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An Overview on Treatment of Transverse Acetabular Fractures

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Abstract

According to Judet and Letournel's classification, the transverse acetabular fracture belongs to the elementary fracture group. It mostly crosses the weight-bearing dome area, which is necessary for maintaining normal hip stability. Treatment of the transverse acetabular fracture is known to have worse results than other fracture types, although this fracture belongs to the elementary fracture group. The operative results of the transverse acetabular fracture, however, have not been well documented.

Keywords: Transverse Acetabular Fractures, percutaneous fixation, anterior column screw

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1. Introduction

Displaced fractures of the acetabulum should be managed like other intra-articular fractures of the lower extremity – by anatomic reduction and stable internal fixation, followed by early motion [1]. All decision making, must take into account the risk-benefit equation. Therefore, the benefits gained must always be measured against the risks involved in the surgery [1]. Operative versus non-operative management depends on two important factors: Stability and Congruity [1]. The type of surgical approach, timing and order of fixation are predicted upon the anatomic pattern of injury, overall status of the patient, making acute and reconstructive management decisions complex. Further study is needed to determine long term functional outcome of these injuries. Inferior functional outcomes were associated with increased severity of the acetabular fracture and the presence of other system injuries [2].

1.1. Indications for Operative Treatment

- Incongruent hip joint.
- Neurovascular compromise.
- Unstable hip joint.
- Impossible closed reduction after hip dislocation.
- Displacement > 2 mm.
- Incarcerated fragments [2].

1.2. Indications for percutaneous fixation of transverse acetabular fractures

Several subsets of transverse acetabular fractures are potentially amenable to minimally invasive surgical fixation:

1. Pure transverse acetabular fractures [3-4].
2. None displaced but potentially unstable fractures involving the weight-bearing dome.
3. Minimally displaced fractures that may be reduced closely with lag-screw fixation.
4. Displaced acetabular fractures that can reduced closely aided intraoperative by Shanz screw.

2. Anterior column lag screw

As the anterior column is thin even at the iliopectineal eminence, so it is challenging to get an extra articular safe osseous corridor. Anterior column screw fixation can be done in an antegrade or retrograde fashion [5]. Starr and Nakatani et al described a classification scheme for superior pubic ramus fractures based on the AP radiograph. Zone I was defined as medial to the obturator foramen, whereas zone III is lateral to the obturator foramen, with zone II representing the area adjacent to the obturator foramen between zones I and III [6]. In general, they selected antegrade placement for zone III fractures and retrograde placement for zones I and II fractures [6].

2.1. Retrograde Anterior column screw

For retrograde screw placement, the guide wire is placed through the ipsilateral public tubercle through a limited incision [7]. The point of entrance for the retrograde pubic screw is medial to the pubic tubercle. The surgeon must be aware of anatomical landmarks in male patients: the spermatic cord is lateral to the pubic tubercle [7]. The position of the drill bit is parallel to the long axis of the superior pubic ramus. The drill should only be introduced 1cm into the medullary pubic bone. The position of the drill is controlled by fluoroscopic imaging in the inlet position to ensure that the posterior cortex is not penetrated. The point of insertion is

checked in the anteroposterior, inlet and outlet views [7]. The screw is placed 1 cm into the hole made by the drill. Before starting, the position of the screw is confirmed by fluoroscopic imaging [7]. Once the screw is in the medullary channel, it is self-guided. Its progression within the corridor is corroborated with inlet and oblique views [7].

2.2. Antegrade anterior column screw

The iliac entry point for the antegrade column screw is at the lateral iliac surface with entry point proximal to the acetabulum toward the pubic symphysis. The entry points were located at the junction of a line drawn along the lateral border of the femur through the greater trochanter and a line from the pubic symphysis through the anterior inferior iliac spine (AIIS) [3-8]. The guide wire advancement is monitored by using the obturator outlet and iliac inlet views or inlet view of the pelvis. The obturator outlet view is used to ensure that the wire or screw does not penetrate the hip joint (superior-inferior orientation). The iliac inlet view or inlet view is used to ensure that the guide wire does not penetrate the inner cortex of the superior ramus (mediolateral orientation) [5]. The obturator oblique view shows the cephalo caudal plan and the inlet view shows the drill position in the anteroposterior plane. We drill until reaching the medial superior pubic ramus [9].

The obturator outlet view is obtained as a combination of outlet tilt and 20 to 25 degrees of obliquity toward the surgical side. This view requires less obliquity than what is required for a teardrop view. This allows for monitoring of superior-inferior trajectory, as well as start point, ensuring that the wire and screw are outside of the hip joint and safe from the neurovascular structures passing above the lateral superior ramus [5]. Antegrade screw insertion dictates that the screw be started superiorly enough to allow for avoidance of the hip joint, without superior cortical breach into the pelvis [9]. An orthogonal iliac oblique inlet is then obtained by swinging the C-arm to a pelvic inlet and 20 to 25 degrees of contralateral obliquity (iliac inlet view), ensuring that the wire is clear of the pelvic contents and bladder and the neurovascular contents as they pass anteriorly [9]. The length of the screw is measured with the drill's milimetric guide and the correct screw is placed [5].

3. Posterior column lag screw

The ischium has a complex 3D structure and narrow "safe corridor" for percutaneous insertion of ischial or posterior column screws. Posterior column screws can be inserted in either an antegrade or a retrograde direction [5].

3.1. Antegrade Posterior column screw

For antegrade placement, a limited lateral window of the illioinguinal approach is performed and the iliacus muscle elevated off the inner table. Under iliac view guidance, the guide wire is inserted 1–2 cm lateral to the pelvic brim and angled 30-45 degrees posterior to the hip to engage the dense cortical bone of the ischial tuberosity [5]. The exact point of entrance is the intersection between a line joining the anterior inferior iliac spine (AIIS) and the sciatic notch with another line from the iliac tubercle to the ischial tuberosity. This point is located at the hour '1' position of the ring of the acetabulum. The drill bit should be parallel to the iliac wing facing the ischial tuberosity. A K wire is placed using both oblique views in fluoroscopic imaging to avoid penetrating the hip joint and inner pelvis [10]. The slope of the inner table makes it is difficult to accurately start this wire without sliding and a long firm cannulated drill sleeve is helpful. The screw passes posterior to the hip joint into the dense bone of the ischial tuberosity [9].

3.2. Retrograde Posterior column screw

The entry start for the retrograde approach is easier but positioning is harder and imaging is more difficult. An assistant must hold the leg up with the knee flexed and hip externally rotated to relax the sciatic nerve [5]. The first step for the introduction of a retrograde posterior column screw is locating the ischial tuberosity with the patient's hip flexed Just 1 cm posterior to the most distal aspect of the ischial tuberosity will mark the entry point for the screw. This ensures that the screw will remain extra-articular with the correct trajectory. The obturator oblique and the iliac oblique views are used for screw guidance [8]. A lateral tuberosity starting point must be avoided because it makes the sciatic nerve at risk as it passes just lateral to the ischial tuberosity [5]. To identify the entry point, an obturator oblique view should be obtained with the hip flexed and abducted. A drill bit for a cannulated 6.5-mm screw is advanced proximally in the ischial ramus with guidance using both obturator oblique and iliac oblique views. Next, a lateral view is obtained to ensure the inner pelvic table has just been breached to have a bi-cortical purchase [8]. Once the wire is placed in acceptable position, the depth is measured, the lateral cortex drilled, and a 6.5-mm partially threaded cannulated screw inserted [8].

3.3. Magic Screws (Outside-in Posterior Column Screws)

Named after their difficulty in insertion technique. They can be used in certain transverse fractures as alternatives to posterior column screws also it is used in quadrilateral plate fractures [9]. Start point is similar to that of an anterior column screw, but more anterior over the gluteus medius pillar but nrea the roof of acetabulum. It is directed down towards the posterior column and medially towards ischial spine. Trajectory is monitored via the iliac oblique view for AP direction and alternating between obturator oblique inlets and outlets [5]. The AP view is used to guide the screw toward the ischial spine. Dangers include the sciatic nerve and hip joint laterally and the abdominal viscera medially. Great care using a threaded wire must be taken because the medial exit can be difficult to be seen. In any such instance, the wire in reverse while gently pushing forward gives better tactile feedback of cortices [5].

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