studies reported that complications related to patellar osteonecrosis, fracture, dislocation, subluxation, and extensor mechanism were not related with electrocautery [10, 11, 31]. Moreover, postoperative complications developed in 54 of the 472 knees in a meta-analysis reported by Cheng et al [5]. Based on the current literature and our results, we suggest that elec-

Table 3. Clinical scores of preoperative and last examinations for both groups.

Pain and Functional Outcomes	Preoperative	Late Postoperative	p
KSS – Knee			
Group PD	55.15 ± 2.82	74.65 ± 4.12	<0.001
Group C	56.41 ± 4.42	76.45 ± 1.44	<0.001
KSS - Function			
Group PD	59.34 ± 1.42	84.31 ± 5.98	<0.001
Group C	61.12 ± 3.82	80.56 ± 6.56	<0.001
PS			
Group PD	19.34 ± 4.62	28.23 ± 3.63	0.012
Group C	18.98 ± 3.22	22.41 ± 4.53	0.023
VAS			
Group PD	6.40 ± 2.52	5.64 ± 0.95	0.032
Group C	6.52 ± 3.27	5.71 ± 1.12	0.031
SF-36			
Physical functioning			
Group PD	17.3 ± 2.4	65.6 ± 13.3	<0.001
Group C	18.1 ± 2.7	61.6 ± 11.3	<0.001
Role limitations due to physical health			
Group PD	11.3 ± 3.1	55.6 ± 13.2	<0.001
Group C	12.1 ± 5.4	51.2 ± 14.2	<0.001
Role limitations due to emotional problems			
Group PD	33.1 ± 9.4	68.2 ± 11.2	<0.001
Group C	32.8 ± 6.7	66.2 ± 10.2	<0.001
Energy/fatigue			
Group PD	50.8 ± 9.1	59.3 ± 12.7	<0.001
Group C	51.3 ± 8.9	57.3 ± 3.4	<0.001
Emotional well-being			
Group PD	61.2 ± 19.2	71.9 ± 21.1	<0.001
Group C	60.9 ± 18.7	72.2 ± 16.4	<0.001
Social functioning			
Group PD	26.4 ± 3.2	69. 9 ± 28.1	<0.001
Group C	25.9 ± 4.5	70.1 ± 21.1	<0.001
Pain			
Group PD	23.2 ± 6.5	81.5 ± 18.7	<0.001
Group C	24.1 ± 5.4	80.6 ± 20.3	<0.001
General health			
Group PD	45.6 ± 14.6	70.3 ± 15.6	<0.001
Group C			<0.001

Values are presented as mean ± SD. P≤0.05 considered significantly different and defined bold. KSS: Knee Society Score, PS: Patellar score, VAS: Visual analogue scale, SF-36: Short Form 36.

trocautery is safe when performed during standard TKA without patellar resurfacing. None of the abovementioned complications were observed in our study.

Increased functional capacity on cardiac functions after TKA was also defined in the literature by Arslan et al [32]. They reported that, after TKA, there was a significant increase in disease-specific, generic evaluations and objective physical capacity measures in the first year and left ventricular diastolic functions may be considered to have recovered in the light of the healing signs via echocardiography. SF-36 results may be affected by this kind of healing like cardiac. These factors also need to be taken into account.

The present study has several limitations. Firstly, the clinical outcomes were only based on KSS, PS and VAS scores. Knee joint range of motion and other physical examination findings were not included in this study. Secondly, postoperative outcomes evaluated at longer follow up durations of 6 and 12 months may provide more reliable outcomes. Thirdly, the retrospective nature of the study and two different surgeons operating on both the groups are other limitations. Lastly, the short follow-up duration prevents us from making long term implications.

Circumpatellar electrocautery denervation can be advantageous in reducing early postoperative knee pain. And clinical, functional and some of the QoL scores were better in the midterm postoperative period of patients with gonarthrosis treated by TKA with PD.

Ethics approval

Uludag University Clinical Research Ethics Committee (Approval number: 2020-10/14, approval date: 10/06/2020).

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