

Preliminary report of the characteristics of the upper thigh spur area of the femoral neck in Garden I and II subcapital fractures

Georgios Touloupakis, Alessio Maione, Maria Gabriella Lettera, Wilfried Stuflessner, Fabrizio Ferrara, Guido Antonini, Cornelio Crippa

Department of Orthopedics and Traumatology, San Carlo Borromeo Hospital, Milan, Italy

Summary. The “heart” of the calcar is the internal cortical septum called “femoral thigh spur”. Nevertheless, the integrity of the femoral thigh spur and its extensions in Garden I and II femoral neck fractures has not been examined in depth, in CT scan-based studies. The aim of this retrospective study is to analyze characteristics as integrity of upper thigh spur area of the intra-capsular femoral neck using precise CT scans, as well as features of the medial cortical bone interruption of orthopedic calcar, in femoral fractures that are radiographically defined as Garden type I-II. A total number of 23 patients was finally included in our study. We called it the “upper thigh spur area” the area around a 360 degree perimeter of the upper thigh spur. The above-mentioned area is a cylindrical intracapsular structure oriented parallel to the intertrochanteric line of the proximal femur. We analyzed the modification of the cortical bone in this specific intra-capsular area of the femoral neck. In all the cases the upper thigh spur area (the internal cortical septum) was intact. The medial cortical (the known “orthopedic calcar”) was evaluated by CT scans in coronal views; it was found to be interrupted in 14 patients and intact in 9; among patients of the first group, 50% were classified as Garden I and 50% as Garden II. The cortical integrity on 360° of the upper thigh spur area was evaluated by CT scans in axial views through different cuts, and it was found to be intact in all cases. More extended studies including CT scans of Garden I-II-III and IV fractures are needed so as to obtain more complete results. In conclusion, it seems that the integrity of the upper thigh spur zone is associated with stable fractures. (www.actabiomedica.it)

Key words: femoral thigh spur, intracapsular femoral fractures, calcar femorale

Introduction

Despite the fact that orthopedic surgeons have gained knowledge and expertise in the field over the past years, the term “femoral calcar” is still a quite ambiguous definition for many orthopedic surgeons of our time (1,2).

The real femoral calcar is a very well described and itemized structure. The “heart” of the calcar is the internal cortical septum called “femoral thigh spur”; it is a dense structure, extended posteromedially from the calcar bow down to the lesser trochanter (3). The up-

permost part of the spur typically starts posteromedially at the femoral calcar, reaching down the distal part of the lesser trochanter. In its proximal part, this thigh spur is orientated parallel to the longitudinal axis of the femoral neck: the shorter distal part is aligned to the posterior cortex.

On conventional radiography the femoral thigh spur could be visualized best in the frog-lateral view of the hip or in Ct images. This structure is not well recognized in anteroposterior or lateral projection.

The frog-lateral view is not popular to classify hip fractures and the Garden classification which is widely

used for subcapital femoral fractures is typically based on anteroposterior films. Types I and II are mentioned by many authors as non-displaced fractures. However, a more detailed analysis, conducted by using lateral films or three dimensional reconstructions, showed that these fractures should be considered as displaced. Moreover, other studies support that incomplete femoral neck fractures identified on x-rays are actually identified as complete ones when examined in CT scans (4). In unstable “vertical” femoral neck fractures like Garden III -IV type, we have robust evidence that femoral neck comminutions in the inferior and posterior quadrants, is typically identified and with high frequency located (5).

Nevertheless, the integrity of the femoral thigh spur and its extensions in Garden I and II femoral neck fractures has not been examined in depth, in CT scan-based studies. The aim of this retrospective study is to analyze characteristics as integrity of upper thigh spur area of the intra-capsular femoral neck using precise CT scans, as well as features of the medial cortical bone interruption of orthopedic calcar, in femoral fractures that are radiographically defined as Garden type I-II.

Material and Methods

Our study was conducted in a group of subjects who had previously suffered from proximal femur fractures. All patients had been operated in our surgical unit over a 3-year period from September 2012 to September 2015. The patients met the following inclusion criteria: (1) patients > 50 years old, (2) Type 1 or 2 according to Gardner classification evaluated in 2 standard X-ray projections (anteroposterior and axial projections) and a CT examination including the pelvic region.

A total number of 23 patients was finally included in our study. The X-ray images of all the eligible subjects were obtained thanks to the Pictures Archiving and Communication System (PACS) located in our Institute. All fractures were fixed by using two simple cannulated screws and classified according to the Garden classification, as seen in anteroposterior X-ray projection. On the axial view we estimated the grade

of misalignment (Displaced or Non-displaced) using the “Alignment Index” described by Garden. All CT scans were acquired in supine position by multi-slice CT (Light- Speed VCT 64, GE Medical Systems, Milwaukee, WI), with routine parameters (slice thickness 0.625 mm, 120–140 kV, 250–380 mA). CT scans were then analyzed by orthopedic surgeons with more than 5 years of expertise in the field.

We evaluated if the medial cortex (Orthopedic calcar) was found to be interrupted on both the AP radiograph and the CT scan. The femoral calcar was identified as the area between the thick dorsomedial part of the femur cortex cranially and the tip of the lower border of the lesser trochanter caudally. The shape of femoral calcar was classified as ridge, septum or spur type; the ridge type is short and thick, the septum type is thin and long like, the shape between these two extremes is the spur type (3). We divided this area into two parts: the upper femoral calcar and the lower femoral calcar.

We called it the “upper thigh spur area” the area around a 360 degree perimeter of the upper thigh spur. The above-mentioned area is a cylindrical intracapsular structure oriented parallel to the intertrochanteric line of the proximal femur (Fig. 1, Fig. 2, Fig. 3). We analyzed the modification of the cortical bone in this specific intra-capsular area of the femoral neck.

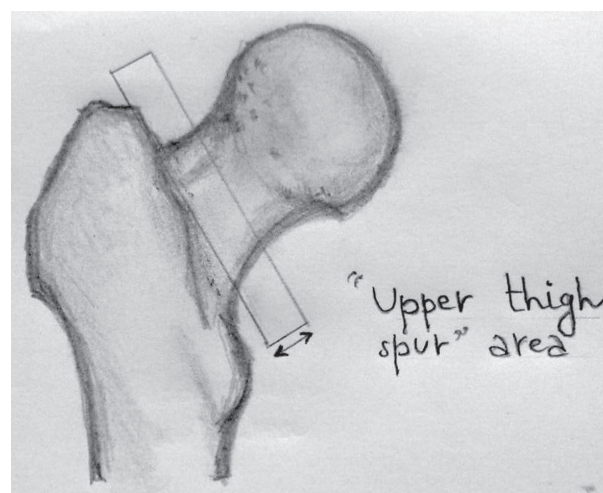


Figure 1. “Upper thigh spur area”: a cylindrical intracapsular structure oriented parallel to the intertrochanteric line of the proximal femur around a 360 degree perimeter of the upper thigh spur

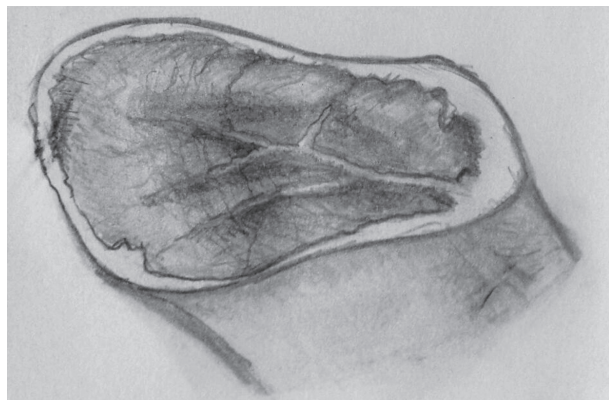


Figure 2. “Upper thigh spur area”: a cylindrical intracapsular structure oriented parallel to the intertrochanteric line of the proximal femur around a 360 degree perimeter of the upper thigh spur

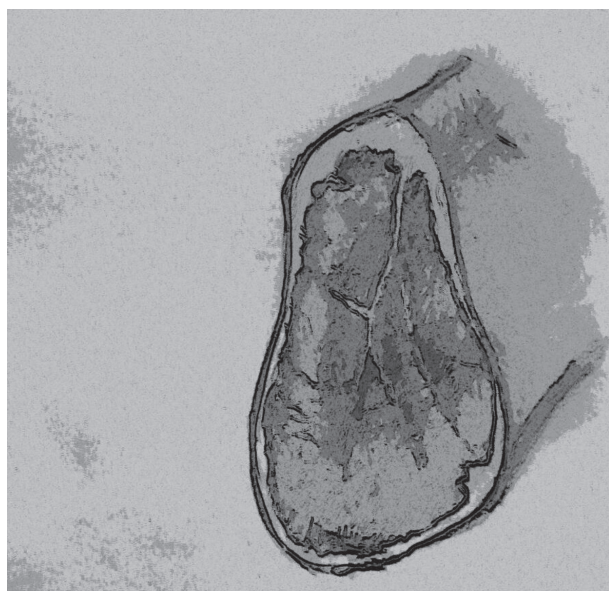


Figure 3. “Upper thigh spur area”: a cylindrical intracapsular structure oriented parallel to the intertrochanteric line of the proximal femur around a 360 degree perimeter of the upper thigh spur

Results

Our cohort included 23 patients, of which 9 were males and 14 were females, with an average age of 82, 13 (total range of 60-93 years). 14 fractures were classified as Garden I and 9 as Garden II by A-P view on the X-rays.

We evaluated, by using the Alignment Index, the displacement or non-displacement of the frac-

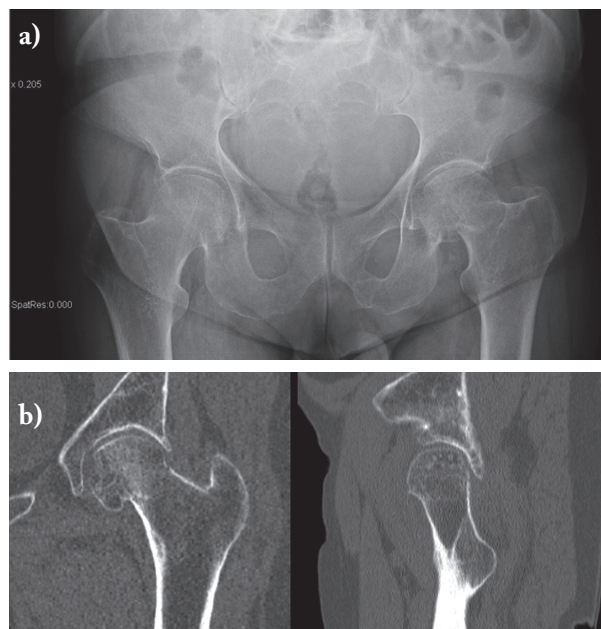


Figure 4. a, b) X-ray and CT scan of a 75-year-old male with a Garden II subcapital fracture showing cortical bone integrity around the upper thigh spur area of the femoral neck

tures detected on axial views. We found that the totality (100%) of Garden I group patients were found to be non-displaced, while in the other group 55, 6% (5 cases) of the fractures were found displaced and the 44, 4% (4 cases) were non-displaced.

In all X-rays, the upper thigh spur area was found intact especially on AP view, subsequently confirmed by a CT scan (Fig. 4a, Fig.4b, Fig. 5a, Fig.5b, Fig.5c). Among the different morphologies of the upper thigh spur, type septum was observed in 14 cases (60%), type ridge in 7 (30%) and finally, the spur type in only 2 (10%).

In all the cases the upper thigh spur area (the internal cortical septum) was intact.

Considering the shape of femoral calcar, we detected an almost absolute overlapping with the contralateral upper thigh spur in non-displacement cases of the contralateral femoral neck that were not fractured previously.

The medial cortical (the known “orthopedic calcar”) was evaluated by CT scans in coronal views; it was found to be interrupted in 14 patients and intact in 9; among patients of the first group, 50% were classified as Garden I and 50% as Garden II.

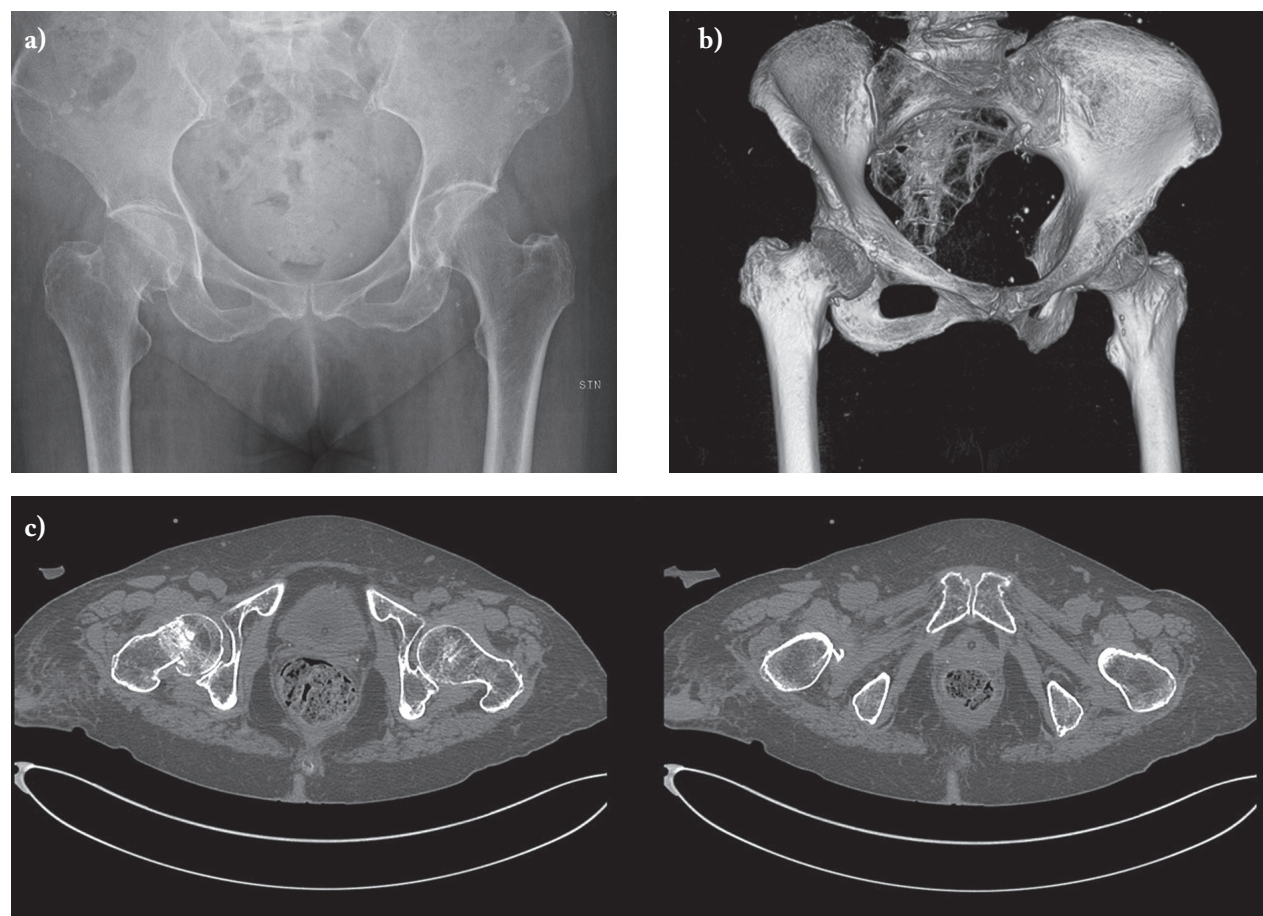


Figure 5. a, b, c) 3D CT scan with and X-ray control of an 85-year-old female patient with a Garden II subcapital fracture showing no corruption of the cortical bone at the “upper thigh spur area”

Lastly, the cortical integrity on 360° of the upper thigh spur area was evaluated by CT scans in axial views through different cuts, and it was found to be intact in all cases.

Discussion and Conclusion

The calcar femoral story is a very attractive topic and several authors in the past tried to describe it. Photographs, cadaver studies, X-ray films, CT and MRI scans have typically been used to analyze the anatomical features of this femoral segment. Traditionally, impassionate researchers, who lacked advanced technological systems, used to inspect directly the internal structure of the proximal femur (6). Nowadays,

the evolution of biomedical engineering offers multiple imaging possibilities for the detection of precise anatomical structures (7-9).

In 1907 Thompson suggested that the femoral calcar could act as a chisel in intertrochanteric extracapsular fractures. Other recent studies report that in intracapsular fractures with vertical orientation, the medial calcar is involved and calcar deficiency should be taken into consideration in implant choice and fixation strategy. Whereas pertrochanteric and unstable vertical medial fractures are characterized by medial calcar involvement.

In this study, we evaluated the intracapsular femoral neck zone which regards the upper thigh spur zone. This area could potentially be interested in medial femoral neck fractures. We hypothesized that the

integrity of the upper thigh spur and its corresponding medial cortical bone area in intracapsular zone is an actual indicator of stability. In stable subcapital fractures, the fracture line does not involve the upper thigh spur area of the femoral neck.

Based on our results, we would like to emphasize the importance of the solidity of the upper thigh spur area which seems to resist to the mechanism of fracture described as Garden I and II fractures. The integrity of the thigh spur has a clinical relevance; it seems to contribute to stability, as it is a solid and supportive base which prevents displacement of the femoral head. As a preliminary result, it seems that Garden I and II are intracapsular fractures with involvement only of the more proximal segment of the femoral neck, data also confirmed by CT scans. Whether displaced Garden III and IV subtypes involve the cortical bone of the upper spur thigh zone or not, should be further investigated. Integrity of the upper thigh spur zone is associated to stability, therefore attempted reduction and fixation could be a valid option of treatment of Garden I and II fractures, as many authors act during hip replacement. The measure of the bone density by DEXA investigation could also be highlighted in the upper thigh spur zone (10).

More extended studies including CT scans of Garden I-II-III and IV fractures are needed so as to obtain more complete results. In conclusion, it seems that the integrity of the upper thigh spur zone is associated with stable fractures. The integrity of the thigh spur area in CT scan could be an important parameter to be considered in future classification systems of the intracapsular hip fractures, as the stability of the fracture is directly related to the integrity of this anatomic area. The investigation of the thigh spur with a frog-lateral view of the hip could be an additional element for establishing the femoral neck fracture type as stable or unstable.

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Correspondence:

Georgios Touloupakis

Via Don Bartolomeo Grazioli 24

20162, Milano

Tel. (+39)3495106291

E-mail: yorgostoulou@gmail.com