

partial posterior instability, type III complete anterior and posterior instability.

Tile/AO Classification: Proposed by Marvin Tile (1984), and recently adapted by AO International. This new classification of pelvic ring disruptions (Table 1) is very useful in planning treatment.

TABLE 1

CLASSIFICATION OF PELVIC RING DISRUPTIONS  
(Tile M 1984, 1987)

CLASSIFICATION	DESCRIPTION
TYPE A	Stable
A1	Fracture of the pelvis not involving the ring
A2	Stable minimally displaced fractures of the ring
TYPE B	Rotationally unstable but vertically stable
B1	Open Book
B2	Lateral Compressing (ipsilateral)
B3	Lateral compression (bilateral)
TYPE C	Rotationally and vertically unstable
C1	Unilateral
C2	Bilateral
C3	Associated with an Acetabular fracture

The goals of Orthopaedic management are to achieve bony union in a satisfactory position and to rehabilitate the patient as quickly as possible. A pelvic deformity can lead to leg length inequality and sitting problems secondary to proximal displacement of one or both ischial tuberosities and possible dyspareunia or difficulties with parturition in women.

Non-union or late sacro-iliac joint instability can cause pain and limit function. Most pelvic ring injuries are stable and can be treated by closed methods. Fractures known to be unstable initially are best treated by open reduction. Colapinto, V. (1980) reviewed the urethral injuries associated with pelvic fractures and proposed classification, diagnostic techniques and therapeutic regimens. Naam N.H. et al, (1983), Perry J.F. Jr. (1980) review the mortality and morbidity associated with pelvic fractures. Saibil EA et al, (1983) emphasized the transcatheter arterial embolization as possibly the definitive therapeutic procedures in pelvic bleeding.

Denis F, et al (1988) described sacral fractures on the basis of their direction, location, and level, and reported association of 25 nerve root injury with these fractures. Lange R.H. and Hansen S.T. (1985) compared two-hole and four-hole plate fixation of pubic symphysis diastasis. They showed that two-hole plate fixation was satisfactory for treatment of this injury. Matta J.M. and Saucedo T. (1989) reported internal fixation of 32 unstable pelvic fractures. They recommend surgery two to three days after the injury. They used suction drain to evacuate haematoma at the site of fracture fixation. In their study internal fixation has been graded superior for anatomic results, union rate and functional results.

Tile M. (1984, 88) introduced the classification based on stability and has shown 19% of pelvic fractures need stabilization (5% by internal means).

INTERNAL FIXATION OF UNSTABLE FRACTURES OF THE PELVIS

MATERIAL AND METHODS

35 patients with unstable pelvic fractures (Table 2) were treated by internal fixation. Using the classification system of Tile, M/AO, there were 3

fractures of B1 type, 1 fracture of B2 type, 14 fractures of C1 type, 1 fracture of C2 type and 16 cases of C3 type (n=35). There were 26 male and 9 female patients. All patient were operated by one of us (First Author).

TABLE 2

DATA REGARDING 35 CASES OF UNSTABLE PELVIC FRACTURES

No.	Age in Year	Sex	Fracture type	Injury to Presentation	Presentation to Surgery days	Surgery to Mobilization days	Surgery to free Walking months	Outcome	Surgical Approach	Implants Used	Complication
1.	55	M	C1	Immediate	49	20	6	LFU	Ilio-inguinal	Screws + Steel Wire	Wound infected surgery was delayed
2.	22	M	C1	Immediate	8	15	3	Good	Extended Ilio-inguinal	Sherman Plate	Impotence for 6 months
3.	39	M	C3	Immediate	4	10	6	Excellent	Do	AO Reconstruction Plate	
4.	65	F	C3	10	14	20	Died	Died	Ilioinguinal + Sherman Post Kockers Plate		
5.	35	F	C3	Immediate	6	10	Walker	Good	Post S.I. Ilio-inguinal	Bern Plate	
6.	45	F	C3	Few hours	16	20	5	Excellent	Ilio-inguinal	Interfragmentary Screws	
7.	55	F	C1	8	18	20	3	Excellent	Extended Ilio-inguinal	Bern Plate + wire	
8.	25	M	C3	Few hours	4	20	3	Excellent	Do	K-wire + Screws + wire	
9.	72	M	B1	1	14	10	5	Good	Pfannenstiel	Screws + Wire	Inguinal hernia
10.	55	M	C1	6	4	10	4	Excellent	Ilioinguinal Pfannenstiel	Bern Plate	
11.	25	M	C1	4 days	10	7	LFU	LFU	Ilioinguinal	Sherman Plate	
12.	39	M	C1	13	34	inside bed 2 weekes	LFU	LFU	Do	Do	LFU
13.	35	M	C1	2	15	5	4	Excellent	Do	Do	LFU
14.	38	M	B2	15	25	4	7	Good	Pfannenstiel	Screw Plate	Infection
15.	45	M	C1	3	7	13	9	Good	Ilioinguinal	Bern Plate	
16.	37	F	C1	5	18	12	6	Excellent	Iliac	Stienman Nus	



DR. SYED MOHAMMAD AWAIS

17. 23	M	C1	15	9	8	3	Excellent	Iliioinginal	Bern Plate	Infection implants removed after 6 months
18. 25	M	C1	16	17	10	6	Excellent	Do	Do	Infection
19. 65	M	C3	2	67	10	LFU	LFU	Do	Do	
20. 33	M	C1	15	120	4	9	Good	Do	Do	
21. 40	F	C1	1	4	4		Walke Fair	Do	Do	Infectional + NU. & BG
22. 25	M	C2	1	15	3	5	Excellent	Posterior S.I.	6.5mm Screws	Screws Cut through refixed
23. 40	M	C3	1	7	3	8	Do	Iliioinginal + Kocker	Woven Plate	
24. 35	M	C3	7	4	2	6	Do	Kocker	Bern Plate	
25. 50	M	C3	3	5	1	5	Good	Pfannensteil	Screw + Wire	Infection
26. 28	M	C3	7	4	5	8	LFO	Iliioinginal	Bern Plate	Do
27. 40	M	C3	3	5	1	6	Excellent	Post Kocker	Do	
28. 65	M	B1	3	7	1	5	Do	Pfannensteil	Screw + Wire	
29. 17	M	C3	3	8	1	6	Good	Iliioinginal	Do	
30. 65	M	B1	7	4	2	5	Excellent	Pfannensteil	Do	
31. 55	F	C3	5	7	2	8	Good	Iliioinginal	Bern Plate	
32. 13	F	C3	5	8	2	5	Excellent	Iliioinginal	Do	
33. 35	M	C3	1	14	2	6	Do	Post Kocker	Do	
34. 30	F	C3	10	4	3	6	Fair	Iliioinginal	Do	Infection
35. 20	M	C1.1	40	2	2	4	Excellent	Post S.I.	Screws + ant	

After receiving the patients, the visceral injuries and haemodynamic status was managed and patients were operated at the earliest but not before 5 days after the first injury, however in those cases who had already lapsed enough time before presentation to us, surgical procedures were carried out after necessary work up at the earliest. All surgeries were carried out under general Anaesthesia.

In all cases of unstable pelvic

fractures, three views of X-ray pelvis (AP, inlet and outlet) were carried out both pre and post operatively. Suction drain was used to evacuate haematoma from site of surgery in all cases. Prophylactic antibiotics were given to all patients. Fixations were performed with AO screws, steel wire G. 16, AO reconstruction plate, sherman plate, Bern plate, Woven plates and external fixator (both AO and Naseer Awais types) (Fig. 1-6). Patients were mobilized in the bed within few days after intensity of pain

was reduced. Mobilization out of bed was started with the help of walking frame or two crutches initially and then according to radiological stage of fracture healing and intensity of pain support free gait was recommended.

## RESULTS

35 cases Male Female ratio (4:1), of displaced unstable pelvic fractures (4 cases of types B and 31 cases of type C) were treated by open reduction and internal fixation. The age range (minimum 13 years, maximum 72 years) with mean of 36.8 years and  $\pm 1$  SD 15.9 (Table 3).

TABLE 3  
TYPE OF FRACTURE (n=35)

B1	=	3 CASES
B2	=	1 CASE
C1	=	14 CASES
C2	=	1 CASE
C3	=	16 CASES
TOTAL	=	35 CASES

In 4 cases sacroiliac joint com-

plex was stable whereas in 31 cases posterior stability was lost as well 16 cases were associated with fracture through the acetabulum. Only 1 case was of bilateral S.I. disruption. The associated injuries in these 35 cases were perineal wound, rupture urethra, rupture urinary bladder, large gut injury, sciatic nerve injury, dislocation hip, fracture femur, fracture tibia, fracture foot, fracture humerus, fracture radius & ulna. One case with multiple fractures including type 03 pelvic fracture came in emergency with adult respiratory distress syndrome and was managed in intensive care unit of Mayo Hospital, and was operated on Day 7 after injury.

Time interval between presentation to surgery ranged from 2 days to 120 days (mean 15.5 days and  $\pm 1$  SD=22.3) (Table 4). Distribution of this time interval was that 32 cases were operated upon within 2 to 17 days after

TABLE 4  
TIME INTERVAL BETWEEN IMPORTANT EVENTS  
IN SURGICAL MANAGEMENT OF PELVIC FRACTURES

EVENTS	MINIMUM	MAXIMUM	MEAN	SD $\pm 1$
Injury to presentation	Few hours	40 days	6.8	8.63
Presentation to surgery	2 days	120 days	15.5	22.8
Surgery to Mobilization	2 days	20 days	7.3 of 32	6.2
		cases 2 bed ridden		
Surgery to Support Free Walking in 29 patients	3 months	9 months	5.3*	1.5

\* One Case Died

\*\* One case remained in wheel chair for long time

\*\*\* Three lost to follow up (LFU)



admission. One case at 34 days, 1 case at 49 days and 1 case at 120 days. The reasons were associated dislocation of hip treated with closed method got displaced later on and was fixed in first case infected perineal wound with soft tissue loss in 2nd case and abdominal injuries who had colostomy done near to ilio-inguinal incision mark (third case).

Time interval between surgery to mobilization within the bed in 33 patients ranged from 2 days to 20 days (mean 7.3 and  $\pm 1$  SD 1.5). One case who had multiple injuries (including complete damage of sciatic nerve) remained in wheel-chair for more than 18 months and has started walking 3 months ago with the help of walking frame. 3 cases were lost in the follow-up.

Different surgical approaches were selected according to each problem (Table 5).

TABLE 5

SURGICAL APPROACHES USED

1. Ilio Inguinal	20
2. Pheninstien	5
3. Kockers	3
4. Ant. + Posterior	5
5. Direct S.I	2
TOTAL	35

In 20 cases surgery was done through ilio-inguinal approach. Out of these in 9 cases this approach was extended to anterior aspect of thigh in T-manner, this provided better visualization of the acetabulum and hip joint; and in 3 cases the ilio-inguinal incision was extended as supra pubic Pfannensteil. In 5 cases Pfannensteil incision

was given to approach the pubic symphysis. In 3 cases posterior Kocher - Langenbeck incision was used to perform internal fixation posteriorly. In 5 cases sacroiliac joints were exposed by vertical incisions 1 cm lateral to SI joints.

Functional rating at one year was possible in 30 cases. 17 cases (57 per cent) were excellent, 10 cases (33 per cent) were good and 3 cases (10 per cent) had fair out come (Table 6) (Fig.1 to 6).

TABLE 6  
FINAL RESULTS OF SURGERY  
(According to Majeed, S.A. 1989,  
rating score)

Pain	= 0-30	Sitting	= 0-10
standing	= 0-36	Work	= 0-20
Sex	= 0-20		

Score	Clinical Grades	Score for Non Workes	Workers	Cases Present InStudy
Exelent		> 85	770	17
Good		70-84	55-69	10
Fair		55-69	65-54	3
		Not Rated		5
		TOTAL		35

**Discussion:** Displaced and unstable pelvic fractures, in addition to be in association with injuries of other body parts in general and viscera of abdomen and pelvis in specific, can lead to significant long term orthopaedic problems. The orthopaedic sequele include malunion, non-union and Lumbar and sacral nerve root deficits. 54% of the patients treated by non-operative methods by Matla J.M. and Saucedo T. (1987) suffered either a malunion or non-union of their fractures. S.I. dislocations and symphysis pubis dislocations are particularly difficult to treat non-operatively. The best results of open treat-



ment of these injuries are obtained in young individuals without any injury to viscera or skin and subcutaneous tissues. Amongst the associated injury the injury to sciatic nerve is most common. (In 11 cases out of 54 pelvic fractures in Matta and Saucedo study (1987), and in 6 cases out of 35 cases in present study.

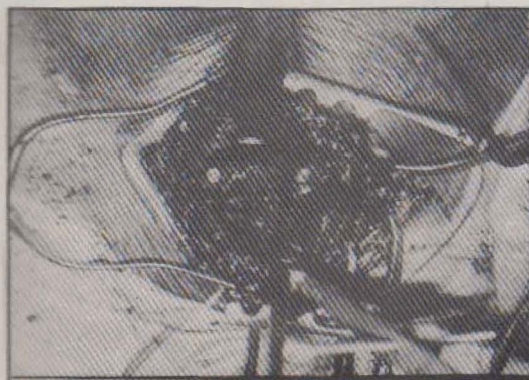


Fig. 1: Wiring across the AO Screws in Management of Pubic Symphysis Diastasis



Fig. 2: Anterior Phenestration Incision Extended to Iliac Incision showing Application of Pre-bent Bern Plate along Symphysis Pubis to access the Acetabulum

In presence of proper instruments there should not be any particular problem in reducing and fixing the fractures, however, like in our situation where all what is required is not avail-

able surgeon must have few alternatives at hand. In one case during surgery the injury to the femoral artery was repaired by excision of injured part and end to end anastomosis. Deep infection occurred in 1 case out of 54 in Matta and Saucedo study (1987), in present study 8 cases out of 35 (23 per cent) had

deep infection. Out of these 8 cases 2 had abdomino-perineal injuries and were infected before surgery was undertaken.

One case died because of unknown reason during 2nd month after surgery in 2 cases infection was treated successfully without sequelae; in 1 case infection destroyed the hip joint and 2 cases were lost in the follow up (Table 7).

TABLE 7  
LIST OF COMPLICATIONS  
IN 9 CASES

Infection	8 out of (35)
Inguinal hernia	2
Impotence (Temporary)	1
AVN Head Femur (18 month)	1

Mobilization of the patient inside the bed after having major injuries is an important point in their management. Most of the patients were allowed to change posture, sit and hang legs on the sides of the bed within one week after surgery shows high success rate of internal fixation than non-operative treatment or external fixation in obtaining satisfactory reduction and union. Although it has been mentioned that single plate fixation for symphysis pubis dislo-



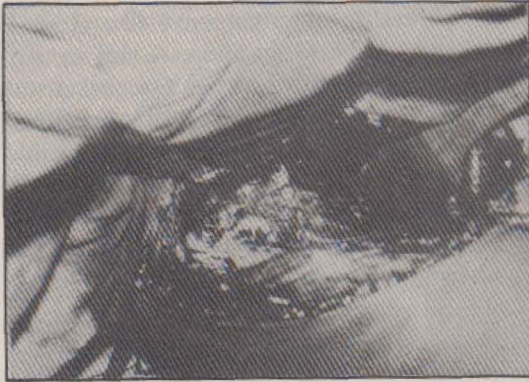


Fig.3. Application of Plates at S.I. Area through Anterior Approach

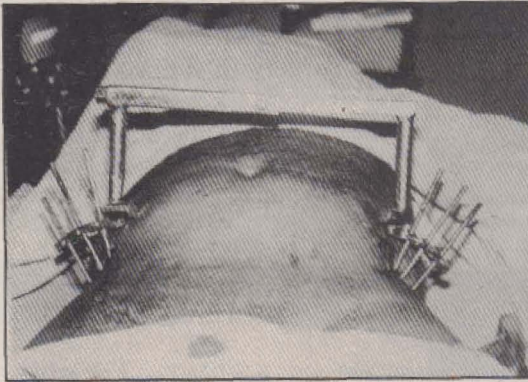


Fig.4. Showing Application of Naseer-Awais Fixator for Pelvis (useful in treating Pubic Symphysis Diastasis without Internal Fixation)

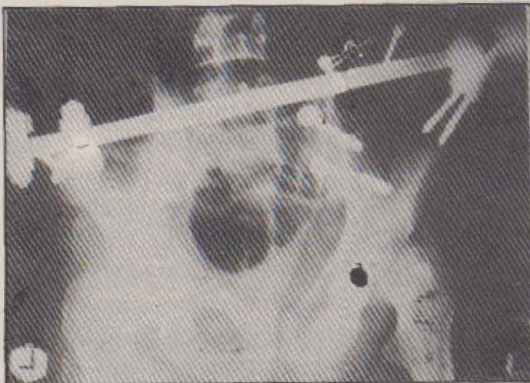


Fig.5. Showing Application of Tubular AO Fixator to provide stability of Anterior Structure of Pelvis

ation is inferior to two plates, Lange R.H., Hansen T.R. (1985) in study of 24 cases has shown that single two-hole plate is satisfactory for maintaining reduction of diastasis. In earlier cases in present study plates were used to fix symphysis pubis dislocation (Table 8).

TABLE 8

DIFFERENT TYPES IMPLANTS USED IN CASES

- |    |                |
|----|----------------|
| 1. | Sherman Plates |
| 2. | Bern Plates    |
| 3. | Women Plates   |
| 4. | Wiring         |
| 5. | Screws         |
| 6. | Ext. Fixator   |
| 1. | NA Type        |
| 2. | AO Type        |

In our situation without proper AO reconstruction plates procedure was technically difficult by inability to contour Bern or other plates according to exact bone surfaces. A new technique was evolved. One 4.5 mm long (50-60 mm) AO Cortical screw was passed on either side into body of the pubic bones. 16 G steel wire was passed around the screws at two levels and wire loops secured tightly (Fig. 6). This costed minimum operative time, required minimum tissue dissection and required minimum implants. We rate this method superior to other available methods to treat this injury.

Our experience of treating sacroiliac joint disruptions with anterior approach is comparable to



## INTERNAL FIXATION OF UNSTABLE FRACTURES OF THE PELVIS



Fig 6a: Pelvic Fracture Type C1.2 Anterior Lesion - Pubic Symphysis Diastasis. Post Lesion - Fracture Dislocation through S.I. Joint



Fig 6b: Fixation of C1.2 Pelvic Fracture Anterior Lesion Fixed with wires across the Screws. Post Lesion Fixed with Intrafragmentary Screw and Plate through Anterior Approach



Fig 6c: Patient in Fig.6a and 6b 10 days after the Surgery

excellent results of other workers (Simpson LA, Waddell J.P., Peighton RK et al, 1987). In one of our patient who had type C3 pelvic fracture, 18 months

after the surgery developed avascular necrosis of head of femur. This complication has not been mentioned in literature so far. It would be therefore, interesting to perform long follow up of patients in whom acetabular reconstruction have been

carried out. Neurologic injury is at present a problem that is not influenced in most cases by a satisfactory reduction of the fracture.

### REFERENCES

1. COLAPINTO V. Trauma to the pelvis: Urethral injury. *clin. Orthop*; 151:46-55. 1980
2. DENIS F, DAVIS AND COMFORT T: Sacral fractures: An important problem. Retrospective analysis of 236 cases. *Clin Orthop* 1988; 227:67-81.



3. LANGE RH, HANSEN ST JR: Pelvic ring disruptions with symphysis pubis diastasis: Indications, technique and limitations of anterior internal fixation. Clin Orthop; 201:130-137, 1985.
4. MATTA JM AND SAUCEDO T: Internal fixation of pelvic ring fractures Clin Orth: 242:83-97, 1989.
5. MATTA J.M AND BRAY TRIMOTHY (1990) pelvis & Acetabulum trauma., Orthopaedic knowledge update 3, pp 447-491. American Academy of Orthopaedic Surgeons, 1990.
6. PERRY JF JR: Pelvic open fractures Clin Orthop: 151:41-45. 1980.
7. SYED ABDUL MAJEED: Grading the out come of pelvic fractures, J Bone surg; 7-B, No.2: 304-6, 1989.
8. SIMPSON LA AND WADDEL JP, Peigten R.K et al: Anterior approach and stabilization of the disrupted sacroiliac joint. J. Trauma; 27:1332-1339, 1988.
9. TILE M: Pelvic ring fractures: should they be fixed? J Bone joint surg; 7 OB: 1-12, 1988.
10. TILE M: Fractures of the pelvis and acetabulum, Baltimore, Williams & Wilkins, 1984.11. TILE M AND SCHATZKER J: The rationale of operative fracture care; Springer Verlag; 133-172, 1987.
11. WILLIAM J CANE; Fractures of the pelvis, in fractures in Adults; edited by Rochwood C.A. and Green D.P.; J.B. Lippincatt Co.; 1112-3; 1984.