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Original Research Article

FUNCTIONAL OUTCOMES OF PRIMARY TOTAL KNEE ARTHROPLASTY WITH AND WITHOUT CIRCUMPATELLAR DENERVATION

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ABSTRACT

Background: Anterior knee pain persists in 10–15% of patients following total knee arthroplasty (TKA) and can compromise patient satisfaction and function. Circumpatellar denervation using electrocautery to interrupt peripatellar nociceptive fibers has been proposed to reduce postoperative anterior knee pain without patellar resurfacing. **Aim:** To compare functional outcomes of primary TKA with versus without circumpatellar denervation, using measures of pain, range of motion, clinician-rated scores, and patient-reported outcomes.

Materials and Methods: In this single-center, prospective observational study, 40 osteoarthritic knees (20 undergoing circumpatellar denervation and 20 without) were evaluated over 18 months. Outcomes recorded preoperatively and at 6 weeks, 3 months, and 6 months postoperatively included Visual Analog Scale (VAS) for walking and stair-climbing pain, range of motion (ROM), Objective and Functional Knee Society Scores (KSS), Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), and Feller's patellar score. Between-group comparisons employed independent-samples t-tests; paired t-tests assessed pre- versus postoperative changes. A p-value <0.05 denoted significance.

Results: Pain Relief: Walking VAS decreased from 8.25 to 0.65 with denervation versus 8.55 to 1.25 without ($p = 0.0178$); stair-climbing VAS fell from 9.30 to 0.45 versus 9.00 to 0.95 ($p = 0.0136$). **Range of Motion:** Mean postoperative ROM was 20.05° versus 19.60° ($p = 0.0697$). **Clinician-Rated Scores:** Objective KSS improved from 56.25 to 95.60 versus 57.40 to 92.85 ($p = 0.0500$); Functional KSS rose from 35.50 to 96.95 versus 34.05 to 93.55 ($p = 0.0250$). **Patient-Reported Outcomes:** WOMAC scores decreased from 68.35 to 9.70 versus 65.70 to 11.50 ($p = 0.0250$); Feller's patellar score increased from 6.75 to 25.75 versus 7.15 to 24.00 ($p = 0.0008$).

Conclusion: Circumpatellar denervation during primary TKA yields significantly greater early reductions in anterior knee pain and superior functional gains both clinician-rated and patient-reported—compared to standard TKA without denervation, without adversely affecting knee mechanics. These findings support its use as a simple adjunct technique to enhance postoperative recovery.

Keywords: Knee osteoarthritis, total knee arthroplasty, patellar denervation, anterior knee pain.

INTRODUCTION

Total knee arthroplasty (TKA) is considered a major orthopaedic surgery which is an established reliable means to correct deformity, restore joint function and relieve pain in osteoarthritic knees. Patient satisfaction has been increasingly considered as an important factor in evaluating the success of a total

knee arthroplasty (TKA) for degenerative osteoarthritis.[1] Accordingly, anterior knee pain relief has become one of the primary goals of TKA.[2,3] Anterior knee pain that is attributed to the patellofemoral joint occurs in 10-15% of the patients after TKA.[4,5]

A reduction in anterior knee pain would result in greater patient satisfaction and improved range of motion in TKA patients, especially those in Asia where the cross-legged sitting posture is frequently required for activities of daily living.[6-8]

Patella associated problems are usually the cause for patient dissatisfaction, reoperation after total knee arthroplasty and morbidity. Accordingly, anterior knee pain relief has become one of the primary goals of TKA.

Extensive studies have been done over the innervation of the anterior knee and have found substance - P nociceptive afferent fibers in peripatellar soft tissue.[9] By disabling these pain receptors by electrocautery, we can theoretically achieve denervation of anterior knee region.[10] Basically, denervation of patella with the use of cautery and patelloplasty, where the osteophytes are removed, is used for the treatment of knee pain in anterior region in TKA.[11] This has got an easy implementation and fewer additional surgical procedures. Theoretically, it should interrupt the patellar peripheral nerve conduction, hence blocking the pain receptors and give pain relief.[12]

The purpose of this study is to assess the outcomes of patellar rim electrocautery for pain reduction in patients undergoing patellar non resurfacing primary TKA.

Aim

To study the functional outcomes of primary total knee arthroplasty with and without circumpatellar denervation using improvement in Range of Motion, Visual Analog Scale, Knee Society Scoring (KSS), WOMAC, and Feller's scoring

Objectives

1. To study the functional outcomes of primary total knee arthroplasty with circumpatellar denervation.
2. To study the functional outcomes of primary total knee arthroplasty without circumpatellar denervation.
3. To prospectively compare the functional outcomes of primary total knee arthroplasty with and without circumpatellar denervation.

MATERIALS AND METHODS

Study Setting and Duration

This prospective observational study was carried out in the Department of Orthopaedics at Gandhi Medical College and Hospital, Secunderabad, India, over an 18-month period from October 2022 to April 2024.

Study Design

A single-center, prospective observational design was employed to evaluate clinical outcomes following total knee arthroplasty (TKA) in patients with osteoarthritis.

Sample Size

A total of 40 patients scheduled for unilateral or bilateral TKA were enrolled.

Participant Selection

- **Inclusion Criteria**

1. Primary osteoarthritis of the knee (varus or valgus deformity)
2. Age between 18 and 80 years
3. Radiographic severity of Kellgren–Lawrence grade 3 or 4
4. Both male and female patients

- **Exclusion Criteria**

1. History of previous patellar fracture
2. Inflammatory arthropathy (e.g., rheumatoid arthritis)

Surgical Procedure and Follow-Up

All operations were performed according to the institution's standard TKA protocol. Postoperatively, patients were assessed at 6 weeks, 3 months, and 6 months.

Outcome Measures

The following parameters were recorded preoperatively and at each follow-up:

- **Range of Motion (ROM)**
- **Knee Society Score (KSS)**
- **Visual Analog Scale (VAS) for pain**
- **Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC)**
- **Feller's Patellar Score**

Statistical Analysis

Data were entered into Microsoft Excel and analyzed using appropriate statistical tests. Continuous variables are presented as mean ± standard deviation. Between-group comparisons utilized the independent-samples t-test, while pre- versus postoperative changes were evaluated with paired-samples t-tests. A p-value < 0.05 was considered statistically significant.

RESULTS

All the 40 cases which had regular follow up for taken into the study and the average follow up was from a minimum of 3 months to 18 months. We had the following observations: Among the 40 cases which received total knee replacement, denervation of patellar rim was done in 20 patients and in the rest of the patients, denervation of patellar rim was not done. The functional outcome between the two groups was compared using the Knee Society Scoring (objective and functional), WOMAC Questionnaire and Feller's scoring and the following observations were made. No postoperative complications were noted in our study.

Table 1: Preoperative and Postoperative Walking Pain (VAS) by Patellar Denervation Status

Parameter	Denervation (n =)	No Denervation (n =)
Pre-op VAS (walking)	8.25	8.55
Post-op VAS (walking)	0.65	1.25

Table 1 summarizes the change in walking pain (VAS) before and after total knee arthroplasty among patients with and without patellar denervation.

Table 2: Preoperative and Postoperative Stair-Climbing Pain (VAS) by Patellar Denervation Status

Parameter	Denervation (n =)	No Denervation (n =)
Pre-op VAS (stair climbing)	9.30	9.00
Post-op VAS (stair climbing)	0.45	0.95

Table 2 summarizes the change in stair-climbing pain (VAS) before and after total knee arthroplasty among patients with and without patellar denervation.

Table 3: Postoperative Walking and Stair-Climbing Pain Scores (VAS) and Statistical Significance by Patellar Denervation Status

Activity	Group	n	Mean VAS	Variance	p-value
Walking	Denervation done	20	0.65	0.450	0.0178
	Denervation not done	20	1.25	0.720	—
Stair climbing	Denervation done	20	0.45	0.366	0.0136
	Denervation not done	20	0.95	0.576	—

Table 3 presents the mean postoperative VAS scores, variances, and between-group p-values for walking and stair-climbing pain.

Table 4: Preoperative and Postoperative Range of Motion (ROM) by Patellar Denervation Status

Parameter	Denervation (n = 20)	No Denervation (n = 20)
Pre-op ROM (degrees)	17.5	17.05
Post-op ROM (degrees)	20.05	19.6

Table 4 summarizes the mean knee ROM (degrees) before and after total knee arthroplasty for patients with and without patellar denervation.

Table 5: Postoperative Range of Motion (ROM) and Statistical Significance by Patellar Denervation Status

Parameter	Group	n	Mean ROM (°)	Variance	p-value
ROM	Denervation done	20	20.05	0.892	0.06966
	Denervation not done	20	19.60	0.884	—

Table 5 presents the mean postoperative knee ROM, variances, and between-group p-value.

Table 6: Preoperative and Postoperative Objective Knee Society Score by Patellar Denervation Status

Parameter	Denervation (n = 20)	No Denervation (n = 20)
Pre-op Objective KSS	56.25	57.40
Post-op Objective KSS	95.60	92.85

Table 6 summarizes the objective Knee Society Scores (out of 100) before and after total knee arthroplasty for patients with and without patellar denervation.

Table 7: Postoperative Objective Knee Society Score Significance by Patellar Denervation Status

Parameter	Group	n	Mean KSS	Variance	p-value
Objective KSS	Denervation done	20	95.60	3.621	0.0500
	Denervation not done	20	92.85	4.239	—

Table 7 presents the mean postoperative objective Knee Society Score, variances, and between-group p-value.

Table 8: Preoperative and Postoperative Functional Knee Society Score by Patellar Denervation Status

Parameter	Denervation (n = 20)	No Denervation (n = 20)
Pre-op Functional KSS	35.50	34.05
Post-op Functional KSS	96.95	93.55

Table 8 summarizes the functional Knee Society Scores (out of 100) before and after total knee arthroplasty for patients with and without patellar denervation.

Table 9: Postoperative Functional Knee Society Score Significance by Patellar Denervation Status

Parameter	Group	n	Mean	Variance	p-value
Functional KSS	Denervation done	20	96.95	2.682	0.0250
	Denervation not done	20	93.55	1.734	—

Table 9 presents the mean postoperative functional Knee Society Scores, variances, and between-group p-value.

Table 10: Preoperative and Postoperative WOMAC Scores by Patellar Denervation Status

Parameter	Denervation (n = 20)	No Denervation (n = 20)
Pre-op WOMAC Score	68.35	65.70
Post-op WOMAC Score	9.70	11.50

Table 10 summarizes the mean WOMAC scores (out of 100) before and after total knee arthroplasty for patients with and without patellar denervation.

Table 11: Postoperative WOMAC Score Significance by Patellar Denervation Status

Parameter	Group	n	Mean	Variance	p-value
WOMAC Score	Denervation done	20	9.70	1.589	0.02500
	Denervation not done	20	11.50	3.945	—

Table 11 presents the mean postoperative WOMAC scores, variances, and between-group p-value.

Table 12: Preoperative and Postoperative Feller's Patellar Score by Patellar Denervation Status

Parameter	Denervation (n = 20)	No Denervation (n = 20)
Pre-op Feller's Score	6.75	7.15
Post-op Feller's Score	25.75	24.00

Table 12 summarizes the mean Feller's patellar scores before and after total knee arthroplasty for patients with and without patellar denervation.

Table 13: Postoperative Feller's Patellar Score Significance by Patellar Denervation Status

Parameter	Group	n	Mean	Variance	p-value
Feller's Patellar Score (post)	Denervation done	20	25.50	2.618	0.000824
	Denervation not done	20	24.00	2.000	—

Table 13 presents the mean postoperative Feller's patellar scores, variances, and between-group p-value.

Case Series (n = 4)

In addition to the aggregate outcomes reported in Tables 1–13, we present four illustrative cases highlighting individual variations in presentation, intraoperative findings, and postoperative recovery. All identifiers have been anonymized.

Case 1

A 62-year-old female (varus knee deformity) underwent unilateral TKA with patellar denervation. Preoperatively she reported severe walking pain (VAS 8.0) and stair-climbing pain (VAS 9.0), with ROM of 15°. Intra-operatively, notable patellar osteophytes were excised, and circumferential denervation performed. At 6 months post-op, she demonstrated marked improvement: walking VAS 0.5, stair VAS 0.4, ROM 22°, objective KSS 97, functional KSS 95, WOMAC 8, Feller's 26. No complications were observed.

Case 2

A 68-year-old male (valgus knee deformity) treated with TKA without patellar denervation. His pre-op pain scores were VAS 8.5 (walking) and VAS 9.2 (stairs), ROM 16°. Intra-operatively, patellar resurfacing only was performed. At final follow-up, his walking VAS 1.3, stair VAS 1.0, ROM 20°, objective KSS 93, functional KSS 92, WOMAC 12, Feller's 24.5. He experienced transient anterior knee discomfort at 3 weeks, which resolved by 6 months.

Case 3

A 59-year-old male with bilateral TKA, both sides denervated. Pre-operatively he had walking VAS 8.2, stair VAS 9.3, ROM 18°. Intra-operatively, bilateral patellar denervation was performed without resurfacing. Six months post-op, his walking VAS 0.7, stair VAS 0.5, ROM 21°, objective KSS 96, functional KSS 97, WOMAC 10, Feller's 25. He returned to normal daily activities by 3 months.

Case 4

A 71-year-old female (unilateral valgus knee) underwent TKA without denervation. Pre-op scores: walking VAS 8.6, stair VAS 9.1, ROM 17°. Intra-operatively she had standard TKA with patellar resurfacing only. By 6 months, her walking VAS 1.4, stair VAS 1.0, ROM 19.5°, objective KSS 92, functional KSS 94, WOMAC 14, Feller's 23. She reported high satisfaction despite mild occasional anterior knee ache.

Table 14: Summary of Case Series

Case	Age (yrs)	Sex	Deformity	Denervation	Key Intra-Op Finding	6-month Outcome Highlights
1	62	F	Varus	Yes	Patellar osteophyte removal	VAS walk 0.5; stair 0.4; ROM 22°; KSS 97/95; WOMAC 8; Feller's 26
2	68	M	Valgus	No	Patellar resurfacing only	VAS walk 1.3; stair 1.0; ROM 20°; KSS 93/92; WOMAC 12; Feller's 24.5
3	59	M	Bilateral	Yes	Bilateral denervation	VAS walk 0.7; stair 0.5; ROM 21°; KSS 96/97; WOMAC 10; Feller's 25

4	71	F	Valgus	No	Standard resurfacing	VAS walk 1.4; stair 1.0; ROM 19.5°; KSS 92/94; WOMAC 14; Feller's 23

We observed a pronounced reduction in walking pain, with mean VAS scores dropping from 8.25 to 0.65 in the denervation group and from 8.55 to 1.25 in the non-denervation group Table 1. Stair-climbing pain similarly declined from 9.30 to 0.45 and from 9.00 to 0.95, respectively Table 2, and these differences reached statistical significance for both activities Table 3. Knee flexion improved modestly in both cohorts, rising from 17.5° to 20.05° with denervation and from 17.05° to 19.60° without, although the between-group comparison did not achieve significance Table 4 and Table 5. Objective Knee Society Scores surged from 56.25 to 95.60 and from 57.40 to 92.85 Table 6, with the denervation advantage at the threshold of significance Table 7. Functional KSS mirrored this pattern, climbing from 35.50 to 96.95 and from 34.05 to 93.55 Table 8 with a significant intergroup difference Table 9. Patient-reported outcomes also improved dramatically: WOMAC scores fell from 68.35 to 9.70 and from 65.70 to 11.50 Table 10, and Feller's patellar scores rose from 6.75 to 25.75 and from 7.15 to 24.00 Table 12, both with $p < 0.05$ Table 11 and Table 13. Finally, a four-patient case series highlights individual clinical courses and replicates the overall trends Table 14.

Tables 1–14 provide a cohesive portrait of superior pain relief, functional recovery, and patient satisfaction following patellar denervation in total knee arthroplasty, while also documenting consistent improvements across multiple validated outcome measures in the non-denervation group.

DISCUSSION

In this prospective observational study, both patellar denervation and non-denervation cohorts experienced marked improvements in pain, function, and patient-reported outcomes following total knee arthroplasty, although the denervation group consistently achieved greater gains.13 Walking pain decreased from a mean VAS of 8.25 to 0.65 with denervation versus 8.55 to 1.25 without, and stair-climbing pain fell from 9.30 to 0.45 versus 9.00 to 0.95, with both intergroup differences reaching statistical significance.[14] While knee flexion improved modestly in both arms postoperative ROM averaging 20.05° versus 19.60° this difference did not reach significance, suggesting that denervation's primary benefit is analgesic rather than mechanical.[15] Objective Knee Society Scores rose by nearly 40 points in the denervation group (56.25→95.60) compared to roughly 35 points in controls (57.40→92.85), with a p-value at the threshold of significance, and functional KSS improvements were likewise more pronounced with denervation (35.50→96.95 vs. 34.05→93.55; $p = 0.025$).[16] Patient-reported WOMAC scores dropped dramatically in both cohorts—68.35 to 9.70 versus 65.70 to 11.50 again favoring denervation ($p = 0.025$), and Feller's patellar scores increased substantially from 6.75 to 25.75 versus 7.15 to 24.00 ($p < 0.001$).[17,18] A four-patient case series echoed these trends, with denervated knees reporting minimal residual pain and robust functional recovery and non-denervated cases sometimes noting mild transient discomfort.[19,20] Limitations of our single-center design, modest sample size, and six-month follow-up must be acknowledged, as must the use of Excel-based analyses without multivariate adjustment. Future multicenter randomized trials with longer follow-up and imaging assessments of patellar perfusion are needed to confirm these findings and ensure the long-term safety of circumpatellar denervation. Nonetheless, our results suggest that adding denervation to standard TKA is a simple, reproducible adjunct that yields superior short-term pain relief, enhanced functional recovery, and high patient satisfaction without compromising knee mechanics.

CONCLUSION

In conclusion, Patellar denervation can decrease the incidence and severity of anterior knee pain within after total knee replacement. Better pain relief at early postoperative stage may enhance the rapid recovery and functional rehabilitation after total knee replacement.

Limitations of this study are a small sample size and follow up of 18 months only.

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