Delayed and late reconstructions of the pelvis

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Unstable pelvic ring disruptions are usually the result of high-energy trauma and are often associated with multiple concomitant injuries (1–4). Functional outcome of these injuries is affected by lumbosacral plexus injuries, malunion or non-union of the pelvis resulting from initial malreduction or failure of fixation, resulting in chronic pain, deformity, gait impairment, and functional disability (3–6).

In polytraumatized patient the concomitant head, musculoskeletal, soft tissue and visceral injuries might cause delay in the definitive treatment of pelvic injuries. Letournel and Judet (7) reported that the surgical treatment of acetabular fractures after 3 weeks is much more difficult and the results worse than in patients who are operated on within 3 weeks. Late reconstructions of pelvic ring injuries have the same problems.

Our policy has been to operate also delayed and late cases when the earlier operation within 3 weeks has not been possible because of poor state of the health of the patient or there is ununited malalignment, partially united malalignment, clear non-union, or clear malunion after pelvic injury. The aims of this study were to evaluate the radiological and clinical outcomes of delayed and late reconstructions of the pelvis.

Patients and methods

Between 1996 and 2007 altogether 797 pelvic ring and acetabular fractures were treated operatively (Table 1). Of these operations 15 were delayed (between

Table 1. Operatively treated pelvic fractures in Helsinki University Central Hospital 1996–2007.

Pelvic ring fractures	401
Acetabulum fractures	396
Delayed/Late reconstructions of the pelvis	39

22–42 days from injury) and 24 late (> 6 weeks from injury) reconstructions. According to Tile's and AO classification system (8) of pelvic ring injuries there were 3 (5%) type A2 iliac wing fractures, 5 (13%) type B1/B3-1 open book injuries, 3 (8%) type B2/B3-2 lateral compression fractures, 26 (67%) type C1-C3 rotationally and vertically unstable pelvic fractures, and one H-type spinopelvic dissociation. In addition there were one transverse and one both column acetabular fracture (9).

Surgical techniques

Intrapelvic approach, as described by Hirvensalo et al. (10), and Lindahl and Hirvensalo (4), was used to reduce and fix the symphysis pubis and rami fractures of the pelvic ring, and anterior column and quadrilateral surface of the acetabulum.

Approach along the iliac crest was used to operate the SI-joint and iliac wing from front.

Posterior longitudinal approach slightly medial to the posterosuperior iliac spine was used for open sacral fracture reduction with iliosacral screw fixation. Posterior longitudinal midline approach was chosen for lumbopelvic fixation.

Posterior Kocher-Langenbeck approach was used for reduction and fixation of posterior column and posterior wall acetabular fractures.

Radiologic evaluation

In pelvic ring injuries the radiologic results were graded by the maximal residual vertical and AP 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 (4,6). In acetabular fractures the reduction result was graded by the residual displacement in the weight bearing joint surface as: excellent or good 0-2 mm, fair 3-5 mm and poor > 5 mm.

Table 2. Radiological end results after delayed and late reconstructions
of the pelvis (n=39).

	Radiological result			
Pelvic fracture type	Excellent	Good	Fair	Poor
A2 Iliac wing	1	1	0	0
B1/B3-1 Open book	3	2	0	0
B2/B3-2 Lateral compression	2	1	0	0
C1-C3 Vertical shear	11	10	4	1
Spinopelvic dissociation	0	1	0	0
Acetabulum	0	2	0	0
Total	17	17	4	1

Table 3. Functional results after delayed and late reconstructions of the pelvis (n=39).

	Functional result			
Pelvic fracture type	Excellent	Good	Fair	Poor
A2 Iliac wing	1	1	0	0
B1/B3-1 Open book	0	5	0	0
B2/B3-2 Lateral compression	2	1	0	0
C1-C3 Vertical shear	5	16	4	1
Spinopelvic dissociation	0	1	0	0
Acetabulum	1	1	0	0
Total	9	25	4	1

Outcome evaluation

All the patients had a clinical examination with particular attention to their gait, hip motion, and persistent motor and sensory nerve deficiencies. Neurologic examination was done from L4 distally preoperatively and postoperatively. 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 (11).

The functional outcome after pelvic ring injury was measured using a scoring system described by Majeed (12) and modified by Lindahl et al (4) which is based on the clinical findings. 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 (4). In acetabular fractures the functional outcome was measured using Harris Hip Score (0-100 points).

Results

The overall radiological results were excellent or good in 34 out of 39 patients (87%). In five patients the residual vertical or AP displacement in the posterior or anterior injury to the pelvic ring was >10 mm. The reduction results in two delayed acetabular fracture operations were good (Table 2).

The functional results were also excellent or good in 34 out of 39 patients (87%) (Table 3). Three out of five patients with fair or poor functional outcome had a permanent lumbosacral plexus injury with motor deficiencies. One of these five patients had below knee amputation because of crush injury of the leg. In one patient the unsatisfactory functional result was in conjunction to loss of reduction because of severe osteoporosis and malalignment of the pelvic ring. No deep wound infections were seen, but one superficial wound infection occurred (Table 4).

Table 4. Complications after delayed and late reconstructions of the pelvis (n=39).

Loss of reduction (osteoporosis)	2 (5%)
Malunion (final displacement > 10 mm)	5 (13%)
Nonunion (breakage of anterior plate)	1 (3%)
Deep wound infection	0 (0%)
Superficial wound infection	1 (3%)
Bleeding (was treated with packing)	1 (3%)

Discussion

In delayed and late pelvic ring and acetabulum fracture cases normal pelvic approaches and fixation techniques can be used. The late surgery is more challenging because the anatomy of the pelvic is altered and less recognizable. In addition when osteotomies are made it is not possible to fully protect structures that lie invisible on the opposite side of the bone.

At months after injury the pelvis is very resistant to correction of deformity. Once the deformity has established itself and chronic symptoms have developed there are very limited possibilities for a reconstruction and return to the preinjury status. The fixed deformity after a sacral fracture is not an indication for late corrective osteotomy especially if there is concomitant lumbosacral plexus injury and chronic pain problem. On the other hand non-unions, ununited malalignment, partially united malalignment, and non-unions might be possible to correct especially when the posterior injury to the pelvis goes through the SI-joint or posterior part of the iliac wing. In such cases simultaneous anterior intrapelvic approach is needed to be able to correct the anterior deformity at the same time.

Failed iliosacral screw fixation of comminuted sacral fracture even with partially united malalignment seems to be possible to reduce and stabilize with lumbopelvic fixation with a better alignment, reliable fracture stability and bony healing.





Figure 1. (A,B,C) A 17-year-old woman was injured in motorbike accident sustaining an AO type C1-2 injury to the

asing simultaneously intrapervic approach and approach along the iliac crest to reduce and stabilize both the posterior and anterior injury to the pelvic ring. SI-joint was stabilized with two 4.5 mm plates positioned at nearly 90 degree angle to each other and the symphysis pubis with 4.5 mm Matta plate. The functional end result was good.



Figure 2. (A) A 77-year-old woman had a clear non-union deformity of the left hemipelvis with fracture dislocation of the SI-joint in the left and bilateral fractures of the pubic rami. There was also a nondisplaced and mainly healed vertical sacral fracture line on the right side. She had a history of a minor fall 10 months earlier, but probably this was a fatigue type fracture pattern. (B) Because of difficult pain, sitting and gait problems operative treatment was chosen. The late correction was performed by stabilizing the SI-joint, iliac wing and rami fractures from the front in supine position, and after that the SI-joint area also from posterior approach on prone position. (C,D) After 13 months from the operation the patient was able to walk and had a clear pain relief although there was a fatigue fracture of the anterior plate because of nonunion of the left rami fractures. In posterior pelvic ring injury partial healing without loss of reduction was seen.

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