

The triradiate incision for acetabular fractures

A prospective study of 23 cases

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24 acetabular fractures, displaced in the dome, were operated on through the triradiate incision, and 23 were followed for at least 2 years. All but one fracture were anatomically reduced in the dome. At follow-up, 7 hips had developed arthrosis, all with comminuted fractures with separate osteochondral dome fragments. Heterotopic bone formation occurred in 13

hips: 10/14 with indomethacin prophylaxis had no heterotopic bone, whereas all 9 without indomethacin prophylaxis had. We conclude that the triradiate incision is suitable for surgical treatment of complex acetabular fractures, and that the heterotopic bone formation can be reduced by indomethacin prophylaxis.

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Reduction and internal fixation of a displaced acetabular fracture are essential if the joint surface in the dome is involved (Letournel 1979, Matta et al. 1988). The posterior or anterior incision often does not provide adequate exposure. An extensile surgical approach is essential to meet the problems of exposure, anatomic reduction, and fixation of these complex fractures.

We evaluated the outcome of 24 patients with complex acetabular fractures operated on through the triradiate incision introduced by Mears and Rubash (1983).

Patients and methods

During 1988 through 1989, 24 patients with acetabular fractures were operated on with the triradiate incision. Our indication for using this incision was a high acetabular fracture with displacement of the fragments more than 3 mm in the dome. All fractures in this study were comminuted, i.e., classified as associated fractures according to Letournel and Judet (1981), and displaced more than 5 mm (Table 1). In 15 cases there were 1 or more separate osteochondral fragments in the dome. The average delay to operation was 12 (2-48) days; 4 patients were operated on later than 2 weeks. All the patients were given antibiotic prophylaxis with cloxacillin the first 24 hours postoperatively. Indomethacin prophylaxis for 6 weeks (25 mg x 3) was introduced in 1988 against heterotopic bone formation and was given to 14 patients. At follow-up, one patient, a foreign citizen, could not be traced. Thus, 23 patients (19 men and 4 women) were

included in the study. The mean age was 38 (16-65) years. The patients were followed for 29 (24-42) months. The functional result was evaluated on a six-point scale for pain, ambulation, and motion (d'Aubigné and Postel 1954, modified by Matta et al. 1986) and graded excellent at 18 points, good at 15-17, fair at 12-14 and poor at ≤ 12 points. Arthrosis was defined as joint space reduction to less than half the width of the contralateral normal hip (Danielsson 1964). The Brooker et al. (1973) classification was used in the assessment of heterotopic bone formation.

Surgical technique. The triradiate incision (Mears and Rubash 1983) consists of three radiating limbs from the central point at the greater trochanter: one limb to the anterior superior iliac spine, one to the posterior superior iliac spine, and one limb directed distally 6-8 cm (Figure 1). By an osteotomy of the greater trochanter the gluteus medius and minimus can

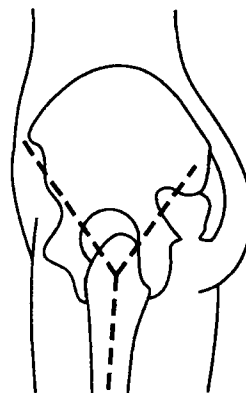


Figure 1. Skin incision for the triradiate approach.

Table 1. Observations in 23 patients with operated acetabular fractures

A	B	C	D	E	F	G	H	I	K	L	M	O	P	R	S
1	48	M	5	48	3.5	≤1		1	38	3	4	1	2	IV	P
2	33	M	2	25	4	≤1		2	32	6	6	6	1	0	E
3	29	M	2	13	4	≤1	h, n	2	31	6	6	6	1	0	E
4	45	M	1	2	4	≤1	r	1	24	4	4	4	2	III	F
5	40	W	1	17	3.5	≤1	n	2	29	4	4	5	1	0	F
6	22	M	2		2.5	≤1		2	40	5	6	4	1	0	G
7	30	M	3	9	3	≤1		2	31	5	5	5	1	I	G
8	44	W	1	14	5.5	≤1		1	46	3	4	3	2	III	P
9	22	M	1	3	4.5	≤1		1	48	5	5	5	1	II	G
10	32	M	2	2	3	≤1		2	24	5	5	6	1	0	G
11	46	M	1	12	3.5	≤1		2	33	5	6	5	1	II	G
12	53	M	4	5	3	≤1		2	26	6	6	6	1	0	E
13	57	M	1	6	4	≤1		2	28	4	5	5	1	0	F
14	25	M	1	9	5	≤1		1	40	3	4	3	2	II	P
15	36	W	1	12	4	≤1		1	45	3	4	3	2	II	P
16	36	M	1	5	4	≤1		1	44	6	5	5	1	II	G
17	26	M	4	5	4	≤1		2	28	6	6	6	1	I	E
18	16	M	3	2	3.5	≤1		2	26	6	6	6	1	0	E
19	19	M	2	35	4.5	≤1		2	36	3	4	1	2	0	P
20	59	M	1	3	4.5	6		1	28	5	5	4	2	II	F
21	25	W	3	15	4	≤1		2	24	6	6	6	1	0	E
22	65	M	1	7	3.5	≤1		1	26	6	6	6	1	II	E
23	57	M	1	10	3.5	≤1		2	36	5	5	5	2	II	G

A Case

B Age

C Sex

D Fracture type according to Letournel and Judet (1981)

- 1 complete both-column
- 2 associated transverse and posterior wall
- 3 t-shaped
- 4 associated anterior and posterior hemitransverse
- 5 associated posterior column and posterior wall

E Operative delay (days)

F Duration of operation (hours)

G Mm displacement in the acetabular dome after reduction

H Complication

- h hematoma
- n neural injury
- r redislocation

I Indomethacin prophylaxis

- 1 none
- 2 prophylaxis

K Follow-up time (months)

L Pain (points)

- 6 no
- 5 slight or intermittent
- 4 after ambulation
- 3 moderately severe, permits ambulation
- 2 severe with ambulation
- 1 severe, prevents ambulation

M Ambulation (points)

- 6 normal
- 5 slight limp but no cane
- 4 long distances with cane
- 3 limited even with support
- 2 very limited
- 1 bedridden

O Range (%) of motion (points)

- 6 100-95
- 5 80-94
- 4 60-79
- 3 40-59
- 1 0-39

P Arthrosis

- 1 none
- 2 arthrosis

R Heterotopic bone formation (Brooker et al. 1973)

S Clinical follow-up

- (d'Aubigne and Postel 1954, Matta et al. 1986)
- E excellent
 - G good
 - F fair
 - P poor

be elevated superiorly. The origin of the tensor fasciae lata is incised from the iliac crest and distally divided in the tendinous insertion; it must be retracted along with the gluteal muscles, in order to avoid injury to the neurovascular bundle originating from the superior gluteal nerve and vessels through the gluteal muscles. Then the joint capsule, the lateral aspect of the ilium, and the anterior column to the iliopectineal eminence medially are exposed. The short external rotators are incised and the posterior column is exposed from the ischial tuberosity to the greater sciatic notch. The

capsule is incised close to the labrum to make visualization of the acetabular surface possible by a 1-cm dislocation of the femoral head. The origin of the gluteus medius and minimus muscles are not incised at the iliac crest in order to minimize the disturbance of venous return from these muscles. In cases where dislocated fractures traverse the crest we preferred making an osteotomy of the ilium from anterior near the anterior superior spine in a posterior direction to the fracture line, rather than detaching the gluteal muscles from the iliac crest. This procedure permits the

Figure 2. Case 21.



Antero-posterior radiograph of an acetabular fracture with medial luxation of the femoral head and displaced fragments in the dome.



Postoperative radiograph with a remaining dislocated fragment medially but with joint congruence and reduction of the acetabular dome fragments.

reduction of the articular fracture fragments without incising the origin of the gluteal muscles. The proximal dislocated fragment is, however, not exactly reduced but fixed with a plate with the muscle-insertion intact. If necessary it is possible to get access to the inner wall of the ilium through incision of the sacrospinous ligament and from anterior through incision of the heads of rectus femoris, the sartorius, and the inguinal ligament. The fragments are debrided and primarily fixed with pins; when reduction has been achieved the fragments are fixed with compression screws. Débridement and the final reposition of the deep fragments is often done from the joint under visual control of the articular surface. Neutralization plates (Müller et al. 1991) are applied to reinforce the stability of the fracture system. Prophylactic irrigation with cloxacillin solution was performed peroperatively and in the suction drains at the end of the operation.

Postoperative care. Continuous passive motion was initiated on the first day after the operation and was continued for about a week. The patients were mobilized during the first week with partial weight bearing for 3 months and then full weight bearing.

Results

The mean duration of the operations was 4 (2.5-5.5) hours. The blood loss was 3.8 (1.2-8.0) L. In 22 cases, the fracture was anatomically reduced in the dome (Figure 2). In one case the reduction was unsatisfactory with a 6 mm gap in the dome and a 2 mm step-off (Figure 3). All the fractures healed.

Complications. A subcutaneous hematoma was evacuated the tenth day after operation. One patient with an atrophy of the proximal part of the tensor fascia lata had a Trendelenburg limp which persisted 2 years after the operation. One patient had slightly impaired sensibility on the dorsal side of the great toe and a weakness of the Achilles' tendon reflex but had an intact motor function. There were no infections or skin problems.

Postoperative arthrosis. No patient had arthrosis of the contralateral hip at follow-up. There were 8 cases of arthrosis of the operated hip: 6 detected within the first year, and 2 at the 2-year follow-up. In 6 of these cases there was a comminuted fracture in the dome with dislocated osteochondral fragments, and 2 of these had surgery delayed for 35 and 48 days, respectively. In one case there was an unsatisfactory reduction with a remaining gap in the dome. One patient with early arthrosis walked with full weight bearing 4 weeks after surgery, and the fracture redislocated.

Heterotopic bone formation. Of the 14 patients with indomethacin prophylaxis, 10 had no heterotopic bone formation, 2 had grade I, and 2 had grade II heterotopic bone formation, whereas of the 9 patients without indomethacin prophylaxis 6 had grade II, 2 had grade III, and 1 had grade IV heterotopic bone formation ($P < 0.0001$; Mann-Whitney U -test).

Clinical follow-up. At follow-up, 14 hips were graded excellent or good, 4 fair, and 5 poor. Of the patients graded fair and poor 7 had an early development of arthrosis. Another 2 patients had no sign of arthrosis, no or slight pain from the hip and normal or slightly reduced range of motion, but had other associated injuries that influenced the hip score rate.

Figure 3. Case 20.



Antero-posterior radiograph of a both-column fracture at admittance.



Postoperative radiograph of an unsatisfactory reduction with a remaining gap in the acetabular dome.

Discussion

In surgical treatment of complex acetabular fractures access to the joint space is necessary to remove loose fragments, to achieve joint congruency and to verify that no misdirected screws invade the articular surface during the internal fixation. The high proportion of anatomically reduced fractures in our series reflects the advantage of the extensile exposure. Reinert et al. (1988) introduced a modification of the extended iliofemoral incision of Letourmel (1981), and reported satisfactory reduction in all of their 20 patients. An alternative to an extensile approach is combined posterior and anterior incisions; Chip Routt and Swionkowski (1990) achieved satisfactory reduction in 21 of 24 patients. However, the average operation time of 7 hours was longer than that of our study.

Isolated insufficiency of the tensor muscle may result in a Trendelenburg limp (Markhede and Stener 1981) as seen in one of our patients. Thus, dissection between the tensor and the gluteal muscles should be avoided to minimize the risk of injury to the superior gluteal nerve and its branches.

The majority of cases with arthrosis after acetabular fractures are detected early radiographically (Rowe and Lowell 1961, Ragnarsson and Mjöberg 1992). Our high incidence of arthrosis (8/23) reflects the selection of dislocated dome fractures in this study with 4 cases operated on late. In delayed surgery, after 2 weeks, a wide exposure is required to debride the fragments from callus tissue to achieve successful reduction. Heeg et al. (1990) reported that delayed operations were a main factor in failure to obtain congruency

when using either a posterior or an anterior iliofemoral approach. This may support the idea of using an extensile approach in these late cases. The delayed reconstruction of the joint surface after fractures may have benefits with regard to subsequent arthroplasty even if it fails to prevent posttraumatic arthrosis. Romness and Lewallen (1990) reported a five times higher incidence of loosening of the acetabular component in arthroplasties after malunited acetabular fractures.

Heterotopic bone formation usually develops during the first 3-6 months and is then unlikely to progress (Garland 1991). Our study confirmed the efficiency of prophylactic indomethacin to prevent heterotopic bone formation (Dahl 1974, Kjærsgaard-Andersen and Schmidt 1991).

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