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Original article

Iliac screw for reconstructing posterior pelvic ring in Tile type C1 pelvic fractures

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ABSTRACT

Background: It is often difficult to achieve stable fixation in Tile type C1 pelvic fractures and there is no standard fixation technique for these types of injuries.
Hypothesis: Iliac screw fixation can be used for treating Type C1 pelvic fractures.
Patients and methods: A retrospective review was performed on 47 patients who underwent iliac screw fixation in posterior column of ilium (PCI) for Tile type C1 pelvic fractures from July 2007 to December 2014. All patients were treated with fracture reduction, sacral nerve root decompression (if needed), internal fixation by iliac screw and connecting rod. The data on surgical time, intraoperative bleeding volume, postoperative neurologic functions and postoperative complications were analyzed. Patients were follow-up for at least 12 months.
Results: The mean surgical time was 148 minutes, and the mean intraoperative bleeding volume was 763 ml. Patients were encouraged in-bed activities immediately after surgery. The postoperative Majeed functional score was 48–100 points (mean 80.2), corresponding to an excellent and good recovery of 91.5%. Postoperative X-radiographs and CT scans indicated satisfactory fracture reduction.
Discussion: Iliac screw fixation combined with sacral nerve canal decompression could effectively restore pelvic alignment and improve neurological functions for complex pelvic trauma.

1. Introduction

Patients with pelvic fractures have significantly high morbidity and mortality, and require immediately accurate evaluation. Fracture classification systems are helpful for determining treatment options. Currently, the most commonly used classification is the modified Tile classification system [1].

Type C pelvic fractures are characterized by complete disruption of posterior sacroiliac complex and are both rotationally and vertically unstable. Type C1 has unilateral complete disruption of posterior arch and can be further classified as C1–1: fracture through iliac, C1–2: sacroiliac dislocation and/or fracture, and C1–3: sacral fracture. Patients with Type C fractures must be prepared for surgical treatment, especially those with neurological deficit [2]. However, improper surgical treatment could cause serious complications, such as fracture mal-union, post-traumatic nonunion, delayed sacral nerve injury, late-onset low back pain, limb length discrepancy and gait disorders [3]. Thus, it is crucial to find an appropriate fixation technique for these types of fractures.

The goal of treating Type C1 fractures is to achieve and maintain an accurate reduction of displaced hemi-pelvis and relieve the compression of sacral nerves. Many experts advocate reduction of fracture and reconstruction of three-dimensional stability of the anterior- and posterior-ring, providing adequate stability for early mobilization, as well as diminishing complications [4–6]. A variety of internal fixation techniques have been used, including transiliac bars, iliosacral screws, local small plates, transiliac plate and lumbopelvic fixation [7–12]. However, no clinical consensus has been reached for Tile Type C1 fractures.

Our preliminary study showed the feasibility of iliac fixation with iliac screws [13]. Iliac screws embedded in posterior column of ilium (PCI) (Fig. 1) can provide enough strength, due to its long screw tunnel and large screw diameter [13]. Moreover, the entire procedure is within fields of vision, which can reduce iatrogenic nerve injury, thorough decompression and precise reduction. This study reports the results of iliac screw fixation for posterior pelvic ring stabilization.

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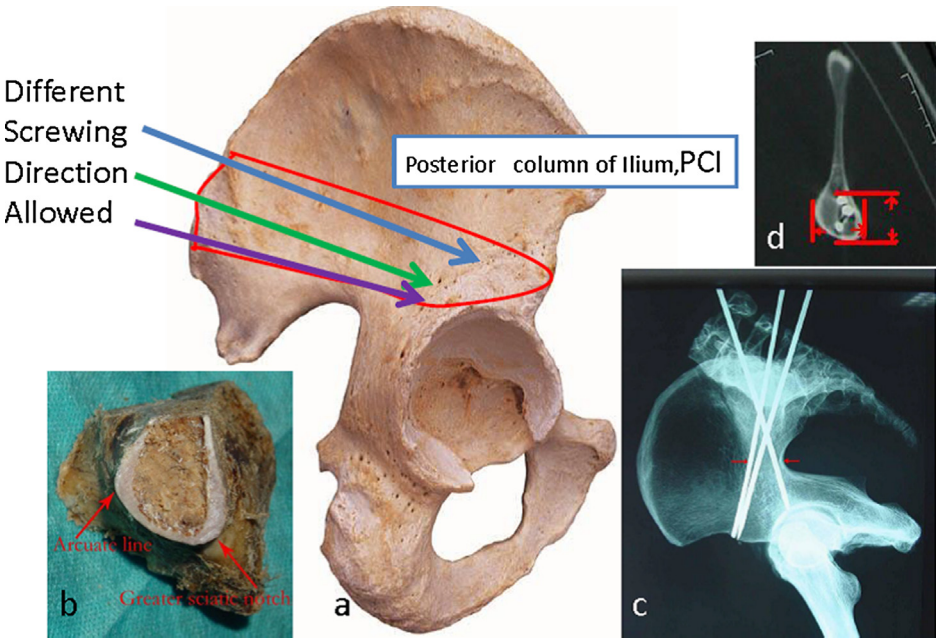

Fig. 1. The different visual angle of iliac bone: (a) the red line represents the safe area of PCI for iliac screw fixation, the blue, green and purple arrow represent different screwing direction allowed; (b): the coronal profile of PCI perpendicular to great sciatic notch; (c) and (d): the orientation and position of Kirschner wire in PCI by X-ray and CT.

2. Patients and methods

2.1. Patients

Forty-seven patients with Type C1 pelvic fractures (30 males and 17 females, age 21–56 years (mean 43.2 years) were enrolled in this study from July 2007 to December 2014. Thirteen patients presented with Tile type C1–1 pattern, five patients presented with Tile type C1–2 pattern, and the rest of twenty-nine patients were type C1–3 pattern. (Denis I 3 cases, Denis II 24 cases, and Denis III 2 cases). Among these patients, 29 patients had traffic accident, 14 felt from height, and 4 had crush. At the time of admission, 37 patients were in a shock state, 3 had Morel-Lavallee lesion, and 6 had severe multiple traumas. This study was approved by the Ethics Committee of Qilu Hospital, Shandong University.

2.2. Surgical procedures

2.2.1. Preoperative preparation

All patients were given emergency care immediately after admission. After patients were stabilized, they were examined by X-ray and CT. The interval between trauma and surgery ranged from 5 to 15 days (mean 7.1 days). Patients with all types of pelvic fracture with nerve injury were included in this study, while those with open pelvic fractures were excluded.

2.2.2. Surgery

All patients were treated using the posterior approach according to previous report [14]. Briefly, patients were put in prone position after general anesthesia. A longitudinal incision was made across the sacral fracture line or sacroiliac joint of the injured side (Fig. 2). Skin was incised, subcutaneous fat, deep fascia, and the fracture site was exposed. Care was taken to avoid compression of the sacral nerve roots. Foraminal decompression was performed if there was neurological deficit. Fracture reduction was achieved through prying, pulling, and lifting. A second incision was placed on the contralateral side with limited soft tissue dissection. Iliac screws (Weigao, Shandong, China) were placed bilaterally into PCI

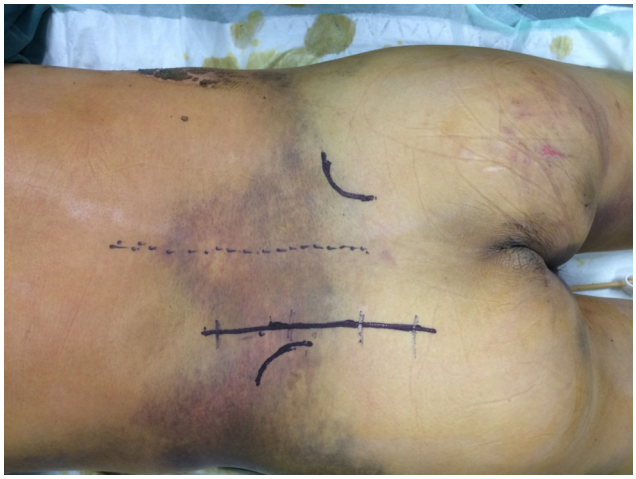

Fig. 2. Incisions planned for internal iliac screw fixation: the dotted line is posterior midline, the solid line is the surgical incision, the bilateral arc line is the posterior-superior iliac spine.

(Fig. 1 and Fig. 3). A connecting rod was prefixed and tunneled subcutaneously through these two incisions and secured behind the iliac screw. In severe fracture cases, two iliac screws and connecting rods were used (Figs. 4 and 5).

2.2.3. Postoperative management

Morel-Lavallee lesion was found in 3 patients during surgery when the skin was incised, where separation of skin from subcutaneous tissue was noted with small amount of transudate. These patients were given broad-spectrum antibiotics for 3 days after surgery. The Negative Pressure Wound Therapy system was applied to these patients 5–7 days postoperatively. Patients without contraindications were encouraged to engage in in-bed functional training: toe-touch weight bearing, and progressed to using crutches or a walker, for 2 to 8 weeks after surgery. Progression to full weight-bearing and return to work were determined

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