Injury, Int. J. Care Injured 48S (2017) S41–S46

Contents lists available at ScienceDirect

Injury

journal homepage: www.elsevier.com/locate/injury

Hip osteoarthritis as a predictor of the fracture pattern in proximal femur fractures

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ARTICLE INFO

Keywords:
Hip osteoarthritis
Hip fracture
Intracapsular
Extracapsular

ABSTRACT

Introduction: Several authors have suggested a correlation between the fracture patterns of proximal femur fractures and the degree of hip osteoarthritis (HOA), but the current evidence to support this are insufficient. The aim of our study was to demonstrate whether there is an association between the grade of HOA and fracture pattern observed, in patients presenting with a fragility fracture of the proximal femur.

Materials and methods: We contacted a retrospective review of all patients presenting to our institution with fragility fractures involving the proximal femur, between March 2012 and October 2013. Pathological fractures, high-energy injuries and patients with less than one year of follow-up were excluded from further analysis. Admission radiographs and severity of HOA were assessed according to Kellgren and Lawrence scale (minimal: Grades 1–2; severe: Grades 3–4). Fractures were classified according to AO/OTA classification.

Results: A total of 1003 patients (725 females; 1003 fractures) met the inclusion criteria, having a mean age of 81.5 (46–106 years). With regards to fracture classification, 417 (41.6%) fractures were classified as extracapsular and 586 (58.4%) as intracapsular. A total of 939 (93.9%) patients presented with minimal HOA, whilst 61 (6.1%) of the patients presented with severe HOA. Of the 61 patients presenting with severe HOA, 42 patients (68.9%) sustained a 31A-interthrocanteric fracture and 19 patients (31.1%) sustained a 31B-intracapsular fracture. Regarding the patients presenting with minimal HOA (832 patients in total), 323 patients (38.8%) sustained 31A-intertrochanteric fracture and 509 patients (61.2%) sustained a 31B-intracapsular fracture. Patients presenting with severe HOA were found to have a statistically significant chance to present with an extracapsular fracture ($p < 0.01$).

Conclusions: The degree of HOA is related to the fracture pattern in patients presenting following simple mechanical falls. More specifically, higher grades of HOA are associated with extracapsular fracture patterns, whereas lower grades of HOA are associated with intracapsular fracture patterns.

Introduction

Fragility fractures of the proximal femur are considered one of the major consequences of the aging population, mainly being associated with osteoporosis [1]. Their incidence has been estimated as high as 400/100.000 per person-years [2]. Their effects can be detrimental due to their high mortality and morbidity, whilst at the same time they represent a significant economic burden to every health care system wordwide [3].

Patient's low Bone Mineral Density (BMD) and low vitamin D serum levels, history of previous falls/fractures, vision disabilities, glucocorticoids intake, background of hyperthyroidism, hypogonadism, chronic kidney disease, increased alcohol intake and smoking are some of the factors that have been associated with an increased risk of proximal femur fragility fracture [4–7]. On the contrary, an increased body mass index (BMI) [8] and normal ranges of serum vitamin D levels [9] have been reported to reduce the risk of these fractures.

Some authors have also reported that the presence of osteoarthritis (OA) is another associated with an increased risk

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http://dx.doi.org/10.1016/j.injury.2017.08.037
0020-1383/

of fragility fractures [5]. A possible explanation of this observation is that pain reduces physical exercise and this reduction is associated to a further BMD loss, that in turn predisposes to fragility fractures [5]. Moreover, several studies designed to assess the hypothesis that hip osteoarthritis (HOA) has a protective action against proximal femur fractures, have been inconclusive due to the difficulties of identifying a non-fractured control sample [5,10–12]. Calderazzi et al., suggested that even though HOA could not be considered as a protective factor, there is possibly a relationship between the grade of HOA and the fracture pattern observed [13]. The same observation was also reported by Middleton and Ferris [14]. More specifically they found a tendency that patients with higher grades of HOA sustaining a proximal femur fragility fracture were more likely to sustain a pertrochanteric fracture.

The potential relationship between HOA and fracture pattern has been explained according to the irregular distribution of bone mineral density throughout the proximal femur in osteoarthritic hips, where there is an increased mineral density around the neck of the femur [15,16]. Some authors have also suggested that the range of hip motion is a predictor of the fracture type, as it has been hypothesised that intracapsular fractures are secondary to impingement of the femoral neck against the acetabulum during the extremes of external rotation [17,18].

Currently, there is no evidence that the different fracture patterns are associated with short-term outcomes. Indeed, several authors report similar lengths of hospital stay, destination on discharge and in-hospital mortality [19–21]. However, there are differences with regards to the type of treatment received as different surgical procedures can be performed. Extracapsular fractures are commonly treated with osteosynthesis, in contrast to intracapsular fractures which are treated with partial or total joint replacement procedures because of their high incidence of complications with osteosynthesis [22]. Additionally, different fracture types have been associated to age [23], ABO blood group [24], parathyroid hormone (PTH) levels [25], serum calcium levels [26], steroids use [23], fall direction and mechanism of injury [22,27,28] morphology and geometry of the hip joint [29].

The aim of our study was to investigate the presence of a potential association between the grade of HOA and fracture pattern observed, in patients presenting with a fragility fracture of the proximal femur.

Materials and method

Following institutional board approval, all consecutive patients admitted to our institution during a 20-month period (March 2012–October 2013) presenting with a proximal femur fragility (osteoporotic) fracture were included in our study. In those patients under the age of 65, a DEXA scan with a T-score of less than −1.5 was necessary for the diagnosis of a fragility fracture. In patients older than the age of 65, fragility fractures were considered as those that occurred as a result of a minimal trauma, such as a fall from standing height or even without any identifiable trauma [30]. Exclusion criteria included high-energy injuries and pathological fractures.

Data collected included patient demographics, fracture classification according to AO-OTA [31], severity of HOA if present, osteoporosis as evident on Dual Energy X-ray Absorptiometry scan (DEXA) results (T-Score of the hip where available), AMTS (Abbreviated Mental Test Score), history of previous fragility fractures and incidence of medical complications during admission. Medical complications were defined as the complications that were not related to the fracture site or surgical wound.

HOA was classified according to Kellgren and Lawrence [32]. Osteophytes, periarticular ossicles, subchondral bone sclerosis, pseudocystic areas and altered shape of bone ends were assessed. Narrowing of the joint space was not considered as a factor as it might be influenced by an intracapsular haematoma, especially in the case of intracapsular fractures.

Patients were then split into two groups according to the severity of their HOA. “Minimal grade” included patients graded 1 and 2, whereas patients graded 3 and 4 were considered as “Severe grade” [13]. Fractures types were classified for analysis as extracapsular (pertrochanteric: AO-OTA 31-A and purely subtrochanteric: AO-OTA 32) and intracapsular (AO-OTA 31-B) [31].

Statistical analysis

This was performed with IBM SPSS for Windows® version 22 (SPSS inc., Chicago, IL). Results were considered statistically significant for $p < 0.05$.

Results

A total of 1003 proximal femoral fractures (1003 patients; 278 males; 490 fractures involved the right side) fulfilled the inclusion criteria and were included into the study. The mean age was 81.5 years (range: 46–106 years, SD: 11.29 years) and the median AMTS was 9 (mode: 10). DEXA scans had been performed to 151 patients and the mean T-Score of the hip was −2.55 (SD: 0.96). Length of stay (LOS) was 19.54 days (1–126 days; SD: 14.24 days).

Fractures were then classified according to the AO-OTA classification. A total of 413 fractures (41.18%) were AO-31-A (intertrochanteric, extracapsular) fractures, four fractures (0.4%) were AO-32 (purely subtrochanteric, extracapsular) whereas 586 fractures (58.4%) were AO-31-B (intracapsular fractures). With regards to the degree of HOA, patients were classified as follows: Grade 0: 110 patients (11%), grade 1: 455 patients (45.4%), grade 2: 377 patients (37.6%), grade 3: 53 patients (5.3%) and grade 4: eight patients (0.8%) (Table 1).

Table 1
Patient demographics.

Number of patients	1003
Age	Mean: 81.5 years Range: [46–106] SD: 11.29
Sex	Male 278 (27.7%) Female 725 (72.3%)
AMTS	Mean: 7.14 Range: [0–10] SD: 3.48
T-Score (DEXA)	N: 151 Mean: −2.549 Range: [−5.6 to 0.2] SD: 0.96
Length of Stay (LOS)	Mean: 19.5 days Range: [0–126 days] SD: 14.24
Fracture type	Extracapsular (31-A) 417 (41.6%) Intracapsular (31-B) 586 (58.4%)
Fracture site	Left 514 (51.2%) Right 489 (48.8%)
Fracture site grade of HOA	Grade 0: 110 (11%) Grade 1: 455 (45.4%) Grade 2: 377 (37.6%) Grade 3: 53 (5.3%) Grade 4: 8 (0.8%)

AMTS: Abbreviated Mental Test Score. DEXA: Dual Energy X-ray Absorptiometry. HOA: Hip Osteoarthritis. SD: Standard Deviation.