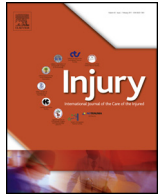




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Factors associated with outcome of spinopelvic dissociation treated with lumbopelvic fixation

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ABSTRACT

Spinopelvic dissociation is a rare high-energy injury, which is frequently associated with lumbosacral plexus and cauda equina deficits. During an 18-year period, 36 consecutive patients with a H-type sacral fracture and spinopelvic dissociation were treated using lumbopelvic fixation with a minimum follow-up of 18 months. We evaluated factors prognostic of outcome after standardised surgical fixation and neural decompression. Neurological recovery was assessed by Gibbons' criteria. Pelvis Outcome Scale (POS clinical score) was used to evaluate the clinical outcome. Despite excellent or good radiological results in the vertical components of the sacral fractures having been achieved in all patients, 15 patients (42%) had a poor clinical outcome. The degree of initial translational displacement in the transverse sacral fracture was significantly associated with neurological recovery (as defined by a change in Gibbons score) ($p = 0.038$) and final POS clinical score ($p < 0.001$). Both neurological recovery and clinical outcome were worse in patients with completely displaced fractures than in patients with a partially displaced sacral fracture. The degree of residual translational displacement and kyphosis in the transverse sacral fracture were also associated with clinical outcome (POS clinical score) ($p = 0.011$ and $p = 0.018$, respectively). However, Roy–Camille classification (type 2 vs. type 3), age, gender, ISS, timing of surgery, and sacral laminectomy did not have a statistically significant association with the outcome. Based on the results, Roy–Camille sacral fracture classification (type 2 vs. type 3) was not prognostic of neurological impairment. Thus further categorisation of the transverse sacral fractures as partially displaced or completely displaced could be used to predict the rate of neurological recovery following lumbopelvic fixation. Accurate reduction of all sacral fracture components seems to be associated with better clinical outcome.

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Introduction

Spinopelvic dissociation, which is described as bilateral longitudinal sacral fractures with a transverse fracture component,

is a rare injury resulting from high-energy trauma. Frequently, these fractures are angulated and undergo translational displacement resulting in a dissociation of the spine and upper central segment of the sacrum from the pelvic ring and caudal sacral segments [1,2]. The associated lumbosacral plexus injuries and cauda equina deficits are present in nearly all cases and constitute a major cause of late disability [3].

This injury type was first described by Roy–Camille et al. [1]. They classified the transverse sacral fracture, not the bilateral vertical sacral fracture components. The treatment of patients with spinopelvic dissociation has evolved from non-operative treatment to open reduction and segmental lumbopelvic fixation [2,4]. In this technique, pedicle screws are inserted in the pedicles of L4 and L5, and the caudal screws are inserted into the iliac bones. Following the reduction, the alignment and rotational stability is maintained by locking the pedicle screws and iliac screws using contoured spinal rods. Lumbopelvic fixation has

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been shown to be biomechanically superior to other techniques [5,6].

The aim of this retrospective study was to evaluate the radiological and clinical outcomes including neurological recovery after segmental lumbopelvic fixation of spinopelvic dissociation, as well as to uncover prognostic factors of outcome. Our hypothesis was that lumbopelvic fixation provides acceptable alignment even in more complex transverse sacral fracture patterns. We assessed whether completely displaced transverse sacral fractures are associated with poor neurological and clinical outcomes regardless of proper fracture reduction. The study protocol was approved by our institution's review board.

Patients and methods

We reviewed the hospital records from March 1993 to July 2011 to identify all patients with H-shaped sacral fractures with spinopelvic dissociation who were operated on using segmental lumbopelvic fixation. We identified 37 patients fulfilling these inclusion criteria. One patient died six weeks after the initial trauma from head injury and was excluded from analysis. This gave a total of 36 patients with a mean follow-up time of 33 months (range, 18–71 months) entered for analysis. Geographical catchment area of our level I trauma centre has remained the same during the study period, but the population has increased from 1.5 to 1.8 million.

Data collection included patient characteristics, the mechanism of injury, fracture characteristics and classification [1,7–9], and the concomitant injuries. We subclassified the Roy-Camille type 2 and 3 transverse sacral fractures as partially displaced (type 2a and 3a) and as completely displaced fractures when the translational displacement in the anterior-posterior (AP) direction in sagittal views was more than the thickness of the sacrum (type 2b and 3b) (Fig. 1). The associated injuries were classified using the Abbreviated Injury Scale (AIS, 2005 version) [10], and the Injury Severity Score (ISS) was calculated [11].

Operative technique

During the 18-year study period, a standardised operative technique with segmental lumbopelvic fixation was used. In patients

with a combined sacral fracture and an anterior pelvic ring injury, a staged reconstruction was performed. The injuries of the anterior part of the pelvic ring were most commonly operated on first using an anterior extraperitoneal approach [12,13]. The lumbopelvic fixation was carried out through a dorsal midline approach (Fig. 2). The operative reduction and correction of displacement and rotational deformity of both hemipelvises and the caudal segment of the sacrum were performed using reduction clamps and caudal distraction of the distal part of the sacrum. The longitudinal rods were fixed to L4 and L5 pedicle screws with a transverse connector between them to act as a counter force for the final correction of the sacral fracture components. When anatomical reduction was obtained, the lumbar spine was fixed to the pelvic ring by placing two pairs of 8-mm iliac screws into the iliac bones with the Galveston technique [14] and connecting them to the longitudinal rods.

Indirect decompression of the lumbar (vertical fracture lines) and sacral neural roots (the transverse fracture line) was achieved through reduction of all the sacral fracture components. Free bony fragments in the sacral foramina were removed prior to the final reduction whenever encountered. Direct decompression by sacral laminectomy was carried out in all completely displaced transverse sacral fracture with occlusion of the central sacral canal in the sagittal view and in the patients in which a clear translational displacement remained in the transverse fracture line after the final reduction. The laminectomy was extended from the transverse fracture level cranially and caudally to decompress the dural sac. In cases with comminutely fractured sacral lamina (floating dorsal sacrum) and/or good alignment after the final reduction (as assessed by a true lateral sacral fluoroscopic view), direct decompression was not performed. Posterolateral arthrodesis across the instrumented lumbosacral levels was not carried out because the internal fixator was planned to be removed later. One orthopaedic trauma surgeon (J.L.) performed 32 of the 36 operative procedures, and two other orthopaedic trauma surgeons performed the remaining four operations. Early and late complications associated with surgical treatment were recorded.

Radiological evaluation

The vertical displacement in the bilateral vertical sacral fractures and in the possible concomitant anterior injury to the

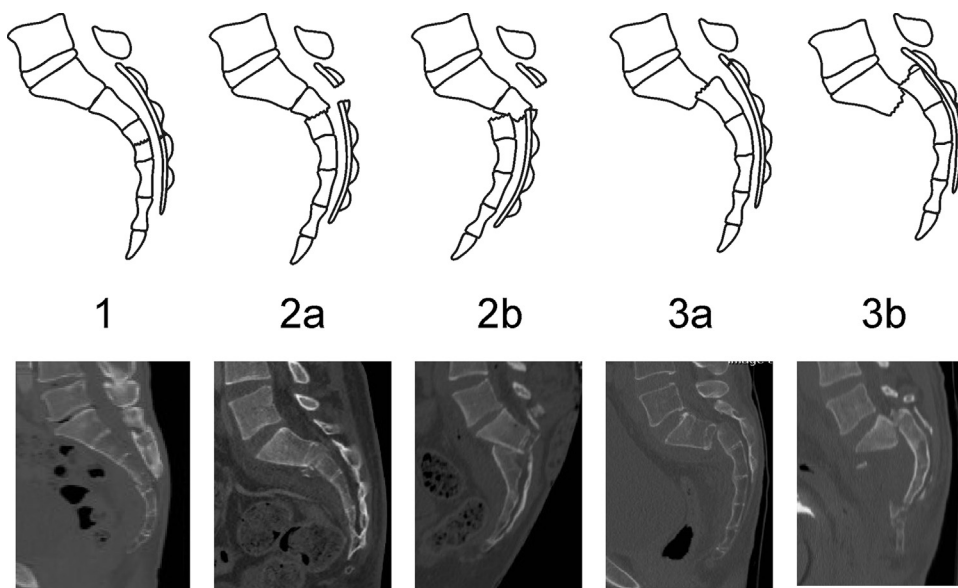


Fig. 1. A modified Roy-Camille classification for spinopelvic dissociations. Type 1, flexion injury without translational displacement. Type 2a, flexion injury with partial anterior translational displacement, and Type 2b, flexion injury with complete anterior displacement of the distal sacral segment. Type 3a, extension injury with partial posterior translational displacement, and Type 3b, extension injury with complete posterior displacement of the distal sacral segment.

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