Comparison of pre- and postoperative functional dependence in older adults submitted to hip arthroplasty

Comparação do nível de dependência funcional pré e pós-operatório de idosos submetidos à artroplastia de quadril

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Abstract

Introduction: Femur fractures and hip osteoarthritis affect the functional independence of older adults. Hip arthroplasty (HA) is a surgery to treat these conditions and physiotherapy can reduce functional dependence levels. **Objective:** Compare pre- and postoperative functional dependence in older adults submitted to HA, assess the association between functional dependence and independence, and whether age is associated with greater functional dependence in these patients. **Methods:** A quantitative cross-sectional descriptive comparative study with older adult volunteers submitted to HA evaluated before and after surgery using the Katz index and Functional Independence Measure (FIM). Comparative analysis was performed via Wilcoxon's matched pairs test and Spearman's correlation. Linear regression was applied to assess the influence of functional dependence on postoperative independence ($p < 0.05$). **Results:** Forty-eight patients were evaluated in the pre- and postoperative stages using the Katz index, which demonstrated reduced functional dependence after HA. The FIM assessment indicated greater postoperative functional dependence, demonstrating the surgical procedure combined with early physiotherapy while patients were hospitalized promoted functional independence in older adults. Additionally, there was a directly proportional relationship between dependence level and age. **Conclusion:** Functional dependence declined after HA, which improved independence in older adults. Functional dependence affected postoperative independence and age influenced functional dependence.

Keywords: Arthroplasty. Older adults. Functional status. Hip. Physiotherapy.

Resumo

Introdução: *Fraturas de colo do fêmur e osteoartrose no quadril afetam a independência funcional de idosos. A artroplastia de quadril (AQ) é uma cirurgia para tratar essas condições e a fisioterapia pode reduzir o nível de dependência funcional.* ***Objetivo:*** *Comparar o nível de dependência funcional pré e pós-operatório de idosos submetidos à AQ, avaliar a associação entre dependência funcional e independência funcional e verificar se a idade está associada à pior dependência funcional destes pacientes.* ***Métodos:*** *Estudo transversal, descritivo, quantitativo e de associação, onde voluntários idosos submetidos à AQ foram avaliados no pré e pós-operatório usando o índice de Katz e a Medida de Independência Funcional (MIF). A análise comparativa foi realizada com os testes estatísticos Wilcoxon pareado e correlação de Spearman. Uma regressão linear examinou a influência da dependência funcional na independência pós-operatória (p < 0,05).* ***Resultados:*** *Quarenta e oito pacientes foram avaliados tanto no pré quanto no pós-operatório por meio do índice Katz, observando-se uma redução da dependência funcional após o procedimento de AQ. A avaliação da MIF demonstrou que houve aumento da independência funcional no pós-operatório, demonstrando que o procedimento cirúrgico associado à fisioterapia precoce, enquanto o paciente ainda está hospitalizado, promoveu a independência funcional. Além disto, houve uma relação diretamente proporcio-nal entre nível de dependência e idade.* ***Conclusão:*** *A dependência funcional reduziu após a cirurgia de AQ e aumentou a independência em idosos. A dependência funcional impactou a independência após a cirurgia e a idade influenciou a dependência funcional.*

Palavras-chave: *Artroplastia. Idoso. Estado funcional. Quadril. Fisioterapia.*

Introduction

Older adults are constantly exposed to conditions that reduce their functional capacity, such as femur fractures and hip osteoarthritis, which directly affect their independence and compromise quality of life.[1] Older patients who experience a broken femur and/or hip osteoarthritis may become more functionally dependent due to reduced range of motion and muscle strength, pain and forced bedrest.[2]

Hip arthroplasty (HA) is a surgical procedure to treat femur fractures and/or hip osteoarthritis, which involves replacing the proximal portion of the femur and/or acetabulum, characterized as partial (PHR) or total hip replacement (THR), respectively.[3]

HA combined with the physical and cognitive decline that older adults may experience as part of the natural aging process can contribute to greater functional deficits.[4,5] Hospitalized older adults may experience temporary or permanent functional decline, since hospitalization is a complex event that compromises their autonomy and may contribute to cognitive decline.[6] As such, physiotherapists in multiprofessional teams play an important role in rehabilitating these patients before or after HA by providing early rehabilitation, safely transferring patients from bed and preventing complications, such as immobility syndrome.[7]

Physiotherapists are also important before HA, when they assess the patient to determine their pre-surgery functional capacity in order to establish post-operative rehabilitation goals.[8] Moreover, they can work alongside the multiprofessional team to provide patients with information on the surgical procedure, correct positioning in bed, positions to avoid after surgery and during rehabilitation, and health education.[9] A systematic review that included studies conducted in Europe, North America, Australia and Asia found that starting rehabilitation before HA significantly improves postoperative aspects such as physical function, pain, quality of life and length of hospital stay.[10]

Thus, by identifying preoperative functional dependence level, removing patients from bed early and beginning rehabilitation during hospitalization, physiotherapists can contribute to the rapid recovery of older adults submitted to HA. Fast and effective recovery is known to shorten hospital stays and increase bed turnover, lowering hospital costs for the health system and reducing the risk of conditions associated with longer hospitalization.[11] This underscores the importance of older patients submitted to HA returning to society with the best possible functional capacity and providing healthcare professionals with reliable instruments to identify deficits that should receive special attention during post-HA rehabilitation.[4,8]

Given the need to address this issue in this population, the present study aimed to compare pre- and postoperative functional dependence in older adults

submitted to HA, assess the association between functional dependence and independence, and whether age is associated with greater functional dependence in these patients.

Methods

A quantitative cross-sectional descriptive comparative study conducted in the Orthopedic Trauma Ward of the University Hospital of the Federal University of Maranhão (HU-UFMA), in São Luís, Maranhão state (MA), Brazil. Data were collected between December 2016 and May 2017.

The volunteers and/or their companions were advised of the objectives and risks of the study and provided written informed consent. Inclusion criteria were older volunteers (≥ 60 years), of both sexes, submitted to elective PHR, FHR and/or a hip revision. Excluded were individuals who underwent any other associated surgical procedure and/or had been submitted to additional surgery while hospitalized. During hospitalization, participants were treated by the physiotherapists on the ward, including everything from health education to early mobilization and gait training.[9]

Data were collected in two stages. In the preoperative period, the participants were interviewed to obtain data on sociodemographic aspects and nosology, and their functional dependence and independence assessed. This initial assessment was conducted one day before surgery.

Functional dependence was analyzed by the Katz index, which is widely used in gerontology to identify the functional capacity of individuals in basic activities of daily living (BADLs): Bathing, dressing, toileting, transferring, maintaining continence, and eating. Based on result interpretation, participants were classified as independent, partially or totally dependent. The sum of the rated items produces a score from 0 to 6, where 0 corresponds to independence and 6 to dependence in all the activities assessed.[12]

The Functional Independence Measure (FIM) was applied to evaluate the level of functional independence, another widely used instrument in clinical gerontology research. The FIM is composed of 18 items scored from 18 to 126. The sum of the scores for each item provides a total score, whereby the higher the score, the greater the functional independence of the individual assessed, with the maximum score (7) indicating complete independence and 1, complete dependence.[13]

Both instruments were reapplied after surgery in order to compare the pre- and postoperative periods. This was done on the third day after surgery, when patient protocol at the hospital in question,[9] recommends that patients begin gait training, since this would minimize the risk of bias. All the assessments and instrument application were performed by a trained and highly experienced physiotherapist.

Sample size was calculated based on the pre- and postoperative Katz index and FIM results, considering experimental power of 95% and $p < 0.05$. The effect size was 1.18, $\alpha = 0.05$ and $\beta = 0.95$, based on the study by Silva et al.,[14] with a 20% dropout rate, resulting in a minimum sample of 48 patients. Analyses were performed using the G*Power Statistical Package, version 3.1.3 (Franz Faul Universität, Kiel, Germany).

Data normality was analyzed using the Kolmogorov-Smirnov test and descriptive measures expressed as mean, standard deviation (SD) and median (interquartile range) for numerical variables and absolute frequencies (f) and percentage (%) for categorical variables. Pre- and postoperative Katz index and FIM results were compared by the Wilcoxon matched pairs test. Associations between these measures were analyzed using Spearman's correlation, considering the following r values: 0 = null; 0.1 to 0.3 = weak; 0.4 to 0.6 = moderate; 0.7 to 1.0 = strong.[15] Additionally, simple linear regression was performed to understand the extent to which functional dependence influenced postoperative functional independence. All the analyses were performed using the Statistical Package for the Social Sciences (SPSS, version 26) and significance was set at $p < 0.05$.

The study was approved by the HU-UFMA Research Ethics Committee under protocol number 1.824.946, CAAE 60389916.0.0000.5086.

Results

A total of 48 patients were evaluated before and after surgery, with no sample losses. The characterization data of the study sample are presented in Table 1.

A comparative analysis of pre- and postoperative functional dependence and independence is shown in Figure 1. Figure 1A illustrates functional dependence comparison via the Katz index, indicating a decline in functional dependence after HA. and Figure 1B pre- and postoperative functional independence assessment via the FIM, showing greater independence after surgery.

Table 1 - Characterization of older adults submitted to hip arthroplasty (n = 48)

Variable	Descriptive measures
Age	72 ± 9
Sex	
Female	30 (62.5)
Male	18 (37.5)
Ethnicity	
White	12 (25.0)
Brown	26 (54.0)
Black	10 (21.0)
Income	
1 minimum monthly wage	40 (8.03)
2 minimum monthly wages	8 (17.0)
Comorbidities	
Systemic hypertension	29 (60.0)
Diabetes mellitus	12 (25.0)
Schizophrenia	1 (2.0)
Parkinson's disease	1 (2.0)
Place of residence	
São Luís	18 (38.0)
Interior do Maranhão	29 (60.0)
Other	1 (2.0)
Diagnosis	
Femur fracture	30 (63.0)
Hip osteoarthritis	16 (33.0)
Implant loosening	2 (4.2)
Cause	
Quedas	28 (58.0)
Outros	20 (42.0)
Medications	
Anti-hypertensive	21 (67.0)
Antidiabetic	10 (21.0)
Diuretic	9 (19.0)
Neurological*	9 (19.0)
Osteoporosis	9 (19.0)
Parkinson's disease	2 (4.0)
Surgical procedure	
Partial hip replacement	24 (50.0)
Total hip replacement	22 (45.8)
Hip revision surgery	2 (4.2)
Length of stay (days)	5 (4 - 6)

Note: Data expressed as absolute frequency and percentage, except for age (mean and standard deviation) and length of stay (median and interquartile range). *Antidepressants, psychotropics, neurologicals.

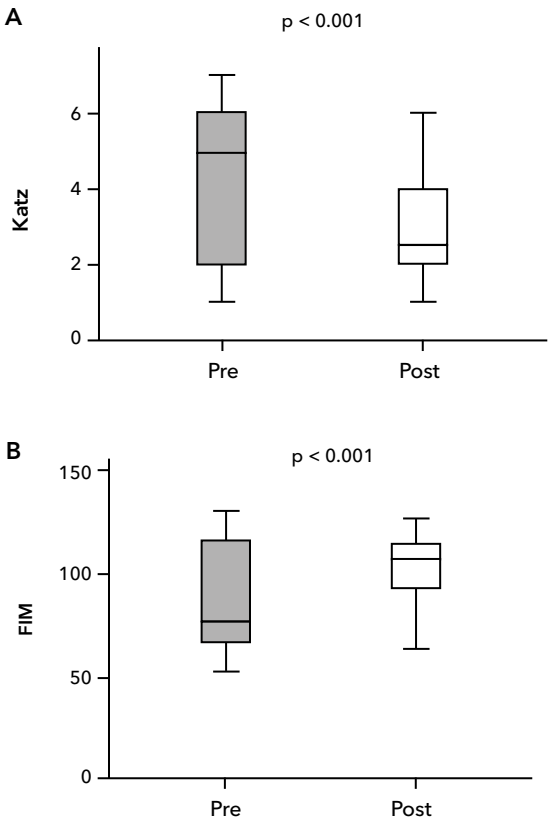

Figure 1 - Analysis of the Katz index and the Functional Independence Measure (FIM) of older adults after hip arthroplasty.

Note: p-value in Wilcoxon's matched pairs test. Significance level $p < 0.05$.

Figure 2 depicts associations between the Katz index, age and FIM for the pre- and postoperative periods. Figures 2A and C show the pre- and postoperative association between the Katz index and age, which is directly proportional, moderate and significant, with a low postoperative p-value, reflecting less functional dependence. Figures 2B and D illustrate the inversely proportional, moderate and significant association between the Katz index and FIM, indicating less postoperative functional dependence, resulting in greater functional independence.

Table 2 shows simple linear regression, indicating that functional dependence, assessed by the final Katz score after HA, had a 28% influence ($R^2 = 0.280$) on functional independence, evaluated by the FIM, in older patients after HA.

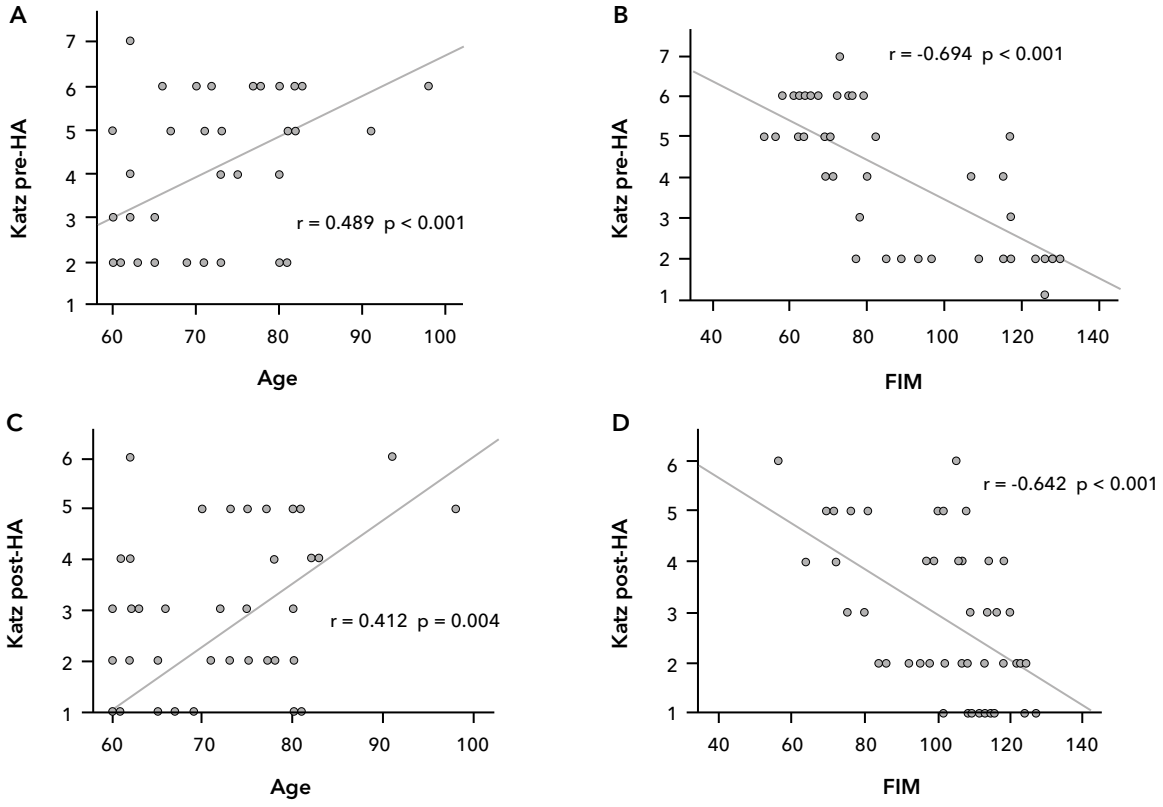

Figure 2 - Association between the Katz index, age, and the Functional Independence Measure (FIM) of older adults before and after hip arthroplasty (HA).

Note: Spearman's p-value test. Significance level $p < 0.05$.

Table 2 - Linear regression to predict the influence of functional dependence, according to the Katz index, on functional independence, assessed by the Functional Independence Measure (FIM), in older patients after hip arthroplasty

Variable	β	SE	p-value	CI
FIM	-0.045	0.011	0.000	-0.066 to -0.024

Note: β = beta coefficient; SE = standard error; CI = confidence interval. adjusted $R^2 = 0.280$; $F = 7.620$.

Discussion

This study aimed to compare pre- and postoperative functional dependence in older adults submitted to HA. The results demonstrate less functional dependence and greater functional independence after surgery. These findings corroborate those of Piovani et al.,[11] who studied physical functioning in older adults submitted to HA and concluded that the surgical procedure significantly reduced the number of dependent patients and increased the number of those classified as semi-independent and independent. However, it should be noted that the authors used the Barthel index, whereas the Katz and FIM instruments were applied in our study.

The functional dependence of older adults submitted to HA is primarily related to loss of strength and function.[16] The clinical scenario that led to the recommendation of surgery means that these patients are often on bedrest or have limited functional mobility.[17] Early rehabilitation during hospitalization can help restore their preadmission functional capacity.[18] As such, physiotherapy should begin during the hospital stay immediately after surgery and/or when it is safe to do so,

in order for them to achieve sufficient independence in activities of daily living.[19] This may have influenced the decline in postoperative functional dependence observed in the present study, since the hospital physiotherapy protocol stipulated early rehabilitation, among other recommendations.[9]

There was a statistically significant difference between the pre- and postoperative functional independence of the volunteers, assessed by the FIM, demonstrating the positive effect of the surgical procedure combined with early rehabilitation on their functional independence.[16] Care during the preoperative phase often limits the mobility of older patients, which, in association with hospitalization, can contribute to the emergence of depression or exacerbate cognitive deficits.[20] While waiting for surgery, some patients may experience limited movement, which can contribute to greater functional dependence, immobility, and worse pain and quality of life.[21]

There was a statistically significant and moderate association between functional dependence and age in both the pre- and postoperative periods. This increase in functional dependence limits the ability of older patients to safely perform daily activities and may overburden their family members and caregivers.[22] Artal et al.[23] aimed to identify risk factors for mortality and functional recovery in hospitalized patients with hip fractures. The authors concluded that advanced age, the presence of comorbidities and previous functional status were associated with mortality and that the prognosis of functional recovery depends on age as well as prior functional status. This reiterates the importance of identifying the level of functional dependence in older adults in the preoperative stage.

On the other hand, there was a statistically significant inverse and moderate association between functional dependence and independence, demonstrating that the more assistance participants needed to perform the activities assessed by the Katz index, the less independent they were in the FIM domains. The two instruments applied (Katz index and FIM) are complementary, with domains not assessed in one addressed in the other, such as cognitive and communication aspects evaluated by the FIM. As such, they make it possible to understand the physical functioning of older adults and provide a more comprehensive assessment. It is important to stimulate functional independence in this population after HA through early mobilization, thereby reducing pain, improving range of motion and ensuring early gait training.[24] As members of the multiprofessional team responsible for rehabilitating these patients while hospitalized, physiotherapists therefore play an important role in restoring their preadmission functional status.[25]

Particular attention must be paid to the functional dependence of older adults, since even the type of surgery indicated is related to patients' previous physical condition, with THR recommended for more functionally independent patients and PHR for those with limitations in executing functional activities.[26] Functional dependence influenced the postoperative functional independence of the volunteers by 28%, indicating that even with improved functional independence, a degree of dependence remained after HA. This confirms the importance of physiotherapists in the early rehabilitation of these patients while hospitalized through mobility exercises and strength training, in order to restore their preoperative functional status,[16,27] since patients submitted to HA experience compromised hip function and gait mechanics even several years after surgery.[28]

Regular physical activity is important in preventing events such as falls and osteoporosis.[29] In the present study, 19% of the participants assessed used medication for osteoporosis and 58% reported falls as the reason for their HA indication. Older patients often exhibit compromised functional independence and are therefore more susceptible to adverse events such as falls and fractures, requiring procedures such as HA.[30] In patient rehabilitation after HA, physiotherapy aims to optimize functional independence, ensuring that they can safely execute their daily activities as they did before the event that led to the surgical procedure. Functional dependence and independence assessment and rehabilitation are important both before and after surgery to ensure that patients achieve preoperative goals and rapid functional recovery after surgery, as well as early discharge and high bed turnover.[31]

The use of interviews to conduct the assessments was a limitation of this study; however, this approach was adopted to standardize data collection since some of the volunteers were illiterate. Additionally, while the sample size precluded extrapolation of the data to the general population submitted to HA, the results presented here pave the way for debate.

Conclusion

Older adults submitted to HA exhibited a decline in functional dependence after surgery, reflecting greater functional independence, with high postoperative values. There was an inverse association between functional dependence and independence both before and after surgery, whereby functional dependence affected postoperative independence in older adults after HA. Moreover, an association was observed between functional dependence level and patient age, with older patients exhibiting greater dependence. Future research should aim to identify the determining factors in the functional dependence of this population and establish protocols to aid in rapid recovery and restoring preoperative functional status.

Authors' contributions

JCAS and TBC participated in study conception. JCAS was responsible for data collection and, along with GMS and MRO, for its analysis and interpretation. JCAS, GMS, NBC and TCAS wrote the manuscript and NBC, MRO and TBC revised it. All the authors approved the final version.

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