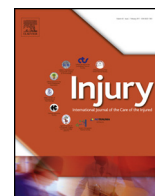




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## A retrospective cohort study of concomitant ipsilateral extra-capsular and intra-capsular fractures of the proximal femur. Are they casual findings or an undervalued reality?

Miquel Videla-Cés<sup>a,\*</sup>, José-Miguel Sales-Pérez<sup>a</sup>, Joan Girós-Torres<sup>a</sup>,  
Rubén Sánchez-Navés<sup>a</sup>, Sebastián Videla<sup>b</sup>

<sup>a</sup> Orthopaedic and Trauma Surgery Department, Hospital Consorci Sanitari Integral, Sant Joan Despí, Barcelona, Catalonia Spain

<sup>b</sup> Department of Experimental and Health Sciences, Faculty of Health and Life Sciences, Universitat Pompeu Fabra, Barcelona, Catalonia, Spain

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### ABSTRACT

**Background:** Fractures of the proximal femur constitute a major public health problem, with an annual incidence in Spain of 7.6 cases per 1000 inhabitants over 65 years of age. Hip fractures are frequent in elderly patients, related to osteoporosis and with low energy trauma, which means that they can be considered a geriatric syndrome. Simultaneous ipsilateral extra- and intra-articular hip fractures are considered as very rare are, and generally speaking, classified as extra- or intra-capsular fractures. Moreover, there is no consensus with regard to treatment of these concomitant fractures.

**Aim:** To estimate the incidence of concomitant ipsilateral extra- and intra-capsular fractures of the proximal femur, and to describe the diagnostic process and the clinical characteristics of these concomitant fractures.

**Patients and methods:** Retrospective cohort study of patients with hip fractures. The incidence of combined extra- and intra-capsular fractures was estimated, a confidence interval of 95% (95%CI) was calculated and a descriptive analysis was drawn up.

**Results:** Between May 2010 (the date on which the Orthopaedic and Trauma Surgery Department of our new Hospital began the surgical activity) and December 2016, 33 (median age, 86 years-old) of the 2625 hip fractures were classified as simultaneous extra- and intra-capsular ipsilateral fractures. The overall cumulative incidence was of 1.3% (95%CI:0.9–1.8%). In 32 (97%) of the patients, the fracture was a consequence of a low energy trauma (ground level fall), while the remainder was due to a medium energy trauma (skating). In all cases the two fracture lines seem to be independent of each other, which suggests different mechanisms of injury from that of isolated subcapital or intrertrochanteric fracture.

**Conclusion:** The incidence of concomitant ipsilateral extra- and intra-capsular fractures of the proximal femur must be taken into account in patients over 65 years of age. It is clinically relevant to identify these concomitant fractures in order to arrive at a correct diagnosis, which will facilitate preoperative planning and the choice of the best treatment to achieve a better outcome.

Misdiagnosis may cause further problems, such as fixation failures, disability and, in a worst case scenario, an increased risk of death. Therefore, a good and complete preoperative study is important, along with both good quality X-ray projections and 2D and 3D Ct-Scans in case of doubt.

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### Introduction

Fractures of the proximal femur (hip fractures) constitute a major public health problem, with an annual incidence in Spain of 7.6 cases per 1000 inhabitants over 65 years of age [1]. Moreover, hip fractures are frequent suffered by elderly patients, related to low energy trauma and osteoporosis. Generally speaking such fractures are classified according to their anatomical location as either extra-capsular fractures (ECF) or intra-capsular fractures

\* Corresponding author at: Orthopaedic and Trauma Surgery Department, Hospital Consorci Sanitari Integral, C/Jacint Verdaguer 90, 08970, Sant Joan Despí, Barcelona, Catalonia, Spain.

E-mail address: [miquel.videla@sanitatintegral.org](mailto:miquel.videla@sanitatintegral.org) (M. Videla-Cés).

(ICF). This anatomical criterion has a physiopathological and therapeutic base [2,3]. ECF occur in cancellous bone, highly vascularized, with a low risk of non-union [4] and, in contrast, the critical factor of ICF is terminal vascularization of the femoral head [5].

Concomitant extra-capsular and intra-capsular fractures in the same limb are extremely unusual, and this association is often related with high-energy trauma in young patients. The combination of both fracture patterns in elderly patient is considered to be very rare and scientific references are extremely scarce, with most references appearing as case reports [6–15]. To our knowledge, the association of both fractures in osteoporotic bone, as a result of low energy trauma, was described thirty years ago in a case report [6,7], and the only series (29 cases of extra-capsular fractures associated with femoral neck fracture) of these rare fractures in proximal femur was drawn up a decade ago [16], reporting an incidence of 7.5% (29 out of 385). Discovering the real incidence of this combination of fractures is clinically relevant, insofar as reaching a correct diagnosis will be instrumental in both the planning and choice of the best treatment in order to achieve a better outcome.

Based on our clinical practice, we believe that these fractures are being misdiagnosed. Our hypothesis is that the incidence of concomitant ipsilateral fractures (extra- and intra-capsular of the proximal femur) represents a low, but not a particularly rare, percentage of all proximal femur fractures in over 65 year-olds. Therefore, the aim of the present study is to estimate the incidence of concomitant ipsilateral extra- and intra-capsular fractures of the proximal femur, and to describe the diagnostic process and the clinical characteristics of these combined fractures. Furthermore, data on the effectiveness of the performed treatments has also been provided.

## Patients and methods

### Study design

This was a single-centre, retrospective cohort study based on data from a prospectively compiled database (electronic medical files) of patients who had suffered a hip fracture. This study was performed according to the terms of the Declaration of Helsinki, while the level of protection of confidentiality, in terms of the protection of personal data, as required by Spanish Law (LOPD 15/1999), was also ensured.

### Study population

Between 1st May 2010 and 31st December 2016, all consecutive patients with fracture of the proximal femur (hip fracture) from the Orthopaedic and Trauma Surgery Department were identified and their medical files were examined. Patients with concomitant

extra-capsular and intra-capsular fractures in the same limb were included.

It is worth mentioning here that the starting point for this cohort (1st May 2010) corresponded to the date on which the Orthopaedic and Trauma Surgery Department, and the Ortho-Geriatrics Unit, of our new Hospital began surgical activity. According to our procedure, patients over 74 years of age, or over 64 and with high comorbidity, are admitted to the Ortho-Geriatrics Unit.

The following data were gathered: date of birth, gender, date of fracture of the proximal femur, cause of fracture (low, medium, high energy), description of the fracture and surgery date, what the treatment was and its evolution (complications included).

### Clinical protocol for hip fracture procedure

Before the inauguration of the new hospital all the clinical protocols from the Orthopaedic and Trauma Surgery Department were examined and updated. The current protocol for hip fractures includes: (1) an emergency radiographic procedure, which comprises a full-size pelvic X-ray and an X-ray of the affected hip in AP and Axial views. In case of a comminuted extra-capsular fracture with an intra-capsular component, which might be unseen, a 2D and 3D Ct-Scan must be performed; (2) The classification of the hip fractures, according to the Müller-AO classification of fractures method [17]; (3) The selection of the best treatment depending on the fracture pattern.

The treatment selected had to be decided on the basis, as indicated by the fracture pattern, of which type of treatment or surgical technique was planned, i.e. just screws, partial or total hip arthroplasty for Intra-capsular fractures and trochanteric nails or dynamic hips screw (DHS), whether alone or in association with cannulated screws with an anti-rotating effect, for the management of extra-capsular fractures. A lesion that causes damage to the femoral head vessels and increases intra-capsular pressure will lead to avascular bone necrosis of the femoral head. Such lesions obtain poor results with osteosynthesis. For this reason, particularly when a femoral neck fracture has been displaced, arthroplasty is the safest and most highly valued alternative for these patients. This treatment offers better results, in terms of postoperative functionality, risk of re-intervention and complications, than internal fixation. Internal fixation systems may be used in certain ICF with a lower or non-displaced pattern [18–20]. On the other hand, given that ECF occur in highly vascularized, cancellous bone, the indication is treatment with reduction-osteosynthesis, both with intramedullary and extramedullary implants.

### Statistical analysis

No formal sample size was established, insofar as the sample size was defined as all patients with concomitant intra-capsular

**Table 1**  
Patient characteristics.

		Concomitant ipsilateral extra- and intra-capsular femoral proximal fractures n = 33
Age (yr)	mean (SD) median (min-max)	84.0 (10.2) 86 (54–100)
Male/Female	n (%) / n (%)	11 (27%) / 24 (73%)
Energy of the trauma		
low	n (%)	32 (97%)
medium	n (%)	1 (3%)
high	n (%)	–

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