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Patellar denervation for Anterior Knee Pain Management in Knee Arthroplasty

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OBJECTIVE: To compare the effectiveness of patellar denervation versus non-patellar denervation in reducing anterior knee pain on a follow-up period of at least one year after total knee arthroplasty.
METHOD: Data from 84 patients, who underwent total knee arthroplasty were analyzed. Participants were divided into 2 groups; group A: 42 patients who previously underwent total knee arthroplasty with patellar denervation; and group B: 42 patients who previously underwent total knee arthroplasty without patellar denervation. Results were evaluated using WOMAC and KSS questionnaires, and the VAS pain measurement. Knee ranges of motion were measured. Preoperative clinical conditions of both groups were similar.
RESULTS: Postoperatively, the following results were observed. (a), the WOMAC scores for group A were significant better when compared to group B (27.95 ± 5.89 vs. 33,55 ± 6.23; (b) better results were also found in KSS scores for group A vs. group B (86.19 ± 7.10 vs. 83,07 ± 4.88); (c) the range of knee flexion was smaller than in group A vs. group B (119.0 ± 10.7 vs 125.5 ± 11.0 degrees); (d) there was no significant difference between the mean of range of knee extension between the two groups groups; (e) in terms pain referred by the patient, no difference was observed according to VAS pain.
CONCLUSION: Patellar denervation does not show better effect in pain reduction compared with TKA with non-patellar denervation. However, it had a better beneficial effect on knee function score, as measured through the KSS and WOMAC questionnaires.

KEYWORDS: Patella, Knee Arthroplasty, Joint Pain.

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INTRODUCTION

Total knee arthroplasty (TKA) is a very effective surgical procedure in reducing pain, enhancing the functional capacity and improving the quality of life of thousands of people who suffer from knee osteoarthritis.[1] This procedure has become quite common, especially in the last two decades due to the aging of population and to the growing number of obese people.[2,3]

One of the most common problems during the postoperative period of this procedure is the incidence of anterior knee pain (AKP). About 10 to 15% of patients undergoing surgery will show these symptoms. It is noteworthy that the presence of pain is of utmost importance when evaluating the results of TKA, because patient satisfaction is linked to its presence or absence during the postoperative period.[4,5]

Some authors assign the AKP to the distribution of nerve fibers and P-substance in soft tissues around the knee, suggesting a relation with hyper-innervation of peripatellar soft tissues. Therefore, disabling these nerve fibers by electrocautery could, in theory, achieve a satisfactory level of denervation and, consequently, reduce local pain.[1,6]

Studies have shown a positive effect of patellar denervation in reducing the incidence of AKP.[7,8] A recent meta-analysis demonstrated that patellar denervation

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can significantly reduce pain in the first 12 months of postoperative follow-up, but with no significant changes in follow-up periods longer than 12 months.[8] In contrast, other studies have shown that patellar denervation does not offer benefits in pain reduction.[5,9,10]

This study's objective was to compare the effectiveness of patellar denervation (PD) in relation to non-patellar denervation (ND) in reducing AKP on a follow-up period of, at least, one year after undergoing TKA.

METHOD

This research is a retrospective cohort design, and is characterized as a quantitative and qualitative comparative study.

Age, sex and the BMI (Body Mass Index) of the included patients was measured.

AKP was assessed after a procedure of TKA, with patellar denervation or non-patellar denervation, without patellar resurfacing. Postoperative function and pain were evaluated using well established and validated questionnaires: WOMAC (Western Ontario and McMaster Universities Osteoarthritis Index)[16] and KSS (Knee Scoring System),[15] and the visual analog scale (VAS). Knee range of motion, in degrees, was also measured.

This research was performed in the city of Salvador, capital city of the state of Bahia, a metropolitan area in the northeast region of Brazil (population 2.6 million, Human development Index 0.756). Data was collected during January to December 2015. Data collection was initiated after approval by the institution's ethical committee, reaffirming all the ethical requirements for medical research involving humans (case #: 50916215.0.0000.5032). All the participants agreed and signed an informed consent term.

The sample size was calculated regarding 95% of power (alfa = 0,05) and based in the difference of 4 points in WOMAC score, yielding a requirement of 84 participants, 42 in each group. We excluded patients (a) that disagreed with the research terms, (b) presenting more than 15 degrees of Valgus or Varus deformity, (c) who underwent previous open surgery in the same knee, (d) presenting postoperative complications in the same knee, (e) presenting post trauma sequelae, (f) having rheumatic arthritis or patellar instability.

All 84 patients underwent total knee arthroplasty performed using the medial pivot implant type (MicroPort®), and sacrificing the posterior cruciate ligament (PCL). Participants were divided into 2 groups, group A, consisting in 42 patients who had been submitted to TKA with PD and group B, consisting in 42 patients who had been submitted to TKA with ND. Three patients, one from group A and two from the group B were lost to follow-up.

Following the routine of this medical center, all patients included for TKA as treatment for osteoarthritis were submitted a standard anamnesis and physical examination, which produced, among other data, knee flexion and extension degrees, using a por-goniometer (Grafco Orthopedic Goniometer 8, Medex Supply®), as well scores for KSS, WOMAC, pain VAS. One year after the surgery, the patients were reevaluated. The same data from the questionnaires and physical exam were collected. All the data were collected from the hospital registries and patient contact by the same investigator. The same team of knee surgeons, from the hospital, executed the procedures.

Data were tabulated using Excel 2016, Macintosh version, and analyzed using SAS 9.4, by SAS Institute Inc. The variable gender was described by absolute and relative frequency, the variables age, BMI, WOMAC, KSS, knee range of motion, and VAS pain were described by mean, standard-deviation and tested for normality using the Anderson-Darling test and compared by the Mann-Whitney non-parametric test. The Pearson's Correlation test was performed on all quantitative variables to determine whether BMI and age could be a confounding factor. A confidence level of 95% was used to determine significance.

RESULTS

Eighty-one observations were obtained, with patients classified into one of two types of surgery: group A - surgery with PD and group B - surgery with ND); 41 patients underwent surgery with denervation corresponding to 50.6 % of the sample.

Demographics are displayed in Table 1. The age of the complete sample mean was 69.9 ± 6.9 years, ranging from 58 up to 84 years. BMI was 26.9 ± 3.0 kg/m^2, ranging from 21 to 35 kg/m^2. Fifty-one of the patients were female (62.9%, IC95%: 51.5% - 73.4%).

When the two groups were compared for age and BMI, patients undergoing PD were 3.1 years younger than those operated without PD (p = 0.039), but no difference was observed for BMI (p = 0.5871).

Table 2 displays the effects of procedure after TKA on WOMAC, KSS, VAS pain and knee range of motion. Pre-operatively, no significant differences were detected between groups for WOMAC, KSS, VAS pain, or knee flexion. However, pre-operative knee extension was significantly better (p < 0.001) in the ND group. Post-operatively, WOMAC scores were significantly better in PD knees (27.95 ± 5.89 - CL95% 26,09 - 29,81), when compared with the ND group (33,55 ± 6.23 - CL95% 31.55 - 35.54, p < 0.001). Similarly, better KSS results were registered for group A (86.19 ± 7.10 - CL95% 83.95 - 88.43), when compared with group B, (83,07 ± 4.88 - CL95% 81.51 - 84.64, p = 0.024). The analysis of pain through the VAS

Table 1. Gender, age and BMI in the total sample and in groups A (denervated) and B (non-denervated) of 81 patients submitted to knee arthroplasty.

	Group A Denervation	Group B No denervation	Total	Statistics
Gender	Females: 22 Males: 19 mean ± std. dev. (range)	Females: 29 Males: 11 mean ± std. dev. (range)	Females = 51 (62.9%) Males: 30 (37.1%) mean ± std. dev. (range)	CI 95% for females 51.5 - 73.44% p values A vs. B
Age (yrs)	68.3 ± 6.2 (range ?)	71.4 ± 7.3 (range ?)	69.9 ± 6.9 (58 - 84)	0.039
BMI (kg/m2)	26.7 ± 2.8 (range?)	27.1 ± 3.3 (range?)	26.9 ± 3.0 (21 – 35)	0.587

scale, revealed no difference between PD and ND patients. Table 2 also shows the pre- and post-operative values for knee range of motion: (a) pre-operative knee flexion was similar between groups, but post-operative flexion was lower in group A (119.0 ± 10.7 - CL95% 115.7 - 122.4 degrees), vs. group B, (125.5 ± 11.0 - CL95% 122.0 - 129.0 degrees); (b) Pre-operative knee extension was lower in the PD group, but no post-operative difference was founded between groups.

Table 3 shows Pearson 's correlation between BMI and AGE vs. WOMAC, KSS, VAS pain, knee Flexion and Extension. No significant correlation occurred, indicating that BMI and AGE are not confounding factors for the outcome of the surgery.

DISCUSSION

It is believed that patellar denervation (PD), during TKA offers greater benefits, in terms of pain and knee function, compared to ND.[4,11,12] The results of this study demonstrate that the group that underwent PD showed significantly better results for the postoperative knee functional scores. Because no significant differences occurred for gender and BMI between groups, we assumed that these variables did not interfere substantially in the analysis of the results, a fact corroborated by the lack of correlation of the variables used to determine knee function and pain.

Pre-surgical mean values for age and knee extension, revealed significant differences between groups. This might be understood as a bias, but it is minimized because (a) there is no significant Pearson correlation of age with postoperative function or referred pain; (b) the difference between knee extension values is less than 1 degree.

Because there was no significant pre-operative difference between IMC, WOMAC, KSS and the VAS pain scale, and adding the fact that there is no significant correlation between age and the post-operative evaluation of pain and function, it is possible to conclude that the pre-operative clinical conditions was homogeneous between both groups.

Table 2. WOMAC, KSS, VAS and Knee Range of Motion compared between groups A (denervation) and B (no denervation).

Measured parameter	A: Denervation mean ± std.dev	B: No Denervation mean ± std dev	p values A vs. B
WOMAC			
Pre-op	62.30 ± 7.44	61.12 ± 7.66	0.489
Post-op	27.95 ± 5.89	33.55 ± 6.23	<0.001
KSS			
Pre-op	43.04 ± 6.28	42.07 ± 6.19	0.484
Post-op	86.95 ± 7.10	83.07 ± 4.88	0.024
VAS			
Pre-op	7.8 ± 0.8	8.0 ± 0.8	0.232
Post-op 24 h	4.5 ± 1.4	4.2 ± 1.3	0.208
Post-op 48 h	3.9 ± 1.4	4.17 ± 1.4	0.342
KNEE MOVEMENT (degrees)			
Pre-op Ext	0.2 ± 1.09	3.5 ± 5.7	<0.001
Post-op Ext	0	0.9 ± 3.4	0.1092
Pre-op Flex	118.8 ± 1.8	114.3 ± 2.5	0.1491
Post-op Flex	119.0 ± 10.7	125.5 ± 11.0	0.009

WOMAC = Western Ontario and Mcmaster Universities Osteoarthritis Index, KSS = Knee Score System, VAS = Visual Analog Scale, Pre-op = Preoperatively, Post-op = Postoperatively, Ext. = Extension, Flex = Flexion, Std Dev = Standard deviation. Significant differences are highlighted.

Table 3. Pearson' Correlation among postoperatively Age, BMI, KSS, WOMAC, VAS for pain and knee movement.

		WOMAC	KSS	VAS24h	VAS48	Knee Ext.	Knee Flex
AGE							
	Correlation Coefficients	-0.057	0.088	-0.185	0.088	0.197	-0.017
	p values	0.613	0.435	0.098	0.436	0.078	0.880
BMI							
	Correlation Coefficients	-0.139	0.092	0.130	0.012	-0.012	-0.214
	p values	0.215	0.414	0.247	0.913	0.915	0.055

WOMAC = Western Ontario and Mcmaster Universities Osteoarthritis Index, KSS = Knee Score System VAS = Visual Analog Scale, , Ext. = Extension, Flex = Flexion, BMI = Body Mass Index.

Thus, it may be concluded that the type of the procedure influenced the results: patients who underwent PD showed better results in final clinical evaluation, when compared with those who underwent ND.

It is a well-established fact that knee function is under multifactorial interference.[13] In this study, we observed that the scores obtained in the KSS and WOMAC questionnaires were significantly better in patients who underwent surgery with PD compared to those without patellar denervation: the former scored, on average, 6 points higher in KSS questionnaire and 6 points less in WOMAC. This is consistent with recent studies that have shown improved joint function in patients submitted to PD,[10,13] indicating a better function of the affected joint. In addition, and considering that both questionnaires also assess referred pain, this may also indicate mild pain relief. However, this must still be seen as a subject of controversy, because other studies reported that patients submitted to PD during TKA, showed no significant differences in joint function measured by KSS, but improvement in WOMAC scores.[9] In our study, post-surgical knee flexion was significantly lower in patients submitted to PD ($p = 0.009$), which is not consistent with function results previously described. Considering that a reduction in knee range of motion can occur in patients TKA in general,[14] more research is needed to better assess this variable.

Even though pain is notoriously a subjective parameter, and its actual measurement is naturally biased, our results indicate that there is no significant difference between groups, 24 and 48 hours after surgery: it is thus possible to infer that the type of procedure (PD or ND) does not interfere with the pain outcome. Paradoxically, this fact diverges from theory, as patellar innervation is provided by the superomedial and superolateral nerves, and selective analgesia of both decreases VAS estimated pain.[7,15]

In summary, we have found inter-group differences in WOMAC and KSS scores versus a similarity of the pain VAS score. This is probably a consequence of the fact that WOMAC and KSS are mainly focused on joint function, which contributes 79% of the WOMAC score, and 50% in KSS.(16) Hence, these results should be analyzed with caution, and future research aimed at analyzing separately pain and knee joint function should be considered.

The present study has some limitations, among which are: 1. A pre-operative difference in age and in knee extension between groups; 2. small number of analyzed variables and only three analysis measurements used.

CONCLUSION

Total knee arthroplasty with patellar denervation does not result in a better effect upon pain reduction compared with the same surgical procedure with non-patellar denervation. However, it has a certain beneficial effect on knee function score, as assessed though KSS, and WOMAC. This is a controversial subject, with several studies showing similar or discordant results to those found in this study, highlighting the importance of further research on this topic.

CONFLICT OF INTEREST

The authors declare no conflicts of interest in the publication of this research**.**

AUTHORS CONTRIBUTION

David Sadigursky and Perseu Almeida were the main contributors in the writing of the manuscipt and literature review and to the intellectual concepts of the study. David Sadigursky performed the surgeries. Gustavo Queiroz, Magda Pinheiro e Matheus Mendes collected the clinical data and performed the statistical analysis.

DENERVAÇÃO PATELAR PARA TRATAMENTO DA DOR ANTERIOR NA ARTROPLASTIA TOTAL DO JOELHO

OBJETIVO: Comparar a eficácia de denervação patelar em relação à não-denervação patelar na redução da dor anterior do joelho em um período de acompanhamento de no mínimo um ano após a artroplastia total do joelho (ATJ).

MÉTODO: Foram analisados dados de 84 pacientes, submetidos a ATJ e divididos em 2 grupos: grupo A formado

por 42 pacientes submetidos à ATJ com denervação patelar (PD) e grupo B formado por 42 pacientes submetidos a ATJ sem a denervação (ND). Os resultados foram avaliados utilizando os questionários WOMAC e KSS, além da escala analógica visual da dor (EVA). Também foi avaliada a amplitude de movimento em graus. As condições clínicas pré-operatórias dos dois grupos foram semelhantes.

RESULTADOS: Comparando a pontuação do questionário WOMAC, o grupo A apresentou melhores resultados, com media de 27,95 ± 5,89, enquanto o grupo B apresentou média de 33,55 ± 6,23. Melhores resultados foram também observados no KSS para o grupo A, apresentando média de 86,19 ± 7,10, em comparação ao grupo B, com média de 83,07 ± 4,88. Observou-se menor amplitude de flexão do joelho no grupo A, 119,0 ± 10,68 graus, em comparação com o grupo B, com média de 125,5 ± 11,02 graus. Analisando exclusivamente a dor, não foi observada diferença entre a dor referida pelo paciente, de acordo com a escore da escala EVA.

CONCLUSÕES: A DP não demonstrou melhores efeitos na redução da dor em comparação com ND na ATJ. No entanto um melhor efeito da denervação nos escores de função, através dos questionários KSS e WOMAC sugerem que a denervação pode ser benéfica neste cenário.

PALAVRAS-CHAVE: Patela; Artroplastia de Joelho; Dor articular; denervação

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