

นิพนธ์ต้นฉบับ

## Acetabular ring reconstruction in total hip arthroplasty (a study in 12 cases)

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วัฒนา วิรุพหัจจรย์, อภิชัย พุทธิประเสริฐ, มานิตย์ ลิมปพยอม. การผ่าตัด  
ข้อตะโพกด้วยการใช้วงแหวนพิเศษเสริมเบ้า (ศึกษาจากผู้ป่วย 12 ราย)  
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การผ่าตัดเปลี่ยนข้อตะโพกได้รับความนิยมอย่างแพร่หลายมาก แต่ปัญหาของ  
การสร้างเบ้าในผู้ป่วยบางรายยังมีอยู่ ที่ภาควิชาออร์โทปีดิกส์และเวชศาสตร์ฟื้นฟู  
คณะแพทยศาสตร์ จุฬาลงกรณ์มหาวิทยาลัย ได้ใช้วงแหวนพิเศษเสริมเบ้าก่อนจะวาง  
ข้อตะโพกเทียมจำนวน 12 ราย (ข้ออักเสบหลังบาดเจ็บ 4 ราย, ข้อเป็นใจแอนท์-  
เซลล์ทูเมอร์ 1 ราย, ข้ออักเสบ 6 ราย, และข้อตะโพกหลุดแต่กำเนิด 1 ราย)  
ทั้งหมดใช้ข้อตะโพกเทียมแบบมุลเลอร์ยักเว็น 3 รายที่ใช้แบบถ้วยสองอัน (ดับเบิลคัพ)  
ผู้ป่วยเพศชาย 3 ราย หญิง 9 ราย อายุระหว่าง 14-56 ปี ทุกรายใช้วงแหวน  
พิเศษรองในเบ้าก่อนจะใช้ข้อเทียมวาง การประเมินผลการศึกษาในระยะเวลาเฉลี่ย 4 ปี  
แรกพบว่าวงแหวนพิเศษทนทานดีและช่วยให้ข้อตะโพกแข็งแรงทำงานได้ดีขึ้น และยังไม่  
มีรายใดต้องเปลี่ยนข้อตะโพกเทียมใหม่อีกเลย

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A well-recognized late complication of total hip arthroplasty is fatigue failure of the medial wall of the acetabulum. Disruption of medial wall of the acetabulum not only causes mechanical loosening of the socket, but may also lead to an irreducible intrapelvic protrusion of the total hip prosthetic components.<sup>(1,2,3,5,6,7,8)</sup> Failure of the medial wall is most common in cases with preexisting attenuation of the medial wall as occurs in protrusio acetabuli, old central fracture-dislocation, rheumatoid arthritis, septic arthritis, migrated femoral head prosthesis or in severe osteoporosis of the acetabular area. This complication can even occur in ordinary osteoarthritis if the medial wall is fractured at the time of socket preparation or weakened by excessive reaming. Whatever the cause, once intrapelvic protrusion of the acetabular component occurs, the surgical revision is severely compromised.<sup>(4,9,10,13,14,15)</sup>

For the prevention of medial wall acetabular failure, we have used a prosthetic metal supporting ring and in some instances combined with bone graft to construct the weakened acetabular wall before the cup is cemented in place.<sup>(10,11,12)</sup>

The purposes of this paper are to

- 1) define the indication for the use of supporting ring.
- 2) discuss the surgical technique and mechanical problems of reconstructing the acetabulum.
- 3) review the results in total hip arthroplasty for weakened or disrupted medial acetabular wall using this supporting ring.

### Materials and Methods

Of the twelve hips studied, five (41.67%) had a follow up of five years, three (25%) four years, two (16.67%) three years and two (16.67%) less than one year.

Age ranged from 14 to 52 years

Sex, there was 3:1 ratio of females to males

the total number of females being 9 (67%)

and that of males being 3 (33%)

The indications and types of the operation are summarized in the Ibeatl

Table I

Case No.	Name	Age(Yr.)	Sex	Diagnosis	Primary operation	Follow up Period(Yr.)
1	A.P.	36	M	Post-traumatic arthritis	THR	3
2	C.P.	49	M	Giant cell tumor with osteoarthritis	THR	5
3	D.S.	14	F	Old septic and Tbc. hip	Double Cup	4
4	T.P.	52	F	Osteoarthritis with Protrusio Acetabuli	THR	3
5	C.P.	22	F	Old CDH c Osteoarthritis	THR	4
6	C.S.	19	F	Old Tbc, hip	THR	5
7	A.T.	17	F	Post-traumatic arthritis	Double Cup	4
8	S.R.	37	M	Old Tbc hip	THR	5
9	K.T.	49	F	Post-traumatic arthritis	THR	5
10	A.K.	15	F	Old Tbc hip	Double Cup	5
11	F.L.	30	F	Post-traumatic arthritis	THR	2/12
12	R.T.	56	F	Rheumatoid arthritis	THR	1/12

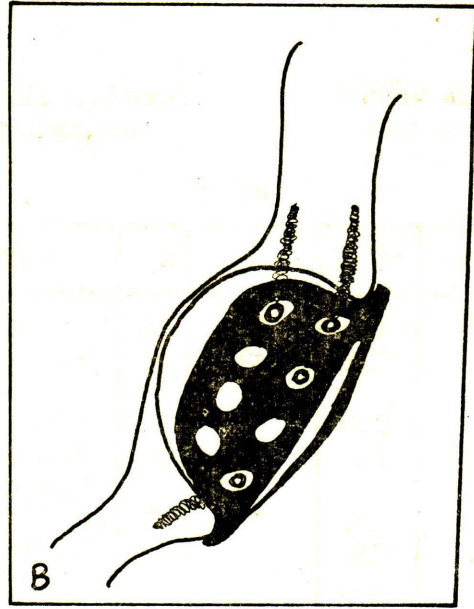
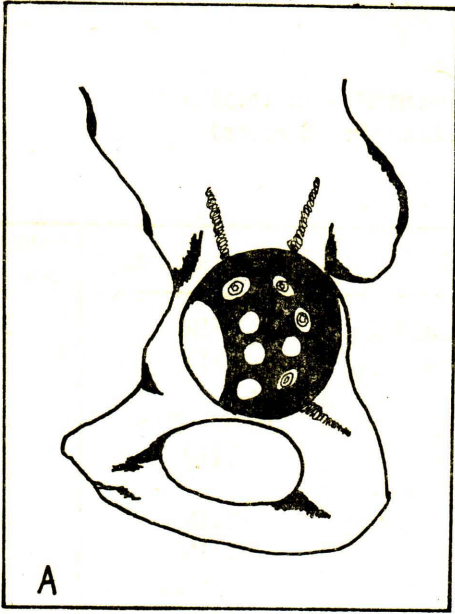
The prostheses used were

- Müller's total hip prostheses in 9 cases
- Double cup prostheses in 3 cases (case No. 3,7,10)

The Supporting ring used were

- the design of Müller's metal supporting rings

No. 44 mm. or 50 mm. (Fig. 1)



**Fig. 1** A. Drawing of Müller's acetabular supporting ring fixed to the ischial and iliac portions of acetabular wall with screws  
 B. Cross section  
 C. Picture shows the real metal acetabular supporting ring fixed to the acetabulum of a hemipelvic skeletal specimen.

### Indications

In the surgical management of acetabulum with compromise of the medial wall, the procedure varies with the severity of the problem. If the medial wall is thin but intact, one or more of the following reinforcement of the medial wall may be used: (Fig. 2)

- A) Bone graft covered with a thin layer of Gelfoam.
- B) Wire mesh.
- C) Acetabular cup of large diameter with extended flange that abuts against the margins of the acetabulum.

If the medial wall is grossly deficient, the supporting ring must be employed (Fig. 3)

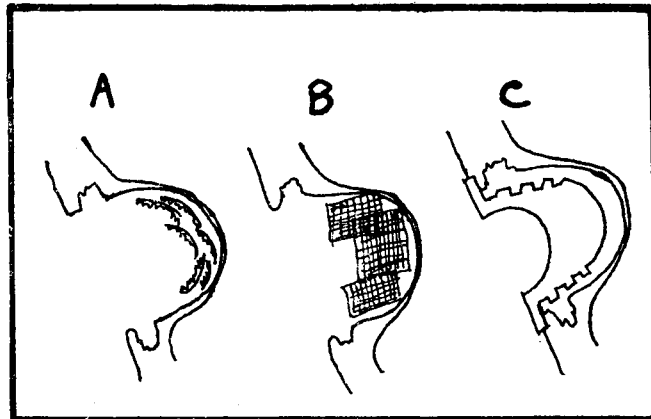


Fig. 2 Methods of reinforcement of the medial wall of acetabulum

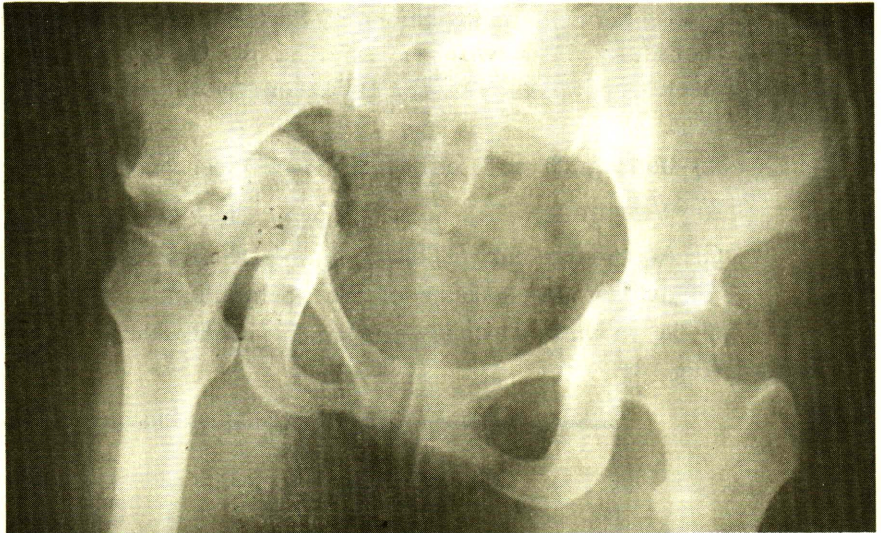
- A. Bone graft
- B. Wire mesh
- C. Large acetabular cup with flange

In certain intermediate cases, e.g., a case with a very thin medial wall that has several fracture lines running through it, the decision to use bone grafting alone, acetabular mesh, large acetabular cup with flange, or supporting ring will depend on such factors as the patient's age, weight, activity level, life expectancy, etc. In general, if the medial wall is seriously compromised, the supporting ring should be employed (Fig. 3 and 4)

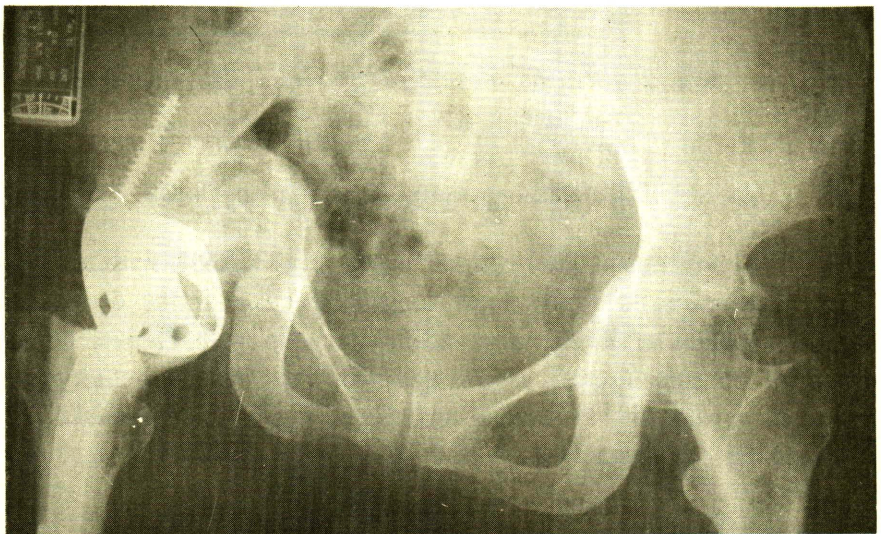
### Surgical Technique<sup>(12)</sup>

For proper insertion of the supporting ring, wide exposure was required to prepare the acetabular rim completely around the acetabulum and for excellent fixation of the supporting ring by the screws.



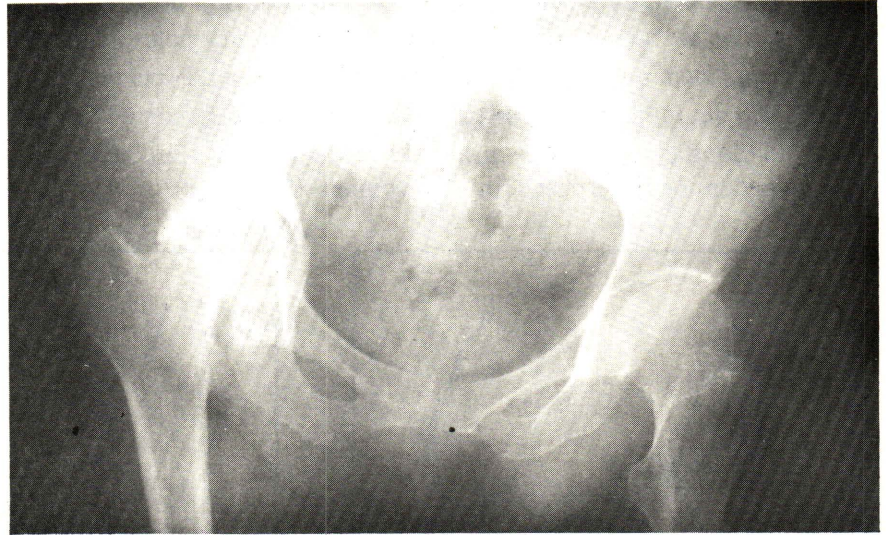


**Fig. 3 A** Anteroposterior roentgenogram of a patient with severe intrapelvic displacement of the femoral head and severe disruption of the acetabular wall resulted from old unreduced central fracture-dislocation on the right hip, also noted was the old acetabular fracture on the left.

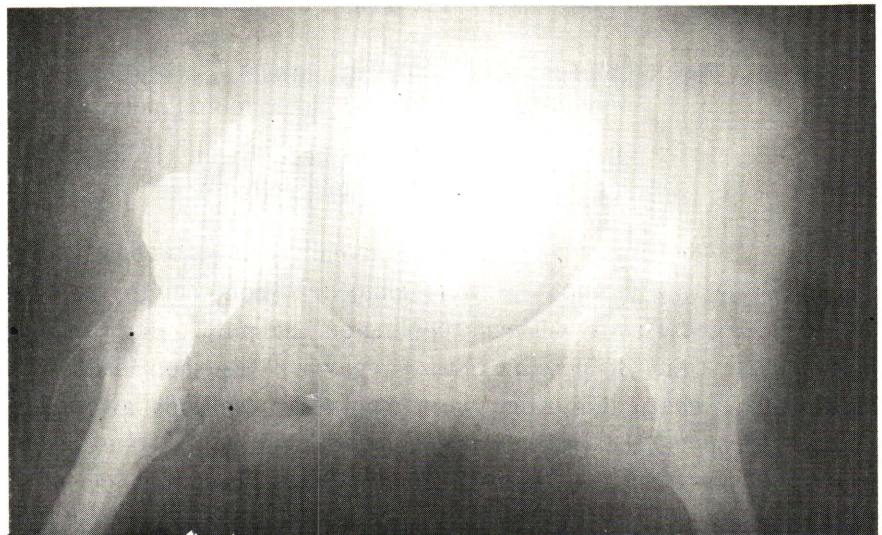


**Fig. 3 B** The use of the supporting ring plus a bone graft was essential for satisfactory management.



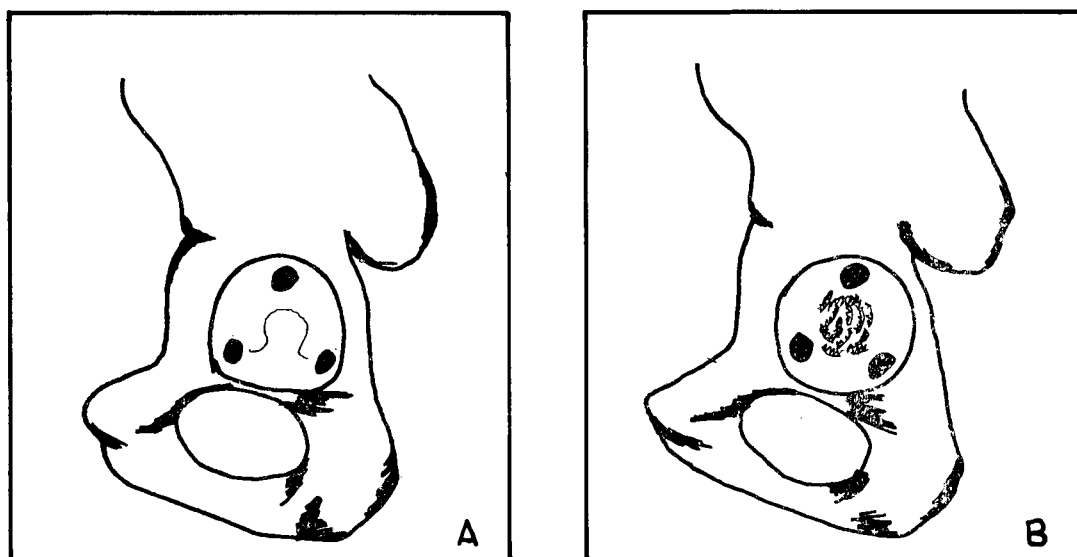


**Fig. 4 A** Anteroposterior roentgenogram of a rheumatoid arthritic patient with protrusio acetabuli of the right hip. The conventional total hip arthroplasty might cause acetabular component loosened and migrated.



**Fig. 4 B** Total hip arthroplasty was performed with supporting ring reinforcing the acetabular wall.

Once the socket was widely exposed, the bone at the base of the acetabulum was prepared by denuding the cartilage. It was important to have the maximum area of cancellous bone exposed and cleaned but no attempt should be made to deepen the weakened acetabular wall. Anchorage holes were made and undercut in the ilium, ischium and pubis. These holes should be confined to bone and not penetrate into the pelvis (Fig. 5 A). If the defect existed in the medial wall it was best to do this with bone grafts covered with a thin layer of gelfoam to prevent them becoming interposed in the cement (Fig. 5 B)



**Fig. 5 A.** Exposure of the acetabular cancellous portion and anchorage holes in the ilium, ischium and pelvis were made and undercut.

**B.** Central defect in medial wall if presents should be covered with bone graft and gelfoam.

The rim of the acetabulum had then be prepared to recieve the supporting ring. Projecting osteophytes were shaped to conform to the flange of the ring so that it rested firmly without toppling on the pubic, iliac and ischial portions of the acetabular rim. If possible, those regions of the bony rim of the acetabulum that came to a sharp thin ridge were trimmed to provide a broader base for the flange. Any defects in the medial wall were covered with bone graft so that maximum pressure could be obtained when the cement was introduced. The ring of proper size was selected (Fig. 6 A) and inserted for its seating and fixed with screws through the holes of the ring mainly into the thicken parts of ilium, ischium and occasionally the pubic part of the acetabulum.



Prior to mixing the cement, a trial position of the acetabular component was done (Fig. 6 B). Mixed the cement with the monomer using appropriate amount which might require two packs. Inserted the mixing cement into the well-prepared acetabular socket supporting with a ring and force into the anchorage holes. The acetabular component was forced into the cement and positioned in the desired angle of inclination and anteversion. Excess cement was trimmed, and everything was absolutely immobilized until polymerization was complete

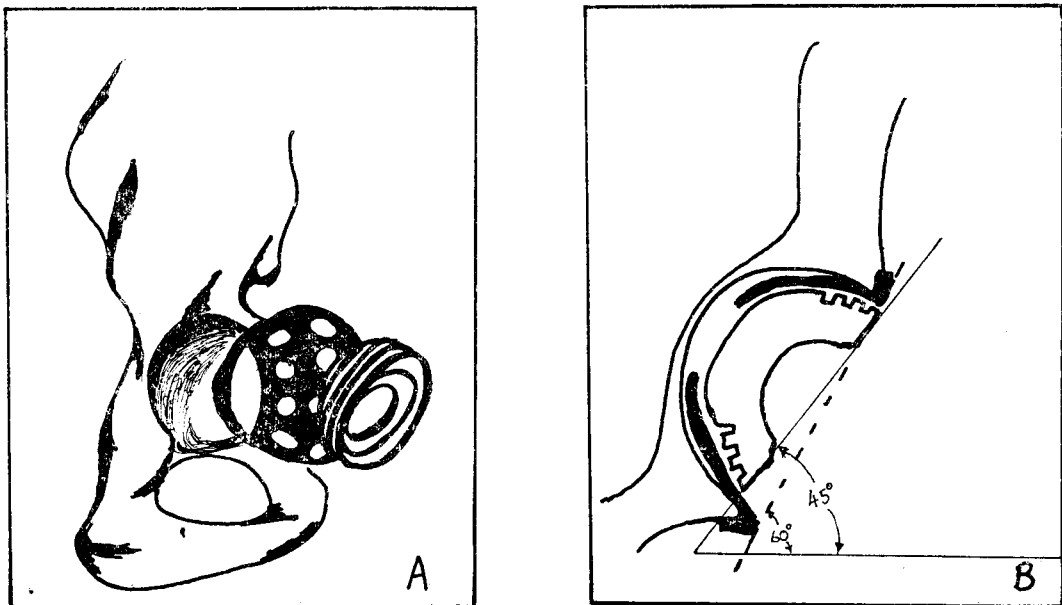


Fig. 6 A. Selection of the proper size supporting ring and acetabular component

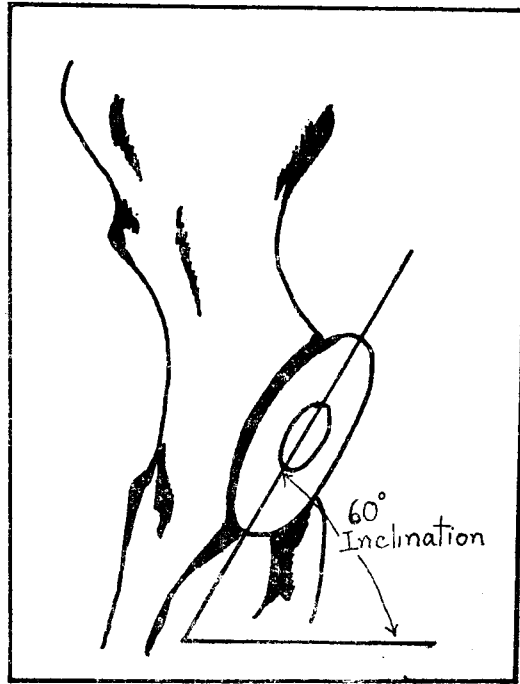
B. Trial position of the acetabular cup prior to fix with cement

### Mechanical Problems

The major problems were the inaccurate preparation of the acetabular rim and improper insertion of the ring.

The proper position of the supporting ring allowed the acetabular cup component to be adjustable for optimal angle of inclination and anteversion. If the flange of the supporting ring was to snugly contact the bony rim of the acetabulum, the ring had to put in an about 60° inclination (Fig. 7) which was a higher degree than that of the proper position for the acetabular cup component (45°). Whenever the acetabular cup component could not be adjusted to its proper angle of inclination and anteversion within the supporting ring it increased the risk of subluxation or dislocation of the femoral component. This could be accomplished by

wide exposure to prepare the acetabular rim completely around the acetabulum and using the proper size of the ring (Fig. 8)



**Fig. 7** If the flange of the supporting ring was to contact the bony rim of the acetabulum, the degree of inclination was increased to about  $60^\circ$ . The cup had to be in suitable size with the ring to be adjusted to make the  $45^\circ$  inclination.

#### Method of Evaluation

The patients were evaluated preoperatively and postoperatively using the method of result evaluation of Harris<sup>(6)</sup> This system assigns a maximum score of 100 points for :

I	Pain (44 points)	
	A. None or ignores it .....	44
	B. Slight, occasional, no compromise in activities .....	40
	C. Mild pain, no effect on average activities, rarely moderate pain with unusual activity, may take aspirin .....	30
	D. Moderate pain, tolerable but makes concessions to pain. Some limitation of ordinary activity or work. May require occasional pain medicine stronger than aspirin .....	20
	E. Marked pain, Serious limitation of activities .....	10
	F. Totally disabled, crippled, pain in bed, bedridden .....	0

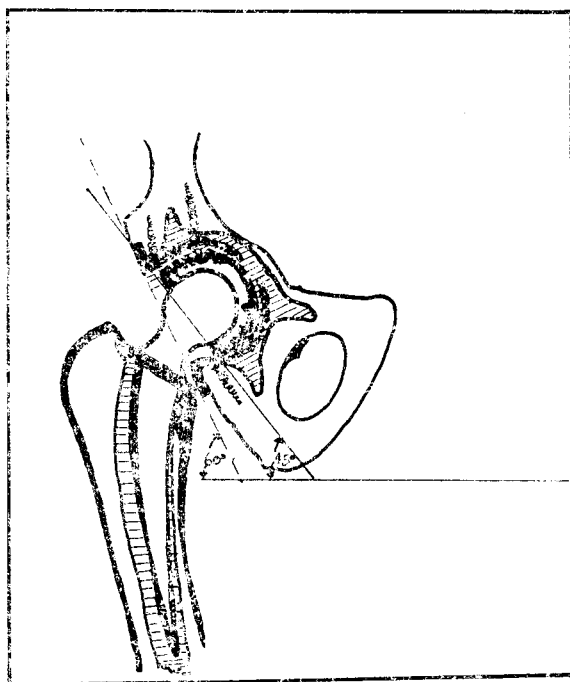


Fig. 8 Proper inclination angle of the cup was  $45^{\circ}$  whereas the inclination angle of the supporting ring was higher to make it conform to the rim of the acetabulum

II

Function (47 points)

A. Gait (33)

1. Limp

- |                   |    |
|-------------------|----|
| a. None .....     | 11 |
| b. Slight .....   | 8  |
| c. Moderate ..... | 5  |
| d. Severe .....   | 0  |

2. Support

- |  |    |
|--|----|
| a. None .....                              | 11 |
| b. Cane for long walk .....                | 7  |
| c. Cane most of the time .....             | 5  |
| d. One crutch .....                        | 3  |
| e. Two canes .....                         | 2  |
| f. Two crutches .....                      | 0  |
| g. Not able to walk (Specify reason) ..... | 0  |

## B. Activities (14)

1. Stairs	
a. Normally without using a railing .....	4
b. Normally using a railing .....	2
c. In any manner .....	1
d. Unable to do stairs .....	0
2. Shoes and Socks	
a. With ease .....	4
b. With difficulty .....	2
c. Unable .....	0
3. Sitting	
a. Comfortably in ordinary chair one hour .....	5
b. On a high chair for one-half hour .....	3
c. Unable to sit comfortably in any chair .....	0
4. Enter public transportation .....	1

## III. Absence of deformity points (4) are given if the patient demonstrates:

- A. Less than 30° fixed flexion contracture
- B. Less than 10° fixed adduction
- C. Less than 10° fixed internal rotation in extension
- D. Limb-length discrepancy less than 3.2 Cm.

## IV. Range of motion (index values are determined by multiplying the degrees of motion possible in each are by the appropriate index)

- |                          |  |
|--------------------------|--|
| A. Flexion 0-45° × 10    | C. External rotation in ext. 0-15° × 0.4 |
| 45- 90° × 0.6            | over 15° × 0                             |
| 90-110° × 0.3            | D. Internal rotation in ext. any × 0     |
| B. Abduction 0-15° × 0.8 | E. Adduction 0-15° × 0.2                 |
| 15- 20° × 0.3            |  |
| over 20° × 0             |  |

To determine the over-all rating for range of motion, multiply the sum of the index value × 0.05. Record trendelenburg test as positive, level, or neutral.

**Result.**

The over-all results at follow up in the twelve arthroplasties as determined by the method of result evaluation of Harris were summarized in the table II.



Table II. Functional hip score before and after operation

Case No.	Name	Functional Hip Score (max. 100 points)	
		Before operation	After operation
1	A.P.	21 (2/4/4/2)	88.3 (8/6/8/8)
2	C.P.	31.1 (2/4/4/2)	96.5 (10/8/10/8)
3	D.S.	33 (0/2/6/2)	89 (10/8/10/10)
4	T.P.	25 (0/4/2/4)	83.5 (8/6/8/8)
5	C.P.	54 (4/4/4/6)	76 (8/6/8/8)
6	C.S.	43 (2/2/4/6)	82.9 (10/8/8/8)
7	A.T.	27 (2/0/6/6)	79.25 (10/4/8/8)
8	S.R.	26 (2/2/4/4)	83.5 (8/6/6/6)
9	K.T.	31.5 (0/4/4/4)	91.25 (10/6/8/8)
10	A.K.	42 (2/0/4/2)	81.95 (8/6/8/8)
11	F.L.	21 (2/4/4/2)	88.3 (8/6/8/8)
12	R.T.	25 (0/2/6/2)	83.5 (8/6/8/8)

### Discussion

A successful total hip arthroplasty is difficult in the deficient medial acetabular wall and the osteoporotic bone which makes adequate cement fixation uncertain.

Harris and Jones<sup>(5,6)</sup> have described the use of wire mesh to reinforce the cement over the medial wall. Later they suggested femoral head bone grafting for severe acetabular deficiency. Charnley, et al published results of total hip arthroplasty in patients with this condition with follow up of longer than five years to be satisfied in whom none of the bone graft or wire mesh were used. They simply placed more than one pack of cement in the acetabulum.<sup>(15)</sup>

Furthermore, to the best of our knowledge, there have not been any reports published in the English literatures about the results of the use of the supporting ring. The only informative report about this supporting ring was confined to the design and the surgical technique booklets.

Of the twelve hips operated on in our series, all are rated as successful result, in respect to the function and pain relief without any failures of the acetabular component with the average follow up period of 4 years.

### Summary

Total arthroplasty in the hips with major deficiencies of the medial wall of the acetabulum caused by previous trauma, old infection, rheumatoid arthritis or tumor, etc. threatens to the acetabular failure. This can be prevented by the special technique in reconstruction of the acetabulum in total hip arthroplasty using a metal supporting ring. The early results have been very satisfactory. The immediate and late complications have been in no way different from those in ordinary cases performed in this hospital.

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