Pantrochanteric Fracture: Incidence of the Complication in Patients with Trochanteric Fracture Treated with Dynamic Hip Screw in a Hospital of Southern Brazil*

Fratura pantrocantérica: incidência da complicação em pacientes com fratura trocantérica tratados com parafuso dinâmico de quadril em um hospital do Sul do Brasil

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Abstract

Objective The aim of the present study was to investigate the incidence of pantrochanteric fractures in cases of trochanteric fractures treated with dynamic hip screw in our service.

Methods A sample of 54 patients with trochanteric fractures treated with dynamic hip screws was included in this retrospective study. Preoperative radiographs were evaluated for fracture classification using the Arbeitsgemeinschaft für Osteosynthesefragen (Association for the Study of Internal Fixation, in German)/Orthopedic Trauma Association (AO/OTA) system for the identification of radiographic osteoporosis and for the measurement of the lateral femoral wall thickness. In the immediate postoperative images, the presence of pantrochanteric fracture was evaluated.

Results The final sample presented an incidence of 16.7% of pantrochanteric fractures. The thickness of the lateral wall was significantly lower in the group with the complication ($p < 0.001$). Although fractures classified as 31-A2 were more numerous in the group with pantrochanteric fracture, the difference was not statistically significant ($p = 0.456$).

Conclusion The percentage of pantrochanteric fractures in this service is in accordance with previous studies. There was an association between lateral femoral wall thickness and the occurrence of iatrogenic fracture of the lateral cortex. There was no significant difference between fracture classification and pantrochanteric fracture, possibly due to sample size.

Keywords
- proximal femur fracture
- trochanteric fracture
- DHS
- pantrochanteric fracture
- lateral wall thickness

Resumo

Objetivo Investigar a incidência de fraturas pantrocantéricas nos casos de fraturas trocantéricas tratadas com parafuso dinâmico de quadril em nosso serviço.

* Work developed at Hospital Universitário de Canoas, RS, Brazil.

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Métodos Uma amostra de 54 pacientes com fraturas trocantéricas tratadas com parafuso dinâmico de quadril foi incluída neste estudo retrospectivo. Foram avaliadas radiografias pré-cirúrgicas para classificação das fraturas com o sistema AO/OTA, identificação de osteoporose radiográfica e mensuração da espessura da cortical lateral, enquanto nas imagens pós-operatórias imediatas foi avaliada a presença de fratura pantrocantérica.

Resultados A amostra final apresentou a incidência de 16,7% de fraturas pantrocantéricas. A espessura da parede lateral foi significativamente mais baixa no grupo com a complicação ($p < 0,001$). Embora a incidência de fraturas classificadas como 31.A2 tenha sido maior no grupo com fratura pantrocantérica, a diferença não foi significativa ($p = 0,456$).

Conclusão O percentual de fraturas pantrocantéricas nesse serviço encontra-se em acordo com trabalhos prévios. Houve associação entre espessura da cortical lateral e ocorrência de fratura iatrogênica da parede lateral. Não houve diferença significativa entre classificação das fraturas e fratura pantrocantérica, possivelmente devido ao tamanho da amostra.

Palavras-chave
- fratura do fêmur proximal
- fratura trocantérica
- DHS
- fratura pantrocantérica
- espessura da parede lateral

Introduction

Proximal femoral fractures are challenging due to their complexity regarding several therapeutic aspects. The increased incidence of such fractures, the need for services that are able to quickly initiate the therapy, the follow-up for postoperative rehabilitation and the high mortality rates are some of the difficulties that permeate the management. Pertrochanteric fractures are known to have a high postoperative mortality rate among surgically-treated fractures.[1]

Most fixation techniques for pertrochanteric fractures use sliding screws (dynamic hip screw, DHS) and intramedullary rods (proximal femoral nail, PFN). The chosen method depends basically on surgeon expertise and fracture complexity. A greater understanding of the role of the lateral cortex in the stability of this pathology is instrumental in choosing the best treatment. The DHS became the gold standard in the treatment of less complex fractures. However, when the lateral wall integrity is compromised by trauma, rods are the best option. They act as lateral support and avoid medialization due to excessive sliding of the femoral diaphysis.

With the increase in incidence and consequent surgical treatment of pertrochanteric fractures, the number of complications also increased. Pantrochanteric fractures represent an operative complication that has recently been described and studied.[2] They correspond to an iatrogenic compromise of the previously intact lateral femoral wall during drilling with sliding screws or intramedullary rod burrs,[3] converting type-31-A1 or 31-A2 pantrochanteric fractures to a more unstable pattern (31-A3).

The aim of this work is to investigate the incidence of pantrochanteric fractures in cases of type-31-A1 and A2 fractures treated with DHS at the Orthopedics and Traumatology Service of Hospital Universitário Cajuru, in Southern Brazil.

Material and Methods

The present study is a retrospective quantitative analysis. The search for patients was performed using code S72.1 of the International Classification of Diseases (ICD), 10th Revision, which corresponds to pantrochanteric fractures, in the electronic medical record system in our service. The search identified 214 patients from November 2015 to August 2016. Next, we analyzed their pelvis and hip X-rays in anterior-posterior and anterior-posterior and lateral views respectively, which were taken upon admission and on the first postoperative day.

The present study enrolled individuals aged $\geq$ 60 years, who were hospitalized for trochanteric fractures and treated with DHS during the aforementioned period, and the final sample was composed of 54 patients.

The exclusion criteria were the following: preoperative deaths, transfers, conservative treatment and treatment with other synthetic materials (PFN/dynamic condylar screw, DCS).

Data was entered in a Microsoft Excel 2017 (Microsoft Corporation, Redmond WA, US) spreadsheet. The studied variables included age, gender, presence of a lateral femoral wall fracture secondary to the surgical treatment of a trochanteric fracture with DHS, radiological signs of low bone mineral density, measurement in millimeters of the preoperative thickness of the lateral femoral wall, laterality, and classification (according to the Arbeitsgemeinschaft für Osteosynthesefragen [Association for the Study of Internal Fixation, in German]/Orthopedic Trauma Association, AO/OTA system).[4]

The quantitative variables were described as means and standard deviations, and the categorical variables were described in absolute and relative frequencies. The means were compared using the Student *t* test. The proportions were compared using the Pearson chi-squared test or the Fisher exact test. The adopted significance level was of 5% ($p < 0.05$), and the analyses were performed using the Statistical Package for the Social Sciences (SPSS, IBM Corp., Armonk, NY, US) software, version 21.0.

The surgical treatment began within 48 to 72 hours after the trauma. The procedures were performed at Hospital Universitário Cajuru by orthopedist teams assisted by second- and third-year medical residents.

Table 1 Sample characterization

Variables	n = 54
Age (years) – mean ± standard deviation	80.7 ± 8.4
Female gender – n (%)	35 (64.8)
Lateral cortical thickness (mm) – mean ± standard deviation	31.9 ± 8.6
Low lateral cortical thickness (< 20.5 mm) – n (%)	6 (11.1)
Radiographic osteoporosis – n (%)	29 (53.7)
AO/OTA classification – n (%)	
A1	21 (38.9)
A2	33 (61.1)
Laterality – n (%)	
Right	31 (57.4)
Left	23 (42.6)

Abbreviation: AO/OTA, Arbeitsgemeinschaft für Osteosynthesefragen (Association for the Study of Internal Fixation, in German)/Orthopedic Trauma Association.

Results

A total of 59 cases of pantrochanteric fractures occurred in patients aged ≥ 60 years who were treated with DHSs at the hospital between November 2015 and August 2016. From these, 3 (5.1%) patients died, 1 (1.7%) was transferred, and 1 (1.7%) was treated conservatively. Therefore, the sample was composed of 54 cases, as shown in ►**Table 1**.

In the final sample, we verified the incidence of 9 (16.7%) pantrochanteric fractures evidenced in postoperative X-rays (►**Fig. 1**).

The lateral cortical thickness was significantly lower in the pantrochanteric fracture group. Although the prevalence of radiographic osteoporosis was higher in the pantrochanteric fracture group, the difference was not significant ($p = 0.480$). Even though fractures classified as 31-A2 were more prevalent in the pantrochanteric fracture group, the difference was not significant ($p = 0.456$). This may be due to the small number of cases with the complication (n = 9). Although the right side was more affected in the group of pantrochanteric fracture, the difference was not significant ($p = 0.273$) (►**Table 2**).

The radiographic osteoporosis group presented a significantly higher mean age ($p = 0.024$) and a larger proportion of females ($p = 0.034$), as shown in ►**Table 3**.

Discussion

The current work aimed to quantify the incidence of a relatively common trauma complication with scarce data in Brazil. Pantrochanteric fracture is considered an iatrogenic complication, as described by Gotfried et al (apud Yechiel),[2] and determining its incidence is a way of evaluating our technical ability in treating trochanteric fractures, which are frequent in trauma routines. Our study found 9 (16.7%) patients with this complication, which is a figure that is consistent with the searched literature, although there is no consensus yet regarding the real incidence of pantrochanteric fractures. However, Langford et al[5] and Bendo et al[6] showed that the estimated values are very relevant. Langford et al[5] observed perioperative lateral wall fractures in 20% of their 337 patients treated with sliding screws, whereas Bendo et al[6] observed fixation failures in 18% of their 142 patients. Both studies evaluated the incidences through intra- or perioperative X-rays, whereas we evaluated only postoperative images.

Isolated postoperative radiographical evaluation may be insufficient for the early identification and proper treatment of pantrochanteric fractures. In a sample with more than 200 patients, Palm et al[3] observed that most iatrogenic lateral wall fractures occurred during the surgical procedure, and they concluded that the main predictor of surgical reintervention requirement was iatrogenic lateral wall involvement. In addition, the authors concluded that trochanteric fractures evolving with intraoperative lateral wall violation are not stabilized only with sliding screws and, therefore, other fixation methods were required during or after surgery,[3] reinforcing that the surgeon must be aware of this complication in order to properly plan the procedure and the treatment before surgery.

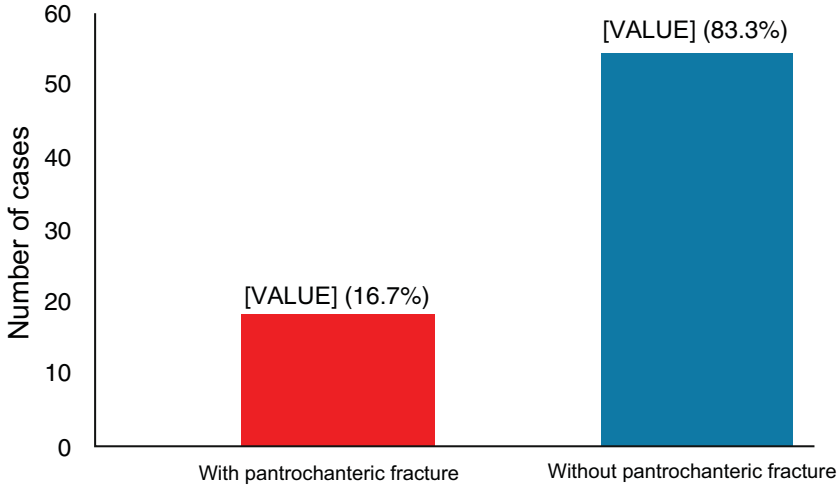

Fig. 1 Sample distribution according to the incidence of pantrochanteric fracture.

Table 2 Association with a pantrochanteric fracture

Variables	With pantrochanteric fracture (n = 9)	Without pantrochanteric fracture (n = 45)	*p*-value
Age (years) – mean ± standard deviation	78.4 ± 8.8	81.2 ± 8.4	0.380
Female gender – n (%)	7 (77.8)	28 (62.2)	0.468
Lateral cortical thickness (mm) – mean ± standard deviation	22.7 ± 5.4	33.8 ± 8.0	< 0.001
Low lateral cortical thickness (< 20.5 mm) – n (%)	4 (44.4)	2 (4.4)	0.005
Radiographic osteoporosis – n (%)	6 (66.7)	23 (51.1)	0.480
AO/OTA classification – n (%)			
A1	2 (22.2)	19 (42.2)	0.456
A2	7 (77.8)	26 (57.8)	
Laterality – n (%)			
Right	7 (77.8)	24 (53.3)	0.273
Left	2 (22.2)	21 (46.7)	

Abbreviation: AO/OTA, Arbeitsgemeinschaft für Osteosynthesefragen (Association for the Study of Internal Fixation, in German)/Orthopedic Trauma Association.

Table 3 Age and gender association with radiographic osteoporosis

Variables	With radiographic osteoporosis (n = 29)	Without radiographic osteoporosis (n = 25)	*p*-value
Age (years) – mean ± standard deviation	83.1 ± 7.5	78.0 ± 8.8	0.024
Female gender – n (%)	23 (79.3)	12 (48.0)	0.034

Due to the growing recognition of the essential role of lateral wall integrity in treating trochanteric fractures[2,7] and the evidence of complications and surgical reintervention requirements in intra- and postoperative fractures, studies are trying to predict the probability of such complications. The seminal paper by Hsu et al[8] proposes the creation of a method to identify patients with higher risk of developing a secondary lateral wall fracture. This retrospective work evaluated the outcomes of 208 patients with trochanteric fractures submitted to surgical treatment with DHS. The predictor used by Hsu et al[8] was the radiographical measurement of the lateral wall thickness (lateral femoral wall thickness), established by one longitudinal line 3 cm distal from the innominate tubercle of the greater trochanter and continuing cephalically at an 135° angle up to the fracture trace. The results showed that, from the total sample, 20% of the patients presented a secondary lateral wall fracture, and, among them, the mean lateral cortical thickness was significantly lower compared with patients without the complication (mean values: 18.4 mm versus 27 mm respectively). Nevertheless, the study concluded that the radiological measurement of the lateral wall thickness is a reliable predictor of intra- and postoperative fracture, and stipulated a cut-off point of 20.5 mm. Our study used the measurement proposed by Hsu et al[8] to correlate the incidence of pantrochanteric fractures in our service, and it was statistically significant. However, it is worth mentioning that the measurement was performed manually using the digital metric system in the software used for x-ray visualization. This fact, associated with the mild rotational variations from the limbs and pelvis during patient positioning and X-ray examination, may be responsible for a non-measurable inaccuracy in the index determination. The authors also recommend that trochanteric fractures with a lateral wall thickness lower than the cut-off point should not be treated solely with DHS.[8] Other studies confirm that unstable fractures resulting in lateral wall compromise should be submitted to a combined surgical treatment, not only with DHS, for better functional outcomes.[9,10] Computed tomography is another option that is considered more reliable for the measurement of the lateral wall thickness,[11] but it is not part of the routine evaluation in our service due to its high cost and lower feasibility compared to X-rays.

The technical inexperience of the surgeon must also be considered an important factor in the incidence of pantrochanteric fractures, especially because this is a complication resulting from the use of sliding screws. Adequate exposure, the entrance point and the force applied during drilling are examples of important factors; moreover, these aspects are directly associated with surgeon expertise, and certainly influence the outcomes. Hospital Universitário Cajuru, where this study was performed, has an orthopedic and

trauma medical residence service, and most cases are performed by residents supervised by their preceptors.

The use of other implant types such as the PFN in the treatment of trochanteric fractures requires a larger learning curve;[12] therefore, the DHS procedure is most frequently performed by residents. Their inexperience may have impacted the number of iatrogenic fractures in the present study, although this is not quantifiable. Another decisive factor worth mentioning is the quality of the available surgical material.

Bone mineral density is considered a predictor for trochanteric fractures, which seldom affect individuals with bone density higher than 1 g/cm.[13] Our attempt to evaluate osteoporosis only by X-rays was incomplete, since it requires corroboration by bone mineral density. The lack of statistical significance between the incidence of pantrochanteric fractures and radiographic osteoporosis may be intimately related to this fact.

The AO/OTA classification system may also be used to predict lateral wall iatrogenic fractures. Trochanteric fractures with more complex patterns, namely 31-A2 and its subtypes 1 and 2, present a higher risk of complication.[14] The higher standards of this classification correlate with the higher instability of trochanteric fractures, which is directly associated with higher postoperative mortality.[15] In our work, despite the higher number of complex fractures (31-A2) in the pantrochanteric fracture group, no statistical significance was observed. A plausible explanation for this result is the small number of patients. It is worth mentioning that there is always an inter- and intraobserver discordance in fracture classification systems.

Conclusion

The present study demonstrates that the incidence of pantrochanteric fractures was of 16.7% ($n = 9$). This figure is consistent with previous researches. There was an association between lateral cortical thickness and the occurrence of lateral wall iatrogenic fractures. No significant difference between fracture classification and pantrochanteric fractures was noted, possibly due to sample size. Studies with more patients are required for a higher statistical significance.

Conflicts of Interest
The authors have none to declare.

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