

Percutaneous iliosacral screwing in pelvic ring injury using three-dimensional fluoroscopy

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Abstract

Background Iliosacral screw fixation is a popular technique for treatment of unstable pelvic injuries involving the posterior ring. However, screw malposition may result in dangerous complications involving injury to adjacent neurovascular structures. This study was conducted in order to evaluate the results and efficacy of using three-dimensional fluoroscopy in the performance of iliosacral screw fixation.

Methods Twenty-nine patients (31 cases, two bilateral) who suffered injury to the pelvic ring requiring surgical treatment were included in this study. According to the Association for Osteosynthesis-Orthopaedic Trauma Association (AO-OTA) classification, there were 14 patients with type B, 13 patients with type C, and 2 patients with a bilateral sacral fracture. The mean age of patients was 39 years. Once the guide pin had been inserted, its safety was confirmed using three-dimensional fluoroscopy; screw fixation was then performed. Eighteen patients underwent percutaneous iliosacral screw fixation and anterior fixation, while 11 patients underwent screw fixation only. Postoperative computed tomography (CT) was performed for evaluation of the screw position, including any invasion into the sacral foramen or canal and neurovascular injury. The perforation of the screw was divided according

to the location (sacral zones I, II, and III) and the degree (grade 0, no perforation; grade 1, perforation <2 mm; grade 2, perforation between 2 and 4 mm; grade 3, perforation >4 mm).

Results The mean operation time was 35.6 min, and the mean radiation exposure time was 85.9 s. For accurate location of the guide pin, one patient underwent three-dimensional reconstruction twice. None of the patients required reoperation or suffered any neurovascular injury. Although seven cases involved perforation, all were less than 2 mm (grade 0: 24 cases, grade 1: 7 cases).

Conclusions When performing percutaneous iliosacral screw fixation in a patient with an unstable pelvic ring injury, use of three-dimensional fluoroscopy may allow for accurate location of the screw and result in fewer complications.

Introduction

Unstable pelvic ring injury is associated with serious complications and a high rate of mortality; therefore, stable fixation for both the anterior and posterior pelvic ring is essential. Iliosacral screw fixation, which has been widely used for stabilization of injury to the posterior ligament complex and sacral fractures, can be performed in a percutaneous, minimally invasive manner. Its excellent biomechanical stability has also been demonstrated [1, 2]. However, achieving successful screw fixation without intrusion of the anterior surface of the sacrum or sacral foramina is not easy, and accurate anatomical knowledge and surgical experience are required. Knowledge of the angle of the screw in all directions, as well as the exact location of the screw, is a prerequisite. Until now, evaluation of the anatomical structure of the sacroiliac joint and

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sacrum has been mainly dependent on two-dimensional fluoroscopy. However, when using two-dimensional fluoroscopy, accurate viewing of the sacral foramina is not always possible, and positional and angular variation of first sacral foraminal anatomy is relatively common. As a result, there have been limitations to precise understanding of the three-dimensional location of sacral foramen using simple radiographs.

Postoperative malposition of a screw during use of simple fluoroscopy has been reported [3, 4], and may result in injury to adjacent nerves and vessels [5, 6]. Therefore, when fixing an iliosacral screw, placement of the screw within the sacrum in order to avoid extraosseous violation is of utmost importance.

Use of two-dimensional fluoroscopy [7] or computed tomography [8] for precise screwing has been reported; however, this is inefficient with regard to operating room space and technical limitations. When considering the efficacy and economic worth, as well as the need to use a computer system [9, 10], its value is limited. Using a fluoroscope that allows for assembly of three-dimensional images, we confirmed the position of the screw in advance, and definite iliosacral screwing was performed. The purpose of this study was to investigate the pros and cons, as well as the accuracy, of this method.

Materials and methods

From January to December 2010, 29 patients suffering from pelvic ring injuries requiring surgical treatment underwent operative treatment at our institution. The study included 17 men and 12 women, with a mean age of 39 (range 17–70). The institution approved the study, which was conducted in strict adherence with established guidelines for treatment of subjects. Mechanisms of injury included traffic accidents (13 patients: 9 pedestrian, 1 motor-vehicle, and 3 motorcycle), a fall from a height (11 patients), and a crushing work-related injury (5 patients). Of these 29 patients, 28 had associated injuries or fractures, with a mean injury severity score (ISS) of 25.2 (range 9–84).

All patients underwent a preoperative radiological evaluation (simple anteroposterior, inlet, and outlet views of the pelvis), including computed tomography (CT) scans for observation of characteristics and the degree of displacement of fractures. According to the AO-OTA classification, there were 14 patients with type B, 13 patients with type C, and 2 patients with bilateral sacral fractures. With consideration for associated injuries and the clinical condition of the patient, early operative intervention was performed as soon as possible. When surgery needed to be delayed because of patients' general medical condition, skeletal traction was applied until surgery could be

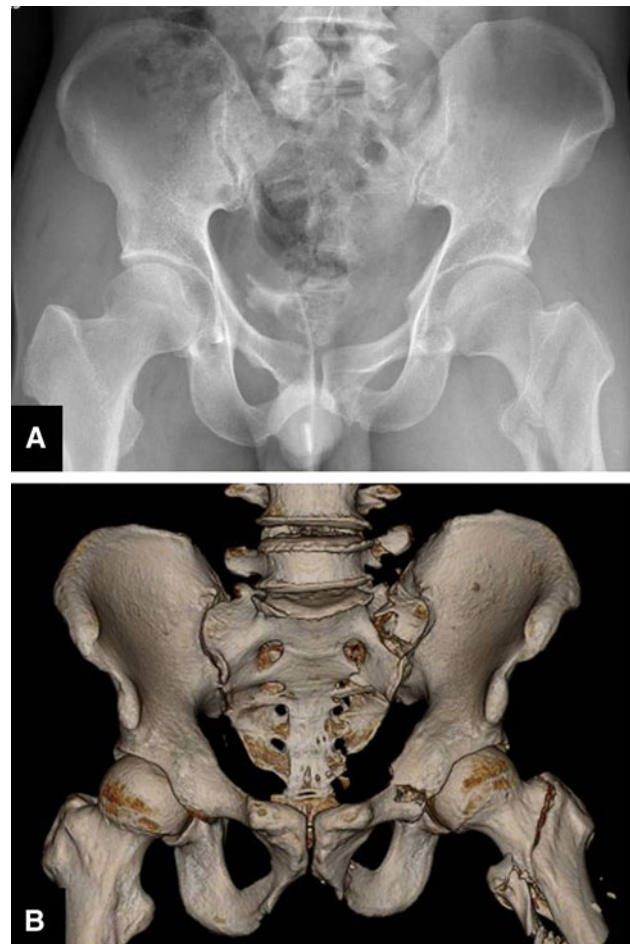


Fig. 1 A 44-year-old male patient suffered from a vertical shear injury of the pelvic ring with a left femoral fracture. A sacral fracture of Denis type II and pubic rami fractures were evident on a three-dimensional CT scan

performed. On average, the period of time from injury to a definite operative treatment was 8 days (range 0–40). Eighteen patients underwent concomitant anterior plating and percutaneous iliosacral screwing, and the remaining 11 patients (13 cases) underwent iliosacral screwing only. All surgical procedures were performed by a single experienced surgeon.

Operation

All patients were placed in a supine position on the radiolucent table. When anterior pelvic ring fixation was required, the operation for treatment of this injury was performed first. A 7.0-mm cannulated screw (Synthes®, Switzerland) was used to perform iliosacral screwing. With the guidance of the pelvic lateral, inlet, and outlet view by rotating and steering the fluoroscope, a metal guide pin was inserted from the iliac wing to the body of the first sacrum until it passed through the center of the sacral body. Then, in order to determine the

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