

A special superior cortex compressive fracture of femoral neck

Two case reports

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Abstract

Rationale: Garden type I femoral neck fractures are incomplete stable fractures with impaction in valgus fractures that the question of whether there exists Garden type I femoral neck fracture is currently uncertain. There is still disagreement on the existence of the Garden type I fractures.

Patient concerns: Herein we report 2 cases with the Garden type I femoral neck fractures. Both of them had a history of simple fall.

Diagnoses: The X-ray showed incomplete fractures of the femoral neck and the Garden classification is type I. Further computed tomography and magnetic resonance imaging were used to confirm the diagnosis of this type fracture, which showed that the superior cortex of femoral neck was discontinuous and the inferior cortex remains intact.

Interventions: The conservative treatment schedule including immobilization of the affected lower limb, strict bed rest, bed-to-wheelchair transfer training, and half-to-full weight bearing mobilization were chosen to treat the patients.

Outcomes: Both of them achieved fracture union with conservative treatment at 3-month follow-up. No secondary displacement, signal of osteonecrosis of the femoral head or other complications occurred during 24-month follow-up in 2 cases.

Lessons: Although the Garden type I femoral neck fractures are rare, our report is in line with the real existence of it.

Abbreviations: AP = anterior-posterior, CT = computed tomography, HHS = Harris hip score, MRI = magnetic resonance imaging, VAS = visual analog scale.

Keywords: femoral neck, garden classification, incomplete fracture, injury mechanism

1. Introduction

Femoral neck fractures are common low-energy trauma in the geriatric population. However, there is a bimodal distribution of these fractures, with 2% to 3% occurring in young patients <50 years old after high-energy trauma.^[1] When a femoral neck fracture is identified, accurate description and classification of the fracture

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pattern can guide the referring clinician in patient education and appropriate treatment. The Garden classification has been widely used in the femoral neck fractures since 1st described by Garden in 1961.^[2] This classification distinguishes 4 types of femoral neck fractures on the basis of an anterior-posterior (AP) radiograph findings: type I, incomplete subcapital fracture, in which fracture of the inferior cortical buttress is greenstick in nature; type II, complete subcapital fracture without displacement; type III, complete fracture with partial displacement; type IV, complete fracture with full displacement. Garden type I fractures may have intrinsic fracture stability and resist fracture displacement. However, there is little detailed information on the diagnosis, mechanism, and treatment. The question of whether there exists Garden type I fracture is currently uncertain. There is still disagreement on the existence of this type of fracture.^[3,4] Herein, we report 2 patients with the Garden type I femoral neck fractures and confirm the real existence of it. This study was carried out in accordance with the guidelines of the Declaration of Helsinki. All experimental protocols were approved by our institutional review board (Xiamen University Ethical Review Committee).

2. Case reports

2.1. Case 1

A 42-year-old female patient presented to our orthopedics department with right hip pain which was exacerbated after active movement for 3 hours. There was a history of sprain when she missed a step during walking down the stairs. The physical examinations revealed slight swelling of the affected hip joint, tenderness in the lateral part of the right hip, and limited

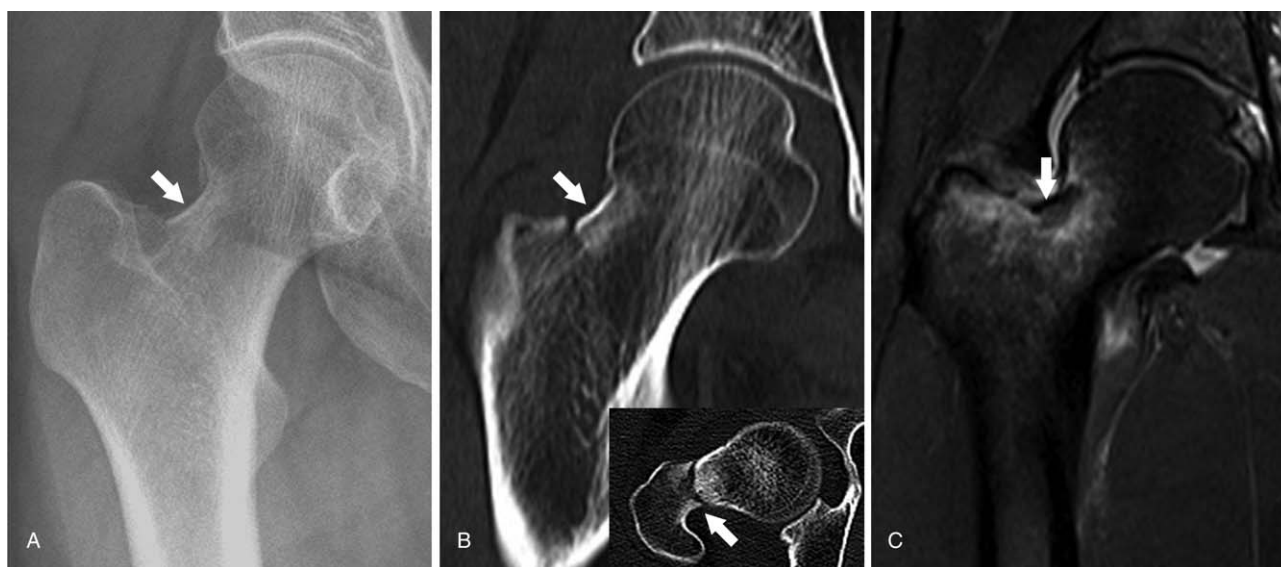


Figure 1. The X-ray showed incomplete fracture of the right femoral neck and the Garden classification is type I (Panel A, arrow). Further computed tomography and magnetic resonance imaging were used to confirm the diagnosis of this type fracture, which showed the superior cortex of femoral neck is discontinuous and the inferior cortex remains intact (Panels B and C, arrows).

movement of the hip due to the pain. The AP view of the X-ray showed incomplete fracture of the right femoral neck and the classification was Garden type I (Fig. 1A). Further computed tomography (CT) and magnetic resonance imaging (MRI) were used to confirm the diagnosis of this type fracture, which showed that the superior cortex of femoral neck was discontinuous and the inferior cortex remained intact (Fig. 1B, C). The patient was given conservative treatment including additional immobilization devices (cast of right lower limb) of the affected lower limb and strict bed rest during the first 3 weeks after injury. Analgesic was used when necessary during the early stage. Then bed-to-wheelchair transfer training and half-to-full weight bearing mobilization supported by a walker began in the following 6 weeks. In case of the secondary displacement, Routine X-ray of the hip joint was performed for the 1st week after injury. Treatment outcomes in patient were assessed by multiple imaging techniques including X-ray and CT scanning as well as functional recovery Harris hip score (HHS) and visual analog scale (VAS).^[5] There was no secondary displacement, signal of osteonecrosis of the femoral head or other complications of conservative treatment observed during the 24-month follow-up. Fracture union was achieved at the time of 3-month follow-up. The HHS of this case was improved from 72 to 95 at the time of 3-month follow-up after treatment. The VAS score of the hip pain declined to 0 at the time of 3-month follow-up while the VAS score was 6 at the 1st visit.

2.2. Case 2

A 43-year-old female patient presented to our outpatient clinic after suffering a twisting injury to her left hip. She was unable to bear her weight. The reason for injury was that she slipped and fell on a wet bathroom floor. The signs were similar to case 1. The AP view of the X-ray and CT scan showed similar type of femoral fracture as case 1 too, which showed that the superior cortex of femoral neck was discontinuous and the inferior cortex remained intact (Fig. 2). The patient was given the same conservative treatment schedule and assessment method as case

1. The 24-month follow-up showed that there was no secondary displacement, signal of osteonecrosis of the femoral head or other complications of conservative treatment observed, and fracture union was achieved at the 3-month follow-up. The HHS of this case was improved from 77 to 97 at the time of 3-month follow-up after treatment, and the VAS score of the hip pain declined to 0



Figure 2. The X-ray and computed tomography showed incomplete fracture of the right femoral neck and the Garden classification is type I.

at the time of 3-month follow-up while the VAS score was 5 at the 1st visit.

3. Discussion

Garden classification is 1 commonly used femoral neck fracture classification system and it is proved to be superior to other classification systems.^[6] Garden type I fracture is an incomplete subcapital fracture with the intact inferior cortex of the femoral neck, but the exact fracture line is unclear in many patients. This may be due to that the Garden classification is based on 2-dimensional images, so it cannot truly represent the spatial displacement of femoral neck fractures. There is still disagreement on the existence of Garden type I fractures.^[3,4] A review from Raaymakers^[7] even considered that the really nondisplaced femoral neck fracture does not exist. With the development of radiology, CT scans allow for more accurate diagnosis of the displacement of femoral neck fractures. Many studies comparing CT scans with X-ray showed that incomplete femoral neck fractures identified on X-ray films are actually complete fractures on CT scan and they intended to simplify the Garden classification by eliminating an inaccurate subcategory.^[3,4] In our study, 2 cases of femoral neck fractures were finally diagnosed as Garden type I fractures definitely by using the X-ray and further CT and/or MRI, which supports the real existence of incomplete subcapital fracture according to the Garden classification.

There is little detailed information on the mechanism of the accurate Garden type I femoral neck fractures up to now. We speculate that the possible mechanism and definition of Garden type I fracture maybe the result of direct or indirect force conduction through the femoral neck in an external rotation or abduction, which produced the extrusion force that goes beyond the limit of elastic collapse load between the femoral head and acetabulum, and finally results in an incomplete compressed fracture of the femoral neck. The fracture can present as simple fracture line through the femoral neck or bone fragment caused by extrusion force on the superior border of the femoral neck. The force may be due to sprain during climbing stairs, which is always an intracapsular fracture. There are many risk factors for hip fracture in older women,^[8] and both of the patients in this study are females and middle aged. In physiologic young adults, the mechanism of the fracture is different from the older ones.^[9] Whether this specific type of femoral neck fracture has an association with gender or age still needs more systematic assessment.

There is no specific symptom of this type fracture, and the possible symptoms of it may include pain of the affected hip joint especially when doing exercise, limited movement of the hip joint and slight edema of the hip. The symptoms of the 2 cases included the possible symptoms mentioned above and both of them had a history of simple fall. The CT scan of the hip joint is necessary, according to which the final type of the fracture could be observed and classified. In addition, MRI scan can be used as an extremely accurate method of Garden type I fracture detection.^[10]

Optimal treatment, including conservative or operative methods, of the Garden type I femoral neck fracture remains unclear.^[11-13] Although the fracture type is incomplete, the risk of secondary displacement and osteonecrosis of the femoral head may need special attention.^[14] In our study, both of the patients are middle-aged females, and conservative treatment including additional immobilization devices of the affected lower limb and

strict bed rest during the first 3 weeks after injury, and then bed-to-wheelchair transfer training and half-to-full weight bearing mobilization supported by a walker began in the following 6 weeks was chosen. Routine anterior and lateral X-ray of the hip joint was used to monitor the secondary displacement at the 1st week after injury. Both of the patients achieved fracture union with conservative treatment at the time of 3-month follow-up. However, the present study has limitation that the sample size was just 2. These kind of patients need to be further evaluated and treated through nonoperative management.

In conclusion, Garden classification for undisplaced femoral neck fractures has its certain limitations. However, it is still an effective system to classify and evaluate the femoral neck fractures. Garden type I femoral neck fracture is one kind of incomplete compressed fracture of the femoral neck which has its own specific mechanisms and we highlight more clinical studies on the mechanisms of this type of intracapsular fracture. Although they are rare, our report is in line with the reality of the Garden type I femoral neck fractures. Patients of Garden type I femoral neck fractures who were treated by comprehensive conservative treatment also can realize satisfying clinical outcome, but which kind of treatment to choose depends on a series of elements and needs further more studies to be confirmed.

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