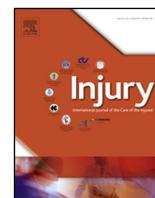




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Quadrilateral plate fractures of the acetabulum: Proposition for a novel classification system

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ABSTRACT

Background: Currently, there is no definition or classification system for quadrilateral plate (QLP) fractures; the aim was to anatomically and radiologically characterise the QLP, propose a definition and classify QLP fractures.

Methods: This study included an anatomical component and a radiological component. The anatomical study aimed at defining the characteristics of the QLP; the QLP was identified using four articulating bony pelvis specimens. A titanium mesh was placed on the specimens' quadrilateral surface; standard anteroposterior and oblique views were obtained, and axial CT images, to determine the radiological landmarks. The radiological study included the review of images of patients with QLP fractures; fractures involving the QLP were identified in a series of 609 consecutive patients with acetabular fractures.

Results: We considered QLP fractures where the QLP is separated from both columns of the acetabulum; this was found in 16% (98 cases). They were mostly encountered with associated both columns fractures (60 cases; 61%), Separation of the QLP could be complete or incomplete, or simple or comminuted, so QLP fractures were divided into three types: QLP1, simple with incomplete separation; QLP2, comminuted with incomplete separation; QLP3, comminuted with complete separation (QLP4), simple with complete separation.

Conclusion: The QLP was characterised, and a definition and classification system Cairo University Hospitals (CUH) Classification was proposed for these fractures. We believe that this classification may prove useful in the future for the identification and management of these fractures.

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Introduction

Quadrilateral plate fractures of the acetabulum are a challenging group of acetabular fractures. The main difficulty lies in the fact that they are usually accompanied by medial subluxation of the femoral head and dome impaction, as well as a high degree of comminution [1–5]. One of the most confusing aspects of these fractures is the lack of a clear definition. Different authors define quadrilateral plate fractures differently, and there is no one clear or all-encompassing definition. Further, their studies have described different modalities of fixation for quadrilateral plate fractures based on different descriptions of quadrilateral plate fractures.

White et al. based their definition on a search of the Medline, Embase and Cochrane library databases for the term “Acetabular Fracture” and “Central Hip Dislocation” [3]. Their results and conclusions were dependent on these search criteria, and they considered it to be any acetabular fracture with medial subluxation of the femoral head [3]. We however believe that a central hip dislocation with an acetabular fracture does not necessarily indicate a separation of the quadrilateral plate, and that a fracture of the quadrilateral plate does not necessarily indicate a central hip dislocation.

Qureshi et al. considered it as a comminution in the quadrilateral plate accompanied with a medial displacement pattern [1]. They also described quadrilateral plate fractures as being accompanied with medial subluxation of the femoral head in the elderly, and they used infrapectineal plates for fixation of these fractures. Further, Sen et al. described a technique for buttress plating of quadrilateral plate fractures; their interpretation of quadrilateral plate fractures was fractures which involved

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comminution in the quadrilateral surface of the acetabulum [5]. Yet another description was provided by Farid, who mentioned that the quadrilateral plate could be separated from the anterior or posterior column, and that this separation could be complete or incomplete [4]. Given these varying and confusing descriptions, in this study, we have tried to anatomically and radiologically characterize the quadrilateral plate and define the fractures based on these characteristics.

The lack of sufficient guidelines in the current literature makes it difficult to deal with these fractures. There is considerable debate around this fracture type, to the extent that even at the same institute, surgeons use different methods to treat these fractures. Some surgeons advocate the use of dedicated approaches or specific methods of fixation, while others believe that reduction of these fractures is mainly dependent on reduction of the acetabular columns and that they are not associated with hip joint stability or the development of posttraumatic arthritis. In this study, we have attempted to establish a classification system for these fractures, which could later be used to develop definite guidelines for the management of this particular group of fractures. This study tries to anatomically and radiologically characterize the quadrilateral plate, propose a definition for quadrilateral plate fractures, and classify them. This is the first time a classification system is being proposed for this type of fracture, and we believe that it will have strong implications for the diagnosis and treatment of these fractures.

Patients and methods

This study was approved and registered in our local institutional review board.

Cadaveric study

The first part of this study is an anatomical study, using four cadaveric bony pelvises (two male and two female), we identified the quadrilateral plate of the acetabulum as the trapezoidal-shaped area that is bound by the greater sciatic foramen posteriorly, the obturator foramen anteriorly, and the pelvic brim superiorly, with a horizontal line joining the ischial spine and the obturator foramen inferiorly (Fig. 1). These boundaries were based

on our understanding of the quadrilateral plate and from previous descriptions by Bircher and Tile [6] and Guyton and Perez [7].

To identify the radiological landmarks corresponding to the anatomical landmarks mentioned in the previous subsection, we used a male dry articulating pelvis. A titanium mesh was placed on the quadrilateral surface of the acetabulum, based on the same landmarks mentioned previously. The dry pelvis was then fixed in position, and the anteroposterior and oblique views were obtained.

In the anteroposterior view, the quadrilateral plate was found to be the area between the iliopectineal and ilioischial lines, which extends superiorly to the area just above the anterior inferior iliac spine and inferiorly till the lower end of the tear drop. In the iliac oblique view, the quadrilateral surface was seen from the anterior end, extending to the ilioischial line, and from the greater sciatic notch down till the upper end of the lesser sciatic notch. In the obturator oblique view, the quadrilateral plate was found to be the area extending from the anterior column anteriorly till the beginning of the posterior wall posteriorly, and from above the anterior inferior iliac spine superiorly till above the obturator foramen inferiorly. The tear drop is seen overlapping this area in the obturator oblique view (Fig. 2).

To identify the quadrilateral plate on CT images, an axial CT scan of 3-mm sections was obtained for the specimen with the titanium mesh fixed in position. The quadrilateral plate was found to be the area corresponding to the medial wall of the acetabulum: from the level of the anterior inferior iliac spine till the appearance of the obturator canal (Fig. 3).

Radiological study

Using the database of a level one trauma center university hospital, we retrospectively reviewed the records of 609 patients who presented between January 2009 and January 2012. Using the previously mentioned axial CT sections, we identified all the fractures involving the quadrilateral plate of the acetabulum. Out of the 609 fractures, 470 involved the medial wall of the acetabulum. These 470 fractures were divided into two main groups: Group A, fractures where the quadrilateral plate was separated from the anterior and posterior column ($n=98$); Group B, acetabular fractures with a fracture line passing through the quadrilateral plate, but not separating the plate from the anterior and posterior column ($n=372$).

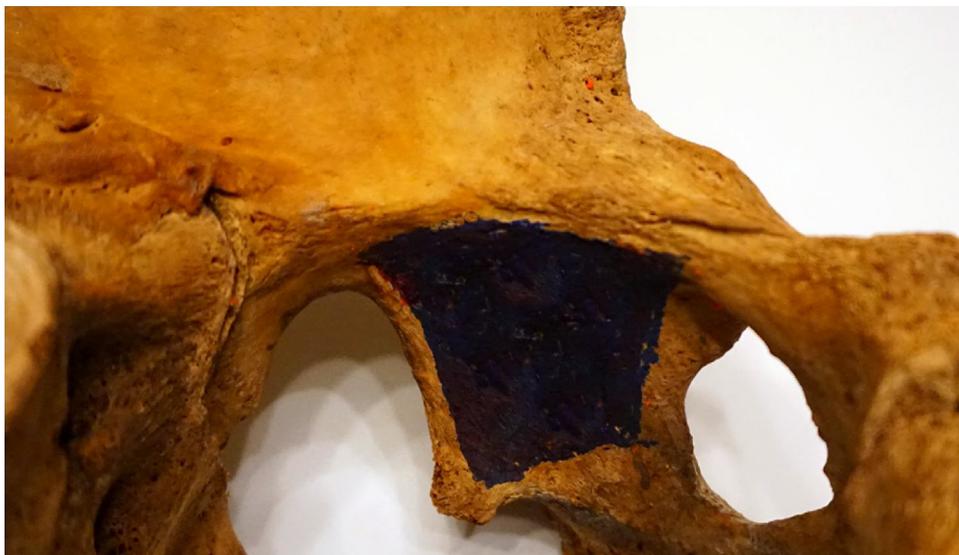


Fig. 1. Anatomical landmarks of the quadrilateral plate. The quadrilateral plate extends from the pelvic brim superiorly till a line joining the ischial spine and obturator foramen inferiorly, and is bound by the greater sciatic notch posteriorly and the obturator foramen anteriorly.

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