

PERFIL DOS PACIENTES SUBMETIDOS À REVISÃO DE ARTROPLASTIA TOTAL DO QUADRIL COM ENXERTO DE BANCO ÓSSEO EM UM SERVIÇO DE REFERÊNCIA

PROFILE OF PATIENTS UNDERGOING TOTAL HIP ARTHROPLASTY REVISION USING BONE BANK GRAFT AT A REFERRAL SERVICE

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Resumo

Introdução: A cirurgia de artroplastia total do quadril (ATQ) com enxerto ósseo de banco de tecidos é um tratamento para o insucesso de uma artroplastia prévia associada a defeitos ósseos. Muitos poucos dados estão disponíveis sobre as condições do perfil desses pacientes e apenas dados relacionados a substituições articulares primárias são comumente encontrados. **Objetivos:** Determinar o perfil dos pacientes submetidos à revisão de ATQ com aloenxerto ósseo de banco de tecidos e possíveis características dessas falhas associadas a grandes defeitos ósseos. **Metodologia:** Estudo observacional transversal realizado por meio da análise de prontuários de um serviço de referência no período de 2013 a 2019. Foram coletadas 36 variáveis com dados como idade, características demográficas, tempo e histórico de intervenções, comorbidades e medicações, informações sobre o período de internação, cirurgia e apresentação do enxerto. Os grupos de enxerto estruturado e de solo foram comparados entre si. **Resultados:** Foram analisados 67 quadris com média de idade de 63,2 anos, sem história de ATQ (52,2%). Aqueles que utilizaram aloenxertos estruturados (33,3%) apresentaram maior diferença média no número de cirurgias prévias ($p=0,01$) e maior intervalo de tempo desde a primeira ATQ ($p=0,03$). **Conclusão:** O perfil aponta para uma população idosa mais jovem, com poucas comorbidades e com grande potencial para obter benefícios do procedimento cirúrgico ATQ com banco de aloenxertos ósseos.

Palavras-chave: Artroplastia do quadril; Próteses de quadril; Epidemiologia; Transplante ósseo; Bancos de tecidos.

Abstract

Introduction: Total hip arthroplasty revision surgery using a tissue bank bone graft is a treatment for failure of a previous arthroplasty associated to bone defects. Very little data are available on the profile conditions of these patients, and only data related to primary joint replacements are commonly found. **Objectives:** To determine the profile of patients undergoing THAR using bone allograft from a tissue bank, and possible characteristics of these failures associated with large bone defects. **Methodology:** An observational cross-sectional study carried out by analyzing medical records of a reference service in the period of 2013 and 2019. A total of 36 variables were collected on data such as age, demographic characteristics, time, and history of interventions, comorbidities and medications, information the hospitalization period, surgery, and graft presentation. The groups of structured and ground graft were compared with each other. **Results:** A total of 67 hips were analyzed with a mean age of 63.2 years, with no history of THAR (52.2%). Those using structured allografts (33.3%) had a greater mean difference in the number of previous surgeries ($p=0.01$) and a longer time interval since the first THA ($p=0.03$). **Conclusion:** The profile points to a younger elderly population, with few comorbidities and with great potential to obtain benefits from the THAR surgical procedure with a bone allograft bank.

Keywords: Hip arthroplasty; Hip prosthesis; Epidemiology; Bone transplantation; Tissue banks.

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1. Introduction

It is estimated that 630,000 hip replacement procedures were performed in the USA in 2017¹. It is expected that primary total hip arthroplasty (THA) surgeries increased by

176% and an increase of 43 to 70 when considering the total hip arthroplasty revision (THAR) in the period from 2014 to 2030². Total hip arthroplasty revision is a highly complex surgical procedure with high costs for the health system^{2,3}. In addition to the impact on the quality of

life⁴ and work productivity of these patients, it also puts a strain on the social security system^{5,6}.

Aseptic loosening, which refers to the gradual loss of fixation of the implant to the bone, occurring without the presence of infection, often due to factors such as wear, material degradation, or an inflammatory response to implant debris. Aseptic loosening is often the main cause of revision in long-term arthroplasties⁷. Its association with bone defects is common, and its treatment is a challenge for medical staff, in addition to major defects being related to worse surgical results^{8,9}. The process of loosening the prosthesis and formation of bone defects are gradually being clarified^{10,11}. However, the fact that some patients have loosening with severe bone defects and others with minimal bone need to be better understood.

THAR surgery using a tissue bank bone graft is a treatment for failure of a previous arthroplasty associated to bone defects. It has been used with good results for decades^{12,13}. However, most of the published studies are regarding techniques and outcomes¹⁴. Very little data are available on the profile conditions of these patients³, and only data related to primary joint replacements are commonly found. However, it is possible to perceive an increasing value in the care with the storage of information, since a progressive creation of National Arthroplasty Registry programs around the world has been observed in the last decades^{1,15}. Thus, the aim of the present study was to determine the profile of patients undergoing THAR using bone allograft from a tissue bank, and possible characteristics of these failures associated with large bone defects.

2. Methodology

This is a cross-sectional study with data collection and analysis from electronic medical records of patients from a referral hospital who were undergoing total hip arthroplasty revision with bone bank graft reconstruction. The research design was approved by the ethics committee of the under the number (CAAE-14177519.2.0000.5134), with the use of the free and informed consent term being waived.

This study includes individuals who underwent THAR with bone grafts from a tissue bank, with complete electronic medical records documented between January 2013 and December 2019. Records must contain detailed quantitative data such as age, time between primary total hip arthroplasty and revision, previous surgeries, and postoperative complications, and must be from procedures performed by the surgical team led by a senior surgeon. Cases where the use of free and informed consent was waived by the ethics committee are also included. Records with unreliable data extraction or inadequate follow-up, particularly if postoperative complications were not recorded within 90 days of surgery, are excluded.

Data were collected by two researchers with 36 variables for each patient. These researchers had clinical and research experience, were previously instructed, trained, and tested for a reliability analysis in data extraction, which proved to be reliable.

The information collected was quantitative data such as age, time between primary total hip arthroplasty and revision using bone allograft,

previous surgeries, time of the last surgery, number of comorbidities and medications, length of stay in intensive care and hospital stay, volume of blood transfusion, time from the first evaluation to surgery and number of postoperative complications. The latter was assessed separately in the case of hospitalization and late precocious interval of up to 90 days, after which they were not considered due to the loss of an important segment of the sample. Furthermore, dichotomous variables such as gender, place of residence, type of graft, laterality, previous complications, comorbidities, contralateral total hip arthroplasty, smoking, and alcoholism (among others) were also collected.

The analyzed medical records constitute all patients who underwent THAR with bone graft from a tissue bank, being duly documented between 2013 and 2019. This period corresponds to the beginning of the performance of the surgical team with this type of procedure and led by only one senior surgeon.

Descriptive statistics were used to characterize the sample, as well as percentages to analyze the variables in terms of frequency. We also considered the analysis of two main groups within the sample, those that used structured allografts and the other with impacted morselized bone allograft compared to each other through the T-test. The significance level was set at 0.05 and 95% confidence intervals were calculated in all statistical tests.

3. Results

A total of 67 hips were analyzed. Table 1 shows the characterization of these patients, with the majority being men with a mean age of 63.2 years (33 to 88 years). Hypertension was the main comorbidity, and only 10.4% had diabetes mellitus, with an average of 1.16 comorbidities and 1.61 class of drugs used at home. The average number of comorbidities was 1.16 and that of home medications was 1.61.

TABLE 1 - Characteristics of the participants

Characteristic	N = 67
Age, mean (SD)	63.2 (10.9)
Sex, male – n (%)	36 (53.7)
Laterality, left – n (%)	37 (55.2)
Region, metropolitan – n (%)	35 (52.2)
Smoking, yes – n (%)	12 (15.4)
Alcoholism, yes – n (%)	17 (23.1)
Comorbidities, yes – n (%)	46 (68.7)
Systemic arterial hypertension, yes – n (%)	36 (53.7)
Diabetes mellitus, yes – n (%)	7 (10.4)
Other comorbidities, metabolic diseases – n (%)	11 (42.3)
Use of home medications, yes – n (%)	40 (59.7)
Basic pathology, arthrosis – n (%)	50 (74.6)
Previous surgeries, no past of THAR – n (%)	35 (52.2)
Total hip arthroplasty opposite member, yes – n (%)	22 (32.8)

Previous complications, – loosening – n (%)

60 (89.6)

N: sample number; SD: Standard deviation.

Arthrosis was the most common underlying disease. A total, 52.2% of the patients had no history of THAR in the studied hip, with an average number of previous procedures on the analyzed hip of 2.04. Moreover, 32.8% had contralateral THA. Loosening of the implants was the most common reason for complications that led to the revision.

Table 2 complements the characteristics of the patients in relation to the surgical procedure, where the impacted bone

allograft was used in isolation in 42 patients, with just over half of the patients presenting some type of complication in the postoperative period. Of these, 40.3% were still hospitalized. Blood transfusions were uncommon. The rate of positive cultures collected during the operation was 12.9%, with a loss of 5 analyzes. However, the rate of acute surgical site infection up to 90 days was 11.9%, and the total rate of the analyzed period was 16.4%.

TABLE 2 - Characteristics of the participants related to the procedure

Characteristic	N = 67
Bone allograft, impacted bone graft – n (%)	42 (66.7)
Growth intraoperative cultures, yes – n (%)	8 (12.9)
Blood transfusion, yes – n (%)	18 (26.9)
Presence of late or acute complications, yes – n (%)	41 (61.2)
Hospital complications, yes – n (%)	27 (40.3)
Acute operative infection, yes – n (%)	8 (11.9)
Late operative infection, yes – n (%)	3 (4.5)
Total infections, n (%)	11 (16.4)

N: sample number; SD: Standard deviation.

The mean time interval between the primary THA and the graft revision was found to be 178 months, with the average calculated at 48.1 years of age when they performed the first joint replacement in the studied hip. The interval between the initial evaluation of the surgical medical team and the performance of THAR was 32.2 months. The average hospital stay was 11.9 days and in the ICU 2.03. There was one death related to complications in the hospital

and another related to immediate late complications.

When studying the groups separated by the type of graft used in the procedure (Table 3), those who used structured graft in relation to those who used impacted bone graft, presented a greater mean difference in the number of previous surgeries ($p = 0.01$) and an interval higher between THA and THAR requiring allograft ($p = 0.03$).

TABLE 3 - Comparison between graft type regarding the studied variables

Variable		N	Mean (SD)	Mean difference (SD) [CI95%]	p
Previous Surgery (n)*	Structured	19	2.76 (1.45)	1.0 (0.36)** [0.27 to 1.73]	0.01**
	Impacted bone graft	41	1.76 (1.08)		
Date of primary total hip arthroplasty***	Structured	19	215(119)	53.4 (24.8)**** [3.8 to 103]	0.03****
	Impacted bone graft	41	161(72)		

N: sample number; SD: Standard deviation; CI: Confidence interval; p: significance.

(*) Normality test (Shapiro-Wilk) $p = <0.001$; (**) Welch's T

(***) Normality test (Shapiro-Wilk) $p = 0.16$; (****) Student's T

4. Discussion

We found a younger elderly population that performed the studied procedure (mean of 63.2 years). It is worth reflecting that a significant part of this population is in the economically active range, and with many years of potential life, since the average life expectancy of Brazilians is 75.5 years¹⁶.

The average age (63.2 years) is lower when compared to patients undergoing general THAR in the USA (67.4 years), for example, but this Brazilian data was not found for comparison¹⁷. However, lower age averages are reported associated with complex reviews. In a study of a population that performed more than one THAR in a reference service within the USA, for which Yu et al.³ reported an average age of 59.6 years. Vastel et al.¹⁸ reported an average age of 60.2 years in a revision study with bone grafts, covering a series of patients with multiple revisions (3.8 previous hip procedures). On the other hand, Zazgyva et al.¹⁹ found an average of 60.3 years in a case series of THAR with structured bone grafts, but without previous reviews.

Most patients were men (53.7%). More than half of these patients came from the metropolitan region of the capital, which warns of a possible discrepancy in access to this type of treatment, since the capital is responsible for approximately 70% of the state's THAR. Approximately two thirds have some comorbidity, with an average of 1.16, and an average of 1.6 drugs used at home, which points to a sample with few comorbidities in general. Hypertension was the main comorbidity, as expected, but only 10.4% had diabetes mellitus, which was not expected, as it is a highly prevalent disease. Smoking and alcohol consumption were uncommon, with 15.4% and 23.1% respectively.

It is a fact that THA procedures in younger patients are more common currently²⁰. And this procedure performed in this age group is related to a higher risk of failure and the need for revision^{21,22}. However, one factor must be clarified in the future: in addition to being a risk for the need for revision, these possible early revision surgical procedures for these joint replacements may contribute to a final picture of

multiple revisions in the future, since THAR is known to have a shorter survival compared to THA²³. His findings showed an average time since the primary THA of almost 15 years, and the mean age of patients at the time of the first prosthetic joint replacement of the hip was 48.1 years. This number is very different from the general average age of THA in the USA, which is 67.4 years old¹⁷.

We found loosening of the prosthesis as the most frequent complication (89.6%) for the revision, while all had common bone defects in common due to the inclusion criterion and required the use of tissue bank graft. The physiological genesis of bone defects in arthroplasty loosening is being progressively better elucidated^{9,10}. However, the factors predisposing to only a few patients to loosening associated with the formation of large bone defects is still unclear.

Treatment with allograft for bone defects in THAR commonly indicates the use of structured bone grafts for managing large defects and in those that do cortical violation²⁴. Impacted morselized bone allografts are more used in those smaller or contained defects²⁵.

Considering this relationship between the type of defect and the bone graft used for the treatment of these patients, we comparatively evaluated those who used structured allografts and those using impacted fragmented allografts. A significant difference was identified between the average time between intervals between performing THA and a revision with bone allograft between these two groups, with this interval being greater in those using a structured graft. It is reasonable to consider that this longer time interval will correspond to a THA performed at a younger age, and so this fact is shown in accordance with the

literature, where THA in younger patients is related to the risk of revisions and their failures^{21,22,26}, and there is still a gap with the lack of robust data on the success of THAR in this population in the long term, which can also contribute to the development of a framework of multiple reviews.

The evaluation of the variable number of surgeries when comparing the two groups, showed a significant difference between the means of the number of procedures in the groups, presenting a higher average in the group with the use of structured bone allograft in comparison with the impacted allograft group. It is plausible to consider extrapolating that a greater number of surgical interventions in these hips, or a picture of multiple revisions, may contribute to the presentation of large bone defects in need of allografts studied for treatment^{21,22}.

In clinical practice, these findings underscore the importance of careful implant selection and long-term follow-up for younger patients undergoing THA. The use of high-durability implants and a rigorous follow-up program are crucial to manage and mitigate potential complications, as new technologies may rapidly alter treatment paradigms²⁰. The study reinforces the need for ongoing research to address complex bone defects in THAR and improve outcomes through better understanding and management of these challenging cases²⁷. This knowledge is essential for developing strategies to avoid or manage severe bone defects and enhance long-term patient outcomes in hip arthroplasty revisions.

The knowledge about the treatment of bone defects in THAR is very robust, whether with the use of bone graft, with

other materials, or even with the new technologies that are evolving rapidly²⁴. However, studies on this topic must be deepened to elucidate the factors related to the presentation of complex bone defects in hip arthroplasties and how to avoid them, since they are technically challenging and are related to worse outcomes²⁷.

This study has several limitations that should be acknowledged. Notably, some valuable data could not be analyzed due to inaccuracies or the absence of specific records in the medical records, such as body mass index, pain quantification, classification of bone defects, and differentiation between isolated acetabular or femoral revision procedures. Additionally, there was a selection bias in the sample, as it primarily consisted of patients undergoing total hip arthroplasty revisions (THAR) for complex bone defects. This does not reflect the general epidemiology of THAR, where many cases are technically less challenging and do not require grafts. Consequently, the findings of this study may not be generalizable to all THAR cases. Further research is needed to explore the factors associated with the formation of large bone defects and to broaden the understanding of THAR across a wider range of clinical scenarios. Avoiding overgeneralization of the results is crucial, as the study's conclusions are specific to the population and conditions examined.

For future research, several key areas should be explored to address the limitations of this study. Firstly, investigations should include more comprehensive data on body mass index, pain quantification, and the classification of bone defects to provide a more nuanced understanding of the

factors influencing revision outcomes. Secondly, research should focus on differentiating between isolated acetabular and femoral revision procedures to assess their specific impacts on outcomes and graft choice. Additionally, expanding studies to include a broader range of patient demographics and settings will help in understanding the generalizability of the findings. Lastly, there is a need for long-term studies to track the durability of various graft types and to identify strategies for preventing complex bone defects and improving long-term outcomes in THAR. Addressing these areas will contribute to a more robust understanding of the factors influencing THAR and guide the development of improved management strategies.

The data and materials collected used in the study are available for consultation through personal contact with the author.

5. Conclusion

The profile of the studied patients reveals a relatively young elderly population with few comorbidities, showing significant potential to benefit from total hip arthroplasty revision (THAR) using bone bank grafts. However, the findings highlight critical issues such as extended waiting times for the surgical procedure and access challenges for patients from rural areas. Additionally, the average differences between graft types suggest that the time interval between primary THA and revision, as well as the number of previous surgeries, may influence the occurrence of severe bone defects in complex THAR cases. Clinically, these findings underscore the need for improved access to orthopedic care,

particularly for patients in remote areas, and careful selection of graft types based on the specific characteristics of bone defects. Implementing long-term follow-up programs to monitor implant wear and potential failures is crucial, especially for younger patients at higher risk for early revisions. Enhanced patient education and continued research are essential to better understand and address the factors contributing to complex bone defects and to develop more effective treatment strategies.

6. Conflict of interests

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of this article.

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