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Unstable fractures of the pelvis treated with a trapezoid compression frame

Sixteen patients with unstable pelvic fractures were treated by early reduction and fixation of the pelvic ring with a trapezoid compression frame. This provided firm fixation of the fractured pelvis in all but one patient. External fixation afforded relief from pain and greatly facilitated nursing. At follow-up, all the fractures but one had healed in the position secured initially by the frame.

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The management of unstable pelvic fractures has consisted of reduction by traction and immobilization in pelvic slings, and even postural reduction and plaster fixation have been advocated (Monahan & Taylor 1975, Watson-Jones 1976). Conservative treatment requires a prolonged period of hospitalization and is frequently associated with complications. The results after conservative treatment have also been less satisfactory and a number of late sequelae have been reported (Räf 1966, Huittinen & Slätis 1972, Karaharju & Slätis 1978). Internal fixation of unstable pelvic fractures has been associated with high mortality and limited success of stabilization (Mears & Fu 1980), and only a few fractures are amenable to this kind of treatment (Jenkins & Young 1978, Letournel 1978, Tile 1980, Dunn & Morris 1981). In recent years, closed reduction and external fixation have been advocated by many (Slätis & Karaharju 1975, Karaharju & Slätis 1978, Mears & Fu 1980, Wild et al. 1982). It is claimed that this method yields excellent immobilization and relief of pain, the nursing care of associated injuries is facilitated, and early weight bearing is possible. Our experiences with the trapezoidal compression frame described by Slätis & Karaharju (1975) (Figure 1) are reported.

Patients and methods

Sixteen patients were treated with the trapezoidal compression frame during 1978–1981. Thirteen patients were men and three were women; the mean age was 37 (16–68) years. The cause of injury was traffic accident in nine patients and a fall from a height in seven. Associated injuries were recorded in 12 patients (Table 1). The fractures were classified from the radiographs, using the system suggested by Pennal et al. (1980), based on the forces causing the fracture. The three types of fractures are: anteroposterior compression fracture (APC); lateral compression fracture (LC) and vertical shear fracture (VS) (Figures 2–4, Table 2).

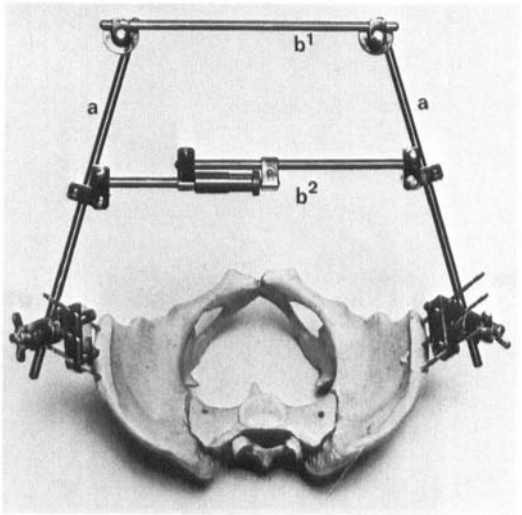

Figure 1. The trapezoid compression frame is anchored to the two iliac crests with three pins on each side. The vertical bars (a) are connected with a horizontal upper bar (b_1). The compression bar (b_2) is placed midway between the upper bar and the anchorage to the iliac crest. Compression conveys the compressive force to the posterior, weight-bearing arch of the pelvic girdle (from Slätis & Karaharju *Clin. Orthop.* 1980, 151, p. 75, Figure 1).

Figures 2–4. Types of pelvic disruption, based on direction of force.

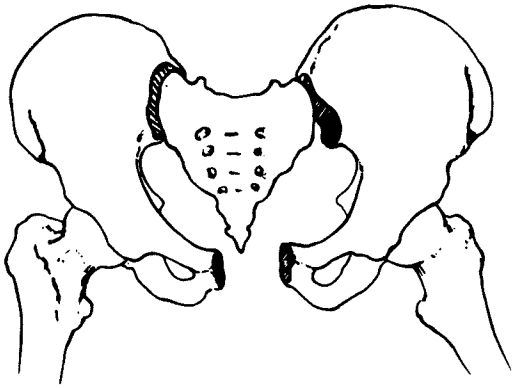

Figure 2. Antero-posterior compression.

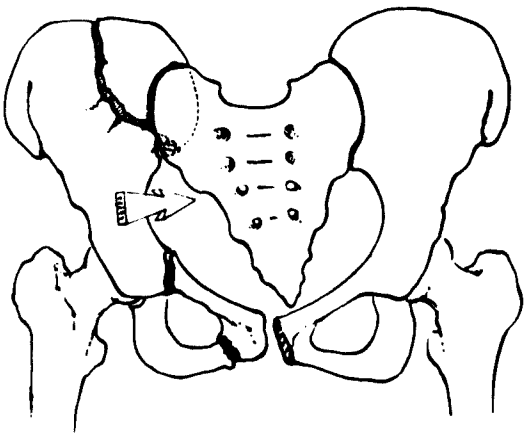

Figure 3. Lateral compression.

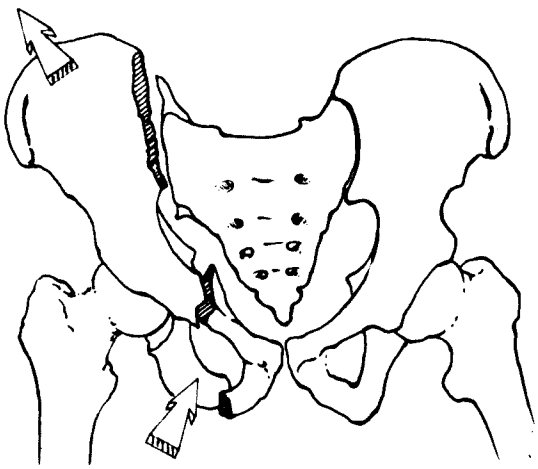

Figure 4. Vertical shear.

Table 1. Associated injuries in 12/16 patients with pelvic fracture

Fractures	
Upper extremity	8
Lower extremity	19
Spinal column	2
Rib	4
Visceral injuries	
Rupture of the urethra	2
Rupture of the rectum	1
Rupture of the spleen	1
Cerebral concussion	2
Total	39

Treatment

In all patients the trapezoidal compression frame was mounted under general anesthesia. In nine patients the frame was applied directly after the injury, either as an emergency procedure or after surgical intervention for abdominal or thoracic injuries. In six patients, it was applied within a week after the injury and in one after 4 weeks.

The reduction of the fracture was radiographically excellent or good in 13 patients and poor in three (Table 3, Figures 5 and 6). The separation of the pubic symphysis in patients with antero-posterior compression fractures was reduced from 3.9 (3.5–5.0) cm to an average of 1.6 (0.7–2.5) cm. The reduction was checked radiographically after 1 and 2 weeks and after the patient was ambulatory. It remained unchanged in all patients but one. This patient had a bilateral vertical shear fracture, and the reduction was partly lost during the first weeks of fixation, in spite of the fact that the patient was non-ambulatory. After application of the compression frame all patients noted instant and dramatic relief of pain. The frame was well tolerated and no pin-tract infection occurred.

The patients were allowed to take partial weight on the affected leg, using crutches, when associated injuries allowed. Before the frame was removed the

Table 2. Type of pelvic fracture and location of the posterior injury

Type of fracture	Posterior injury			
	Sacrum		Sacro-iliac joint	
	Unilat.	Bilat.	Unilat.	Bilat.
APC	1		2	1
LC	3		3	1
VS	2	1	1	1

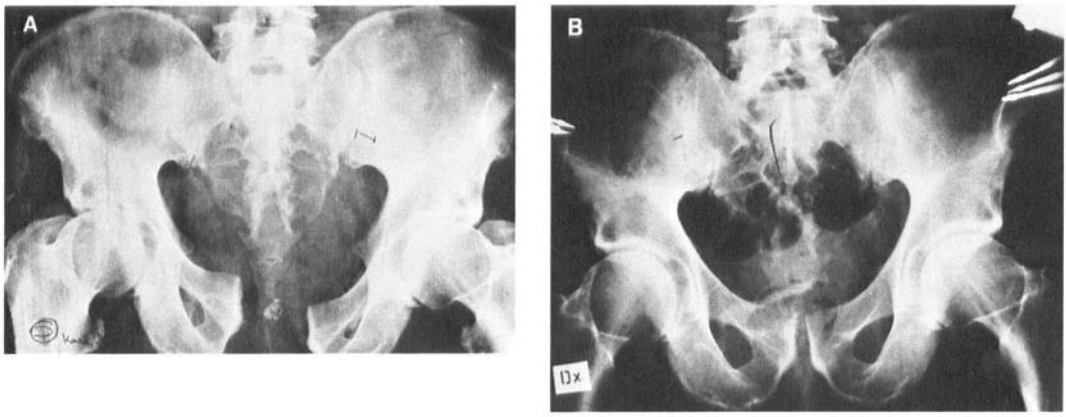

Figure 5 A–B. 70-year-old man. Pedestrian hit by car.
A. Antero-posterior compression injury with separation of the symphysis (50 mm) and the left sacroiliac joint.
B. After application of the frame the dislocation is completely reduced.
At follow-up the patient had no pain and walked normally. Sensory loss in roots L5-S1 left leg.

compression was released and pelvic stability was checked radiographically, with the patient bearing weight on one leg at a time. If the pelvis was unstable the fixation was maintained for another 2 weeks. The patients were ambulatory on average 4 weeks after injury. The average range of hospitalization was 56 (14–147) days and was mostly dependent on associated injuries. Six patients were discharged from the hospital with the compression frame *in situ*. The frame was removed after 7 (5–13) weeks.

Table 3. Reduction achieved in 16 patients with pelvic fracture

Type of fracture	Reduction		
	Excellent	Good	Poor
APC	4	–	–
LC	3	4	–
VS	–	2	3

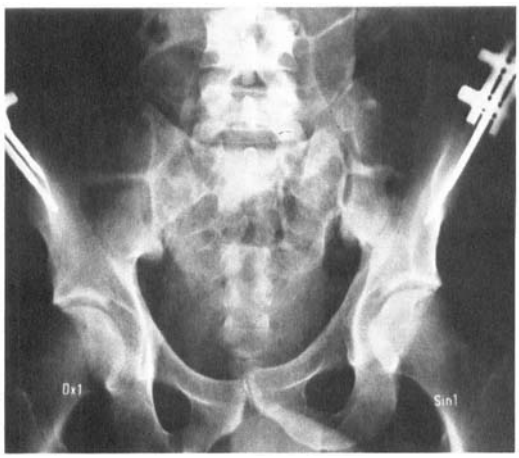

Figure 6. 29-year-old-man. Fall from height. Vertical shear disruption of the left hemipelvis with dislocation of the symphysis and the left sacroiliac joint. Poor reduction with remaining rotation and proximal dislocation of the left hemipelvis. At follow-up, the patient complained of stiffness and intermittent slight pain after work.

Reexamination

Four patients (three with vertical shear fracture and one with lateral compression fracture) died from associated injuries within a month after injury. The remaining 12 patients were reexamined clinically and radiographically 1–4 (mean 3) years after the accident.

Results

Antero-posterior compression fractures (4)

All fractures had healed without residual symptoms.

Lateral compression fractures (6)

Three fractures had healed in an anatomical position, and three with minor rotational malalignment. These latter three patients complained of slight, intermittent pelvic pain at follow-up. One of them had a nerve root injury

of the lumbo-sacral plexus and another had a malunited acetabular fracture.

Vertical shear fractures (2)

Both fractures had healed with remaining minor malalignment of the hemipelvis. However, no patient complained of pelvic pain or impaired gait.

Nerve injuries

At follow-up, five patients (two with APC and three with LC fractures) showed signs of injury to the lumbo-sacral plexus, with varying degrees of motor and sensory loss in roots L5–S4.

Discussion

External fixation of unstable pelvic fractures should be firm enough to maintain the reduction once obtained and to enable early mobilization of the patient. Biomechanical studies by Slätis & Karaharju (1975) and Gunterberg et al. (1978) have shown high stability and load acceptance of most fractures if the external device is mounted as a trapezoid compression frame. However, recent biomechanical studies and expanding clinical experience have shown that anterior external frames do not stabilize all types of pelvic fracture dislocations (Johnston et al. 1982, Letournel 1982, personal communication, Slätis et al. 1982, Wild et al. 1982). Grossly unstable injuries with bilateral total disruption of the sacroiliac joints or bilateral posterior fractures may redislocate in spite of successful reduction and external frame support. To provide further stability some authors advocate double fixation with anterior and posterior quadrilateral frames (Mears & Fu 1980) and some open reduction and internal fixation of the posterior fracture combined with external fixation (Letournel 1982, personal communication Slätis et al. 1982).

However, since the trapezoid compression frame is easy to manage and has shown high stability and load acceptance, we have used this type of frame in all unstable pelvic fractures since 1978.

In our series the most stable lesion, after reduction and mounting of the frame, was the *antero-posterior compression fracture,* which is in accordance with the experience of others (Slätis et al. 1982, Wild et al. 1982). No cases of early or late dislocation were observed and no residual symptoms were recorded. *Lateral compression fractures* posed more problems in our series than the antero-posterior compression fracture. Although the reduction was acceptable in all cases, it was only anatomical in 3/7 of the patients. Residual symptoms in the form of pelvic pain and walking difficulties were, however, mild. The reduction and maintenance of reduction in *vertical shear fractures* are more difficult and anatomical reduction was not achieved in any of our five patients.

Transfusion requirements were rather low. Twelve of our patients required an average of 13 units of packed red blood cells. The transfusion requirements diminished in those patients in whom the frame was applied early. Slätis & Karaharju (1980) have confirmed that reduction and external fixation of the unstable pelvic fracture reduced bleeding in their patients and lowered mortality. Wild et al. (1982) stated that reduction and fixation were directly lifesaving in four patients. Reduction and external fixation should therefore be performed as soon as possible. Slätis & Karaharju (1978) have stressed that reduction should be done within 2 days of the injury.

Although our series is relatively small it confirms the experience of others (Slätis & Karaharju 1978, 1980, Wild et al. 1982) that external fixation is a safe treatment of most unstable pelvic fractures. The high mortality in our series was attributable to associated injuries in all patients. The patients were pain-free and transfusion requirements were reduced.

All the fractures healed and residual sequelae, such as persistent back pain, pelvic pain and difficulties with walking, were infrequent. The patients were ambulatory when other injuries allowed. The treatment was well-tolerated without complications and the compression frame was not removed prematurely in any patient.

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