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Original Research Article

The influence of retropatellar fat preservation on the positioning of the tibial component of total knee arthroplasty

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ABSTRACT

Background: The good clinical-functional outcomes of total knee arthroplasty (TKA) depend on several factors, such as the surgical time and the adequate positioning of the prosthesis components. The present study aims to evaluate whether the preservation of retropatellar fat pad during the surgical act influences the rotational alignment of the tibial component and the surgical time of the procedure.
Methods: The study was carried out with 50 patients operated on by the main author, who were randomly divided into two groups, experimental and control. For the evaluation of the positioning of the tibial component, the patients underwent computed tomography (CT) four weeks after the surgery, on average. Casuistry was determined by pilot study with the first five patients of each group. For the sample calculation, the t-student test was used for two independent samples.
Results: All patients presented internal rotation of the tibial component, with no statistical difference in mean rotation between the experimental and control groups. When there was complete detachment of the fat in the experimental group, the tibial component showed greater external rotation, with a statistical difference. Surgical time was shorter in the experimental group, varying in this group according to the degree of osteoarthrosis.
Conclusions: Maintenance of retropatellar fat pad did not influence the rotational alignment of the tibial component; however, in patients with advanced osteoarthrosis, such maintenance increases the surgical time.

Keywords: Total knee arthoplasty, Tibial component, Hoffa's fat pad

INTRODUCTION

Total knee arthroplasty (TKA) is one of the most commonly performed surgical procedures within orthopedics. Its good clinical-functional outcomes depend on a series of biomechanical and technical factors. Among the most important factors in TKA, it is important to highlight the precise cutting of the articular surfaces of the femur and tibia, the adequate positioning of the prosthesis components, in addition to the total surgical time of the procedure. Studies conclude that the imprecise rotational alignment of the tibial component can lead to distortions in articular biomechanics and the increased time in the duration of the procedure leads to a greater risk of surgical site infection.[1,2]

In order to provide adequate exposure of the articular cavity, the retropatellar fat pad is usually removed by most surgeons.[3] However, the maintenance of retropatellar fat pad presents a series of benefits, such as shock absorption, protection of the patellar ligament, dispersion of mechanical stress during movement, among others.[4] These benefits led several authors to research the impact of preserving the retropatellar fat pad, especially regarding the clinical-functional results, in TKA.[5]

This study aims to evaluate whether maintenance of retropatellar fat pad influences the rotational alignment of the tibial component and the surgical time, in addition to analyzing whether patient characteristics may interfere with this alignment and verifying the status of insertion of retropatellar fat pad in the tibia.

METHODS

This study was carried out in a university hospital, the Hospital Universitario Ciências Médicas in Belo Horizonte, and it was previously approved by the research ethics committee of the institution.

The present study consists of a randomized controlled trial and was carried out with 50 patients who underwent total knee arthroplasty in the period of September 2017 to December 2018, and it had as inclusion criteria patients with indication for total knee arthroplasty due to gonarthrosis, who were operated by the main author (RBV) and who agreed to participate in the study. Among the exclusion criteria of the present study, there is the limitation of flexion below 60º and inflammatory joint disease, as it requires wide synovectomy, including complete removal of retropatellar fat pad. Previously operated knees were also excluded, since in order to access the articular cavity, even in arthroscopic surgeries, there is aggression to the retropatellar fat pad, with subsequent formation of scar tissue, a fact that could interfere with the results.

In order to determine the sample size, a pilot study was carried out with the first five patients of each group, in which a standard deviation of 8.26 was observed. It was defined to find a minimum difference of seven degrees of rotational alignment of the tibial component between the experimental and control groups. To reach a statistical power of 80% and a significance level of 0.05, 23 patients were needed in each group. The authors decided to add two more patients to each group to obtain a safety margin, resulting in 50 patients.

The patients were randomized into a control group and an experimental group (group A: experimental [retropatellar fat pad removal], group B: control group [retropatellar fat pad maintenance]) using sealed envelopes, with a total of 25 patients assigned to each group. The study had the participation of three researchers for the purpose of minimizing biases: one responsible for capturing data (pre, intra and postoperatively), one for performing the procedures and a third for formatting the database.

The study gathered demographic data (gender, age, weight, height, body mass index [BMI] and laterality), maximum knee flexion range, anatomical alignment of the lower limb (these last two were evaluated in the physical examination using goniometer) and the degree of osteoarthritis (OA) classified according to Kellgren and Lawrence, in the preoperative period.

In the control group, the complete removal of the retropatellar fat pad was performed, among with the menisci and the anterior cruciate ligament, for better exposure of the articular cavity. In the experimental group, the aforementioned structures were removed, except for the retropatellar fat pad, being vigilant to not detach it from the proximal tibia.

In order to minimize damage to the retropatellar fat pad, in patients in whom this structure was preserved (experimental group), the cut in the proximal tibia was performed using a 10 mm width saw blade, compared to the use of 19 mm width saw blades in surgeries of the control group.

After the conclusion of the surgical procedure, information was gathered about the group to which the patient belonged (experimental or control), the surgical time (timed in minutes, from arthrotomy until closure of the joint capsule) and the status of the retropatellar fat pad in terms of its insertion in the proximal tibia at the end of the surgery, according to the following stage: without compromise, partial detachment of the tibial bed, total detachment of the tibial bed.

In the second postoperative follow-up, four weeks after the surgical procedure, the patients were referred to the institution's radiology sector, where a computed tomography (CT) scan of the knee was performed.

The study used images of three axial cuts, with a thickness of 1.5 mm, the first being the most proximal to the tibial tray level, the second to the keel level and the third to the anterior tibial tuberosity (ATT) level, at the insertion of the patellar ligament, as described by Berger et al.[6] The parameters used were a line perpendicular to the axis of the posterior edge of the tibial component, crossing the geometric center of the proximal tibia. Then, a line was superimposed between the apex of the ATT and also passing through the geometric center of the proximal tibia. The intersection of these two lines forms the rotation angle of the tibial component. The neutral point for rotation is directed internally at 18º, with alignments above this value indicating internal rotation and below, external rotation

For the sample calculation, the study used the t-student test for two independent samples. The software used was Minitab 17.

In the descriptive analysis of the qualitative variables, absolute and relative frequencies were used, while in the description of the quantitative variables, the study used means, medians, standard deviations, confidence intervals, in addition to 1st and 3rd quartiles. The Shapiro-Wilk normality test was applied. For comparison between categorical variables, Fisher's Exact test and the Chi-square test were used. In the comparison between categorical variables with two levels and numerical variables, the Mann Whitney test was used, while for categorical variables with more than two levels and

numeric variables, the Kruskal-Wallis test was used. For multiple comparisons, the Mann Whitney test was used.

The significance level used was 0.05. The software used in the analyzes was the R (version 3.5.2).

RESULTS

Patient demographic data comparison between groups A and B are presented in the following tables (Tables 1 and 2). All 50 patients in the study had some degree of internal rotation of the tibial component taking into account the apex of the ATT.

The mean internal rotation was 20, 50° for group A and 18, 30° for group B, with no statistical difference (p>0.05) using the Mann Whitney test (Table 3).

Regarding the rotation of the tibial component, variation was observed in group A between 10.20º and 29.30º (Q1 to Q3) with a median of 18.30º. In group B, the variation was between 10.80 and 27.40º (Q1 to Q3), with a median of 15.80º.

When analyzing the rotational alignment of patients in group A, it was observed that complete detachment of the retropatellar fat pad in the proximal tibia led to greater external rotation of the tibial component compared to partial detachment of this structure, with a statistical difference (p=0.002) (Table 4).

When comparing the preoperative variables regarding rotation of the tibial component between groups A and B, no statistical difference was found in any of the comparisons (Table 5).

The mean surgical time in patients in group A was 96.96 minutes and 91.24 minutes in group B, with no statistical difference being observed by the Mann Whitney test (p>0.05).

Figure 1 shows a greater variation (Q1 to Q3) of surgical time in group A, between 88 and 103 minutes with a median of 93 minutes, than in group B, which was between 88 and 96 minutes with a median of 91 minutes (Figure 1).

There was no difference in surgical time between patients in group A, regarding partial or complete detachment of retropatellar fat pad (p>0.05).

When comparing the surgical time in patients with different grades of OA within the same group, it was observed in group A, shorter time in those with grades 2 and 3 when compared to those in grade 4, with a statistically significant difference (p<0.05) (Table 6).

There was no difference when comparing preoperative variables within group A (p>0.05) (Table 7).

In the comparison of preoperative variables in group B, a significant difference was observed between patients who had more pronounced valgus (between 11º and 20º) in relation to the others (p<0.05) (Table 8).

In group B, there was no difference regarding any of the analyzed parameters (p>0.05) (Table 7).

Regarding to surgical time, Table 6 shows that in patients with Kellgren and Lawrence grade 4 OA, an average of 104.20 minutes was spent in group A and 89.50 minutes in group B (p<0.05).

Table 1: Demographic data and pre-operative variables comparison between groups A and B.

Demographic variables	Group A		Group B		P value
	N	%	N	%	
Gender					
Female	15	60.00	19	76.00	0.363[4]
Male	10	40.00	6	24.00	
Side					
Right	15	60.00	10	40.00	0.258[4]
Left	10	40.00	15	60.00	
BMI (kg/m^2)					
≥30	19	76.00	14	56.00	0.232[4]
<29.9	6	24.00	11	44.00	
Pre-operative axis					
11°-20º valgus	4	16.00	5	20.00	1.000[3]
11°-20º varus	1	4.00	0	0.00	
<10° valgus	5	20.00	6	24.00	
<10° varus	13	52.00	13	52.00	
Neutral	2	8.00	1	4.00	
Maximum flexion					
≤100°	7	28.00	9	36.00	0.762[4]
More than 100°	18	72.00	16	64.00	

Continued.

Demographic variables	Group A		Group B		P value
	N	%	N	%	
OA classification[1]					
2+3	15	60.00	13	52.00	0.776[4]
4	10	40.00	12	48.00	
Prosthesis type[2]					
CR	12	48.00	7	28.00	0.145[4]
PS	13	52.00	18	72.00	

[1]Kellgren & Lawence, [2]CR=cruciate-retaining, PS=posterior-stabilized, [3]Fisher's exact test, [4]Chi square test, N: number of patients, BMI: body mass index, OA: osteoarthrosis

Table 2: Age comparison between groups A and B.

Group	N	Median age	I.C 95%	SE	1º Q.	2º Q.	3º Q.	P value[1]
A	25	68.00	[65.64;70.52]	1.29	63.00	69.00	71.00	0.838
B	25	68.92	[66.44;71.56]	1.35	63.00	67.00	73.00	

[1]Mann Whitney test, N: Number of patients, CI 95%: confidence interval, SE: standard error, Q: quartile

Table 3: Descriptive measurements of rotation of the TKA tibial component.

Group/ rotation	N	Mean (º)	CI 95% (º)	SD (º)	1º Q. (º)	Median (º)	3º Q. (º)	P value[1]
A	25	20.50	[14.55;25.95]	14.41	10.20	18.30	29.30	0.720
B	25	18.30	[14.18;22.69]	10.78	10.80	15.80	27.40	

[1]Mann Whitney test, N: Number of patients, CI 95%: confidence interval, SE: standard error, Q: quartile

Table 4: Analysis of the internal rotation of the tibial component according to the status of the retropatellar fat pad.

Status of the retropatellar fat pad	N	Mean (º)	CI 95% (º)	SD (º)	1º Q. (º)	Median (º)	3º Q. (º)
Partial detachment	21	24.13	[18.34-29.93]	12.73	15.3	21.5	36
Complete detachment	4	1.45	[-0.64-3.49]	1.29	0.47	1.05	2.75

[1]Mann Whitney test, N: Number of patients, CI 95%: confidence interval, SE: standard error, Q: quartile

Table 5: Descriptive analysis of rotational positioning between groups A and B according to preoperative variables.

Variable	Group	N	Mean (º)	C.I 95% (º)	S.D. (º)	1º Q. (º)	2º Q. (º)	3º Q. (º)	P value[1]
BMI									
Until 29.9	A	19	19.19	[13.43;25.37]	13.60	7.75	16.90	29.05	0.942
	B	14	19.18	[14.87;23.64]	8.85	11.30	17.40	26.50	
≥30	A	6	24.67	[12.42;36.93]	17.40	15.50	20.65	45.00	0.451
	B	11	17.23	[9.87;25.64]	13.21	6.00	11.70	28.50	
Flexion									
≤100°	A	7	17.66	[9.35;27.18]	13.28	7.75	15.80	23.80	0.672
	B	9	19.32	[12.53;25.8]	10.79	11.70	18.60	28.80	
More than 100°	A	18	21.61	[15.17;28.01]	15.04	11.80	20.95	34.60	0.448
	B	16	17.76	[12.9;23.26]	11.08	9.05	15.30	24.40	
AO classification									
K-L 2+3	A	15	17.11	[10.25;24.59]	14.31	4.30	15.80	26.15	0.695
	B	13	18.25	[13.53;23.01]	9.35	11.30	15.80	26.50	
K-L 4	A	10	25.59	[18.32;33.53]	13.67	15.50	23.80	40.60	0.210
	B	12	18.40	[11.78;25.2]	12.57	6.65	15.35	30.25	
Preoperative axis									
Varus	A	14	21.69	[13.86;29.6]	15.48	10.20	17.60	37.40	1.000
	B	13	20.58	[15.21;26.18]	10.29	14.10	19.00	27.40	

Continued.

Variable	Group	N	Mean (º)	C.I 95% (º)	S.D. (º)	1º Q. (º)	2º Q. (º)	3º Q. (º)	P value[1]
Valgus	A	9	14.97	[7.84;21.06]	10.56	5.30	15.80	21.50	0.939
	B	11	14.70	[9.24;21.51]	10.94	6.65	11.00	18.55	

[1]Mann Whitney test, N: Number of patients, CI 95%: confidence interval, SE: standard error, Q: quartile

Table 6: Descriptive measurements of surgical time in group A compared between subgroups of preoperative variables.

Variables	N	Mean (min)	C.I 95% (min)	S.D (min)	1º Q. (min)	2º Q. (min)	3º Q. (min)	P value
BMI								
≥30	19	98.67	[89.17;108.33]	13.47	89.00	96.50	110.00	0.750[1]
Until 29.9	6	96.42	[91.79;101.58]	11.13	87.50	92.00	102.00	
Flexion								
≤ 100°	7	98.57	[89.29;109.29]	14.16	88.00	91.00	110.00	0.856[1]
More than 100°	18	96.33	[91.72;101.11]	10.66	88.00	96.50	101.00	
AO classification[3]								
2+3	15	92.13	[87.60;96.47]	9.72	85.50	89.00	97.00	0.013[1]
4	10	104.2	[98.30;110.60]	10.34	100.0	100.0	117.00	
Preoperative axis								
11° until 20º valgus	4	103.5	[94.00;113.50]	11.70	95.00	103.0	112.00	0.345[2]
11° until 20º varus	1	118.0	[53.43;65.21]	-	118.0	118.0	118.00	
Until 10° valgus	5	94.60	[85.80;104.00]	12.22	85.00	92.00	103.00	
Until 10° varus	13	94.46	[89.54;100.23]	10.74	87.00	92.00	101.00	
Neutral	2	95.50	[91.00;100.00]	6.36	91.00	95.50	100.00	

[1]Mann Whitney test, [2]Kruskal-Wallis' test, [3]Kellgreen & Laurence, N: Number of patients, CI 95%: confidence interval, SE: standard error, Q: quartile

Table 7: Descriptive measurements of surgical time in group B compared between subgroups of preoperative variables.

Variables	N	Mean (min)	C.I 95% (min)	S.D (min)	1º Q. (min)	2º Q. (min)	3º Q. (min)	P value
BMI								
≥30	14	93.43	[88.93;98.79]	10.17	88.00	91.00	97.00	0.681[1]
Until 29.9	11	88.45	[82.45;93.36]	9.45	85.00	91.00	95.50	
Flexion								
≤100°	9	89.67	[85.44;93.78]	7.05	88.00	91.00	95.00	0.712[1]
More than 100°	16	92.13	[86.81;97.31]	11.42	87.50	91.50	96.50	
AO classification[3]								
2+3	13	92.85	[87.46;98.85]	11.06	88.00	91.00	95.00	0.935[1]
4	12	89.50	[84.50;93.83]	8.80	85.50	91.50	96.00	
Preoperative axis								
11° until 20º valgus	5	89.80	[78.200;97.00]	12.52	91.00	95.00	96.00	0.493[2]
Until 10° valgus	6	90.67	[85.50;95.00]	6.38	88.00	91.50	96.00	
Until 10° varus	13	91.46	[86.31;97.46]	11.13	87.00	89.00	92.00	
Neutral	1	99.00	[44.45;55.35]	-	99.00	99.00	99.00	

Table 8: Descriptive analysis of surgical time between groups A and B according to preoperative variables.

Variables	Group	N	Mean (min)	C.I 95% (min)	S.D (min)	1º Q. (min)	2º Q. (min)	3º Q. (min)	P value
BMI									
Until 29.9°	A	19	96.42	[91.89;101.16]	11.13	87.50	92.00	102.00	0.477
	B	14	93.43	[88.78;99.22]	10.17	88.00	91.00	97.00	
≥30	A	6	98.67	[89.17;109.33]	13.47	89.00	96.50	110.00	0.174

Continued.

Variables	Group	N	Mean (min)	C.I 95% (min)	S.D (min)	1º Q. (min)	2º Q. (min)	3º Q. (min)	P value
	B	11	88.45	[82.82;93.46]	9.45	85.00	91.00	95.50	
Flexion									
≤100°	A	7	98.57	[88.71;109.14]	14.16	88.00	91.00	110.00	0.448
	B	9	89.67	[85.11;93.78]	7.05	88.00	91.00	95.00	
More than 100º	A	18	96.33	[91.5;101]	10.66	88.00	96.50	101.00	0.276
	B	16	92.13	[87;97.38]	11.42	87.50	91.50	96.50	
OA classification									
2+3	A	15	92.13	[87.8;97.2]	9.72	85.50	89.00	97.00	0.747
	B	13	92.85	[87.61;98.62]	11.06	88.00	91.00	95.00	
4	A	10	104.20	[98.2;110.5]	10.34	100.00	100.50	117.00	0.002
	B	12	89.50	[84.25;93.92]	8.80	85.50	91.50	96.00	
Pre-operative axis									
Varus	A	14	96.14	[90.36;102.36]	12.08	87.00	92.50	101.00	0.356
	B	13	91.46	[86.23;97.69]	11.13	87.00	89.00	92.00	
Valgus	A	9	98.56	[91.44;106.23]	12.17	90.00	100.00	106.00	0.171
	B	11	90.27	[84.54;94.91]	9.12	88.50	94.00	96.00	

[1]Mann Whitney test, N: Number of patients, CI 95%: confidence interval, SE: standard error, Q: quartile

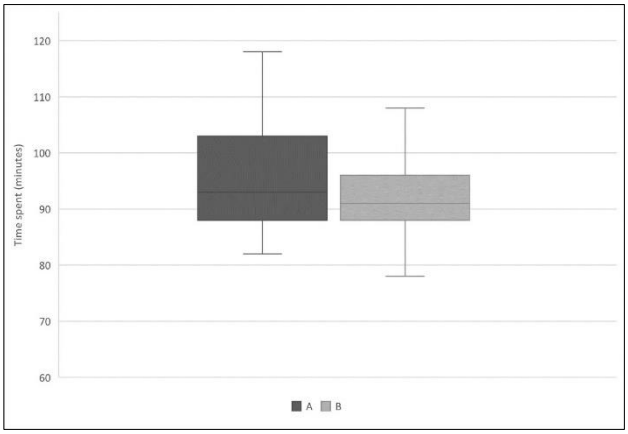

Figure 1: Boxplot of measures of time spent on surgical procedures (minutes) according to groups.

DISCUSSION

There are several studies that support the advantages of preserving the retropatellar fat pad, such as lower pain intensity, better functional result, and less possibility of lowering the patella due to shortening of the patellar ligament.[3,7-9] Most surgeons deem it necessary to remove it for better exposure of the joint, increasing the precision of implantation of the tibial component.[10] In contrast, possible disadvantages of preserving the retropatellar fat pad would be the possibility of fibrosis, leading to worse outcomes.[11]

Studies show that imprecise rotational alignment can lead to distortions in the biomechanics of the joint, such as incongruence between the surfaces of the femur and tibia during complete weight discharge, alteration of the 'screw home' mechanism at the end of the extension and increased contact pressure between the femur and the tibia, which may lead to wear of the polyethylene.[1,12-14] Furthermore, the kinematics of the patellofemoral joint is altered, with an increase in retropatellar pressure.[15] These changes can lead to worse functional outcomes, interfering with the durability of the prosthesis and dissatisfaction rates of up to 20% after TKA.[16-18]

There is still great diversity in the literature regarding the best method for measuring the rotation of the tibial component, in addition to divergences regarding the ideal degree of rotation of this component.[6,19,20] Insall advises that the tibial component must be aligned with the medial third of the ATT, which is one of the most used methods, with greater reproducibility and accuracy.[21] In the present study, this was the reference used.

In the present study, it was observed that in all cases there was preservation of contact between the body of the retropatellar fat pad and the patellar ligament, and its proximal extension surrounding the patella, as described by Stephen et al.[22] However, some displacement of the distal insertion was identified in all knees where it was preserved. This finding can be justified by the indirect insertion of the retropatellar fat pad in the tibia, performed by the meniscotibial ligaments.[22]

It should be considered that the increase in its mobility, resulting from disinsertion in the proximal tibia, can cause an impact against the components of the prosthesis, leading to an inflammatory process, pain and fibrosis.[23-25]

A mean internal rotation of 20.50º was observed in the present study for patients in whom retropatellar fat pad was maintained and 18.30º in the group in which it was removed, with no statistical difference. However, in knees with maintenance of retropatellar fat, it was observed that when its detachment was complete in the proximal tibia, there was greater external rotation of the tibial component compared to knees with partial detachment ($p<0.05$).

A greater tendency for external rotation of the tibial component was also observed in the present study in knees with marked valgus alignment, compared to varus or mild valgus alignments (p=0.045). This finding can be justified by the lateralization of the ATT in valgus knees, according to the conclusion by Hatayama et al.[26]

Parameters that could be used in this study to measure the technical difficulty of maintaining or removing retropatellar fat pad were not found in the researched literature. Surgical time was an indirect way to evaluate this aspect.

Data in literature are disparate regarding the mean surgical time for performing TKA, ranging from 108.2 to 60.5 minutes and regarding the moment of beginning and end of this time taken.[27,28]

In the present study, the time elapsed from the arthrotomy to the closure of the joint capsule was analyzed, since the opening and closing of the skin and subcutaneous tissue are aspects judged as not relevant for the research. Mean surgical time was 96.96 minutes in patients with preservation and 91.24 minutes in resection of retropatellar fat pad, with no statistical difference being observed. It was also identified that the degree of insertion of this structure in the proximal tibia did not influence the time spent for the procedure. However, a longer surgical time was observed in patients with advanced OA in whom the retropatellar fat pad was preserved compared to patients with its removal (p=0.002). A longer surgical time was also identified in those with preservation of retropatellar fat pad associated with more advanced arthrosis compared to less advanced arthrosis (p=0.013). It can be assumed that in more severe gonarthrosis, the difficulty in exposing the joint cavity may be aggravated by the maintenance of retropatellar fat pad, resulting in increased surgical time.

In order to minimize the risk of bias in this study, the groups were randomized and were shown to be homogeneous in terms of sample characteristics, prostheses of the same brand and model were used in all procedures, in addition to the fact that only one professional was responsible for all surgeries, in order to reduce the weakening of the results.

As a limitation of this study, it should be noted that it was carried out in a teaching hospital, where there is a possible need to reduce the speed of the surgery to explain it to the students, a fact that may interfere with some results.

CONCLUSION

In summary, the maintenance of retropatellar fat pad did not influence the rotational alignment of the tibial component and there is difficulty in fully preserving the retropatellar fat pad, since in all cases there was detachment of its bed in the tibia. And advanced osteoarthrosis is a factor that led to a longer surgical time in patients with maintenance of retropatellar fat pad.

Recommendations

This study suggests there is no reason for surgeons to try to preserve retropatellar fat pad aiming better rotational alignment of the tibial component, especially in cases of advanced osteoarthrosis, since in addition to not influencing the rotational alignment of the tibial component, the maintenance of retropatellar fat pad in these cases led to a longer surgical time, which could lead to an increased infection risk.

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