

Effect of Patellar Denervation by Electrocautery on Anterior Knee Pain and Functional Outcomes in Total Knee Arthroplasty Without Patellar Resurfacing: A Randomized Controlled Trial

Dasari Rajashekar¹, Kurimilla Akhil², Keetha Vijetha³

¹Assistant Professor, Department of Orthopaedics, Government Medical College, Suryapet, Telangana, India. ²Consultant Orthopaedic Surgeon, Shivaram Hospital, Shadnagar, Telangana, India. ³Senior Resident, Department of Orthopaedics, Government General Hospital, Suryapet, Telangana, India

Abstract

Background: Anterior knee pain remains a common cause of patient dissatisfaction following total knee arthroplasty (TKA). Patellar denervation by electrocautery has been proposed as an adjunctive technique to improve postoperative outcomes in TKA without patellar resurfacing. The objective is to evaluate the effect of intraoperative patellar denervation by electrocautery on pain relief, knee function, patellar score, and range of motion in patients undergoing TKA for primary osteoarthritis. **Material and Methods:** This randomized controlled prospective study was conducted at a tertiary care hospital in Bangalore between July 2019 and May 2021. Seventy patients with advanced primary osteoarthritis of the knee were randomized into two groups: Group 1 (n=35) underwent TKA with patellar electrocautery, and Group 2 (n=35) underwent TKA without denervation. Pain was assessed using the Visual Analogue Score (VAS), functional outcome using the Insall Knee Score (KSS), patellar function using the Patellar Score (PS), and mobility with Range of Motion (ROM). Assessments were made preoperatively and at 1, 3, 6, and 12 months postoperatively. **Results:** Both groups showed significant postoperative improvements; however, the electrocautery group achieved superior outcomes. VAS reduction was greater in Group 1 (0.03 vs. 0.49 at 12 months, $p < 0.001$). Similarly, improvements in KSS (94.63 vs. 89.74, $p < 0.001$) and PS (27.23 vs. 22.26, $p < 0.001$) were significantly higher in the electrocautery group. Although ROM increased in both groups, the difference was not statistically significant (114.06° vs. 108.46° , $p = 0.211$). **Conclusion:** Patellar denervation by electrocautery significantly reduced anterior knee pain and improved functional and patellar outcomes after TKA without resurfacing. The procedure is a simple, safe, and effective adjunct to enhance patient satisfaction.

Keywords: Total knee arthroplasty, patellar denervation, electrocautery, anterior knee pain, knee function

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INTRODUCTION

Osteoarthritis (OA) of the knee is among the most prevalent degenerative joint disorders and remains a leading cause of pain and disability in the elderly population. Total knee arthroplasty (TKA) is the definitive surgical intervention for advanced OA, providing substantial pain relief, correction of deformity, and restoration of mobility. Despite these well-established benefits, a significant proportion of patients continue to experience anterior knee pain (AKP) following TKA, which can negatively influence postoperative satisfaction and long-term functional outcomes.^[1-3]

The reported incidence of AKP after TKA ranges between 4% and 49%.^[2,4] Multiple factors contribute to its occurrence, including patellofemoral maltracking, peripatellar soft tissue irritation, and nociceptive signaling from innervated structures such as the synovium, retinaculum, and infrapatellar fat pad.^[3,5] Although the articular cartilage of the patella itself is aneural, studies have identified abundant substance P-positive nociceptive fibers in surrounding peripatellar tissues, supporting the role of neural pathways in mediating persistent pain.^[2,5]

Circumferential patellar denervation using electrocautery has

been introduced as a simple adjunctive procedure aimed at ablating nociceptive fibers and thereby reducing postoperative AKP. Several randomized controlled trials and meta-analyses have suggested that patellar denervation may significantly reduce anterior knee pain and improve functional outcomes after TKA without patellar resurfacing.^[1,2,4-6] However, evidence remains inconsistent, particularly regarding the durability of benefit, influence on knee kinematics, and long-term functional outcomes.^[3,5]

Given these uncertainties, this study was designed as a randomized controlled prospective trial to assess the impact of patellar denervation by electrocautery on pain relief, knee

Address for correspondence: Dr. Dasari Rajashekar, Assistant Professor, Department of Orthopaedics, Government Medical College, Suryapet, Telangana, India
E-mail: shekar2223@gmail.com

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function, patellar score, and range of motion in patients undergoing TKA without patellar resurfacing.

MATERIALS AND METHODS

Study Design and Setting: A randomized controlled prospective study was conducted in the Department of Orthopaedics, BGS Global Hospital, Bangalore, between July 2019 and May 2021.

Study Population: Seventy patients (aged 45–80 years) diagnosed with advanced primary osteoarthritis of the knee and scheduled for total knee arthroplasty (TKA) were included. Both unilateral and bilateral cases were eligible.

Inclusion criteria:

- Age between 45 and 80 years
- Advanced primary osteoarthritis of the knee
- Patients willing to undergo surgery and follow-up

Exclusion criteria:

- Rheumatoid arthritis or other inflammatory arthropathies
- Any active or prior knee infection
- Long-term glucocorticoid therapy
- Patients receiving epidural anesthesia
- Refusal to participate

Randomization and Intervention

Participants were randomized into two groups (n=35 each) using block randomization:

Group 1 (Electrocautery): TKA with intraoperative circumferential patellar denervation using monopolar diathermy (50 W), applied to the synovial tissue within 1 cm of the patellar rim.

Group 2 (Control): TKA without patellar denervation.

All patients underwent standard TKA using Zimmer NexGen or PFC SIGMA implants, cemented with gentamicin-loaded polymethylmethacrylate. Osteophytes were removed in all cases. A standard medial parapatellar approach was employed. Patients, assessors, and statisticians were blinded to group allocation.

Postoperative Management: All patients received prophylactic antibiotics and deep vein thrombosis (DVT) prophylaxis. Early mobilization with full weight-bearing and physiotherapy was initiated on the first postoperative day. Standard rehabilitation protocols were followed uniformly across both groups.

Outcome Measures

Patients were evaluated preoperatively and postoperatively at 1 month, 3 months, 6 months, and 12 months using:

- Visual Analogue Score (VAS): pain intensity
- Insall Knee Society Score (KSS): functional outcome
- Patellar Score (PS): patellofemoral function
- Range of Motion (ROM): assessed by goniometer

Statistical Analysis

Data were analyzed using SPSS software (version 22, IBM Corp., Chicago, USA). Continuous variables were expressed as mean ± standard deviation, while categorical variables were presented as frequencies and percentages. Repeated measures analysis of variance (ANOVA) was used to compare changes within and between groups over time. A p-value <0.05 was considered statistically significant.

Ethical Approval: The study was approved by the Institutional Ethics Committee of BGS Global Hospital, Bangalore, and written informed consent was obtained from all participants prior to enrollment.

RESULTS

A total of 70 patients with advanced primary osteoarthritis of the knee who underwent total knee arthroplasty (TKA) were included in this randomized controlled study. Participants were equally distributed between the electrocautery (n=35) and control (n=35) groups. The mean age of the cohort was 66.11 ± 7.52 years, with the majority of participants falling in the 66–75 years age group (48.6%). Females predominated in both groups (57.1% in the electrocautery group and 62.9% in the control group) [Table 1].

Table 1: Baseline Characteristics of Study Participants

Variable	Electrocautery (n=35)	Control (n=35)	Total (N=70)
Age (Mean ± SD)	66.11 ± 7.52 years	66.11 ± 7.52	66.11 ± 7.52
Age Distribution			
46–55 years	3 (8.6%)	3 (8.6%)	6 (8.6%)
56–65 years	14 (40.0%)	11 (31.4%)	25 (35.7%)
66–75 years	16 (45.7%)	18 (51.4%)	34 (48.6%)
>75 years	2 (5.7%)	3 (8.6%)	5 (7.1%)
Gender (Male/Female)	15 / 20	13 / 22	28 / 42

Pain Outcomes: The Visual Analogue Score (VAS) demonstrated a significant reduction in pain over the follow-up period in both groups, with a greater improvement in the electrocautery group. Preoperatively, the mean VAS was comparable between groups (7.29 vs. 7.26). At 1 month, mean VAS reduced to 2.43 in the electrocautery group

compared with 3.14 in the control group. By 12 months, pain was almost completely alleviated in the electrocautery group (0.03) compared with residual discomfort in the control group (0.49). The differences were statistically significant (p<0.001) [Table 2].

Table 2: Visual Analogue Score (VAS) over 12 Months

Time Point	Electrocautery (Mean ± SD)	Control (Mean ± SD)	p-value
Pre-operative	7.29 ± 0.89	7.26 ± 0.91	<0.001
1 month	2.43 ± 0.65	3.14 ± 0.73	
3 months	1.20 ± 0.72	2.40 ± 0.78	
6 months	0.43 ± 0.50	1.20 ± 0.67	
12 months	0.03 ± 0.16	0.49 ± 0.61	

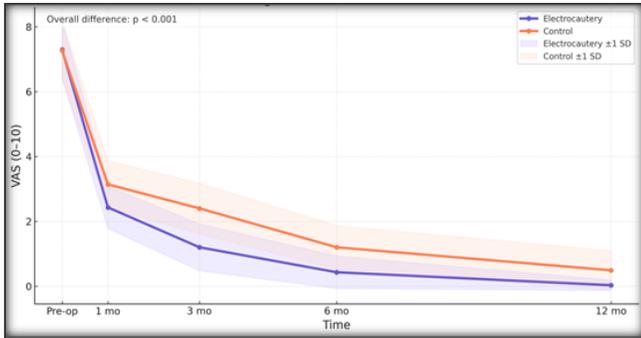


Figure 1: Visual Analogue Score (VAS) over 12 Months

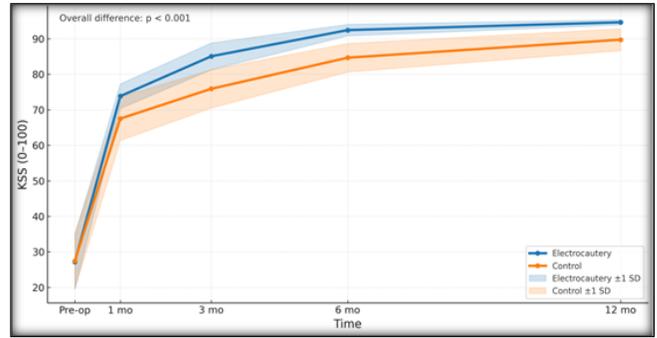


Figure 2: Insall Knee Score(KSS) over 12 Months

Functional Outcomes: Knee function assessed by the Insall Knee Score (KSS) showed significant improvements across all time points in both groups, with consistently higher scores in the electrocautery group. Baseline preoperative scores were similar (27.17 vs. 27.46). At 3 months, the mean KSS in the electrocautery group rose to 85.06 compared with 75.91 in the control group. At 12 months, scores further improved to 94.63 and 89.74, respectively. The inter-group differences were statistically significant ($p < 0.001$) [Table 3].

Patellar Function: The Patellar Score (PS) also improved markedly in the electrocautery group compared with controls. Baseline values were similar (9.74 vs. 10.03). At 6 months, the mean PS was significantly higher in the electrocautery group (26.37) compared with the control group (21.34). By 12 months, the intervention group maintained superior scores (27.23 vs. 22.26), with statistical significance ($p < 0.001$) [Table 4].

Table 3: Insall Knee Score (KSS) over 12 Months

Time Point	Electrocautery (Mean ± SD)	Control (Mean ± SD)	p-value
Pre-operative	27.17 ± 7.74	27.46 ± 7.82	<0.001
1 month	73.83 ± 3.46	67.51 ± 6.13	
3 months	85.06 ± 3.77	75.91 ± 5.39	
6 months	92.43 ± 1.61	84.66 ± 4.02	
12 months	94.63 ± 0.73	89.74 ± 3.07	

Table 4: Patellar Score (PS) over 12 Months

Time Point	Electrocautery (Mean ± SD)	Control (Mean ± SD)	p-value
Pre-operative	9.74 ± 3.75	10.03 ± 3.52	<0.001
1 month	17.31 ± 1.27	15.20 ± 2.02	
3 months	21.34 ± 1.86	18.31 ± 1.38	
6 months	26.37 ± 1.57	21.34 ± 2.16	
12 months	27.23 ± 1.68	22.26 ± 2.03	

Table 5: Range of Movements (ROM) over 12 Months

Time Point	Electrocautery (Mean ± SD)	Control (Mean ± SD)	p-value
Pre-operative	73.11 ± 7.87	73.54 ± 7.48	0.211
1 month	92.71 ± 7.79	91.68 ± 6.28	
3 months	105.11 ± 7.39	103.11 ± 7.24	
6 months	112.31 ± 7.57	107.37 ± 7.90	
12 months	114.06 ± 8.62	108.46 ± 8.23	

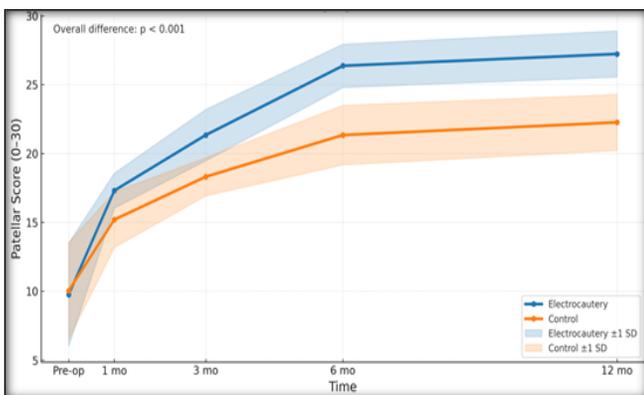


Figure 3: Patellar Score(PS) over 12 Months

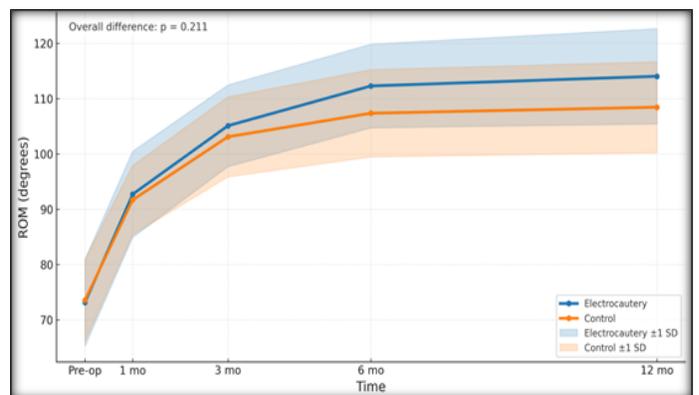


Figure 4: Range of Movements (ROM) over 12 Months

Range of Motion: Improvement in range of motion (ROM) was observed in both groups following surgery. Preoperative ROM was comparable between groups (73.11° vs. 73.54°). By 12 months, the electrocautery group achieved a mean ROM of 114.06°, while the control group attained 108.46°. Although the trend favored electrocautery, the difference was not statistically significant (p=0.211) [Table 5].

DISCUSSION

This randomized controlled prospective study evaluated the role of patellar denervation by electrocautery in patients undergoing total knee arthroplasty (TKA) without patellar resurfacing. The results demonstrated that patients in the electrocautery group experienced significantly greater reductions in anterior knee pain and superior improvements in knee function and patellar scores compared with controls. However, the differences in range of motion (ROM) between the two groups were not statistically significant.

Pain Outcomes: Pain relief remains the cornerstone of successful TKA. In this study, Visual Analogue Score (VAS) decreased more rapidly and consistently in the electrocautery group, with near-complete pain resolution by 12 months. This finding is in agreement with Alomran,^[6] who observed reduced anterior knee pain following patellar denervation in a randomized controlled trial of non-resurfaced TKA. Budhiparama et al,^[7] further supported this, reporting that circumferential denervation significantly lowered pain scores and enhanced patient-reported outcomes in simultaneous bilateral TKA. On the other hand, Li et al,^[8] demonstrated functional improvement even in non-resurfaced knees without denervation, suggesting that while denervation enhances pain relief, surgical precision and rehabilitation protocols remain critical. Ji et al,^[9] provided additional evidence that peripheral patellar denervation may even surpass patellar resurfacing in reducing postoperative anterior knee pain, reinforcing its clinical relevance.

Functional Outcomes: Knee function assessed by the Insall Knee Score (KSS) improved significantly in both groups, with superior gains in the electrocautery group. This suggests that reduced pain likely facilitated earlier mobilization and rehabilitation. The functional benefit of denervation has been highlighted by Budhiparama et al,^[7] who observed improved patient-reported outcomes, and was also supported by Altay et al,^[11] who found significantly better scores in denervated knees. In contrast, Li et al,^[8] cautioned that long-term outcomes may depend on factors beyond denervation, such as implant design and patient compliance with physiotherapy. Collectively, these findings indicate that denervation contributes to enhanced early functional recovery, though its long-term superiority remains to be established.

Patellar Outcomes: Patellar scores in the present study improved significantly in the electrocautery group compared with controls, consistent with previous randomized trials and meta-analyses. Ji et al,^[9] reported that peripheral denervation led to better patellofemoral function compared with resurfacing, highlighting its potential as a safe alternative. Similarly, Altay et al,^[11] found that patellar denervation

substantially reduced patellofemoral pain and improved knee-specific functional scores. A broader meta-analysis by Feng et al,^[12] emphasized that factors such as maltracking, implant alignment, and soft tissue balance also influence anterior knee pain, suggesting that denervation should be seen as part of a multifactorial strategy.

Range of Motion: Although ROM improved postoperatively in both groups, no significant difference was observed between electrocautery and control groups. This is in line with prior studies,^[7,11] which showed that while denervation enhances pain relief and function, it does not independently improve joint mobility. Instead, ROM is more strongly influenced by surgical exposure, implant positioning, and postoperative rehabilitation protocols. This reinforces that denervation should be considered an adjunctive technique rather than a determinant of mobility.

Generalizability and Evidence Context: The current findings strengthen the growing body of literature supporting patellar denervation as a low-cost, low-risk, and technically simple procedure that improves outcomes in non-resurfaced TKA.^[6-9,11] Several meta-analyses,^[10,12] have highlighted the ongoing debate between resurfacing, non-resurfacing, and denervation strategies, with no universal consensus. However, the consistent observation across studies is that denervation significantly reduces early anterior knee pain and improves functional satisfaction, without adding operative complexity or complications.

The study was limited by its single-center design and relatively small sample size, which may affect generalizability. The follow-up period was restricted to one year, preventing assessment of long-term outcomes. Additionally, potential confounding factors such as implant type and rehabilitation compliance were not fully controlled.

CONCLUSION

This randomized controlled study demonstrated that intraoperative patellar denervation by electrocautery significantly improved postoperative outcomes in patients undergoing total knee arthroplasty without patellar resurfacing. Patients in the electrocautery group experienced greater reductions in anterior knee pain, as reflected by lower VAS scores, and showed superior improvements in knee function and patellar scores compared with controls. Although range of motion improved in both groups, the difference was not statistically significant. Patellar denervation is a simple, safe, and effective adjunctive technique that enhances patient satisfaction and functional recovery. Its incorporation in routine practice may help optimize TKA outcomes in selected patients.

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Conflicts of interest

There are no conflicts of interest.

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