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Technical note

The added value of intraoperative CT scanner and screw navigation in displaced posterior wall acetabular fracture with articular impaction

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ABSTRACT

Posterior wall with transverse acetabular fractures represents the most common type of acetabular fractures and is generally associated with poorer outcomes. This is caused by improper visualization of the fragments leading to imperfect reductions. Navigation in pelvic and acetabular trauma is reserved nowadays to non-displaced or mildly displaced fractures. To add to that, perioperative control of reduction is difficult using the conventional X-ray. The described 3D imaging method allowed proper reduction control. On the other hand, screw navigation of acetabular screws enabled better control of screw position as well as screw placement in otherwise inaccessible zones. In conclusion, peroperative 3D imaging and screw navigation optimize fracture reduction promoting better radiological and functional results.

1. Introduction

Displaced acetabular fractures creates incongruency between the acetabulum and the femoral head [1]. Anatomical reduction had been advised to obtain a favorable functional outcome [2]. In contrast, reduction and internal fixation of displaced fracture is technically demanding with a steep learning curve [3,4]. Despite specific approaches were described to manage these fractures, there are general and technical complications, in particular insufficient reduction and screw malpositioning [5].

The most common type of acetabular fracture is the posterior wall with transverse fracture associated with articular impaction [6]. Treatment consists in reduction of the fracture using the femoral head as a guide. Thereafter, the posterior wall fragment is closed like a hood and control of the reduction is then totally lost with poor reliability of fluoroscopy [7]. In addition, routine postoperative CT-scan (computed tomography) showed a number of imperfect reductions caused by fragment instability and lack of surgical control (Fig. 1).

Intraoperative imaging using CT-scan became popular in spine surgery in adjunct to navigated pedicular screw placement [3]. In trauma of pelvic bone, intra-operative imaging and screw placement navigation was evaluated for iliosacral screws and for percutaneous fixation of non-displaced acetabular fractures [3,8–10]. We describe a technical note on management of displaced posterior wall with transverse acetabular treated with open reduction and internal fixation using the 3D intraoperative imaging and screw navigation.

2. Surgical technique

The patient, who signed a preoperative consent for the use of this technique, is positioned in a ventral decubitus on a radiolucent traction table with traction applied to the injured limb with a 45° of knee flexion (to decrease tension in the sciatic nerve). The O-ARM imaging device (Medtronic, Sofamor, Broomfield, CO) is then introduced to check the absence of conflict with the patient and/or the operative table (Fig. 2). The Kocher-Langenbeck approach is used exposing the comminuted fracture and the impacted fragments. After opening of the "hood" (posterior wall fragment) and exposing the impacted articular surface, intra-articular lavage is performed. Reduction of the transverse fracture is more challenging and is done using special reduction forceps and clamps. Reduction of the articular fragments is performed followed by the closure of the hood. If reduction is deemed stable, no fixation for the acquisition is required. If not, provisional fixation could be done using Kirschner wires or small plates (2–4 holes).

The acquisition and navigation part follows: a bolt with the reference frame is inserted in the ipsilateral posterior iliac crest. The reference frame should be between the camera and the O-Arm during acquisition (camera on the head side). The O-Arm device is introduced to the surgical field after draping. Special care should be taken not to soil the device with the bloody surgical drapes. The device must be centered over the desired hemipelvis (Fig. 3).

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Fig. 1. A 31-year-old male was victim of a motor vehicle accident. He presented a posterior dislocation of the left hip with a posterior wall acetabular fracture. Preoperative CT-scan showed a comminuted posterior wall fracture as well as impaction of the acetabular roof (A). The patient was operated 5 days after trauma with open reduction and internal fixation without O-ARM navigation via Kocher-Langenbeck approach. Reduction of the fragments was done using the reduced femoral head as a scaffold. Fixation was carried with 2 Letournel plates (Stryker, Kalamazoo, Michigan). Postoperative X -rays showed good reduction. Nonetheless, routine postoperative CT-scan showed displacement of the acetabular roof fragment with a step off of around 4 mm (B).

Fig. 2. The O-ARM device (Medtronic, Sofamor, Broomfield, CO) is introduced to check for possible conflict with the operating table and then removed for preparing of the operative site.

Fig. 3. The device is introduced after its draping and the first acquisition is done.

The first imaging of the reduced fracture is performed using low dosage radiation mode in order to reduce the irradiation to the patient. This step should always be done after reduction of the fracture in order to make screw navigation possible. The device is then put in parking mode (towards the feet) enabling repetitive image acquisition without uncomforting the surgical team. Operative time was increased by 13 minutes for this step.

One or two Letournel plates (Stryker, Kalamazoo, Michigan) are used for internal fixation. They are bent to exact anatomy of the patient. With the use of intraoperative navigation (Medtronic,Sofamor, Broomfield, CO), screws were inserted using a navigated drill and length was measured using the passive probe.

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