

Central dislocation of femoral head without involvement of acetabular anterior and posterior columns

Xingling Xiao, Jiahui Chen , Canbin Wang, Han Liu, Tao Li, Hua Wang and Shicai Fan 

Abstract

Objective: This study was performed to explore the treatment of central dislocation of the femoral head without involvement of the acetabular columns.

Methods: Preoperatively, a three-dimensionally printed model of the patient's pelvis was manufactured according to the patient's computed tomography data. An all-locking anatomical plate was designed based on the mirror of the ipsilesional semi-pelvis. The fracture was reduced using reduction forceps and femoral traction via the lateral rectus approach. The customized plate was used as a template for reduction of the quadrilateral plate fracture.

Results: Reduction and fixation of this patient's fracture was achieved with a customized all-locking anatomical plate with a propeller shape via the lateral rectus approach.

Conclusions: This report describes an isolated quadrilateral plate fracture with central dislocation of the femoral head without involvement of the columns, which is a rare injury that has not yet been classified. It was effectively treated using a customized all-locking anatomical plate with propeller shape via the lateral rectus approach.

Keywords

Acetabular fracture, three-dimensional printing, customized plate, quadrilateral plate, central dislocation, lateral rectus approach

Date received: 23 September 2017; accepted: 6 February 2018

Introduction

The Judet–Letournel classification¹ is the most commonly used acetabular fracture classification system and is based on the involvement of the columns and walls.

The Third Affiliated Hospital of Southern Medical University, Guangzhou, China

Corresponding author:

Shicai Fan, The Third Affiliated Hospital of Southern Medical University, No. 183 Zhongshan Road (West), Tianhe District, Guangzhou, Guangdong 510630, China. Email: fanscyi@sohu.com



Isolated quadrilateral plate fractures are rare. To date, only two cases of linear quadrilateral plate fractures without dislocation of the femoral head treated by nonsurgical procedures, one case of a quadrilateral plate fracture accompanied by central dislocation of the femoral head and a femoral neck fracture treated by reduction and fixation, and one case of a quadrilateral plate acetabular fracture treated nonoperatively have been reported in the literature.²⁻⁴ In contrast, the present report describes an isolated quadrilateral plate fracture with central

dislocation of the femoral head without involvement of the columns. The fracture was surgically treated with a customized plate via the lateral rectus approach. This report may provide clinicians with a better treatment option for this rare injury and promote an update of the Judet–Letournel classification.

Case report

The study protocol was approved by the Medical Ethics Committee of the Third Affiliated Hospital of Southern Medical University. The patient was informed of the full implications and provided written informed consent.

A 28-year-old woman sustained an injury of the left hip following a fall when using the toilet, resulting in left hip pain and immobility. Radiographs revealed a left acetabular fracture with central dislocation of the femoral head (Figure 1). A computed tomography (CT) scan with three-dimensional reconstruction showed a comminuted quadrilateral plate fracture of the left acetabulum and central dislocation of the femoral head without involvement of the columns or walls. (Figure 2(a)–(c)).



Figure 1. Anteroposterior radiograph of the pelvis showing a left acetabular fracture, dislocation of the femoral head, and severe osteoporosis.

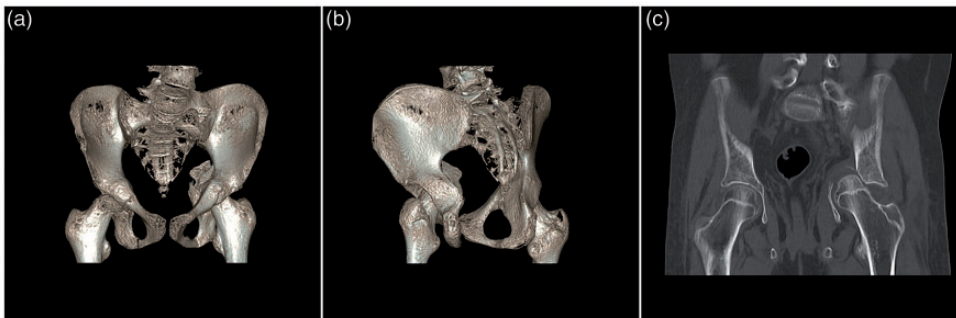


Figure 2. (a) Computed tomography (CT) three-dimensional reconstruction of the quadrilateral plate fracture with no involvement of the anterior acetabular column and wall. (b) CT three-dimensional reconstruction of the quadrilateral plate fracture with no involvement of the posterior acetabular column and wall. (c) CT three-dimensional reconstruction of the quadrilateral plate fracture with dislocation of the femoral head.

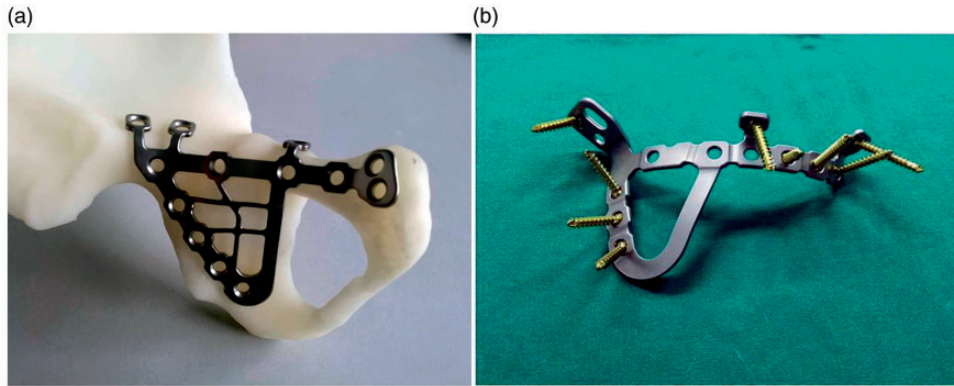


Figure 3. (a) Matching of the customized plate to the three-dimensionally printed model designed based on the mirror image of the ipsilesional semi-pelvis. (b) All-direction screw holes were designed for the differences in the materials between the plate and screws, and the all-locking effect was achieved by the screw thread biting the plate.

Moreover, the patient had a 21-year history of treatment with oral glucocorticoids following removal of her pituitary gland in 1996 and therefore had severe osteoporosis.

After admission, a three-dimensional printed model of the patient's pelvis was manufactured using her CT data. An all-locking anatomical plate was designed based on the mirror image of the ipsilesional semi-pelvis (Figure 3(a), (b)). Under general anesthesia, the patient was treated via the lateral rectus approach^{5,6} in the supine position. The fracture was reduced with assistance of reduction forceps and femoral traction. The customized plate was used as a template for reduction of the quadrilateral plate fracture (Figure 4). The customized all-locking acetabular anatomical plate with a propeller shape was then placed for fracture fixation after satisfactory fracture reduction. After placement, the fracture reduction and plate joint were checked again by radiographic examination. The direction of the locking screw was adjusted according to the bone quality, ensuring that the screws were located in the thick part of the acetabulum but did not exit the acetabular fossa. The operation time was 75 minutes, and the intraoperative bleeding volume was 300 mL.



Figure 4. Intraoperative radiograph showing fracture reduction using the plate assisted by the reduction forceps and auxiliary femoral traction.

After surgery, the patient was administered preventive treatment for infection and lower limb deep vein thrombosis as well as other symptomatic treatment, and her postoperative recovery was good. No surgery-related complications occurred during the postoperative course. At the last follow-up

(6 months after surgery), the patient attained a Merle d'Aubigné score of 16 points (pain, none; walking, long distance with cane or crutch; range of motion, 95%).

Discussion

The acetabulum comprises the ilium, ischium, and pubis, which are connected by cartilage during infancy. The cartilage is replaced by hard bone after gradual ossification of the ossification center. The ilium, ischium, and pubis of the adult acetabulum are thick. The weight-bearing structures of the acetabulum are the anterior column (formed by the ilium and pubis) and the posterior column (formed by the ilium and ischium). The non-weight-bearing structure of the acetabulum is the quadrilateral plate, which is the junction of the ilium, ischium, and pubis and is the anatomical basis for fracture formation because of its thinner bone structure and smaller bone mass compared with the ilium, ischium, and pubis. Central dislocation of femoral head was reported as a result of axial loading the femur in abduction.⁷ Moreover, an uncontrolled and strong contraction of muscles inserting at the greater trochanter caused by convulsion can account for Central dislocation of femoral head as a direct impact to the greater trochanter.⁸ When an impact occurs, the force is usually transmitted from the femoral head to the acetabular columns and walls. Therefore, most quadrilateral plate fractures are associated with acetabular anterior and/or posterior column fractures.⁹ Isolated quadrilateral plate fractures with no involvement of the acetabular columns are rare. To date, only three such cases have been reported (including the present case), indicating that such fractures involve complex mechanisms of injury. Because these fractures are atypical, a high index of suspicion is advised regarding a direct impact on the greater tuberosity in patients with severe osteoporosis.

Such fractures have not yet been classified because of the lack of adequate description and classification systems.¹⁰ The use of currently available classification systems for acetabular fractures appears to be inadequate for isolated quadrilateral plate fractures. In one classification, a high-grade intrapelvic dislocation of >1.5 cm was distinguished from a moderate dislocation.¹¹ However, associated injuries to the femoral head or proximal femur or non-orthopedic trauma were not incorporated in this classification. Therefore, a modification of the Judet-Letournel classification system may be required.

In the two previously reported cases involving linear quadrilateral plate fractures without displacement, the hip range of motion was not affected; therefore, these fractures were treated with nonsurgical procedures.^{2,3} Because our patient had an isolated quadrilateral plate fracture with central dislocation of the femoral head, her quality of life might have been seriously influenced if she had undergone treatment without repair of the structure and function of the hip. In 1987, Meinhard et al.⁴ reported a case involving a young man with a central acetabular fracture with an ipsilateral femoral neck fracture and intrapelvic dislocation of the femoral head. The patient was treated with reduction and fixation of the femoral neck fracture and no surgical procedures for the quadrilateral plate acetabular fracture. In the present case, the patient's pituitary gland had been removed at 9 years of age, and her endocrine system was completely disordered. She had been treated with glucocorticoids for a long period of time. Therefore, in addition to the fracture, the patient had severe systemic osteoporosis with type II diabetes. Reduction of the femoral head dislocation and reconstruction of the isolated quadrilateral plate fracture would have been difficult to achieve by closed traction, and other fractures might have been caused

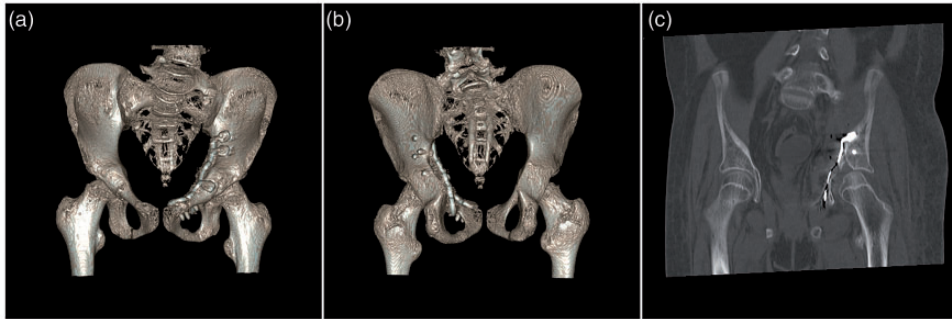


Figure 5. Postoperative computed tomography three-dimensional reconstruction of reduction and fixation. (a) The anterior view of three-dimensional reconstruction showed satisfactory reduction and fixation of the anterior column and wall. (b) The posterior view of three-dimensional reconstruction showed satisfactory reduction and fixation of the posterior column and wall. (c) The coronal plane of computed tomography showed satisfactory reduction and fixation of the quadrilateral plate.

by violent traction. The “V” sign on postoperative radiographs after open reduction and internal fixation was recently suggested to indicate a congruous joint and may require operative treatment.¹² Thus, our patient was treated with the lateral rectus approach. This operation allowed us to verify that the acetabular anterior and posterior columns were intact via exposure of the quadrilateral plate and anterior and posterior columns of the acetabulum. Considering the patient’s severe osteoporosis, tolerance of the reduction forceps by the bone, holding force of the screw, and special anatomic structure of the quadrilateral plate, we customized an all-locking anatomical plate with a propeller shape for the patient. After exposure of the fracture, the plate assisted by the reduction forceps was used to fix the fracture under lower extremity traction. Radiographs and a CT scan showed good reduction (Figure 5(a)–(c)).

This report has described a comminuted quadrilateral plate fracture of the left acetabulum with central dislocation of the femoral head without involvement of the columns or walls. Traditional plates are difficult to fix in patients with quadrilateral plate fractures and severe osteoporosis. In this present case, fracture reduction and

fixation were achieved using a customized all-locking anatomical plate with a propeller shape via the lateral rectus approach.


Declaration of conflicting interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The authors disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: This study was supported by the Special Program of Guangdong Frontier and Key Technological Innovation (No. 2015B010125006) and the “Clinical Research Initiative” of Southern Medical University (No. LC2016ZD032).

ORCID iD

Jiahui Chen  <http://orcid.org/0000-0002-1458-1761>

Shicai Fan  <http://orcid.org/0000-0002-1993-6074>

References

1. Judet R, Judet J and Letournel E. Fractures of the acetabulum. Classification and

- surgical approaches for open reduction. *J Bone Joint Surg Am* 1964; 46: 1615–1646.
2. Laflamme GY, Delisle J, Leduc S, et al. Isolated quadrilateral plate fracture: an unusual acetabular fracture. *Can J Surg* 2009; 52: E217–E219.
 3. Douraiswami B and Vinayak G. Isolated quadrilateral plate fracture of the acetabulum – a unique case scenario. *J Orthop Case Rep* 2012; 2: 32–34.
 4. Meinhard BP, Misoul C, Joy D, et al. Central acetabular fracture with ipsilateral femoral-neck fracture and intrapelvic dislocation of the femoral head without major pelvic-column disruption. A case report. *J Bone Joint Surg Am* 1987; 69: 612–615.
 5. Xia G, Yang X, Xiong R, et al. [Pararectus approach for treatment of acetabular both-column fracture combined with translocation of quadrilateral surface.] *Zhonghua Wai Ke Za Zhi* 2015; 53: 700–703 [Article in Chinese].
 6. Mai JG, Gu C, Lin XZ, et al. [Application of three-dimensional printing personalized acetabular wing-plate in treatment of complex acetabular fractures via lateral-rectus approach.] *Zhonghua Wai Ke Za Zhi* 2017; 55: 172–178 [Article in Chinese].
 7. Alho A. Injuries in the femoral axis. *Int Orthop* 1980; 3: 271–279. doi.org/10.1007/BF00266021
 8. Pearson JR, Hargadon EJ. Fractures of the pelvis involving the floor of the acetabulum. *Bone Joint J.* 1962; 44: 550–561. doi.org/10.1302/0301-620X.44B3.550
 9. White G, Kanakaris NK, Faour O, et al. Quadrilateral plate fractures of the acetabulum: An update. *Injury* 2013; 44: 159–167. doi.org/10.1016/j.injury.2012.10.010
 10. Bastian JD, Giannoudis PV. Central acetabular fracture dislocations: Are existing classifications comprehensive? *Injury* 2014; 45: 1807–1815. doi.org/10.1016/j.injury.2014.10.046
 11. Gothlin G, Hindmarsh J. Central dislocation of the hip. The prognosis with conservative management. *Acta Orthop Scand* 1970; 41: 476–487. doi.org/10.3109/17453677008991535
 12. Magu NK, Rohilla R and Arora S. Conservatively treated acetabular fractures: a retrospective analysis. *Indian J Orthop* 2012; 46: 36–45.