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Minimally-invasive fixation for anterior pelvic ring disruptions

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KEYWORDS

Pelvic fracture
External fixator
Plating
InFix technique

ABSTRACT

Pelvic fractures are usually the result of high-energy trauma. In addition to the underlying disruption of the pelvic ring extensive damage to the surrounding soft tissue envelope might be present. Different fixation techniques have been developed including open plating, external fixation and transramus intraosseous screw fixation. Recently another method has been reported the so called pelvic Bridge or Infix technique. In this short review article the different techniques of pelvic fixation are described.

Introduction

Methods of anterior pelvic fixation include formal open plating, external fixation and transramus intraosseous screw fixation. A minimally-invasive technique for the anterior ring has also been developed. This technique comprises subcutaneous implants fixed into the ilium with or without fixation into the parasymphyseal region and has been referred to as the Pelvic Bridge [1] or InFix [2] technique.

ORIF

Open reduction and internal fixation with a plate is indicated for pure ligamentous pubic dislocations. In the setting of pelvic ring disruptions, ORIF may also be used for parasymphyseal or ramii fractures, with plate fixation spanning the anterior column (Figure 1), but many surgeons prefer to spare the patient from extra dissection for exposure and opt for minimally-invasive approaches or external fixation.

Open plating may be relatively contraindicated when the surgical field has been contaminated by bowel or bladder content due to visceral injuries, intraabdominal surgical procedures have been conducted, if there has been significant traumatic damage to the native soft tissues, or suprapubic catheters are present within the field of potential surgery. Open plating can be executed successfully with either small or large fragment reconstruction plates and screws and, in the case of pure symphyseal injuries, with two or three screws on either side of the midline (Figure 2a,b).

External fixation

Anterior external fixation frames are a definitive treatment option for anterior pelvic disruptions and are of particular interest in the setting of ramii fractures or complex parasymphyseal fractures when extensive exposure of the anterior pelvis may be unfavourable. The advantages of external fixation are that it is minimally invasive, preserves the biology at the fracture site, can be removed easily, and is generally technically less demanding, requiring less operating room time and blood loss than ORIF. The disadvantage is that it is usually less stable than ORIF because of the distance of the external fixation from the bone.

Modern frames employ one or two pins, anchored to each iliac crest or to the supraacetabular area of the ilium, and interconnected by pin bar clamps and carbon fibre rods. The advantages of the iliac crest site for pin placement are its ease and access, which is optimal at the level of the gluteus medius tubercle and pillar. The advantages of the supraacetabular location are the excellent bone stock and biomechanically advantageous position. These frames can be revised later to another form of permanent fixation or left alone as a definitive treatment modality, usually for 6-8 weeks. Multiple biomechanical studies have demonstrated that frames anchored to the iliac wings and supraacetabular bone provide acceptable stability for the anterior pelvis. Posterior pelvic disruptions must be stabilised separately unless the posterior tension band is intact. When posterior instability has been ignored, application of the anterior frame can result in over internal rotation of a hemipelvis, which must be avoided during application (Figure 3).

External frames have been associated with pin-tract infection rates of up to 30%. Septic hip arthritis due to inadvertent pin insertion into the femoral head or penetration of the joint capsule has been described. The use of external frames is limited

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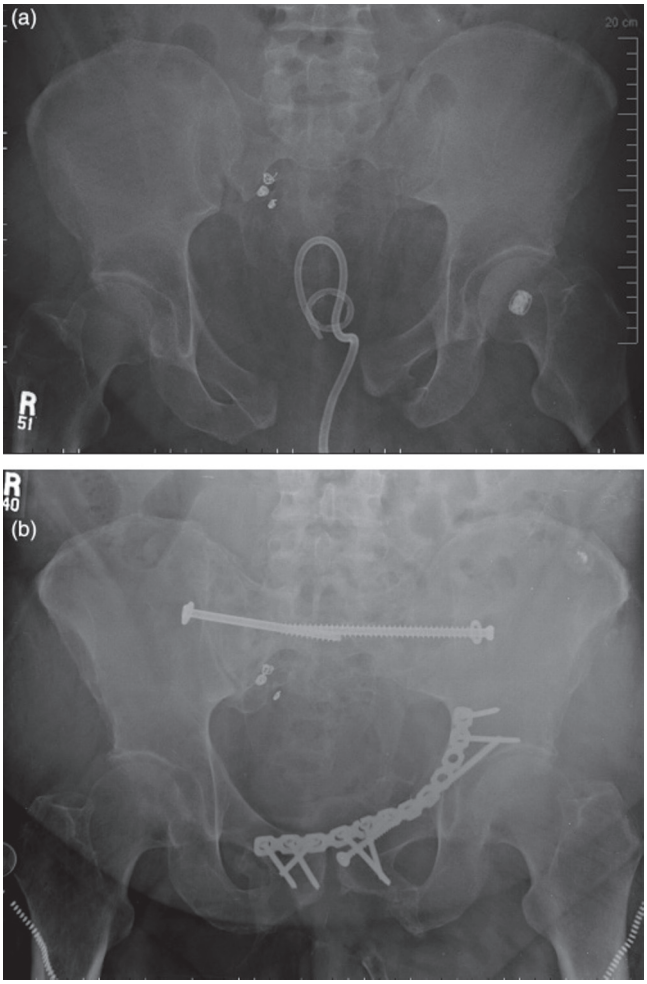

Fig. 1. (a) This is an AP pelvis X-ray of a 45-year-old patient who was crushed between two cars while officiating at a car demolition derby. He had massive displacement of his pelvic ring, both anterior and posterior, with an open pelvis, disrupted urethra and severe degloving injury. Pubic symphyseal disruption and left sided ramus fractures can be appreciated. (b) Depicted is the post fixation AP X-ray 6 months after healing. The anterior trans column fixation can be appreciated using a 3.5 reconstruction plate which broke at hole 5, presumably due to residual motion in the perioperative rehabilitative period. The patient went on to ambulate well, with minimal pain, but had long-lasting urogenital complications.

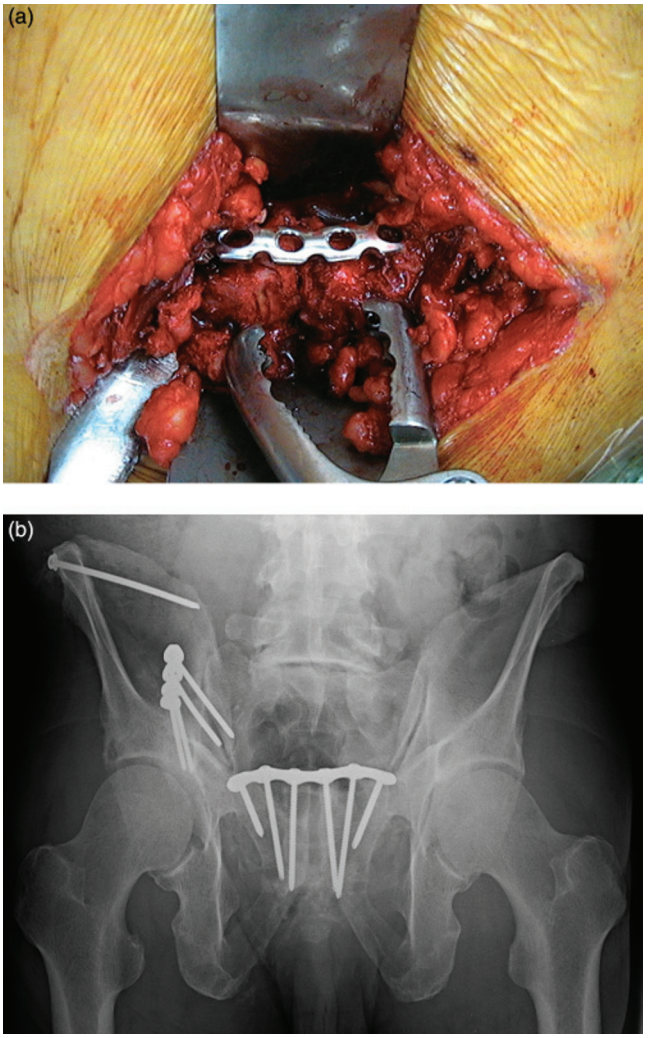

Fig. 2. (a) An intraoperative image of a 6-hole 3.5 reconstruction plate placed over the reduced pubic symphysis, prior to screw deployment. A Farabeuf clamp can be seen placed on two screw anchors to enable compressive reduction of the symphysis. (b) This outlet pelvis X-ray shows parasymphyseal deployment of screws around a well reduced symphysis.

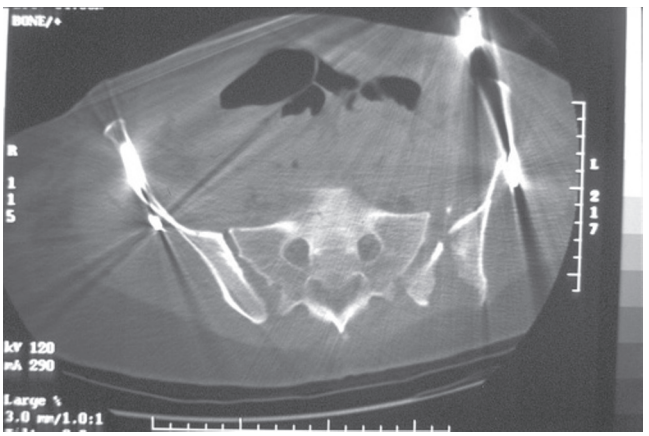

Fig. 3. This is an axial CT scan cut through the posterior pelvic ring. It was taken after placement of an external fixator and shows the widely displaced posterior crescent fracture on the left side of the patient. This phenomenon occurred because the surgeon who applied the fixator placed an internal rotation force through the Schanz pins that were placed in the ilium.

in cases of concomitant iliac wing or acetabular fractures, or poor bone quality. Patients usually complain of significant discomfort and limitation of activities of daily living, such as intercourse and dressing, sitting and sleeping. Nursing care can also be complicated because of the need for pin-tract care several times daily. Furthermore, external fixation in the obese is even more poorly tolerated and is associated with higher rates of pin-related complications (Figure 4a, b).

The idea of intramedullary fixation of the broken superior pubic ramus was initially conceived by Lambotte and also described by Tile in the beginning of the 20th century [3,4]; however, it was Routt et al. who mastered, described and educated others about the technique from the mid 1990s [5,6]. The screw can be inserted either through the pubic tubercle retrograde, or through the supraacetabular region of the ilium antegrade (Figure 5). Starr et al. published radiographic guidelines for such screw placement [7]. Both open and percutaneous approaches have been shown to be successful. Large fragment screws are generally used for this fixation option. Accuracy of the instrumentation can be improved with fluoroscopic- and CT-guided navigation systems, but this technology adds significant cost and time for experienced pelvic surgeons [8-11]. Although biomechanical studies have shown that the strength of fixation was comparable to plating, in practice the retrograde transramus screws fixation has been shown to fail in 15% of elderly patients