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Original article

Radiographic anatomy of the proximal femur: femoral neck fracture *vs.* transtrochanteric fracture☆

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ABSTRACT

Objective: To evaluate the correlation between radiographic parameters of the proximal femur with femoral neck fractures or transtrochanteric fractures.
Methods: Cervicodiaphyseal angle (CDA), femoral neck width (FNW), hip axis length (HAL), and acetabular tear drop distance (ATD) were analyzed in 30 pelvis anteroposterior view X-rays of patients with femoral neck fractures ($n = 15$) and transtrochanteric fractures ($n = 15$). The analysis was performed by comparing the results of the X-rays with femoral neck fractures and with transtrochanteric fractures.
Results: No statistically significant differences between samples were observed.
Conclusion: There was no correlation between radiographic parameters evaluated and specific occurrence of femoral neck fractures or transtrochanteric fractures.

Palavras-chave:
Fraturas do quadril
Colo do fêmur
Radiografia

Anatomia radiográfica do fêmur proximal: fratura de colo *vs.* fratura transtrocantérica

RESUMO

Objetivo: Correlacionar parâmetros radiográficos do fêmur proximal com a ocorrência de fraturas do colo do fêmur ou fraturas transtrocantéricas do fêmur.
Métodos: Foram avaliados o ângulo cevicodiafisário (ACD), a largura do colo femoral (LCF), o comprimento do eixo do quadril (CEQ) e a distância entre as lágrimas acetabulares (DL) de radiografias de bacia em incidência anteroposterior de 30 pacientes com fratura de colo de fêmur (n = 15) e fratura transtrocantérica de fêmur (n = 15). A avaliação foi feita com a comparação dos pacientes com fratura de colo de fêmur com os pacientes com fratura transtrocantérica.

☆ Study conducted at Hospital Otávio de Freitas, Recife, PE, Brazil.

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Resultados: Não foram observadas diferenças estatisticamente significantes entre as amostras obtidas entre os dois grupos comparados.
Conclusão: Não houve correlação entre os parâmetros radiográficos avaliados e ocorrência específica de fraturas de colo de fêmur ou fraturas transtrocantéricas de fêmur.

Introduction

Advances in medicine and pharmacology have led to a significant increase in global life expectancy, reflected positively in the growing number of elderly people. However, there is a real concern about the quality of life of these aging adults, and especially, regarding how to adequately prevent and treat the complications inherent to this age group. Among these complications are low-energy fractures, or those that are a consequence of associated pathological complications.[1–3]

Hip fractures have serious impact on elderly patients, especially the very elderly (over 80 years).[3] This issue is relevant due to the high morbidity and mortality, high postoperative disability index, and increasing costs to society with less beneficial results related to treatment.[4] These fractures are considered one of the largest public health problems in the world.[4] According to American statistics, over 250,000 hip fractures occur each year; it is expected that over the next 30 years, there will be an increase of 100% in the number of cases/year. In Brazil, in 2010, the incidence was 100,000 fractures per year, and the mean mortality one year after the fracture was 30%. Femoral fractures, especially proximal fractures, are among the most relevant.[4]

Adequate surgical treatment is paramount for good prognosis; the method chosen is directly related to the type of hip fracture, specifically the types of femoral fractures (distal or proximal). Proximal fractures can be divided into two types: intracapsular and extracapsular. The first type includes fractures of the femoral neck, and the second type, transtrochanteric fractures. Both have low-energy trauma as the main etiology, and both have great influence in associated pathologies, such as osteoporosis.[5–7]

Osteoporosis, undoubtedly the most common of bone diseases, has become a burden of considerable economic significance. Factors such as ethnicity, gender, physical activity, and nutrition influence the maximum bone quality achieved by each individual, but are not the only determining factors for fractures. The specialized literature emphasizes that bone mineral density (BMD), an age-related predictor of fracture, is not always consistent: individuals with very low femoral neck BMD may not present fracture, while those with normal BMD might.[8] There may be other relevant variables that determine fractures and especially their types, such as bone anatomy.[8,9]

Bone geometry of the proximal femur has been studied[10] as a potential risk factor, and has been positively associated in the prediction of fracture risk. However, most hip fracture studies do not distinguish the predisposition between the two main types of fracture (femoral neck and transtrochanteric), which in clinical practice would be fundamental, since the surgical approach of choice can be different due to the high rate of hip arthroplasty indication in femoral neck fractures, which in turn has financial repercussions and affects patient recovery in the postoperative period.

Thus, this study is aimed at analyzing the influence of proximal femoral bone geometry in the type of femur fracture presented, by measuring standard pelvic radiographs.

Material and methods

This was a prospective, cross-sectional study performed in an orthopedic and trauma service in Brazil between August 10, 2015 and September 8, 2015. The study included 30 radiographs of patients with hip fractures, randomly selected as cases were admitted. The study followed the Declaration of Helsinki and was approved by the internal Ethics Committee (No. 1.221.094).

Radiographs were taken in the anteroposterior view, with the X-ray generator located one meter from the chassis. Patients were placed in a horizontal dorsal recumbent position, with the lower limbs rotated internally at 15°.

The inclusion criteria were panoramic radiographs of the hip of patients aged over 60 years, of both genders, with femoral neck and transtrochanteric fractures.

Exclusion criteria included radiographs of skeletally immature patients; bilateral hip fracture; and presence of tumor, infectious lesions, or metabolic diseases that could alter the hip and proximal femur anatomy.

After classification and selection, the radiographs were anatomically evaluated, according to the following measures:

- Cervicodiaphyseal angle (CDA): angle between the axis of the femoral neck and the diaphysis.
- Femoral neck width (FNW): distance between cortical lines, at the midpoint of the femoral neck, perpendicular to its axis.
- Hip axis length (HAL): the distance in a straight line between the base of the great trochanter to the end of the femoral head, following the line of the axis of the femoral neck.
- Acetabular tear drop distance (ATD): the distance in a straight line between the acetabular tear drops.

The choice of these measurement indexes was based on previous studies that conducted morphometric analyses of the proximal femur.[11] All measurements were made by two blinded examiners using a goniometer (MSD, Europe BVBA-Belgium).

The measurements were collected by manual marking of the aforementioned reference points. It was decided not to

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