DOI: http://dx.doi.org/10.1590/1413-785220223004e250492

STUDY BETWEEN SEMI-CONSTRAINED TOTAL KNEE ARTHROPLASTY WITH OR WITHOUT INTRAMEDULLARY STEM

ESTUDO ENTRE ARTROPLASTIA TOTAL DO JOELHO SEMI-CONSTRITA COM OU SEM HASTE INTRAMEDULAR

Rodrigo Sattamini Pires e Albuquerque[1,2], *Pedro Guilme Teixeira de Sousa Filho*[1], *Rui Felipe Pache de Moraes*[1], *Dalton Roberto de Melo Franco Filho*[1], *Allan Mozella*[1], *Hugo Cobra*[1], *Vinicius Schott Gameiro*[2]

1. National Institute of Orthopedics and Traumatology Instituto Nacional de Traumatologia e Ortopedia, Knee Surgery Center, Rio de Janeiro, RJ, Brazil.
2. Universidade Federal Fluminense, Niterói, RJ, Brazil.

ABSTRACT

Objective: This research sought to carry out a comparative study observing the clinical and radiographic analysis of primary prostheses of the type TC3 Depuy Johnson® with or without a stem during a short-term follow-up. Methods: The sample was divided into three groups: Group 1 (with stem), Group 2 (without stem) and Group 3 (mixed). Patients were evaluated to assess whether the implants were loosening and a clinical analysis was performed. Results: Preoperative deformities were predominantly considered severe. The total range of motion in the postoperative period was above 96.7° in the three groups. In the postoperative period, the femoral-tibial angle oscillated on average between 5 to 6° valgus. There was no record of implant loosening for cases treated with stem, and the incidence of loosening was 14.3% for the group without stem and 16.7% among cases in the mixed group. Conclusion: In general, preoperative deformities were considered severe. In the postoperative period, the total range of motion was above 96.7°. The postoperative femoral-tibial angle obtained an average of 5 to 6° valgus. There is no significant difference in implants loosening in the three groups. ***Level of Evidence III, Retrospective Comparative Study.***

Keywords: Arthroplasty, Replacement, Knee. Knee. Follow-up Studies.

RESUMO

Objetivo: Realizar um estudo comparativo observando a análise clínica e radiográfica das próteses primárias do tipo TC3 Johnson® com ou sem haste durante um seguimento de curto prazo. Métodos: A amostra foi dividida em três grupos: Grupo 1 com haste, Grupo 2 sem haste e Grupo 3 misto. Foi realizada a análise clínica dos pacientes e verificado se ocorreu soltura dos implantes. Resultados: As deformidades pré-operatórias foram predominantemente graves. O arco de movimento total no pós-operatório foi acima de 96,7° nos três grupos. No pós-operatório o ângulo tíbio-femoral oscilou na média entre 5 e 6° de valgo. Não houve registro de soltura do implante para os casos tratados com haste; a incidência de soltura foi de 14,3% entre os casos do grupo sem haste e de 16,7% entre os casos do grupo misto. Conclusão: Em geral, as deformidades pré-operatórias foram consideradas graves. No pós-operatório a amplitude total do arco de movimento foi acima de 96,7°. O ângulo tíbio-femoral pós-operatório obteve uma média entre 5 e 6° de valgo. Não há diferença significativa na soltura dos implantes nos três grupos. ***Nível de Evidência III, Estudo Retrospectivo Comparativo.***

Descritores: *Artroplastia do Joelho. Joelho. Seguimentos.*

Citation: Pires e Albuquerque RS, Sousa Filho PGT, Moraes RFP, Franco Filho DRM, Mozella A, Cobra H, Gameiro VS. Study between semi-constrained total knee arthroplasty with or without intramedullary stem. Acta Ortop Bras. [online]. 2022;30(4): Page 1 of 6. Available from URL: http://www.scielo.br/aob.

INTRODUCTION

Knee osteoarthritis associated with complex deformity is a challenge for orthopedists.[1] Sharp angular deviations, as well as severe flexion contractures, often require more constrained implants.[2] Extensive soft tissue releases or change of the articular interline in these deformities can generate instabilities, requiring more constrained implants to balance the flexion and extension spaces.[3]

More constrained implants with varus and valgus restriction increase stress transmission at the prosthesis-bone interface. Herewith, it is often necessary to use intramedullary stems in this type of prosthesis in order to achieve a better distribution of loads (Figure 1).[1]

All authors declare no potential conflict of interest related to this article.

The study was conducted at the Knee Surgery Center at the National Institute of Orthopedics and Traumatology and at the Graduation Program in Medical Sciences at the Universidade Federal Fluminense.
Correspondence: Rodrigo Sattamini Pires e Albuquerque. Rua Ataulfo Coutinho, 200, bloco 1, apt. 102, Rio de Janeiro, RJ, Brazil, 22793520. rodalbuquerque19@gmail.com

Article received on 03/30/2021, approved on 07/02/2021.

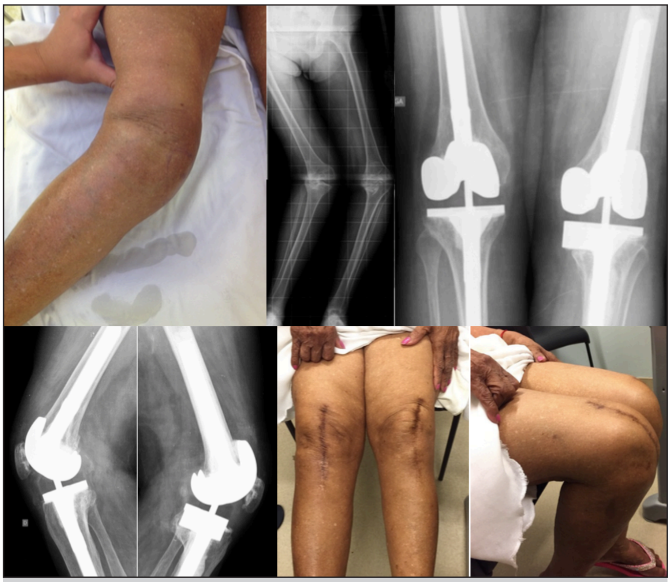

Figure 1. Clinical and radiographic analysis of total knee arthroplasty with stem.

Knee prosthesis associated with intramedullary stem allows for a better load distribution in the femoral-tibial region, reducing the risk of implant loosening.[4,5]

The literature is scarce on the absence of stems in more constrained knee implants (Figure 2).[6] The association of a prosthesis with intramedullary stem increases the risk of embolization, as well as the cost of the implant, morbidity, and the time of the surgery.[5] The pain at the tip of the stem should also be considered if there is a need for revision and removal of the implants, which can hinder the procedure.[5]

This research aims to conduct a comparative study observing the clinical and radiographic analysis of TC3 Johnson® primary prostheses with or without stem during a short-term follow-up.

Figure 2. Total arthroplasty of the knee without stem.

MATERIAL AND METHODS

This is an observational, cross-sectional, and retrospective study. Participants were identified using data from the hospital implant sector. By identifying the patients linked to the specific implant, it was possible to have access to the medical records of those subjected to primary total knee arthroplasty (TKA). Thus, a comparative study was conducted, observing the radiographic analysis of the patients subjected to primary semi-constrained TKA from the TC3 Depuy Johnson® brand with or without stem during a minimum 2-year postoperative follow-up. The sample was divided into three groups: Group 1 with stem in both tibial and femoral components, Group 2 without stems and Group 3 with a mixed approach, i.e., with stem in the tibial component.

The sample consisted of patients of all genders and ages, who underwent primary TKA in the hospital with the TC3 Depuy Johnson® prosthesis who were admitted for treatment from 2012 to 2016. The inclusion criteria were: patients subjected to primary TKA with TC3 Depuy Johnson® prosthesis, regardless of the use or not of intramedullary stems. The exclusion criteria were: failure to collect data from the medical record and the use of another prosthesis model. No patients were excluded. The research was approved by the Institutional Ethics Council (protocol No. 98772718.0.0000.5273) according to established ethical standards. All participants signed the informed consent form.

Medical records were analyzed by a single physician who was a member of the Brazilian Society of Knee Surgery, and demographic data of patients were collected, as well as the range of movement (ROM), comorbidities, body mass index (BMI), American Society of Anesthesiology (ASA) classification and the etiology of the surgical indication.

The radiographic analyses of the implants were performed by a graduated (Doctor in Radiology) physician , without prior knowledge of the patients. The radiographs, according to the study hospital standards, were performed with bipodal support in the anteroposterior, lateral, and axial facets of the patella. The radiographic analysis evaluated implant loosening with the criteria used by the Knee Society Total Knee Arthroplasty Roentgenographic Evaluation and Scoring System.[7] The evaluation of osteolysis consisted in the observation of a radioluscent line in the region of the prosthesis-cement or cement-bone interface, which was quantified in millimeters of thickness and subsequently analyzed in each radiographic incidence for comparison. In addition, the type of deformity of the lower limb and the femoral-tibial angle were analyzed. This angle was calculated by drawing lines between the anatomical axes of the femur and tibia. The analysis of radiographic data was performed via the mDicomViewer 3.0 software (Microdata, RJ-Brazil, 2007).

The data collected from the study were arranged in an electronic spreadsheet analyzed by the SPSS (Statistical for the Social Science) Program, version 22.0, and by the Microsoft Excel 2007 program. The descriptive analysis was based on frequency distributions, and on the calculation of descriptive statistics (proportions of interest, minimum, maximum, mean, median, standard deviation, coefficient of variation – *CV*) seeking to synthesize and to characterize the behavior of the variables as well as to trace the participants' profile. The variability of the distribution of a quantitative variable was considered low if $CV < 0.20$; moderate if $0.20 \leq CV < 0.40$ and high if $CV \geq 0.40$. The Wilcoxon test was also used.

All discussions about significance tests were conducted considering a maximum significance level of 5% ($p < 0.05$).

RESULTS

Table 1 shows the frequency distribution of the variables that characterize the patients of the three groups. The main frequencies of each group (highest frequency and frequency that differs from the highest frequency by a maximum of 10%) are highlighted. The data show that the G1 and G2 present a higher frequency of patients aged from 67 to 77 years. On the other hand, G3 participants are aged from 47 to 57. Regarding BMI, all groups presented greater patterns for overweight or obesity. The predominant profession is "homeworker." White and Brown were the predominant skin color; the most frequent comorbidity is systemic arterial hypertension. All groups were graduated as 2 via the ASA rating. Laterality can be considered well-distributed for the Group 1; however, for G2 or G3, we obtained a higher frequency of left-handedness. Most surgery indicated deformity; however, we observed a higher frequency of ligamentous cases in the Group 2 (35.7% of the cases, while in the other groups this percentage was below 10%). The frequencies of valgus/varus deformities can be considered well-distributed for both Group 2 and 3; however, Group 2 presented more cases of varus deformity. The time after surgery was two years at least; however, 25.0% of individuals in the G3 presented 5 years of surgery. There was no record of implant loosening for cases treated with stem. Furthermore, the occurrence of loosening was 14.3% among cases in the G2 (Figure 3) and 16.7% among cases in the Group 3 (Figure 4). In Group 2, we observed two patients with tibial component loosening. In these two cases, one presented ligamentous instability whereas the other presented joint deformity. In Group 3, we found a patient with bilateral implant loosening. The patient presented severe bilateral deformity and we observed bilateral loosening of all components. The three groups do not differ significantly with respect to any of the analyzed variables (all p-values are greater than 5%); that is, the patients of the three groups do not have significant differences in the analyzed characteristics.

Table 1. Frequency distribution of the variables that characterize the patients of the three groups.

Characteristic	With stem n = 20		Without stem n = 14		Mixed n = 12		p-value of the test comparing the distributions of the three groups
	F	%	F	%	F	%	
Age							0.296
27 I- 37	0	0.0%	1	7.1%	0	0.0%	
37 I- 47	1	5.0%	0	0.0%	0	0.0%	
47 I- 57	2	10.0%	0	0.0%	6	50.0%	
57 I- 67	3	15.0%	4	28.6%	0	0.0%	
67 I- 77	10	50.0%	8	57.1%	4	33.3%	
77 I- 87	4	20.0%	1	7.1%	2	16.7%	
BMI							0.926
Underweight	2	10.0%	0	0.0%	0	0.0%	
Normal weight	0	0.0%	2	14.3%	2	16.7%	
Overweight	8	40.0%	6	42.9%	4	33.3%	
Obesity Class 1	6	30.0%	3	21.4%	2	16.7%	
Obesity Class 2	2	10.0%	0	0.0%	4	33.3%	
Obesity class 3	2	10.0%	3	21.4%	0	0.0%	
Profession							-
Retiree	0	0.0%	1	7.1%	0	0.0%	
Trucker	1	5.0%	0	0.0%	0	0.0%	
Salesperson	0	0.0%	1	7.1%	0	0.0%	
Cook	1	5.0%	0	0.0%	0	0.0%	
Daytime cleaner	1	5.0%	0	0.0%	0	0.0%	
Homeworker	13	65.0%	7	50.0%	8	66.7%	
Housekeeper	1	5.0%	1	7.1%	1	8.3%	
Cleaner	1	5.0%	0	0.0%	1	8.3%	
Woodworker	0	0.0%	0	0.0%	1	8.3%	
Sailor	0	0.0%	1	7.1%	0	0.0%	
Auto mechanic	0	0.0%	1	7.1%	0	0.0%	
Metalworker	1	5.0%	0	0.0%	0	0.0%	
Baker	1	5.0%	0	0.0%	0	0.0%	
Bricklayer	0	0.0%	1	7.1%	0	0.0%	
Painter	0	0.0%	0	0.0%	1	8.3%	
Secretary	0	0.0%	1	7.1%	0	0.0%	
Skin color							
White	8	40.0%	9	64.3%	3	25.0%	0.091
Brown	7	35.0%	2	14.3%	8	66.7%	
Black	5	25.0%	3	21.4%	1	8.3%	
Comorbidity							
SAH	20	100.0%	13	92.9%	10	83.3%	0.099
DM	2	10.0%	3	21.4%	2	16.7%	0.680
RA	2	10.0%	1	7.1%	1	8.3%	1.000
Hypothyroidism	0	0.0%	0	0.0%	1	8.3%	0.261
Lupus	0	0.0%	1	7.1%	0	0.0%	0.565
Fibromyalgia	0	0.0%	1	7.1%	0	0.0%	0.565
AIDS	1	5.0%	0	0.0%	0	0.0%	0.435
Visually impaired	0	0.0%	1	7.1%	0	0.0%	0.565
Hyperthyroidism	0	0.0%	0	0.0%	1	8.3%	0.261
ASA							0.779
1	2	10.0%	1	7.1%	0	0.0%	
2	18	90.0%	13	92.9%	12	100.0%	
Laterality							0.566
Right-handed	11	55.0%	5	35.7%	5	41.7%	
Left-handed	9	45.0%	9	64.3%	7	58.3%	
Etiology							0.151
Deformity	18	90.0%	9	64.3%	11	91.7%	
Ligamentous	2	10.0%	5	35.7%	1	8.3%	
Prior deformity							
Valgus	11	55.0%	3	21.4%	6	50.0%	0.131
Varus	9	45.0%	11	78.6%	6	50.0%	
Surgery time							0.300
2 years	12	60.0%	7	50.0%	4	33.3%	
3 years	2	10.0%	2	14.3%	2	16.7%	
4 years	3	15.0%	2	14.3%	2	16.7%	
5 years	3	15.0%	3	21.4%	3	25.0%	
8 years	0	0.0%	0	0.0%	1	8.3%	
Loosening							0.148
No	20	100.0%	12	85.7%	10	83.3%	
Yes	0	0.0%	2	14.3%	2	16.7%	

BMI: body mass index; SAH: systemic arterial hypertension; DM: diabetes mellitus; RA: rheumatoid arthritis; AIDS: acquired immunodeficiency syndrome; ASA: American Society of Anesthesiology Classification.

Figure 3. Total knee arthroplasty without stem in valgus deformity with tibial component loosening.

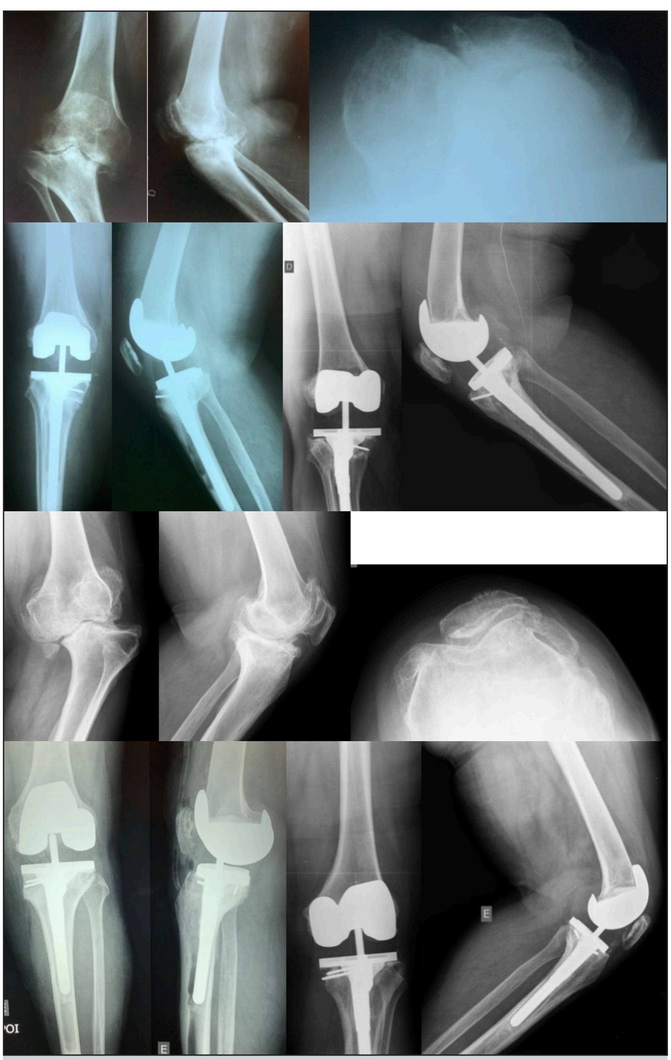

Figure 4. Total mixed knee arthroplasty with implants loosening.

Table 2 analyzes the total ROM before and after surgery. In Group 1, the ROM in the pre- and postoperative periods reached a mean of 103.5° and 105.5°, respectively. In Group 2, ROM in the pre- and postoperative periods reached a mean of 103.2° and 109.3°, respectively. As for Group 3, ROM in the pre- and postoperative periods reached a mean of 95.8° and 96.7°, respectively.

Table 2. Statistical analysis of the total angle of the range of motion in the pre- and postoperative periods of all groups.

Evaluation	Statistics	Procedure		
		stem (n = 20)	Without stem (n = 14)	Mixed (n = 12)
Preoperative	Minimum	65.0	50.0	30.0
	Maximum	135.0	130.0	120.0
	Median	105.0	107.5	100.0
	Mean	103.5	103.2	95.8
	SD	16.6	20.2	24.4
	CV	0.16	0.20	0.25
Postoperative	Minimum	80.0	90.0	60.0
	Maximum	135.0	120.0	120.0
	Median	110.0	110.0	100.0
	Mean	105.5	109.3	96.7
	SD	14.2	10.0	17.8
	CV	0.13	0.09	0.18
p-value of the Wilcoxon Test comparing pre-and post-operative measurements		0.671	0.319	0.686

Table 3 shows the angles of preoperative deformities subdivided by group and by type of deformity. In Group 1 , valgus deformities were all above 20°, mostly ranging from 38° to 47°. Also in G1, but for varus subgroup, deformities from 20° to 29° are highlighted. In Group 2 , valgus deformities ranged from 11° to 38° and varus deformities raged from 20° to 29°. In Group 3, the most frequent valgus deformities were found from 29° to 38°, and 47° to 58°; in the varus subgroup, the most frequent deformities ranged from 29° to 38°.

Table 3. Frequency distribution of angle measurements in prior deformities, by group and by type of deformity.

Axis angle (degrees)	With stem				Without stem				Mixed			
	Valgus (n = 11)		Varus (n = 9)		Valgus (n = 3)		Varus (n = 11)		Valgus (n = 6)		Varus (n = 6)	
	f	%	F	%	F	%	F	%	f	%	f	%
2 |- 5	0	0.0%	0	0.0%	0	0.0%	1	9.1%	0	0.0%	0	0.0%
5 |- 8	0	0.0%	1	11.1%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
8 |- 11	0	0.0%	1	11.1%	0	0.0%	1	9.1%	1	16.7%	0	0.0%
11 |- 20	0	0.0%	1	11.1%	1	33.3%	2	18.2%	1	16.7%	0	0.0%
20 |- 29	3	27.3%	3	33.3%	1	33.3%	5	45.5%	0	0.0%	1	16.7%
29 |- 38	2	18.2%	2	22.2%	1	33.3%	2	18.2%	2	33.3%	4	66.7%
38 |- 47	4	36.4%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
47 |- 58	2	18.2%	1	11.1%	0	0.0%	0	0.0%	2	33.3%	1	16.7%

Table 4 analyzes the femoral-tibial angles in the pre-and postoperative periods of the groups. The Wilcoxon test attests that the correction of deformity by the three groups is statistically significant with p-values of < 0.001, $= 0.035$ and $= 0.002$, respectively. The three groups underwent effective deformity correction.

Table 4. Statistical analysis of the angles of pre-and postoperative deformities in the three groups.

Evaluation	Statistics	With stem (n = 20)		Without stem (n = 14)		Mixed (n = 12)	
		Initial Deformity		Initial Deformity		Initial Deformity	
		Valgus	Varus	Valgus	Varus	Valgus	Varus
Preoperative	Minimum	20.0	58.0	17.0	31.0	10.0	47.0
	Maximum	52.0	5.0	36.0	4.0	52.0	28.0
	Median	40.0	22.0	20.0	20.0	30.5	31.0
	Mean	36.2	25.3	24.3	19.3	31.8	34.0
	SD	11.0	15.8	10.2	8.6	16.8	7.0
	CV	0.30	0.63	0.42	0.45	0.53	0.21
Postoperative	Minimum	3.0	5.0	5.0	13.0	5.0	5.0
	Maximum	13.0	7.0	6.0	6.0	7.0	7.0
	Median	5.0	5.0	6.0	5.0	5.5	5.0
	Mean	5.8	5.4	5.7	3.6	5.7	5.3
	SD	2.5	0.7	0.6	5.5	0.8	0.8
	CV	0.43	0.13	0.11	0.83	0.14	0.15
p-value of the Wilcoxon Test comparing pre- and postoperative measurements		< 0.001		0.035		0.002	

DISCUSSION

As there are few studies on the topic,[1,4,5,8-15] we believe that our research is relevant and interesting to the orthopedic community. Anderson et al.[1] evaluated patients with primary TKA with a semi-constrained implant without intramedullary stem. The complication rate was low with a short- and medium-term follow-up. These authors question the use of intramedullary stems in constrained prostheses.[1] We have ratified this question and believe that there is room for the use of the semi-constrained implant without stem.

Anderson et al.[1] observed low incidence of radioluscent line and no progression on radiographs. Our study did not find significant difference in implant loosening.

Sculco[16] reports that the use of stems increases the cost between 350 and 500 dollars. Also, complications when using stems, such as pain at the tip of the stem and the risk of embolization should be highlighted.

TKA without stem and with varus and valgus restriction is safe in selected cases; furthermore, it is cheaper and can reduce operative time and preserve bone stock.[15] We believe that treatment should always be individualized, and we emphasize the importance of preoperative planning.

The tibial constrained polyethylene has a higher and central post; as such, there is a greater fit in the femoral component box reducing varus-valgus translation and rotational movement.[12] Our study evaluated an implant with varus and valgus restriction. There is a study that evaluates a constrained polyethylene in a primary implant,[17] however, this is not the scope of our work.

Nam et al.[5] indicated the semi-constrained implant for patients with severe bone deformity and ligament instability. Our research confirms these indications, and we further highlight that there is a predominance of severe cases in our study.

Ruel, Ortiz, and Westrich[9] observed the loosening of the femoral component in semi-constrained stemless implants. Therefore, these authors recommend the use of stems in patients with osteopenia. We believe the prosthesis model is responsible for the femoral component loosening. In our research, tibial component presented the highest rate of failure. We obtained two cases of tibial component loosening in the Group 2, as well as a patient with bilateral mixed prosthesis who presented loosening of all components.

Macdessi et al.[10] report four cases of aseptic loosening of the femoral component in semi-constrained stemless implants. In this study, three patients reported trauma prior to implant loosening. The authors conclude that a stemless semi-constricted prosthesis should be cautiously used. In addition, they mention that this prosthesis model has a larger femoral bone resection. We agree that this type of implant has a deeper femoral box to absorb polyethylene with a larger post. Thus, there is a greater risk femoral component loosening when a stem is not used; however, we did not observe any isolated cases in our sample.

Nam et al.[5] report excellent clinical results with a semi-constrained prosthesis without a stem. They concluded that it is an excellent option in patients with ligament instability. The femoral region obtained the highest rate of loosening. Our indications of this model of prosthesis with ligamentous instability also showed good results. Our patients obtained an overall postoperative range of motion above 96.7° in the three groups.

In severe valgus knees, the semi-constrained stemless implant is a good option.[4] Anderson et al.[4] observed a low rate of complications. Our rationale is that in severe valgus deformity, ligaments may fail , as well as bone loss. As such, the most constrained implant can be an excellent option in some cases. In our research, varus deformity was more frequent.

Moussa et al.[13] recommend the cautious use of the stemless semi-constricted implant. They report that this model of prosthesis is used in more complex cases; however, they also observed that the revision rate is twice as high when compared with less constrained implants. In our opinion, comparing a more constrained prosthesis versus an already stabilized model is inappropriate. We have no doubt that a less constrained implant has a longer survival; however, there are cases in which this type of prosthesis does not generate good stability.

Padgett et al.[11] analyzed 56 knees that were revised after the use of a stemless semi-constrained implant. These prostheses were revised with a mean follow-up of 21.2 months. The causes of revision were: infection 34%, instability 21%, aseptic loosening 18%, stiffness 11%, recurrent synovitis 9%, and unknown cause 7%. According to these authors, all polyethylenes presented some wear regardless of the failure etiology.[11] We believe that that some causes of failure Padgett et al. study may had masked the bad results of the implant.

Nazarian, Mehta, and Booth[8] analyzed patients undergoing TKA revision with and without intramedullary stem. The analysis of bone quality, component fixation, and ligament integrity based the decision to use the stems. They conclude that there was no significant difference in implant failure between the groups; however, they observed a higher rate of tibial component loosening with or without a stem.[8] In the TKA review we preferred the use of stems.

Jordan, Kligman, and Sculco[18] evaluated patients with poliomyelitis undergoing TKA. Implant with varus and valgus restriction with and without stems were used. They conclude that the topic is controversial; however, they did not observe any clinical or radiographic benefit with the use of the stem.[18] Even though we ratify their statements, in a patient with poliomyelitis, we would probably use a more constrained prosthesis.

Our study has a minimum follow-up of two years postoperatively based on the research of Moussa et al.[14]

Other semi-constrained prostheses from other models and manufacturers were used over several years in our hospital; however, none of them were used in scale and effectiveness as the TC3 Depuy Johnson®. Thus, the choice of implant for analysis is justified, not presenting any type of conflict of interest in the evaluation.

In contrast Moussa et al.[14] evaluated four models of prostheses. We believe that multiple implant models could bias the research. The limitations of our research are because it is a retrospective and short-term study. Furthermore, some indications of a more constricted prosthesis were decided in the intra-operative act. We know that a simple radiographic analysis can mask an instability.

CONCLUSIONS

In general, preoperative deformities were considered severe. In the postoperative period, the total range of motion was above 96.7°. The postoperative femoral-tibial angle obtained a mean ranging from 5° to 6° of valgus. There is no significant difference in implant loosening in the three groups.

AUTHORS' CONTRIBUTIONS: Each author contributed individually and significantly to the development of this article. RSPA: data collection, writing, performing surgeries and radiographic analysis; PGTSF: data collection; RFPM: data collection and writing; DRMFF: data collection and writing; AM: data analysis and performing surgeries; HC: text review and performing surgeries; VSG: article review and intellectual concept of the article.

REFERÊNCIAS

1. Anderson JA, Baldini A, MacDonald JH, Tomek I, Pellicci PM, Sculco TP. Constrained condylar knee without stem extensions for difficult primary total knee arthroplasty. J Knee Surg. 2007;20(3):195-8.
2. Lachiewicz PF, Soileau ES. Ten-year survival and clinical results of constrained components in primary total knee arthroplasty. J Arthroplasty. 2006;21(6):803-8.
3. Deshmukh AJ, Rathod PA, Moses MJ, Snir N, Marwin SE, Dayan AJ. Does a non-stemmed constrained condylar prosthesis predispose to early failure of primary total knee arthroplasty? Knee Surg Sports Traumatol Arthrosc. 2016;24:3194-9.
4. Anderson JA, Baldini A, MacDonald JH, Pellicci PM, Sculco TP. Primary constrained condylar knee arthroplasty without stem extension for the valgus knee. Clin Orthop Relat Res. 2006;442:199-203.
5. Nam D, Umunna BP, Cross MB, Reinhardt KR, Duggal S, Cornell CN. Clinical results and failure mechanisms of a nonmodular constrained knee without stem extensions. HSS J. 2012;8(2):96-102.
6. Dayan I, Moses MJ, Rathod P, Deshmukh A, Marwin S, Dayan AJ. No difference in failure rates or clinical outcomes between non-stemmed constrained condylar prostheses and posterior-stabilized prostheses for primary total knee arthroplasty. Knee Surg Sports Traumatol Arthrosc. 2020;28(9):2942-7.
7. Meneghini RM, Mont MA, Backstein DB, Bourne RB, Dennis DA, Scuderi GR. Development of a modern knee society radiographic evaluation system and methodology for total knee arthroplasty. J Arthroplasty. 2015;30(12):2311-4.
8. Nazarian DG, Mehta S, Booth RE Jr. A comparison of stemmed and unstemmed components in revision knee arthroplasty. Clin Orthop Relat Res. 2002;(404):256-62.
9. Ruel A, Ortiz P, Westrich G. Five year survivorship of primary non-modular stemless constrained knee arthroplasty. Knee. 2016;23(4):716-8.
10. Macdessi SJ, Rich DS, Buly RL, Walcott-Sapp S, Westrich G. Early femoral component loosening of constrained condylar primary total knee arthroplasties inserted without stems. Journal of Orthopaedics. 2008;5(1):e20.
11. Padgett DE, Cottrell J, Kelly N, Gelber J, Farrell C, Wright TM. Retrieval analysis of nonmodular constrained tibial inserts after primary total knee replacement. Orthop Clin North Am. 2012;43(5):e39-43.
12. Soranoglou V, Poultsides LA, De Martino I, D'Apolito R, Sculco PK, Sculco TP. Stemless constrained total knee arthroplasty: an obsolete concept or a contemporary solution? Semin Arthroplasty. 2015;26(4):236-41.
13. Moussa ME, Lee YY, Westrich GH, Mehta N, Lyman S, Marx RG. Comparison of revision rates of non-modular constrained versus posterior stabilized total knee arthroplasty: a propensity score matched cohort study. HSS J. 2017;13(1):61-5.
14. Moussa ME, Lee YY, Patel AR, Westrich GH. Clinical outcomes following the use of constrained condylar knees in primary total knee arthroplasty. J Arthroplasty. 2017;32(6):1869-73.
15. Morcos MW, Howard JL, Lanting B, MacDonald S, Naudie D, McCalden R, Vasarhelyi EM. Outcomes of stemmed versus un-stemmed varus-valgus constrained components in primary total knee arthroplasty. Orthop Res Rev. 2021;13:9-13.
16. Sculco TP. The role of constraint in total knee arthoplasty. J Arthroplasty. 2006;21(4 Suppl 1):S54-6.
17. Crawford DA, Law JI, Lombardi AV Jr, Berend KR. Midlevel constraint without stem extensions in primary total knee arthroplasty provides stability without compromising fixation. J Arthroplasty. 2018;33(9):2800-3.
18. Jordan L, Kligman M, Sculco TP. Total knee arthroplasty in patients with poliomyelitis. J Arthroplasty. 2007;22(4):543-8.