

Comparative Evaluation of Patellar Denervation Using Circumferential Electrocautery in Reducing Postoperative Anterior Knee Pain After Total Knee Arthroplasty: A Historical Cohort Study

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Abstract: Background: The study was aimed at evaluating the role of patellar denervation vs no through circumferential electrocauterization vs no denervation in reducing post-operative anterior knee pain in patients undergoing Total Knee Arthroplasty. Methods: We conducted a single centre cohort study with historical control to compare the two study groups wherein Anterior knee pain and functional outcomes were compared and statistically analysed for a minimum period of 12 months post-operatively and functional comparison was done using various scores like Feller's Patella score, Oxford knee score. Results: With 36 participants in each group and a minimum follow-up for 12 months and analyses of various functional scores, though the pain scores decreased significantly during follow-up and functional improvement was statistically significant in both groups, individually there was no statistically significant difference in pain and functional outcomes of both the study group. Conclusion: Patellar denervation through circumferential electrocauterization in Total knee Arthroplasty does not yield a statistically significant difference in the Post-operative pain and functional outcomes of the patients.

Keywords: Total knee arthroplasty, patellar denervation, anterior knee pain, Oxford Knee Score, knee society score, Patellar-Feller score

1. Introduction

Total Knee Arthroplasty is one of the most popular and functionally enabling orthopaedic surgery performed worldwide. Around 49% of patients with osteoarthritis of the knee undergo total knee arthroplasty globally. It is one of the most effective elective orthopaedic surgeries because of the outstanding long-term results it provides for the patients with osteoarthritis of the knee. However, there are a few drawbacks to this treatment, in particular, it has been noted that between 4 and 60% of patients who have a total knee replacement, report having post-operative knee pain, specifically anterior knee pain.

Anterior knee pain is the pain which occurs at the front and center of the knee due to friction between the posterior surface of patella and the femoral component of the implant. This causes the dissatisfaction rate to go as high as 19% post total knee arthroplasty.

Anterior knee pain can be traced to various root causes such as patellar maltracking (patella alta / baja), functional causes (muscle imbalances, dynamic valgus), mechanical causes (incorrect positioning of prosthetic components, patellar fractures, aseptic loosening, etc.).

Various methods have been tried to get rid of this complication of anterior knee pain following total knee arthroplasty. Patellar resurfacing is one of the techniques which is followed by many surgeons to decrease anterior knee pain following surgery but the outcomes in form of functional scores and pain scores are similar in most of the studies

comparing patellar resurfacing total knee arthroplasty and patellar non resurfacing total knee arthroplasty.

To overcome this problem, patellar replacement was then started along with Total Knee Arthroplasty. For this minimum bony thickness of 12-15mm after resection of patella is necessary. Patellar components thickness: 8-10mm (average normal patellar thickness: 22-26mm). Patellar replacement can be challenging in Asian population as the patellar thickness is inherently less. Besides it can also lead to known complications such as patella fractures, ligament injury, implant loosening, etc.

Circumferential electrocauterization of the patella was then started with the view of denervation of the patella thus decreasing the post-operative anterior knee pain but studies showed that pain score obtained in both groups i. e. patients with patellar denervation and without denervation total knee arthroplasty were similar. Though not proven statistically but some studies have also shown that circumferential electrocoagulation of patella would lead to avascular necrosis and damage to patella in longer run. We have been traditionally doing circumferential electrocoagulation in our patients operated at AIIMS Patna. We want to evaluate these new subsets of patients (cases) where we will not be doing circumferential denervation by electrocoagulation with our historic controls where we have done circumferential denervation by electrocoagulation.

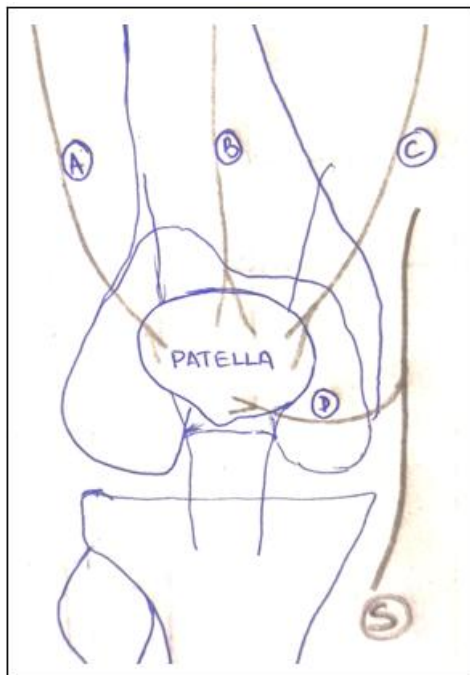


Figure 1: Nerve supply around patella by A) Lateral femoral cutaneous nerve B) Anterior cutaneous branches of femoral nerve C) Medial cutaneous femoral nerve D) Cutaneous branches of saphenous nerve

Rationale

Since post operative knee pain following total knee arthroplasty is still an unsolved mystery of an otherwise very successful surgery, we are taking up this matter with a view of providing any possible solution to it. Lot many things have been suggested and is being followed without any solid evidence and one of them is circumferential denervation of parapatellar tissues by electrocoagulation. Patellar resurfacing which was practised by many to decrease the anterior knee pain following total knee arthroplasty had its own complications like potential risk of patellar fracture and prosthetic revision in future. Again, patellar retention has its own benefits like conservation of patellar bone stock, reduction in operative time. So, denervation of patella by electrocautery is a relatively simple and thought to be an effective method to reduce the severity and incidence of anterior knee pain. Nevertheless, papers have also documented conflicting results of patellar denervation in total knee arthroplasty so far as their effect on the post operative anterior knee pain is considered. Yet, electrocauterization of patella is still a widely used procedure to reduce the post operative anterior knee pain following total knee arthroplasty. Though it is still not clear whether it works in patients or not.

When the source of the pain was searched for, it was found that both the peripatellar soft tissue and the infrapatellar fat pad are responsible for the anterior knee pain following total knee arthroplasty. When the degenerated patellar articular cartilage meets the femoral component, pain is felt. But it is well documented that healthy articular cartilage does not contain pain fibres; so, this further added to the confusion regarding the origin of pain and finally, immunohistochemical studies demonstrated that peripatellar soft tissue in association with degenerate cartilage are hyper innervated. From here the concept of denervation of the

patella came into being and Vega, Golano, Perez-Carro put forward a technique of introducing thermal lesion to the peripatellar soft tissues for patellofemoral joint pain.

Till now there is not enough documentation regarding the efficacy of patellar denervation through circumferential electrocauterization in decreasing the anterior knee pain following total knee arthroplasty. In fact, there is hardly any document providing evidence of utility of this procedure in Indian subcontinent.

This study will give us the evidence whether peripatellar circumferential electrocauterization and denervating the neural structure around patella is an effective technique to curb the post-operative anterior knee pain in patients undergoing total knee arthroplasty.

2. Materials and Methods

This study was conducted as a single centre, 2 group study wherein there was a Prospective group of patients undergoing TKA who underwent patellar denervation through circumferential electrocauterization and were compared with a historical cohort of the patients who underwent TKA without patellar denervation, the study was undertaken after approval from the Institute Ethics Committee.

Participants

Patients aged 45 years and above undergoing Primary Total knee Arthroplasty were included in the study. Those who had a history of any previous knee surgeries, a History of Patella fracture or undergoing Revision arthroplasty were excluded from the study. A total of 84 patients underwent Total Knee Arthroplasty during the study duration, a total of 12 patients did not follow up for a period of 12 months or more and hence were dropped out of the study, a total of 72 patients completed the follow-up and were included in the statistical analyses (36 in each group).

Recruiting centre

All the patients were recruited from a single centre, who underwent Total Knee Arthroplasty at All India Institute of Medical Sciences, Patna

Interventions

All the participants underwent Primary Total knee Arthroplasty using the standard Medial Parapatellar approach with Posterior stabilised implant designs using similar instrumentation and implant (Depuy Synthes PFC Sigma™). For the patients allocated to the patellar denervation group, electrocautery of the soft tissue circumference of the patella was performed following the implantation of the definitive knee arthroplasty components. Electrocautery of the entire circumference of the rim of the patella was performed from inside the capsule using the 'cutting' mode of monopolar cautery.

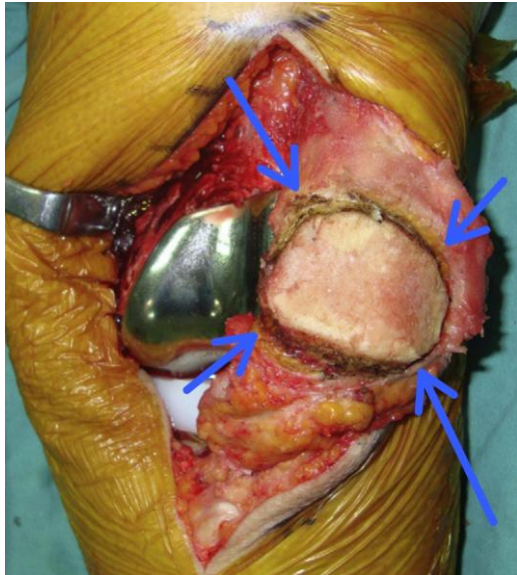


Figure 2: Intraoperative image of Patellar denervation by circumferential electrocauterization after Implantation

The cohort of the non-denervation group underwent the procedure in exactly the same fashion without patellar denervation. None of the groups underwent patellar resurfacing of any sort. All the patients underwent the routine postoperative physiotherapy protocol for the patients undergoing Total knee Arthroplasty.

Outcome

The outcomes in both the groups were measured and compared using the functional outcome scores such as Oxford Knee score, Feller's Patellar score, Oxford knee score and VAS score. The follow-up was done on 1 week, 3 months, 6 months and 1 year post-operatively. A minimum of 1-year follow-up was mandatory for all the participants. The Preoperative knee functional score was also recorded for all the patients.

Sample Size

Taking the study of Altay et al into consideration (19), results of patellar scores, knee society scores, Visual Analog Scores (VAS) into consideration taking power as 80%, our sample size is calculated using the openepi software to be 72 out of which 36 will belong to the patellar denervation group and rest 36 will be controls.

Data Analyses

Statistical analysis was carried out using statistical packages for IBM SPSS vs 22 for Windows. Continuous and categorical variables were expressed as mean $\pm$ SD and percentages, respectively. Descriptive statistics were done for the distribution of age and gender. An Independent t-test was done to compare the VAS score, Feller's Patellar score, Oxford score and Knee Society Score at Pre-op, 1 week, 3 months, 6 months and 1 year between the two groups-ANOVA (Repeated Measures ANOVA) was done to compare changes within the group at each time interval. Two-sided p-values were considered as statistically significant at p-value <0.05 .

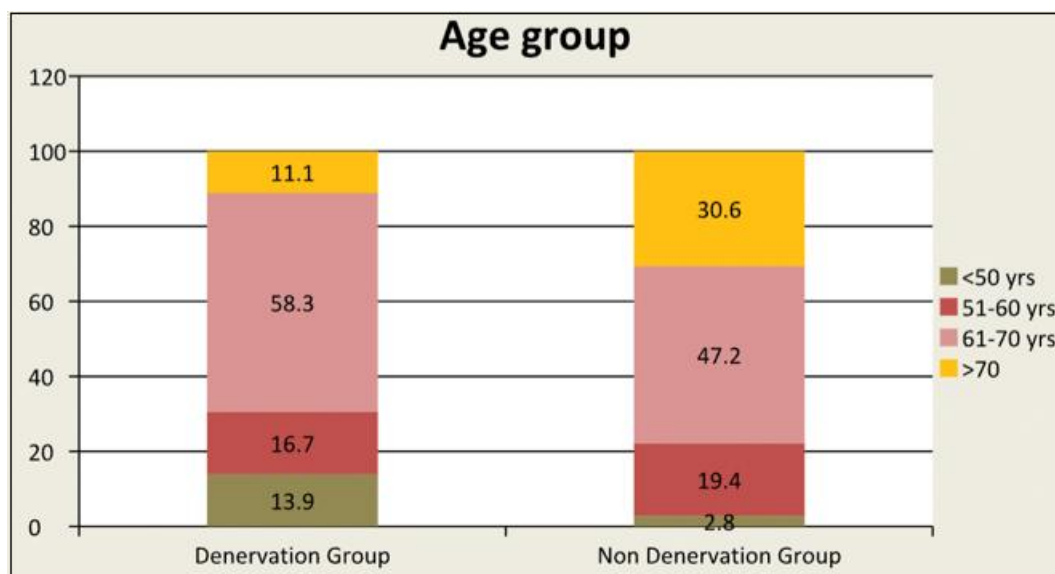
3. Results

The mean age in the denervation group was 62 ± 18.16 years whereas in Non-denervation group it was 66.47 ± 8.01 years with P-value of 0.092, the difference was statistically insignificant and hence both the groups were matched for age.

Table 1: Descriptive statistics of age.

Age group	Denervation Group		Non- Denervation Group		P value
	N	%	N	%	
<50 yrs	5	13.9	1	2.8	0.092
51-60 yrs	6	16.7	7	19.4	
61-70 yrs	21	58.3	17	47.2	
>70 yrs	4	11.1	11	30.6	
Mean $\pm$ SD	62 $\pm$ 18.16		66.47 $\pm$ 8.01		

Chi square test; $p > 0.05$ not significant



There were 17 male participants in the denervation group whereas 24 in Non-denervation group. A total of 19 females were recruited in denervation group and 12 in the Non-denervation group with a p-value of 0.096 this was

statistically insignificant as well and hence both the study groups were matched for gender.

Table 2: Descriptive statistics of Gender

Gender	Denervation Group		Non- Denervation Group		P value
	N	%	N	%	
Male	17	47.2	24	66.7	0.096
Female	19	52.8	12	33.3	

Chi square test; $p > 0.05$ not significant

Both the groups were similar in basic demographic parameters of age and gender along with other variables such as implant used, surgical approach and Post-operative rehabilitation protocols.

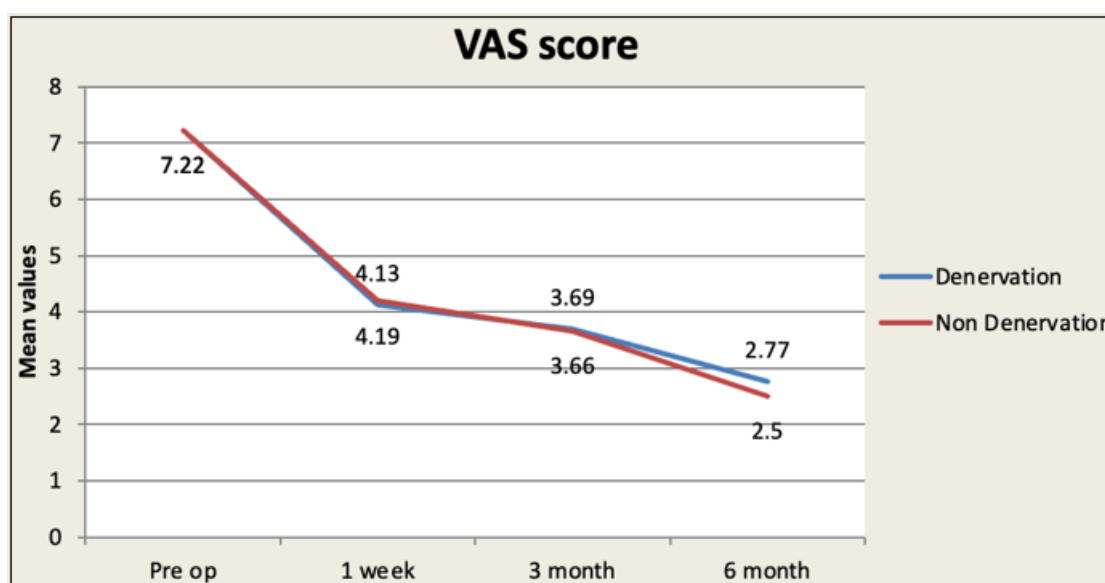
Table 3: Comparison of VAS Score at different time period between the group.

VAS	Denervation Group		Non- Denervation Group		p value (t test)
	N	%	N	%	
Pre op	7.22	0.98	7.22	0.98	0.655
1 week	4.13	0.35	4.19	0.40	0.828
3 month	3.69	0.46	3.66	0.47	0.930
6 month	2.77	1.01	2.50	0.94	0.909
1 year	1.61	0.49	1.58	0.50	1.00
RM- ANOVA P value	<0.001**		<0.001**		

Independent t test; $p > 0.05$ not significant

RM-ANOVA; ** $p < 0.001$ highly significant

The VAS score improved significantly in both the groups over the 1 year follow up period. The mean VAS at the end in Denervation and Non-denervation group was 1.61 and 1.58 respectively and hence was not statistically significant.


Table 4: Comparison of Pateller Feller Score at different time period between the group.

Pateller Feller	Denervation Group		Non-Denervation Group		P value
	N	%	N	%	
Pre op	16.44	1.31	16.30	1.30	0.655
1 week	22.19	1.61	22.27	1.63	0.828
3 month	26.47	1.34	26.44	1.34	0.930
6 month	27.33	1.01	27.30	1.03	0.909
1 year	27.50	0.91	27.50	0.91	1.00
RM- ANOVA P value	<0.001**		<0.001**		

Independent t test; $p > 0.05$ not significant

RM-ANOVA; ** $p < 0.001$ highly significant

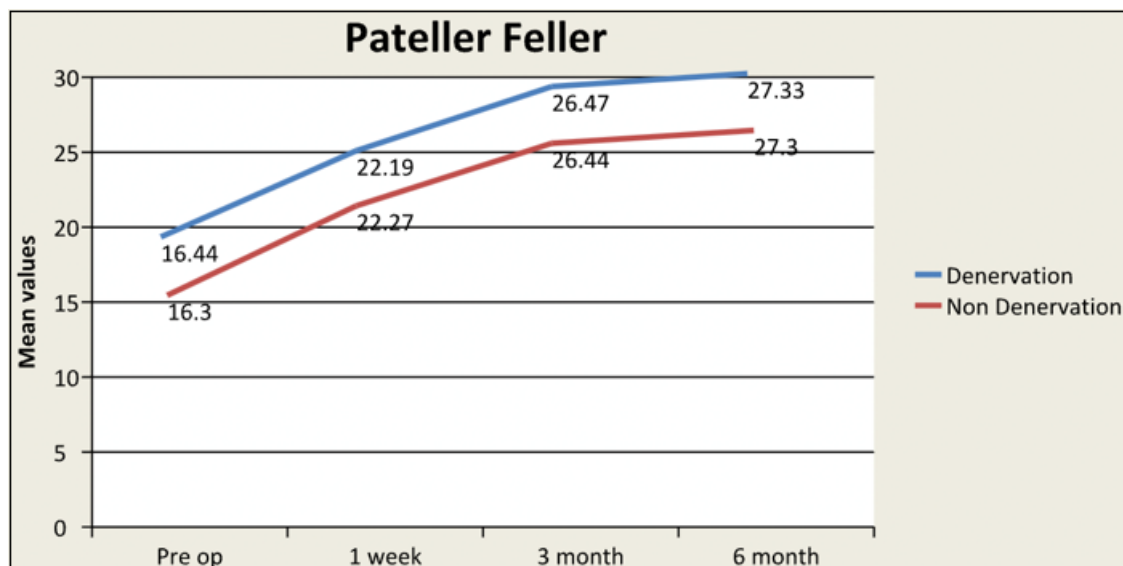


Table 5: Comparison of Oxford Score at different time period between the group

Oxford	Denervation Group		Non-Denervation Group		P value
	N	%	N	%	
Pre op	29.19	4.03	29.08	4.00	0.907
1 week	43.63	2.58	43.66	2.34	0.962
3 month	44.13	2.33	44.83	1.97	0.178
6 month	44.33	1.37	44.52	1.31	0.542
1 year	44.69	1.43	44.97	1.53	0.430
RM- ANOVA P value	<0.001**		<0.001**		

Independent t test; $p > 0.05$ not significant

RM-ANOVA; ** $p < 0.001$ highly significant

Table 6: Comparison of Knee Society Score at different time period between the group.

Knee Society	Denervation Group		Non-Denervation Group		P value
	N	%	N	%	
Pre op	43.91	3.29	44.19	3.54	0.732
1 week	58.36	4.45	58.63	4.22	0.787
3 month	80.13	5.13	80.41	4.83	0.814
6 month	85.83	3.87	85.83	3.87	1.00
1 year	86.52	3.74	86.52	3.74	1.00
RM- ANOVA P value	<0.001**		<0.001**		

Independent t test; $p > 0.05$ not significant

RM-ANOVA; ** $p < 0.001$ highly significant

4. Discussion

This study found no statistically significant difference in outcome following Total Knee Arthroplasty for patients who received a circumferential patellar denervation in comparison to patients undergoing no denervation during the surgery. For all the outcome measurements (VAS, Feller's Patellar score, Oxford knee score, Knee society score) with a Confidence Interval of 95% the p-value showed a difference that was statistically not significant. The study is further strengthened by the fact that it was a single centre study with all the participants undergoing surgery using the same standard implant design and instrumentation, surgical approach and post-operative rehabilitation.

A meta-analysis by Chang T in 2014 regarding the efficacy of patellar electrocauterization for anterior knee pain found similar outcomes in terms of incidence of anterior knee pain in patients with denervation or no denervation, though there was a slight improvement in knee scores in electrocautery group but it was way below the levels to be clinically significant and they recommended further RCT for evidence.

A systematic review by Fan L in 2015 reported potential benefits of patellar denervation in terms of functional outcomes after Total Knee Arthroplasty, though they found an improvement in Oxford Knee score and WOMAC in the group undergoing electrocauterization, the difference was less than the minimal clinically important difference for the outcome measures (MCID).

There are chances that the occurrence of Anterior knee pain in patients undergoing Total Knee Arthroplasty can be multifactorial with factors such as implant design, surgical approach, alignment of the tibial and femoral components and Patellofemoral degeneration contributing to its incidence and intensity along with affecting the overall functional outcome of these patients and hence the long-term level of satisfaction or dissatisfaction from the surgery.

There was no reported complication in both the study groups for the stipulated follow up period such as Deep or superficial infection, Need for revision surgeries, deep venous thrombosis, Peri-prosthetic fractures or patellar maltracking.

The study does have some limitations such as controls being a historic cohort and not a direct control as in a Randomised clinical trial. Another limitation is in the fact that there is no real -time measurement criteria to show that rim electrocauterization by monopolar diathermy causes complete, effective and Non-reversible patellar denervation in these patients. This is more of a basic science limitation in the procedure undertaken, though, the study was designed to test the clinical outcomes only.

The follow-up has been for a period of 12 months and there is a possibility of changes to occur in further long-term follow up, although previous long-term studies have shown that

functional scores such as OKS stabilise over a period of 1 year with reported diminished effects.

5. Conclusion

This study demonstrates no benefits of Patellar rim denervation (without patellar resurfacing) using electrocauterization in patients undergoing Total Knee Arthroplasty both in terms of incidence of Anterior Knee pain and Functional outcomes both immediate and in a follow-up of 12 months. Hence, Patellar denervation need not be a recommended step in patients undergoing TKA.