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TECHNICAL NOTE

Intra-operative imaging technique to aid safe placement of screws in percutaneous fixation of pelvic and acetabular fractures

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Percutaneous internal fixation of pelvic fractures is becoming increasingly more popular among trauma surgeons worldwide due to reduced surgical related morbidity and facilitation of early mobilisation. Visualisation of the pelvic bony anatomy during percutaneous fixation is difficult, making the procedure technically demanding. We present a simple and easy intra-operative imaging technique that helps to confirm safe positioning of screws, particularly in the narrow anterior acetabular column, by use of radiopaque contrast medium to define the appropriately drilled track.

Keywords : pelvis fractures ; percutaneous fixation ; imaging.

INTRODUCTION

Percutaneous internal fixation of pelvic fractures has gained popularity due to reduced surgical related morbidity and an association with rapid mobilization (*7*). During the last decade navigation assisted surgical techniques in pelvic and acetabular surgery have expanded to include CT-based navigation, 2D C-arm navigation and 3D C-arm navigation (*10*). The main indication for navigated techniques around the pelvis has been percutaneous SI screw fixation, but more recently other pelvic fractures, such as suitable anterior and posterior column fractures, have been treated by percutaneous and limited open techniques (*1,2,4,6*). This technique is demanding and requires adequate visualization for reduction of the fracture and screw placement. One of the chief potential complications associated with these procedures is inaccurate drill and screw placement with perforation of nearby neurovascular structures (for example femoral vessels and nerve in anterior column fixation) or, perhaps more easily, perforation of the acetabulum. These risks may be increased for surgeons early on the learning curve for these procedures and may also be exacerbated in many units when using single C-arm fluoroscopic techniques, as imaging is only available in one plane at a time and it is not always possible to obtain truly accurate images in all planes due to instrumentation, patient positioning and where there is a lack of practical experience on behalf of radiography staff. We report a technique that helps to confirm safe positioning of screws, particularly in the narrow anterior acetabular, by use of radiopaque contrast medium to define the appropriately drilled track.

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TECHNIQUE

The standard operative techniques and principles underlying percutaneous fixation of acetabular and pelvic fractures are described in detail elsewhere (*1,2,4,6*). In our institution 2-D fluoroscopy using a C-arm is employed to confirm satisfactory reduction and monitor safe and accurate passage of an initial guide wire. This guide wire is overdrilled with a cannulated drill before ultimate passage of a cannulated screw, where depending on bone dimensions, we typically use 6.5 mm cannulated screws. Our modification of this technique requires use of cannulated systems. After measuring the screw length from the guide wire, the appropriate partially threaded cannulated screw is inserted over the wire. To confirm that the screw is not breaching the pubic rami cortex or transgressing the hip joint, after passing the fracture , the wire is removed and 10 ml of radiopaque contrast medium is injected through the cannulated screw. In our experience it is reliably visualised whether the contrast remains contained in the pre-drilled screw tract. The technique is easily modified to earlier injection if there are concerns about wire placement using a cannula over the guide wire or injection through the cannulated drill. We used this intra-operative imaging technique in four patients (five hips) that were suitable for percuteanous screw fixation. All patients had the fractures at the junction between the superior pubic ramus and the anterior acetabular wall . All fractures except one were not extending into the hip joint.

Illustration of technique

We illustrate the use of the described technique in a 18-year-old male who sustained multiple trauma following 40 feet jump from a balcony. Injuries included splenic rupture, duodenal tear, right pneumothorax, multiple ribs fractures, left intertrochanteric femoral fracture and pelvic fracture with bilateral superior pubic rami fractures (Fig. 1). He underwent emergent splenectomy followed by dynamic hip screw fixation of the left femoral neck fracture. Four days later, after his condition was stabilised in the Intensive Care Unit, the patient

Fig. 1. — Pelvis radiograph of an 18-year-old man after a fall from 40 feet, showing a left intertrochanteric femoral fracture and a pelvic fracture with bilateral superior pubic rami fractures.

underwent bilateral percutaenous transpubic retrograde screw fixation of the anterior pelvic ring. The left displaced superior pubic ramus was sufficiently reduced using femoral traction, while the right pubic ramus was satisfactorily reduced without manipulation. The technique described above was employed ; a cannulated, partially threaded 6.5 mm screw was used for fixation (Fig. 2). The injected contrast medium was well contained in the drilled screw tract, not leaking in the hip joint or outside the superior pubic rami, thus confirming correct positioning of the screw. The same technique was used to percutaneously insert the second screw in the right superior ramus (Fig. 3 & 4) Post-operatively, the patient was mobilised full-weight bearing and was discharged home after ten days. His fractures all went on to heal without complication and he had returned to normal function with no complaints of pain or restriction by 6 months.

DISCUSSION

The benefits of percutaneous fixation techniques in terms of blood loss, infection, lengthy operative times, neurovascular complications and rapid mobilisation have been well described and are

Fig. 2. — Intra-operative fluoroscopy image using contrast medium to outline the screw tract in the anterior pelvic column. The contrast medium is well contained in the drilled screw tract and should not leak into the hip joint or outside the superior pubic rami.

Fig. 3. — Post-operative pelvis radiograph of the same patient showing a left Dynamic Hip Screw and bilateral percuteanous retrogade transpubic screws *in situ*.

significant, but it is only appropriate for certain fractures and the gold standard treatment of many pelvic and acetabular fractures remains formal open reduction with internal fixation (*1,2,6,7,10*). Although

Fig. 4. — Post-operative lateral left hip radiograph showing a left Dynamic Hip Screw and left percutaneous retrogade transpubic screw *in situ*.

the early results of percutaneous fixation have shown a decrease in hospital stay and morbidity in longitudinal studies and in case reports and are associated overall with very good results, they are technically demanding procedures (*3,4,5,6,8-11*). There has been much interest in developing methods to improve the accuracy and reliability of these fixation techniques, mainly through computer-assisted navigational systems (*5,8,11*). Advantages of these techniques include reduced radiation exposure, diminished operating time, accurate assessment of alignment and improved precision in the placement of internal fixation. However, the equipment and instruments required can also present technical challenges and are very costly, and financial considerations will probably hinder their widespread acceptance in the medium term.

We have described a simple modification to a standard technique of percutaneous pelvic/acetabu-

lar fixation using routine 2-dimensional fluoroscopy with a single C-arm. This can help in confirming screw placement until a surgeon develops greater confidence and experience or in cases where imaging equipment is limited and not quite state of the art or to expedite cases where the radiographers may not be very experienced in practice with these techniques. We found the described technique very useful in reducing the learning curve and increasing the confidence of adequate screw placement for the performing surgeon in all five pelvic fractures we treated. Limitations of the technique are that every effort must be made to achieve the best possible wire position as, if extravasation of contrast is seen, further injections may be difficult to interpret. Because of this, we would suggest that a very dilute contrast be used on first injection so that a subsequent injection of more concentrated contrast will give suitable definition of a second wire tract. We encountered this problem in one fracture we treated using this technique. Although the contrast extravasated through the fracture and partially obscured our image, the techniquet was still useful in confirming drill tract and extra-articular screw placement. Care must also be taken in interpretation when the fracture involves the joint, although we have found it is still possible and useful to use the current technique in one such case.

We feel that this imaging technique should be part of the trauma surgeon's armamentarium in treating pelvic and acetabular fractures by percutaneous methods.

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