Operative reduction and lumbopelvic fixation of spino-pelvic dissociation

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Sacral fracture dislocations that result in spino-pelvic dissociation are usually combinations of a transverse sacral fracture with associated bilateral longitudinal transforaminal sacral fractures. These injuries result in dissociation of the spine and upper central segment of the sacrum from the pelvic ring and caudal sacral segments (1). The purpose of this prospective study was to evaluate the results of operative reduction and lumbopelvic fixation of patients with high-energy sacral fracture dislocations with spino-pelvic dissociation and neurologic deficits.

Patients

During a 14-year period, nineteen consecutive patients with Roy-Camille et al. (2), and Strange-Vognsen and Lebech (3) type 2 - 3 comminuted horizontal and bilateral vertical sacral fractures with spinopelvic instability and cauda equina deficits and/or lumbosacral plexus injury, were treated with segmental lumbopelvic fixation. Twelve of the patients had an anterior injury to the pelvic ring. There were three concomitant acetabular fractures. Two were open fractures with extensive perineal wound into the pelvis. One patient had a thoracal (th XII) burst fracture with spinal cord injury and paraplegia, and three other patients a lumbar burst fracture with paraparesis. The mean injury severity score (ISS) was 40 (18-66) (4). Eleven of the patients were females and eight males with a mean age of 30 years (range, 16-43). Four patients were included in the analysis of early complications and radiographic result, but were excluded from the functional and neurological outcome analysis. All patients had high-energy trauma (Table 1).

Table 1. Mechanism of injury (n=19)

Suicide jumping from heights (6-20 meters)	11	(58%)
Accidental falls from heights (3-10 meters)	4	(21%)
Motor-vehicle accidents	2	(11%)
Motorcycle-car accident	1	(5%)
Bicycle-car accident	1	(5%)

Methods

Operative technique

Injuries of the anterior part of the pelvic ring were most commonly operated on first. Wide diastasis or displacement in the anterior part of the pelvic ring caused by rotational malalignment of one or both hemipelvicies is difficult to reduce, if the posterior realignment, and stabilization procedure is performed first. The method for lumbopelvic fixation included two pairs of lumbar pedicle screws, and two pairs of iliac screws. The other iliac screw on both sides might be possible to put to S1 body if sacral body comminution does not prevent it. Longitudinal rods were connected to the lumbar pedicle screws after having been contoured to lie close to posterior lamina of the sacrum and medial to the posterior superior iliac spines. Two transverse connecting rods between longitudinal rods were used to secure the fixation. Operative reduction, correction of antero-posterior and vertical displacement, and rotational deformity, was carried

out by using bilateral AO-reduction clamps placed at both caudal ends of longitudinal rods and superior aspect of the iliac wings. To achieve this goal, bifemoral manual traction and hyperextension of both legs might help. The lumbar spine and central upper sacral segment was then fixed to the pelvic ring by placing 8-mm iliac screws and connecting them to longitudinal rods. Four patients had sacral neurologic decompression. Posterolateral arthrodesis across the instrumented lumbosacral levels was not carried out, because the internal fixator was planed to remove later on.

Radiologic Evaluation

The vertical displacement in the posterior and anterior injury to the pelvic ring was measured from AP radiographs of the pelvis. Vertical displacement was measured as the difference in height of the superior aspect of the sacrum from a line perpendicular to the long axis of the sacrum on the AP radiograph (5). The AP displacement of the posterior pelvic ring injury was determined by CT. Sacral kyphotic angulation was measured from lateral sacral radiographs and/or sagittal CT reformations by drawing lines along the posterior sacral cortices of the adjacent fragments inferior and superior to the transverse fracture. The angle subtended by the intersection of these lines represents the kyphotic angulation of the fracture. Translation of the transverse sacral fracture was determined from these same views by measuring the displacement of the posterior cortex of the sacrum above and below the transverse fracture. Radiographs were taken before primary treatment, after reduction and internal fixation, and at the final follow-up.

The radiologic results of the pelvic ring and vertical sacral fractures were graded by the maximal residual displacement in the posterior or anterior injury to the pelvic ring as: excellent, 0 - 5 mm; good, 6 - 10 mm; fair, 11 - 15 mm; and poor, more than 15 mm (6).

Outcome Evaluation

All the patients had a clinical examination with particular attention to their gait, hip motion, difficulties in sitting, and persistent motor and sensory nerve deficiencies. Neurologic examination was done preoperatively and postoperatively, and at the final follow-up by the author. Motor neurologic deficits of the lower extremities were graded on a six-point scale: 0, no palpable muscle action; 1, muscle contraction palpable, produces no limb motion; 2, moves limb, but less than full range of motion against gravity; 3, moves limb segment through full range of motion against gravity; 4, muscle strength better than fair but less than normal; and 5, normal, comparable to contralateral normal limb (7).

The residual pain was graded as: no pain, mild (intermittent, normal activity), moderate (limits activity, relieved by rest), and severe (continuous at rest, intense with activity) (8). The site of pain in the pelvic ring (anterior or posterior) was recorded.

The functional outcome was measured using a scoring system described by Majeed (8) and modified by Lindahl et al (6), which is based on the clinical findings. The original scoring system was modified to focus on the outcome after an unstable fracture of the pelvic ring and not on the handicap caused by multiple injuries. The final score for the clinical outcome also was modified specifically to take account of the outcome after the pelvic injury. Therefore, the ability to work was removed from this assessment giving a maximal total score of 80 points for each patient to compare the outcome of different types of fracture. The outcome was graded by total points as: excellent, 78 - 80 points; good, 70 - 77 points; fair, 60 - 69 points; and poor, less than 60 points (6).

The Hannover pelvic outcome scoring system also was used because it takes both urologic deficiencies and bowel incontinence into account (9). In this system the ratings of the radiologic result and the clinical result are assessed as one score on a 7-point scale, where the maximum of 7 points represent an excellent result, 6 points is a good result, 5 and 4 points is a fair result, and 3 and 2 points is a bad or poor result.

Results

The mean time from injury to definitive surgical treatment was 11 days (range, 0-34). One patient (5%) was operated within 24 hours of injury, one patient (5%) between 24 and 48 hours after injury, 15 patients (80%) between 48 hours and 21 days after injury, and 2 patients (10%) later on (one 26 days and the other 34 days after injury).

Outcome

Radiological end results were excellent or good in all cases. Overall preoperative kyphosis was 43º (range, 0º-90º), and final kyphosis 21º. There was no secondary loss of reduction. Outcome data is collected to Table 2. All patients except one, who had spinal

Table 2. Results of lumbopelvic fixation of sacral fracture dislocations

Patient	Age (years)	Sex	Fracture type[a]	Radiological result	Initial sacral kyphosis	Final sacral kyphosis	Functional result	Hannover score
1	43	M	3	G	20	5	P (58)	F (4)
2	19	F	3	G	15	55	P (50)	P (3)
3	36	F	3	G	15	15	G (75)	G (6)
4	16	F	2	G	90	30	G (76)	G (6)
5	18	M	3	E	0	0	G (71)	G (6)
6	40	F	3	G	65	20	G (71)	G (6)
7	37	M	3	G	35	20	F (66)	F (4)
8	19	M	3	E	45	18	G (76)	G (6)
9	31	F	2	G	65	25	G (71)	G (6)
10	40	F	3	E	50	30		
11	17	M	3	G	15	20	E (80)	G (6)
12	24	F	2	G	90	45	P (56)	F (4)
13	19	F	2	E	30	15	E (80)	E (7)
14	27	M	3	G	60	35	P (40)	P (3)
15	41	F	2	E	45	20		
16	27	F	2	E	60	15	G (75)	G (6)
17	33	M	3	E	45			
18	41	F	3	E	10	10	G(73)	G(6)
19	42	M	3	E	40	10		
aRoy-Camille et al. and Strange-Vongsen and Lebech								

cord injury and paraplegia because of unstable thoracal fracture, showed at least some evidence of neurologic recovery.

Complications

Complications were rare (Table 3).

Conclusions

The initial diagnosis of these fractures might be difficult. Sacral fracture-dislocations with spino-pelvic instability should be suspected in patients who jump or fall from heights. Early lateral sacral radiographs and pelvic sagittal CT reformations show the injury. In this series radiological end results were excellent or good in all cases. Lumbopelvic fixation provided sufficient stability for bony union without loss of reduction. It is important to place the longitudinal rods and clamps as close as possible to the dorsal surface of the sacrum and medial, but not posterior, to the posterior superior iliac spines to avoid wound-healing

Table 3. Complications (n=19)

Loss of reduction	0
Malunion (displacement > 10 mm)	0
Nonunion	0
Deep wound infection	0
Superficial wound infectiona	1
Breakage of hardwareb	4

a Patient had an open fracture with extensive wound in perineal region and degloving soft tissue injury on the sacrum. Infection was treated with wound debridement and antibiotics without any further complications.

b Two patients had unilateral breakage of one or two iliac screws, one patient breakage of lumbar L4 pedicle screw, and one patient breakage of both longitudinal rods. These were seen after bony healing and did not lead to redisplacement or deformity of the sacral fracture.

problems. All patients except one who had thoracal fracture with spinal cord injury showed at least some evidence of neurologic recovery. The indications for surgical decompression remain unclear.

References

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