OPEN ACCESS

GAVIN PUBLISHERS

Journal of Orthopedic Research and Therapy

Reddy KJ, et al. J Orthop Ther: JORT-197.

Research Article

DOI: 10.29011/2575-8241. 000097

Patelloplasty in Total Knee Arthroplasty with Circumpatellar Denervation Versus without Denervation - A Randomized Prospective Trial

Kankanala J Reddy*, S.R.K. Dikshith, R. Raviteja

Department of Orthopedics, SVS medical college and hospital, Mahbubnagar, Telangana, India

***Corresponding author:** Kankanala J Reddy, Department of Orthopedics, SVS medical college and hospital, Mahbubnagar - 509001, Telangana, India. Tel: +91-0854225632; Fax: +91-0854225632; Email: kjreddy@hotmail.co.uk

Citation: Reddy KJ, Dikshith SRK, Raviteja R (2018) Patelloplasty in Total Knee Arthroplasty with Circumpatellar Denervation Versus without Denervation - A Randomized Prospective Trial. J Orthop Ther: JORT-197. DOI: 10.29011/2575-8241. 000097

Received Date: 14 May, 2018; **Accepted Date:** 01 June, 2018; **Published Date:** 08 June, 2018

Abstract

Introduction: Anterior knee pain is still a major problem in Total Knee Arthroplasty (TKA). Although the most widely accepted opinion is that anterior knee pain is often associated with a patellofemoral etiology, there is no clear consensus as to etiology or treatment. In general, denervation of the patella by electrocautery and patelloplasty with removal of osteophytes have been used for treatment of anterior knee pain in TKA. The purpose of our study is to compare the anterior knee pain and clinical outcomes of patelloplasty in Total Knee Arthroplasty (TKA) with patellar denervation by electrocautery and without patellar denervation at a minimum follow-up of 1year.

Materials and Methods: This study was conducted among a total of 108 patients, who underwent TKA at our institution between June 2015 and December 2016. Patients between age 55 to 80 years, who are suffering from osteoarthritis, rheumatoid arthritis of knee were included in this study. Patients were randomly allocated into patelloplasty with denervation group and non-denervation group. The denervation of the patella was done in electrocautery group using a monopolar coagulation diathermy set to 50 W. (Valleylab Inc., Boulder, CO). post-operatively, Patients are assessed at regular intervals of 3, 6, 9, 12, months. To assess patient outcome, questionnaires to determine the Knee Society score (KSS - knee and function scores), a specific patellofemoral pain questionnaire (Kujala score) including the patella score, range of motion (ROM) and a visual analogue scale (VAS) to assess anterior knee pain were used.

Results: The data obtained was analyzed using SPSS version 17.0. Continuous variables were expressed as mean ± SD values. Of the 108 patients, 9 patients were lost for follow-up. Among the remaining 99 patients, 50 were included in denervation group and 49 in non-denervation group. In our study, there was no statistically significant difference in Mean KUJALA score preoperatively ($p>0.05$). Post operatively, the mean KUJALA score was significantly higher in denervation group at 3,6,9,12 months follow up when compared to TKR with no denervation ($p<0.05$). There was no statistically significant difference in Mean VAS score preoperatively ($p>0.05$). However, post operatively at 6months, 12 months and 24 months the mean VAS score was significantly lower in denervation group. There was no statistically significant difference in Mean KSS score preoperatively and post operatively ($p>0.05$). The mean ROM was significantly higher in denervation group than when compared to TKR with no denervation $p<0.05$.

Conclusion: In our study, there less postoperative anterior knee pain, increased range of motion, significant lower VAS scores in denervation group compared with non-denervation group. In conclusion, circumferential denervation of patella during primary TKA with patellar resurfacing appears to be a safe procedure that may improve patient satisfaction, decrease anterior knee pain and improve range of flexion in the post-operative period and at follow up visits post-operatively.

Keywords: Anterior Knee Pain; Denervation; Patelloplasty; Total Knee Arthroplasty

Introduction

Anterior knee pain is still a major problem in Total Knee Arthroplasty (TKA). Although the most widely accepted opinion is that anterior knee pain is often associated with a patellofemoral etiology, there is no clear consensus as to etiology or treatment [1]. Unfortunately, many aspects of anterior knee pain after TKA have yet to be fully understood. In addition, patellar resurfacing for anterior knee pain reduction in TKA still remains controversial, because it has been associated with fracture, subluxation and dislocation of the patella, aseptic loosening, and patella necrosis [2]. The results of recent meta-analyses show that patellar resurfacing reduces the risk of re-operation, while not reducing anterior knee pain after TKA. Patella-related problems are responsible for patient dissatisfaction, morbidity and re-operation after TKA. Anterior knee pain is reported in 4 to 49% of patients after primary TKA. In general, denervation of the patella by electrocautery and patelloplasty with removal of osteophytes have been used for treatment of anterior knee pain in TKA [1]. The purpose of our study is to compare the anterior knee pain and clinical outcomes of patelloplasty in Total Knee Arthroplasty (TKA) with patellar denervation by electrocautery and without patellar denervation at a minimum follow-up of 1year.

Materials and Methods

This study was conducted among a total of 108 patients, who underwent TKA at our institution between June 2015 and December 2016. All the surgeries were performed by single surgeon, the primary author, who has over 30 years of experience in performing primary and revision total knee replacement surgeries. He also worked as head of orthopedic unit in London and presently professor of orthopedics at our institution. Patients between age 55 to 80 years, who are suffering from osteoarthritis, rheumatoid arthritis of knee were included in this study. Patients with previous patella surgery/fracture, previous high tibial osteotomy, revision TKA's were excluded from the study. Of the 108 patients, 55 were included in patelloplasty with electrocautery group and other 53 in non-electrocautery group. The allocation was done on simple randomization method. Inside the operation theatre, patients were allocated to denervation or non-denervation group based on a chit. Neither the operating surgeons nor the assistants knew to which group the patient is allocated prior to the procedure. All the patients who are planned admitted for Total knee arthroplasty underwent routine blood investigations for surgical profile. Physician fitness & consent are taken prior to surgery. X-rays of involved knees in AP and Lateral views are taken. Grading of patellofemoral and tibiofemoral arthritis is done. Radiological and clinical assessment is done in terms of deformities, crepitus, and anterior knee pain.

4.1. Surgical Technique

Standard surgical technique involving anterior midline incision and medial parapatellar approach was used for all the patients. Cruciate sacrificing PFC SIGMA implants were used in all cases. Patellar tracking was then checked with 'no thumb test' both on trial implants as well as after seating of definitive implants. After implantation of femoral and tibial components, the patellar surface was removed with an electric saw. Both facets of the patella were reshaped to mimic a normal anatomical shape of the patella with 130° angle between the facets. All the marginal osteophytes were removed. Peripheral denervation around patella was performed with electrocautery for a depth of 2 to 3mm in electrocautery group. The denervation of the patella was done using a monopolar coagulation diathermy set to 50 W. (Valleylab Inc., Boulder, CO). In non-electrocautery group only patelloplasty was performed. Later, Wound was closed in layers over suction drain (Figure 1-4).

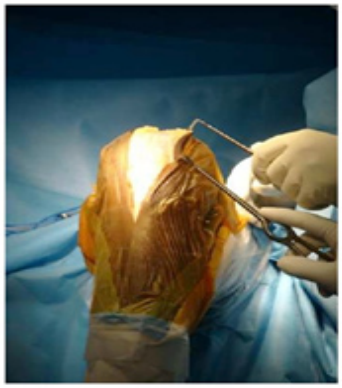


Figure 1: Standard anterior midline incision.

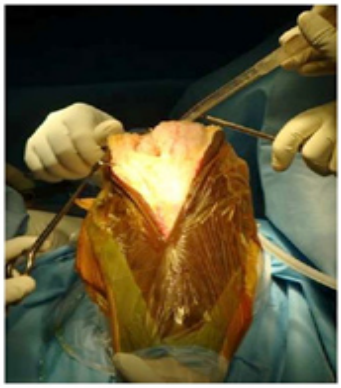


Figure 2: Medial para-patellar Approach

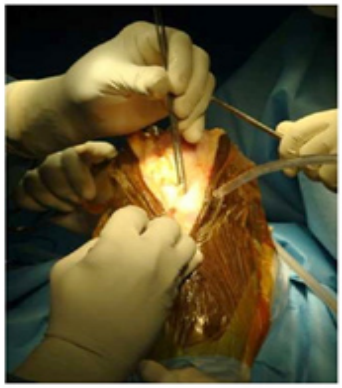


Figure 3: Retropatellar fat pad excision.

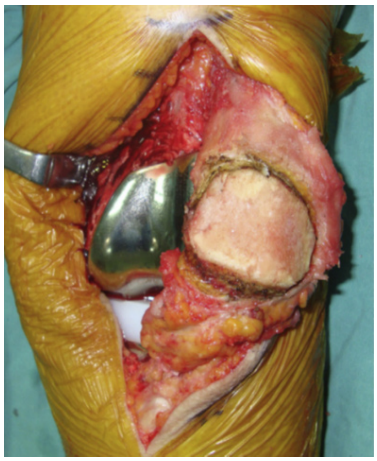


Figure 4: Circumpatellar coagulation Diathermy.

Patient Evaluation

Post-operative x-rays were taken in AP and lateral views. Patients are assessed at regular intervals of 3, 6, 9, 12, months. To assess patient outcome, questionnaires to determine the Knee Society score (KSS - knee and function scores), a specific patellofemoral pain questionnaire (Kujala score) including the patella score, Range of Motion (ROM) and a Visual Analogue Scale (VAS) to assess anterior knee pain were used. The total KSS consists of two components. The first component is the Knee Society Function Score and the second component is the Knee Society Pain Score. Written informed consent was obtained from all patients, and approval to use their medical records and re-evaluate each patient was taken from the Local Research Ethics Committee.

Radiological Assessment

Standard weight-bearing anteroposterior, lateral and skyline views were taken preoperatively, immediately postoperatively and at the follow-up visits. Radiographic evaluation followed the Knee Society Roentgenographic Evaluation and Scoring System. Patellar size and Insall - salvati ratio was assessed. Patellar tilt, patellofemoral joint space (normal, moderate loss and severe loss) and patellar sclerosis were assessed on the skyline view.

Method of Statistical Analysis

SPSS statistical software version 17.0 (SPSS Inc., Chicago, IL, USA) was used to process the data. We used the following parametric tests: (1) paired t test for intragroup comparison of two variables i.e. Pre- and postoperative values and (2) non-paired t test for intergroup comparison of two variables. We chose the Pearson correlation coefficient to measure correlation. Continuous variables will be expressed as mean ± SD. A P-value <0.05 is considered significant.

Results

Of the 108 patients, 9 were lost in follow-up. Among the 99 who were studied, 50 were in electrocautery group and 49 in non-electrocautery group. Patients who underwent total knee replacement surgery were followed up post operatively at 3 months, 6 months 12 months and 24 months. At all preoperative and postoperative visits, all clinical score was determined with respect to function, range of motion VAS etc. The data obtained was analyzed using SPSS version 17.0. Continuous variables were expressed as mean±SD values. Appropriate statistical tests were used to determine outcomes of patelloplasty in Total Knee Arthroplasty (TKA) using with and without coagulation diathermy. Patients in both study group were comparable in terms of age, gender, mean age being 63.6 years. There was no significant difference in the distribution of patients based on age ($p > 0.05$). Mean Age group in patients with denervation 62.7 ± 7.5 and the mean age group in patients without denervation was 63.6 ± 8.11(Table 1,2). There was no statistically significant difference in mean age distribution between groups ($p > 0.05$). The gender distribution between the groups is also not significant statistically ($p > 0.05$). Male to female ratio was 0.26:1

Age group in years	Denervation		Non-denervation	
	Number	%	Number	%
≤ 40	1	2	1	2
41 - 50	3	6	2	4
51 - 60	11	22	13	26
61 - 70	28	56	23	48
≥ 71 yrs	7	14	10	20
Total	50	100	49	100
Chi square		1.20	P value	0.877

Table 1: Distribution of patients based on Age.

Age	Denervation		Non-denervation		T value	P value
	Mean	SD	Mean	SD		
Age	62.7	7.5	63.6	8.1	0.57	0.56

Table 2: Comparison based on Mean Age.

In our study, there was no statistically significant difference in Mean KUJALA score preoperatively ($p > 0.05$) (Table 3, Figure 5).

KUJALA	Denervation		Non-denervation		T value	P value
	Mean	SD	Mean	SD		
Pre-operatively	19.2	4.03	17.7	5.94	1.45	0.148
3 months	50.34	6.23	37.8	5.6	10.53	<0.001
6 months	66.4	6.15	52.18	6.95	10.86	<0.001
12 months	71.68	6.20	60.64	5.65	9.29	<0.001
24 months	78.64	6.75	66.68	6.33	9.13	<0.001

Table 3: Mean Kujala score pre and post operatively between groups.

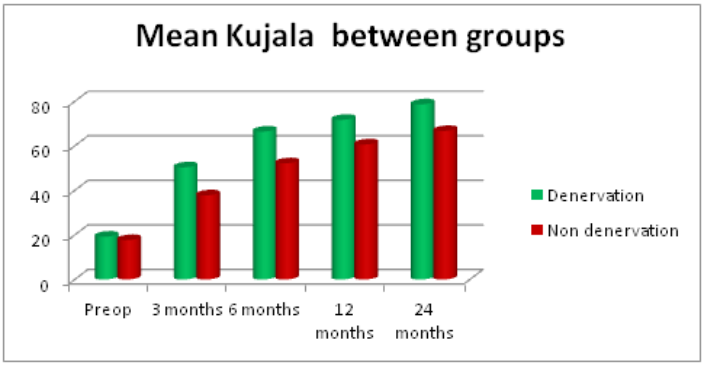


Figure 5: Mean Kujala score between two groups. The mean kujala score is higher in denervation group at 3 months (50.34), 6 (66.4), 12 (71.6) and 24 months (78.64) is higher than non- denervation group. And the difference is significant.

Post operatively, the mean KUJALA score was significantly higher in denervation group at 3,6,9,12 months follow up when compared to TKR with no denervation ($p<0.05$). There was no statistically significant difference in Mean VAS score preoperatively ($p>0.05$). However, post operatively at 6months, 12 months and 24 months the mean VAS score was significantly lower in denervation group (Table 4, Figure 6).

VAS	Denervation		Non-denervation		T value	P value
	Mean	SD	Mean	SD		
Pre-operatively	8.1	0.58	8.22	0.67	0.95	0.344
3 months	3.54	1.29	4.18	2.02	1.8	0.63
6 months	2.52	0.7	3.14	0.7	4.4	<0.001
12 months	1.68	0.65	2.52	0.50	7.2	<0.001
24 months	1.34	0.47	1.6	0.53	2.56	0.012

Table 4: Mean VAS score pre and postoperatively between groups.

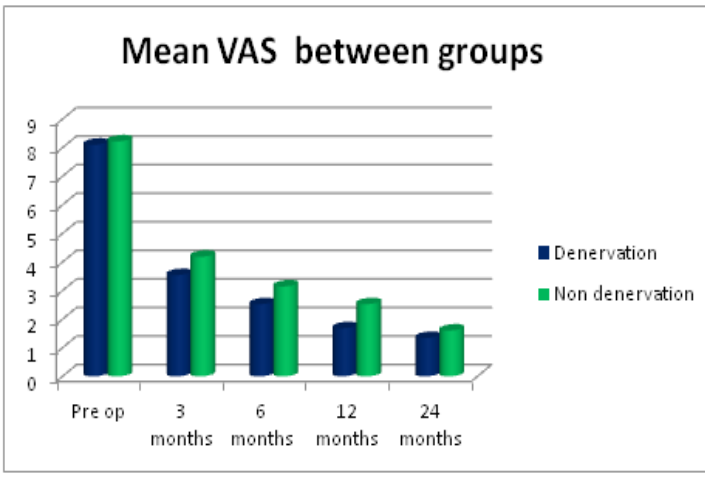


Figure 6: The mean Visual Analogue pain Score is significantly lower in denervation group when compared to non-denervation group. The mean VAS score in denervation group is 2.52(6 months) and 1.36(12 months. Whereas in denervation group, it is 3.1 and 2.5 at 6 and 12 months respectively.

There was no statistically significant difference in Mean KSS score preoperatively and post operatively ($p>0.05$) (Figure 7).

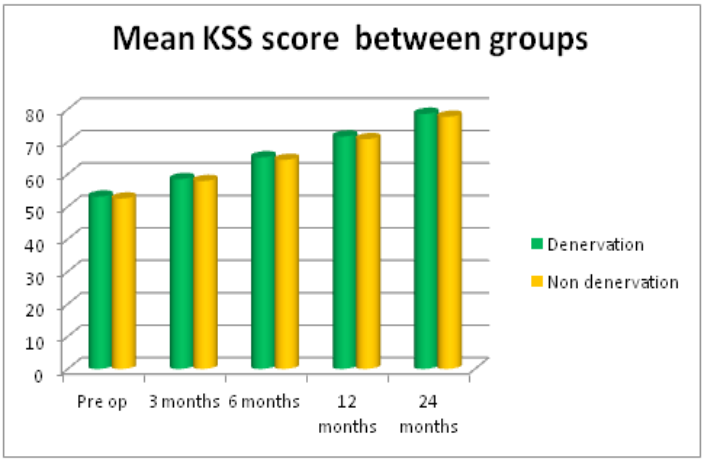


Figure 7: Mean Knee Society score between groups. There was no statistically significant difference in Mean KSS score preoperatively and post operatively ($p>0.05$). The mean KSS score was 58.5, 65.2, 71.6, 78.6 at 3,6,12,24 months respectively in denervation group. It is 57.9, 64.4, 70.8, 77.7 at 3,6,12, 24 months in non-denervation group.

The mean ROM was significantly higher in denervation group than when compared to TKR with no denervation ($p<0.05$) (Figure 8, Table 5).

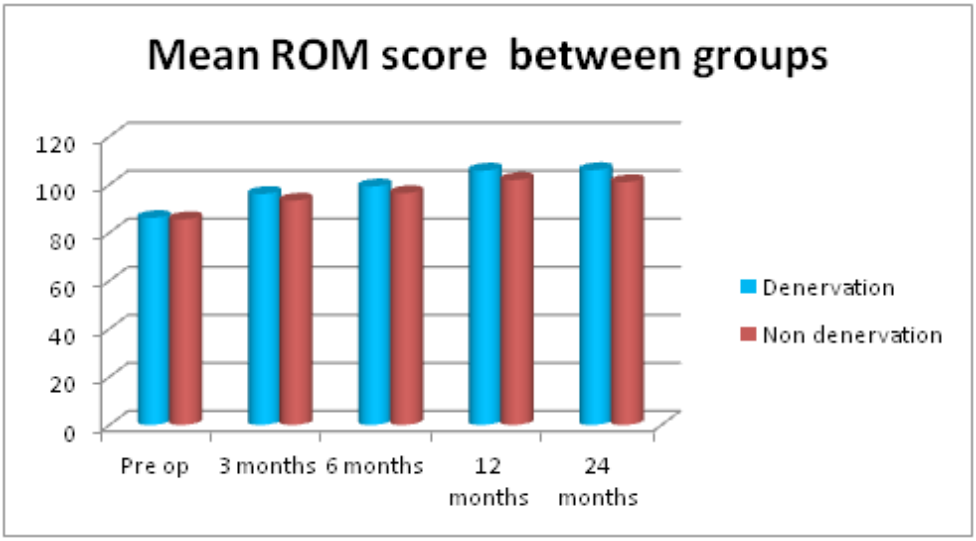


Figure 8: Mean Range of motion between two groups. In denervation group the mean ROM was 96, 99, 105, 106 at 3,6,12, 24 months respectively. Whereas in non-denervation group ROM mean was 93, 96, 101, 101 respectively. The difference is statistically significant.

patient satisfaction	Denervation		Non-denervation	
	Number	%	Number	%
Excellent	39	78	27	54
Good	7	14	12	26
Fair	4	8	10	20
Total	50	100	49	100

Table 5: Distribution of patients based on patient satisfaction.

Discussion

AKP is reported to occur in up to one-half of all patients following primary TKR. The presence of AKP after TKR is negatively correlated with patient satisfaction and quality of life. The ultimate goal of TKR is to relieve pain and to improve the functional outcome. Residual patellofemoral pain is one of the main problems in TKA without patellar resurfacing. Therefore, achieving better outcomes after primary TKR without patellar replacement remains a significant clinical problem. Although the pathophysiology of anterior knee pain in osteoarthritis is often uncertain and frequently multifactorial, patellar cartilage erosion and surface incongruities (patellar maltracking) probably contribute to anterior knee pain in many patients [3,4]. Both the peripatellar soft tissue, such as retinaculum and synovium, and the infrapatellar fat pad were implicated as the source of anterior knee pain [5]. Also, several studies on innervation of the anterior knee found substance-P nociceptive afferent fibers in the peripatellar soft tissue [6-8]. Disabling these pain receptors by electrocautery could theoretically achieve desensitization or denervation of the anterior knee region.

Different consensus exists in regards of circumpatellar denervation, with some studies finding it beneficial and some studies not. To reduce the prevalence of anterior knee pain, circumpatellar electrocautery has been used by several authors [7,9]. Following demonstration of a positive effect of patellar denervation in intractable patellofemoral pain [5,7,9,10], researchers tried to establish the relationship between patellar denervation and treatment of patellofemoral pain. We hypothesized that patellar denervation with electrocautery would have some advantages in terms of pain and clinical results after TKA along with patellar resurfacing. Although patellar denervation is not a new technique in TKA, there are very few articles about patellar innervations and denervation [9-12]. We, designed a randomized control study with a null hypothesis that there is no difference in the outcome between two groups. Our results show that postoperative knee and function scores, ROM, patellar score and VAS were significantly better in the denervation group. These findings indicate that patellar denervation by electrocautery can provide decreased anterior knee pain and clinical improvement after TKA without patellar resurfacing.

According to Maralcan, et al. the patella has two nerve supplies, to the superomedial and superolateral quadrants, coursing within the substance of the vastus medialis and lateralis; additionally, they are accompanied by small vessels that can be traced through the course of the nerves. We therefore performed circumpatellar denervation; the increase in clinical scores and decrease in VAS scores in the patellar denervation group can be attributed to adequate complete denervation. In TKA, electrocautery was used for patellar denervation by several authors. Rand and Gaffey [1],

described electrocautery has potentially harmful effects on the articular cartilage and, when utilized in an intra-articular location, must be handled carefully to avoid cartilage trauma. The consensus in the literature is that adult joint cartilage is capable of a limited response following injury. We therefore applied electrocautery only to the peripheral rim of the patella to prevent surface exposure (Table 6).

Ref (#)	Study Id (Year)	Country	Study design	Follow up	Number of electrocoutery group	Number of Non-electrocoutery group	Outcome measures	Loss to Follow-up
1	S. Baliga (2012) [15]	England	RCT	1 Year	91	94	OKS and VAS	15
2	H.P.W. van Jonbergen (2011) [11]	Netherlands	RCT	2 Year	131	131	The incidence of anterior knee pain, WOMAC score, AKSS: knee scores and function scores	0
3	Abdelfattah Mohammed Fathy Saoud (2004) [5]	Egypt	RCT	9 Months	20	20	AKSS: knee scores and function scores	2
4	M.A. Altal (2012) [14]	Turky	RCT	2 Years	35	35	AKSS: knee scores and function scores, patellar score, VAS and Range of Motion (ROM)	0
5	Soo Jae Yim (2012) [16]	Korea	RCT	1Year	50	50	Range of Motion, AKSS: knee scores and function scores, patellar score, WOMAC score	0
6*	Ramnadh S. Pulavarti (2013) [17]	England	RCT	2 Years	61	58	Range of Motion, AKSS: knee scores and function scores, patellar score, VAS, OKS	7

OKS: Oxford nee score. VAS: visual analogue scale. AKP: anterior knee pain. AKS: American Knee Society. WOMAC: Western Ontario and McMaster Universities Osteoarthritis Index. RCT:Randomized controlled trial. *N=63 in electrocoutery group and N=62 in non-electrocoutery group at 12 months of follow-up.

Table 6: The main characteristics of the included studies.

Vega and Golano, et al. [7] surmised that a thermal lesion applied to this region would lead to desensitization of the anterior knee area in a process known as patellar denervation. Circumpatellar electrocautery was performed using a standard technique with monopolar diathermy set at 50 W, and the synovial soft-tissue layer within 1 cm of the circumference of the patella was cauterized. The technique used only superficial electrocautery to a depth of no more than 1-3 mm. Wito´nski and Wagrowska- Danielewicz [13], however, showed that substance-P positive fibers appear to be more prevalent in the fat pad and medial retinaculum than in the other soft tissue around the knee in case of anterior knee pain. In a postal questionnaire study, van Jonbergen, et al. [10,11] found that 56% of Dutch orthopedic surgeons performing TKA used circumpatellar electrocautery to prevent anterior knee pain when not resurfacing the patella, compared to 32% in case of patellar resurfacing. Our study is comparable with studies conducted by, Ramnath pulvarthi, et al. [17] in 2013 and s gupta and augstine, et al [9], in terms of age, gender distribution. In our study there was no statistically significant difference in Mean KUJALA score preoperatively ($p>0.05$). However, post operatively the patient was followed 3months ($p<0.001$), 6months ($p<0.001$), 12 months ($p<0.001$) and 24 months ($p<0.001$) it was observed that the mean KUJALA score was significantly higher in denervation group than when compared to TKR with no denervation ($p<0.05$). Ramnadh, et al. [17] study also observed significant improvement in knee pain (kujala score) ($p=0.02$) at 3 months($p=0.14$) in denervation group but at 6 months($p=0.13$) ,9 months($p=0.17$) ,12 months($p=0.21$)and 2 years(p value=0.20) is not significant compared to both the groups.

There is no statistically significant difference in Mean VAS score preoperatively (p>0.05). There was no significant difference in Mean VAS score observed at 3months post operatively (p>0.05). However, at 6months, 12 months and 24 months it was observed that the mean VAS score was significantly lower in denervation group than when compared to TKR with no denervation (p<0.05). Results by Ramnadh pulavarthi, et al. [17] showed VAS score Preoperative (p= 0.5) VAS scores are significant at 3 months (p=0.02) but not significant at 12 months p= 0.1 and 24 months (p=0.35) in denervation group compared to nondenervation group. Another study by Saoud[5] of total 40 patients received the same type non-patellar resurfacing total knee of fixed bearing design. The author reported a statistically significant difference in the pain scores between groups favoring the denervation group. In this study it was observed that there was no statistically significant difference in Mean KSS score (p>0.05). Preoperatively p=0.53 and post operatively 3months p=0.57, 6 months p=0.53, 12 months p=0.57 and 24 months p= 0.53 which are consistent with other studies published by M A Alay et al[14] p>0.05 (p=0.946) preoperatively and postoperatively (p=038). Ramnadh et al study also noticed there is no statistical difference in preoperative and post-operative KSS scores p>0.05. Sun et al. retrospectively studied clinical outcome of patelloplasty and traditional treatment in TKA. Their mean follow-up was 55 months and they compared KSS, Feller patellar score, Lonner patellar score, and patient satisfaction, joint range of motion and incidence of post-operative anterior knee pain between the two groups [16]. The patelloplasty group had significantly higher Knee Society Function Scores, Feller patellar scores, Lonner patellar scores and patient satisfaction [16]. They found no statistically significant difference in KSS between the two study groups [16], which correlates with our findings.

When compared to our study, patients in both groups, patelloplasty and traditional treatment, had higher KSS [16]. We can attribute this to a longer followup time, as it seems that the KSS scores improve with time [20]. In contrast to the study by Sun, et al. we found no differences in Knee Society Function Score between patelloplasty and the traditional treatment group. Ramnadh, et al. [17] reported significant difference preoperative Range of motion (p=0.48) to post-operative range of motion (p<0.01) between denervation group and non-denervation group. M.A. Alay, et al. [14] also reported there is significant difference in post-operative ROM (p=0.015) in between denervation and no denervation groups. In this study it was observed that there was no statistically significant difference in Mean Range of Movements (ROM) score preoperatively (p>0.05). Post operatively the mean ROM was significantly higher in denervation group than when compared to TKR with no denervation (p<0.05). We suggest that the pain relief achieved in the denervation group at the early stages of the postoperative period has helped in achieving a better range of motion both at 12 and 24 months postoperatively. This may be why there was higher patient satisfaction in the denervation group. Besides the limited number of surgeons involved using a standardized technique, robust inclusion / exclusion criteria and minimum 24 months of follow-up, our study has also got a strength of using a number of validated outcome measures which, we hope, would help in drawing a pooled data from various other studies in future. The limitations in our study are small sample size and short term follow up. This study believes that larger, prospective randomized controlled trials and longer follow-up studies are needed to better evaluate the effect and long-term results of patellar denervation. Also, further scoring systems have to evolved to evaluate knee pain after Total knee replacement.

Conclusion

The concept of patellar denervation is intriguing, but the proper technique remains poorly understood This study has shown that there less postoperative anterior knee pain, increased range of motion, significant lower VAS scores in denervation group compared with non-denervation group. However, shorter period of follow-up, small sample size are limitations in our study. In conclusion, circumferential denervation of patella during primary TKA with patellar resurfacing appears to be a safe procedure that may improve patient satisfaction, decrease anterior knee pain and improve range of flexion in the post-operative period and at follow up visits post-operatively.

References

1. Rand JA, Gaffey TA (1985) Effect of electrocautery on fresh human articular cartilage. Arthroscopy: The Journal of Arthroscopic & Related Surgery 1: 242-246.

2. Baker PN, van der Meulen JH, Lewsey J, Gregg PJ (2007) The role of pain and function in determining patient satisfaction following total knee arthroplasty: data from the national joint registry for England and wales. J Bone Joint Surg Br 89: 893-900.

3. Hirasawa Y, Okajima S, Ohta M, Tokioka T (2000) Nerve distribution to the human knee joint: anatomical and immunohistochemical study. International orthopaedics 24: 1-4.

4. Stein DT, Ricciardi CA, Viehe T (2002) The effectiveness of the use of electrocautery with chondroplasty in treating chondromalacic lesions: A randomized prospective study. Arthroscopy 18: 190-193.

5. Saoud AMF (2004) Patellar denervation in non-patellar resurfacing total knee arthroplasty. Pan Arab J Orth Trauma 8: 25-30.

6. Bohnsack M, Meier F, Walter GF, Hurschler C, Schmolke S, et al. (2005) Distribution of substance-P nerves inside the infrapatellar fat pad and the adjacent synovial tissue: a neurohistological approach to anterior knee pain syndrome. Archives of orthopaedic and trauma surgery 125: 592-597.

7. Vega J, Golanó P, Pérez-Carro L (2006) Electrosurgical arthroscopic patellar denervation. Arthroscopy: The Journal of Arthroscopic & Related Surgery 22: 1028.

8. Lehner B, Koeck FX, Capellino S, Schubert TE, Hofbauer R, et al.

(2008) Preponderance of sensory versus sympathetic nerve fibers and increased cellularity in the infrapatellar fat pad in anterior knee pain patients after primary arthroplasty. Journal of Orthopaedic Research 26: 342-350.

9. Gupta S, Augustine A, Horey L, Meek RM, Hullin MG, et al. (2010) Electrocautery of patellar rim in primary total knee replacement: beneficial or unnecessary? Bone & Joint Journal 92: 1259-1261.

10. Van Jonbergen HP, Barnaart AF, Verheyen CC (2010) A Dutch survey on circumpatellar electrocautery in total knee arthroplasty. The open orthopaedics journal 4: 201-203.

11. Van Jonbergen HP, Scholtes VA, van Kampen A, Poolman RW (2011) A randomised, controlled trial of circumpatellar electrocautery in total knee replacement without patellar resurfacing. J Bone Joint Surg Br 93: 1054-1059.

12. Fan L, Ge Z, Zhang C, Li J, Yu Z, et al. (2015) Circumferential electrocautery of the patella in primary total knee replacement without patellar replacement: a meta-analysis and systematic review. Scientific reports 5: 9393.

13. Baliga S, McNair CJ, Barnett KJ, MacLeod J, Humphry RW, et al. (2012) Does circumpatellar electrocautery improve the outcome after total knee replacement?: a prospective, randomised, blinded controlled trial. J Bone Joint Surg Br 94: 1228-1233.

14. Altay MA, Ertürk C, Altay N, Akmeşe R, Işıkan UE (2012) Patellar denervation in total knee arthroplasty without patellar resurfacing: a prospective, randomized controlled study. Orthop Traumatol Surg Res 98: 421-425.

15. Yim SJ, Jang MS, Kim WJ, Lee SH, Kang HK (2012) The effect of electrocautery around the patellar rim in patellar non-resurfacing total knee arthroplasty. Knee Surg Relat Res 24: 104-107.

16. Pulavarti RS, Raut VV, McLauchlan GJ (2014) Patella denervation in primary total knee arthroplasty - a randomized controlled trial with 2 years of follow-up. J Arthroplasty 29: 977-981.

17. D. Witoński, M. Wagrowska-Danielewicz (1999) Distribution of substance-P nerve fibers in the knee joint in patients with anterior knee pain syndrome. A preliminary report. Knee Surg Sports Traumatol Arthrosc 7: 177-183.

18. van Jonbergen HP, Scholtes VA, Poolman RW (2014) A randomised, controlled trial of circumpatellar electrocautery in total knee replacement without patellar resurfacing: a concise follow-up at a mean of 3.7 years. Bone Joint J 96: 473-478.

19. Handel M, Riedt S, Lechler P, Schaumburger J, Köck FX, et al. (2014) Denervation of the patella: influence on mid-term results after total knee arthroplasty]. Orthopade 43: 143-147.

20. Li T, Zhou L, Zhuang Q, Weng X, Bian Y (2014) Patellar denervation in total knee arthroplasty without patellar resurfacing and postoperative anterior knee pain: a meta-analysis of randomized controlled trials. J Arthroplasty 29: 2309-2313.

Clinical and X-Ray Photographs

Case Pictures - Denervation of Patella

Pre – Op x-ray

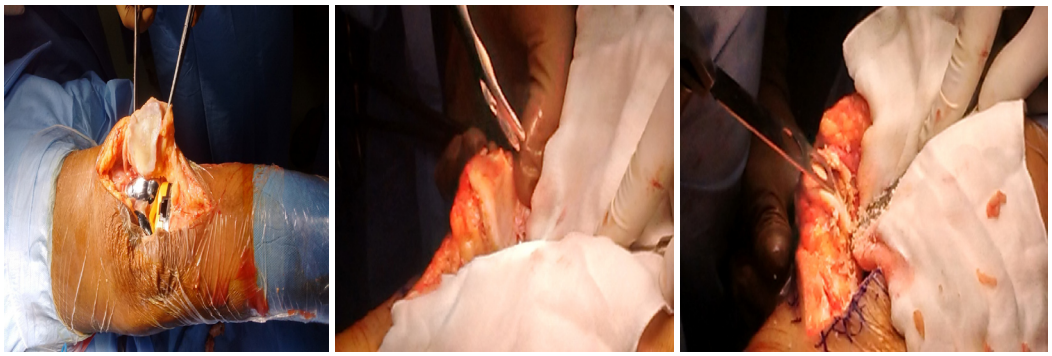
Post Op X- ray

Circum-patellar denervation

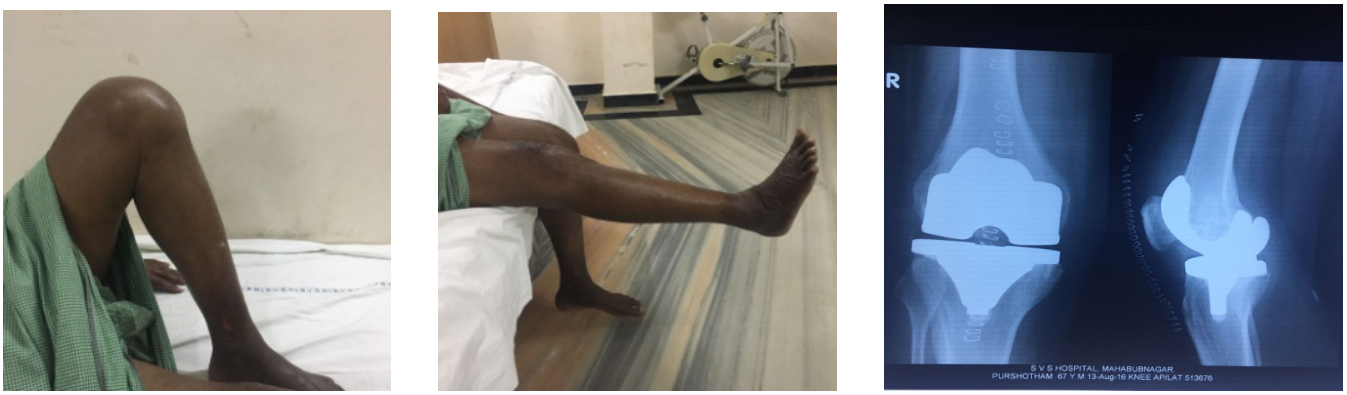
Post – Op Range of movements

Case Study Pictures – Non-Denervation of Patella

Pre – Op X- ray



Patellar resurfacing



Post – Op X- ray and clinical image