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SURGICAL TECHNIQUES

Percutaneous ilio-sacral screw insertion. Fluoroscopic techniques

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Introduction

Unstable pelvic ring fractures raise treatment challenges in severely injured patients. Ilio-sacral screw fixation is an elegant option for stabilising the posterior lesion, which is a common source of residual pain. This technique provides secure fixation. The first description can be found in a 1913 treatise by Lambotte [1]. In 1978, Letournel reported the treatment of sacro-iliac joint dislocation by open ilio-sacral screw placement with the patient in the prone position and direct digital control [2]. A decade later, Matta et al. [3] extended the indications to sacral lesions by using the inlet, outlet, and antero-posterior views described by Pennal et al. [4]. Ebraheim et al. in 1987 then Routt et al. in 1993 described strictly percutaneous ilio-sacral screw insertion with the patient in the supine position [5,6] to allow the use of this technique in fragile multiply injured patients while eliminating the risk of surgical site infection. Routt et al. improved the fluoroscopic technique by analysing the features of the lateral sacral view [7]. Prior reduction of the posterior lesion using an external method is a prerequisite to ilio-sacral screw fixation. Thorough familiarity with the anatomic features of the lumbo-pelvic junction and neighbouring vessels and nerves is crucial [8]. A high level of expertise with the surgical procedure is necessary to avoid iatrogenic complications and to minimise radiation exposure of the patient and surgeon [9,10].

Prior reduction of the displacement

Reduction to restore the normal pelvic ring anatomy is a prerequisite to percutaneous ilio-sacral screw fixation. The posterior bone and ligament lesions must be reduced using indirect methods.

Reduction of posterior Tile type B lesions opened into the anterior ring lesion involves approximation of the two coxal bones. There is no vertical instability. When the anterior lesion consists in symphyseal dislocation, plate fixation

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of the pubic symphysis is an effective and simple means of achieving coxal bone reduction in the supine position. Fixation of the obturator rim is not performed in everyday practice, as preservation of the obturator membrane and inguinal ligament limits the instability of this lesion. Reduction can then be achieved by simple compression to approximate the two antero-superior iliac spines. The assistant usually maintains the compression while the surgeon inserts a pin into the sacro-iliac joint. A sheet wrapped around the two iliac wings may be needed. An opening is fashioned in the sheet at the screw insertion site in the skin. After ilio-sacral implantation an anterior simple external fixator could be placed with a pin in each antero-superior iliac spine. This could help to stabilize the horizontal stability until obturator rim(s) healed.

Posterior Tile type C lesions combine horizontal and vertical instability and must be reduced within 48 hours of the injury. After this interval, organisation of the haematoma at this highly vascularized site precludes manipulative reduction. Transcondylar femoral traction with an initial weight of up to 20% the patient's body weight is used to correct the ascension of the detached hemi-pelvis. Subsequently, the weight is decreased to 10% of the patient's body weight. In haemodynamically unstable patients, a clamp must be placed after traction is complete. Combined traction and clamping ensures the full reduction of complete Tile type C posterior lesions. Inlet, outlet, and lateral views as described below are used to check that reduction has been achieved before percutaneous screw insertion. Even when reduction in the horizontal plane is less than perfect, the patient can wait in the position ensuring reduction in the vertical plane. Definitive reduction in the horizontal plane can then be achieved on the operating table as described above for Tile type B lesions.

Sacro-iliac dislocation may require additional manipulations to achieve full reduction. Two hard pads (folded sheets) placed under the posterior iliac spines and ischial tuberosities may facilitates re-positioning of the coxal bone relative to the sacrum, as the sacrum is usually displaced anteriorly. Pins inserted into the anterior iliac crest serve to displace the coxal bone anteriorly or posteriorly in order to seat the sacrum into the auricular surface. Ilio-sacral screw placement should not be relied on to reduce the dislocation. At the most, compression serves to close the joint space, but anatomic approximation of the two bones must be obtained first. An external fixation system can be used to secure the intact contra-lateral hemi-pelvis and femur to the traction table. This method increases the effectiveness and strength of the transcondylar traction on the detached hemi-pelvis, while preventing ipsilateral tilting. Finally, neuromuscular blockade of the abdominal and ilio-psoas muscles is required to facilitate this closed reduction procedure.

When closed reduction is suboptimal, the sacro-iliac joint should be approached either anteriorly via the middle portion of the ilio-inguinal approach, with the same installation, or posteriorly with the patient in the prone position. Severely displaced sacral wing fractures, i.e., with more than 10 mm of upwards displacement on the antero-posterior radiograph, require a posterior approach in the prone position. Upwards displacement of less than 10 mm has no functional impact and can therefore be tolerated. The screws are then inserted percutaneously, under direct visual guidance via the open surgical approach used for the reduction.

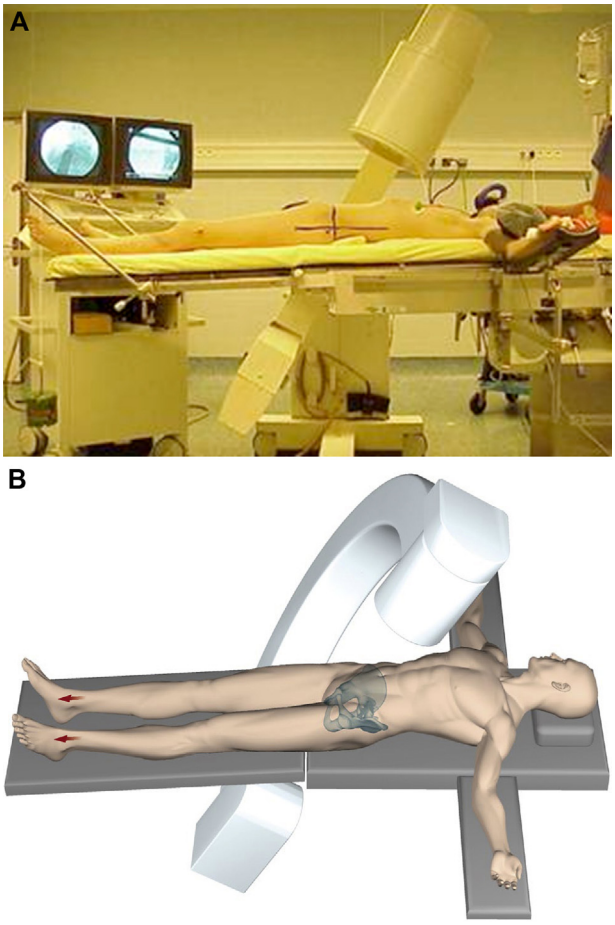

Figure 1 Inlet view. Patient installation and traction.

Preparation of the material

We prefer screws with large diameters, either 7 mm for steel screws or 7.3 mm for titanium screws. These screws are cannulated, which simplifies the procedure, as the only requirement is optimal positioning of the guide-wire. A skin suture kit is needed and a mallet may be useful. The table should have a transparent top, an intra-operative traction system, and an image amplifier with image persistence that can be rotated and translated along the 6 degrees of freedom in space (Fig. 1).

Installation

The patient is in the supine position. Unilateral or bilateral transcondylar traction is left in place during the procedure, depending on the extent of the displacement (Fig. 1). The table should be inclined towards the head to compensate for the traction. The pelvis is elevated from the table top to increase the obliquity of the screw trajectory in the posterior-to-anterior and lateral-to-medial directions. General anaesthesia and neuromuscular blockade are used.