

Results

Representative cases

RESULTS

* Preoperative, clinical, radiological and laboratory findings:
 * Clinical presentation:

(1) Age and Sex:

Table (7) : Age and sex distribution of the studied patients:

Age (Years)	Males		Females		Total	
	No.	%	No.	%		
6-9+	10	58.8%	2	66.7%	12	60%
	7	41.2%	1	33.3%	8	40%
Total	17	100%	3	100%	20	100%

Adjusted $\chi^2 = 0.147$

$P > 0.05$ (insignificant).

(2) Pain:

The pain was localized to the affected hip region in 12 cases, to the knee region of the same side in 2 cases, and in both the hip and knee regions in 6 cases.

It was difficult to assess the severity of pain but the pain was worsened by exertion and at the end of activity in all patients.

(3) Limping:

It was the prominent complaint in all cases.

The movement limited		
Abduction	20	100%
Internal rotation	20	100%
External rotation	8	40%
Flexion	4	20%
Extension	4	20%
Adduction	3	15%
No. of hips		Percentage %

Table 8: Limitation of hip movements.

(4) Range of motion:

Abduction and Internal rotation were found to be limited in all cases.

The abduction was limited with varying degrees, it ranged between 30° and 20° with a mean of $24.8^\circ \pm 4.7^\circ$.

The internal rotation ranged between 30° and 10° with an average of $18.4^\circ \pm 6.5^\circ$.

External rotation was limited in 8 hips only. It varied between 45° and 20° with an average of $35.25^\circ \pm 8^\circ$.

Adduction was limited in only 3 hips. Flexion was full in most of cases, but was restricted in 4 cases. Extension range was restricted in 4 cases in which flexion deformity between 20° and 30° was present.

cases.

Group II were 11 cases, group III were 6 cases and group IV were 3 cases. According to Catterall's classification of the degree of epiphyseal involvement, the cases selected were group II, III, IV.

Catterall grouping:

* Radiological findings:

cases.

Wasting of the gluteal and thigh muscles was found in all

(7) Muscle wasting:

Trendelenburg's test was positive in only 2 cases.

(6) Trendelenburg's test:

Light antalgic gait was present in early cases. Trendelenburg's gait was present in cases with positive Trendelenburg's test.

(5) Gait:

Limb length inequality was ranging between $\frac{1}{4}$ cm and 2 cm.

(4) Limb length discrepancy:-

Head at risk	No. of cases	Percentage (%)
Lateral subluxation	19	95%
Lateral calcification	12	60%
Metaphyseal cysts	10	50%
Gage sign	2	10%

Table (10) : Incidence of head at risk signs.

Head at risk signs:

Lateral subluxation was the common sign in most cases and it was the main indication for surgical interference. The lateral subluxation was detected by measuring the center-edge angle and comparing the medial joint space with the normal side (Head-tear drop distance). The other commonly detected at risk signs were calcification lateral twthe epiphysis and wtaphyseal cysts. Gage sign was present in only two cases.

Group	No. of hips	Percentage (%)
I	0	0%
II	11	55%
III	6	30%
IV	3	15%
Total	20	100%

Table (9) : Catterall grouping:

C - E angle of Wiberg:

Pre-operatively, the lowest angle was 13 degrees while the highest angle was 20°, with an average of 17.9 ± 2.5 .

	Highest	Lowest	$\bar{X}$	$\pm S.D.$
C-E angle	20°	13°	17.9°	2.5°

Table (11): Pre-operative C - E angle of Wiberg.

Epiphyseal extrusion index:

The epiphyseal extrusion index, was ranged between 16 and 46 with an average of 21.8 ± 7.5 .

Table (12) : Epiphyseal extrusion index.

	Highest	Lowest	$\bar{X}$	$\pm S.D.$
Epiphyseal extrusion index	46	16	21.8	7.5

* Laboratory findings:

Routine biochemical investigations were negative except for the erythrocyte sedimentation rate, which was slightly raised in a few cases.

Results of the work

The patients were examined clinically and radiologically at the follow up visits until the end of follow up period for every child.

On the follow up visits the patients were asked about their

Limping:

The limping was progressively improving as the period of follow up had been long.

Pain:

At the time of the latest follow-up, occasional episodes of hip pain was present in only 2 cases. In none of the patients was the pain functionally disabling.

* Clinical results:

Duration of follow up (in months)		S.D.	±	$\bar{X}$
Minimum	Maximum			
7	47	12.5		28.2
Range				

Table (13) : $\bar{X} \pm S.D.$ and range of follow up period (in months).
Ranging from 7 to 47 months, with an average of 28.2 ± 12.5 months.

The patients were followed-up after operation for periods and lateral frog positions.

Radiographic evaluation was also carried out using both A-P and lateral frog positions.

The patients were examined clinically to detect the range of motion, the limb - length discrepancy and Trendlenburg's test and gait.

complaint mainly the pain and limping.

Range of motion:

There was a marked improvement in the range of motion of the affected hip joints. Both abduction and internal rotation, which were limited in all patient preoperatively, are significantly improved at the last follow up ($P < 0.01$).

The average value of external rotation is significantly reduced following femoral and combined femoral and innominate osteotomies ($P < 0.05$).

Table (14) : $\bar{x} \pm S.D.$ of the range of motion pre and post-operatively.

Movement	$\bar{x} \pm S.D.$		t	p
	pre-operatively	post-operatively	Paired	
Abduction	24.8° $\pm$ 4.7°	33.0° $\pm$ 6.9°	4.616	<0.01
Int-rotation	18.4° $\pm$ 6.5°	35.8° $\pm$ 11.4°	5.999	<0.01
Ext-rotation	35.3° $\pm$ 8.0°	30.5° $\pm$ 9.3°	2.702	<0.05

The patients were graded as good, fair and poor results on clinical bases as given before. Accordingly the studied patients were evaluated clinically as shown in table (15).

Table (15) : Clinical evaluation of the studied patients at the end of the follow up period versus the type of osteotomy.

Clinical Results	No.	%	Innominate	No.	%	Combined	No.	%
Good	11	68.7%	1	50%	0	0	12	60%
Fair	3	18.8%	1	50%	1	50%	5	25%
Poor	2	12.5%	0	0%	1	50%	3	15%
Total	16	100%	2	100%	2	100%	20	100%

Limb length discrepancy:

Table (16) : Patient distribution according to type of Osteotomy versus leg-length discrepancy:

Leg Length discrepancy	Femoral	Innominate	Combined	Total
	No.	No.	No.	No.
0 -	6	2	0	8
1 -	8	0	2	10
2 +	2	0	0	2
Total	16	2	2	20
	37.5%	100%	0%	100%
	50%	0%	100%	50%
	12.5%	0%	0%	10%

The maximum amount of shortening was 2 cm and the minimum amount of shortening was 0 cm

The maximum amount of shortening was 2 cm and the minimum amount of shortening was $\frac{1}{2}$ cm following femoral and combined osteotomies. The shortening not exceeded 1 cm following innominate osteotomy.

Trendlenburg's test		+ ve		- ve		Total	
Femoral	No.	%	No.	%	No.	%	Total
	Innominate						
	2	100%	2	100%	1	50%	2 100%
	0	0%	1	50%	3	15%	17 85%
							20 100%
Combined		Total					

at the latest follow up:

Table (18) : + ve Trendlenburg's test versus the type of osteotomy
 Trendlenburg's test preoperatively.
 at the time of the diagnosis. The 3 patients had negative
 osteotomies. All of the three patients were more than 9 years old
 Trendlenburg's sign. Two of the patients had had a femoral
 At the latest follow-up, 3 patients had a positive
 Trendlenburg's test:

shortening osteotomy	$\bar{X}$	$\pm$ S.D.	Femoral	Innominate	Combined
	1.00	0.52	0.50	1.25	0.35
			0.00		

Table (17) : $\bar{X} \pm$ S.D. of shortening at the end of the follow up
 period:

*** Radiological assessment:**

The following radiological measures were chosen to assess the results:

Center - edge (C-E) angle:

The center-edge angle of Wiberg markedly improved post-operatively and at the end of follow-up in comparison with the pre-operative values indicating improvement in the coverage of the head (fig. 87) ($P < 0.01$).

Table (19) : Comparison of C-E angle of Wiberg pre-operatively and at the end of follow up period.

C-E angle	time	Pre-operative			At the last follow up	
		$\bar{X}$	$\pm$ S.D.	Lowest	Highest	Range
		17.9°	2.5°	13°	20°	30°
		25°	4.6°	18°		

Paired $t = 7.575$

$P < 0.01$ (highly significant).

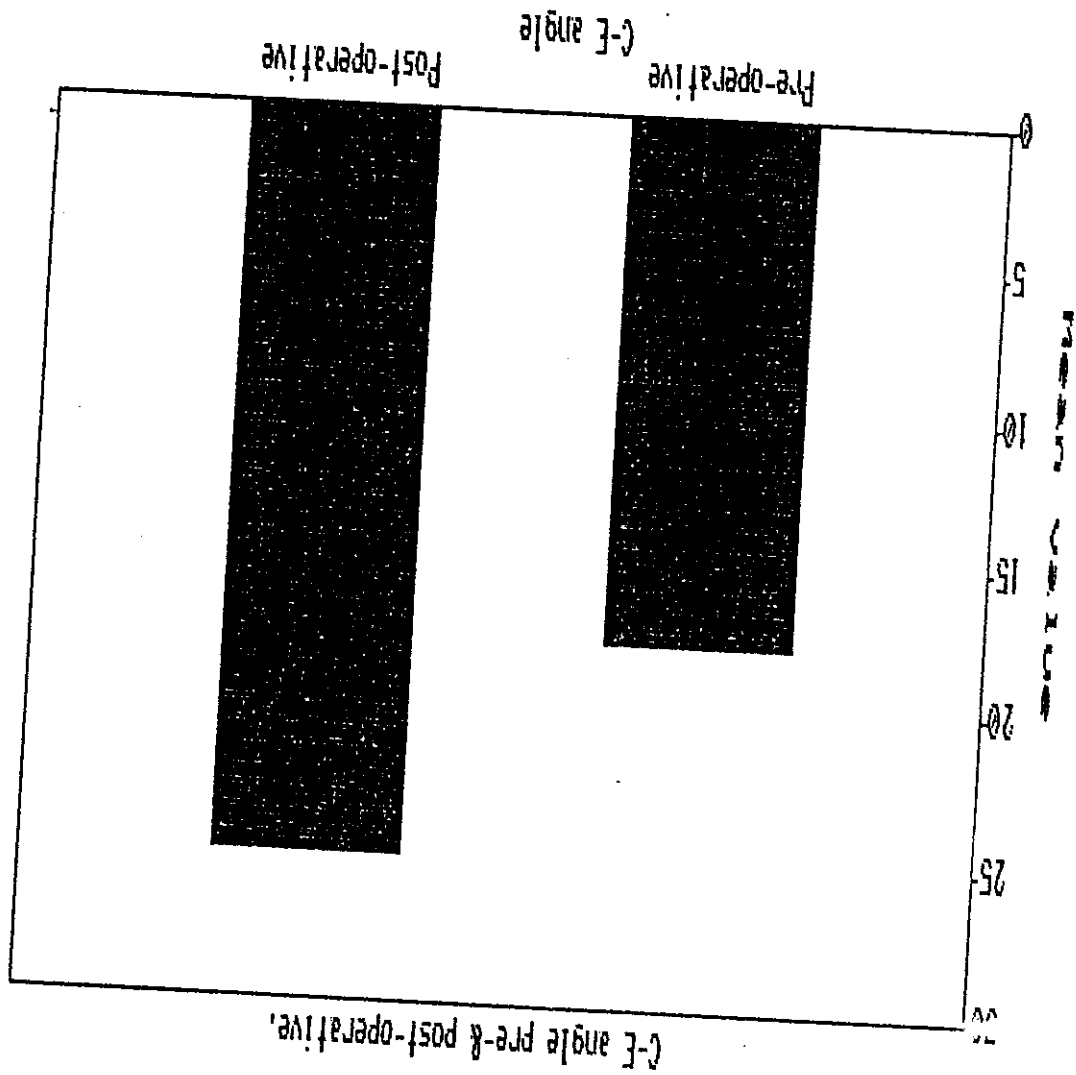
In the 20 hips operated upon, the average angle before the operation was 17.9° (poor), while the average angle after treatment was 25° (good).

Mose template rating:

According to the method of measuring the sphericity of the femoral head using the concentric circles method (Mose template), the following results were obtained:

Mean value of the C-E angle of Wiberg pre and post-operatively.

Fig. 87



latest follow up:

The articulothrochanteric distance (ATD) was measured at the

The articulothrochanteric distance:

Mose rating	No. of cases	Percentage %
Good	10	50%
Fair	7	35%
Poor	3	15%
Total	20	100%

Table (21) : Results of operative containment versus Mose rating.

Mose rating	Femoral		Innominate		Combined	
	No.	%	No.	%	No.	%
Good	9	56%	1	50%	0	0%
Fair	5	31%	1	50%	1	50%
Poor	2	13%	0	0%	1	50%
Total	16	100%	2	100%	2	100%

Mose rating.

Table (20) : Hip distribution according to type of osteotomy versus

test.

in patients with ATD of 5mm or more had a positive Trendlenburg's test. In patients with ATD less than 5mm was 75% while none of the

Trendlenburg's test		ATD		s clear that the incidence of positive Trendlenburg's test is			
		+ ve		- ve		Total	
		No.	%	No.	%	No.	%
< 5	3	75%	1	25%	4	100%	
	0	0%	16	100%	16	100%	
Total		3	15%	17	85%	20	100%

Trendlenburg's Test versus ATD.

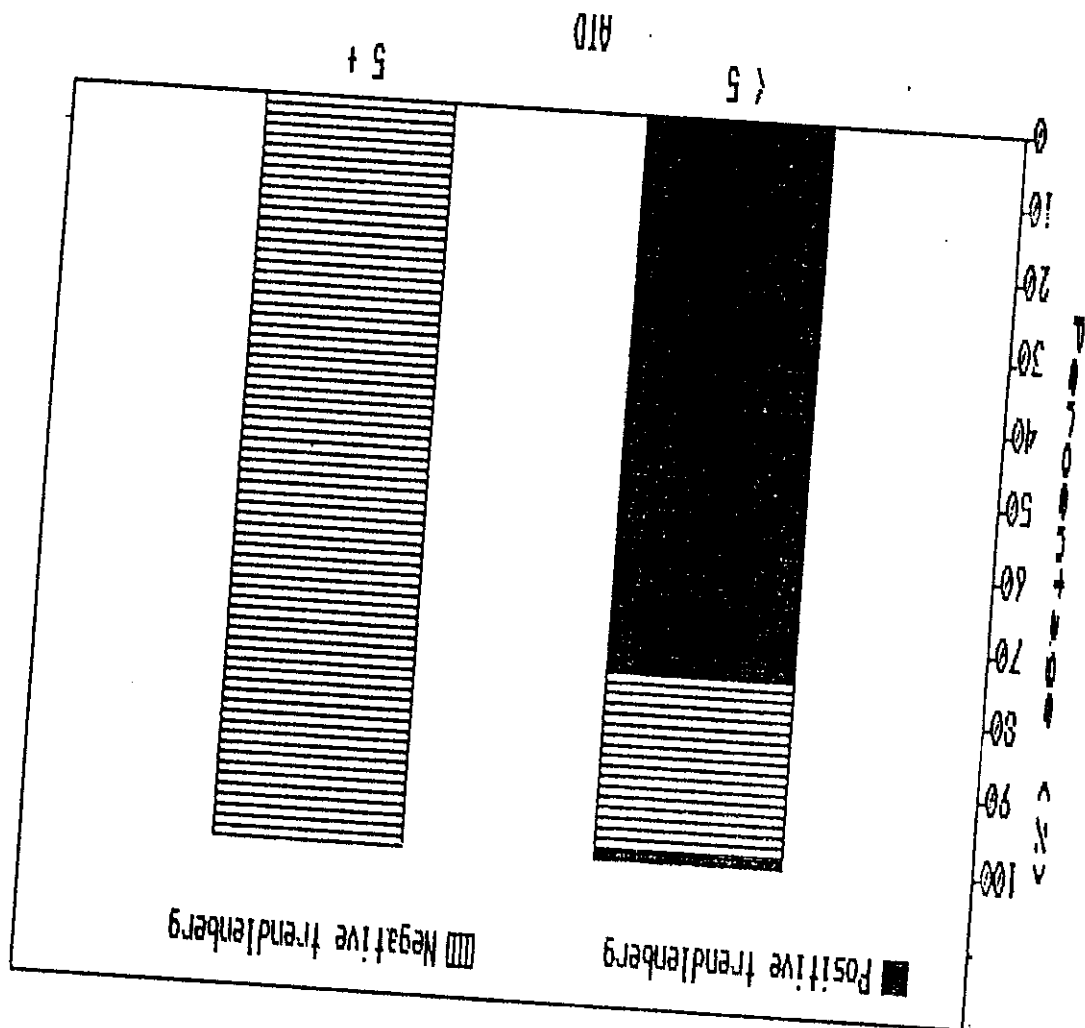
Table (23) : Distribution of the studied patients according to positive Trendlenburg's test in patients with ATD less than + 5 mm (fig. 88).

ATD (m.m)		Femoral		Innominate		Combined		Total	
		No.	%	No.	%	No.	%	No.	%
< 0	0	0%	0	0%	1	50%	1	5%	
	3	18.7%	0	0%	0	0%	3	15%	
	13	81.3%	2	100%	1	50%	16	80%	
Total		16	100%	2	100%	2	100%	20	100%

Analysis of our results provide a higher percentage of
five Trendelenburg's test in patients with

Table 22: Hip distribution according to the type of osteotomy versus ATD:

Fig. 88 Distribution of the studied potients according to the ATD and Trendlenburg's test.

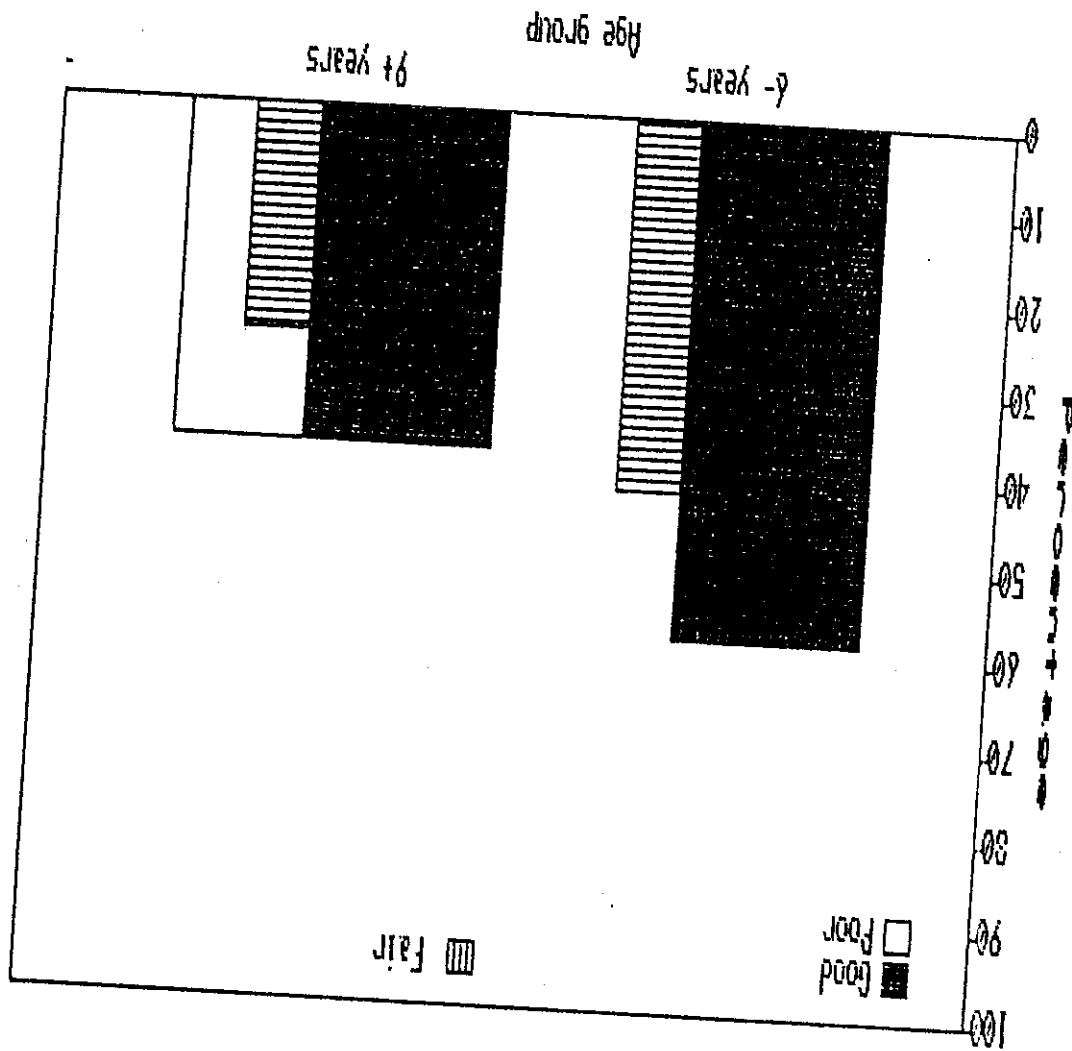


(2) Catterall grouping:
Analysis of the results revealed that good results were higher in Catterall group II patients and least in Catterall group IV. In contrast poor results were higher in Catterall group I patients (fig. 90).

Age (Years)	No. of hips	Good			Fair			Poor		
		No.	%		No.	%		No.	%	
6-	12	7	58.3%		5	41.7%		0	0%	
9+	8	3	37.5%		2	25%		3	37.5%	
Total	20	10	100%		7	100%		3	100%	

osteotomies.
Table (24): Effect of age on the results of containment outcome of the first group patients was much better (fig. 89).
The second group consists of patients aging 9 years or more. The including patients whose ages ranged from 6 years to 9 years, and The cases were distributed in 2 groups, the first group (1) Age:
Factors:-
and combined osteotomies were found to be affected by the following
The results of operative containment by femoral, innominate
Analysis of the results in relation to the prognostic factors:

Fig. 89
Distribution of the studied patients according to the age and the radiological outcome of containment osteotomies.



Distribution of patients according to Catterall grouping and the radiological outcome.

Fig. 90

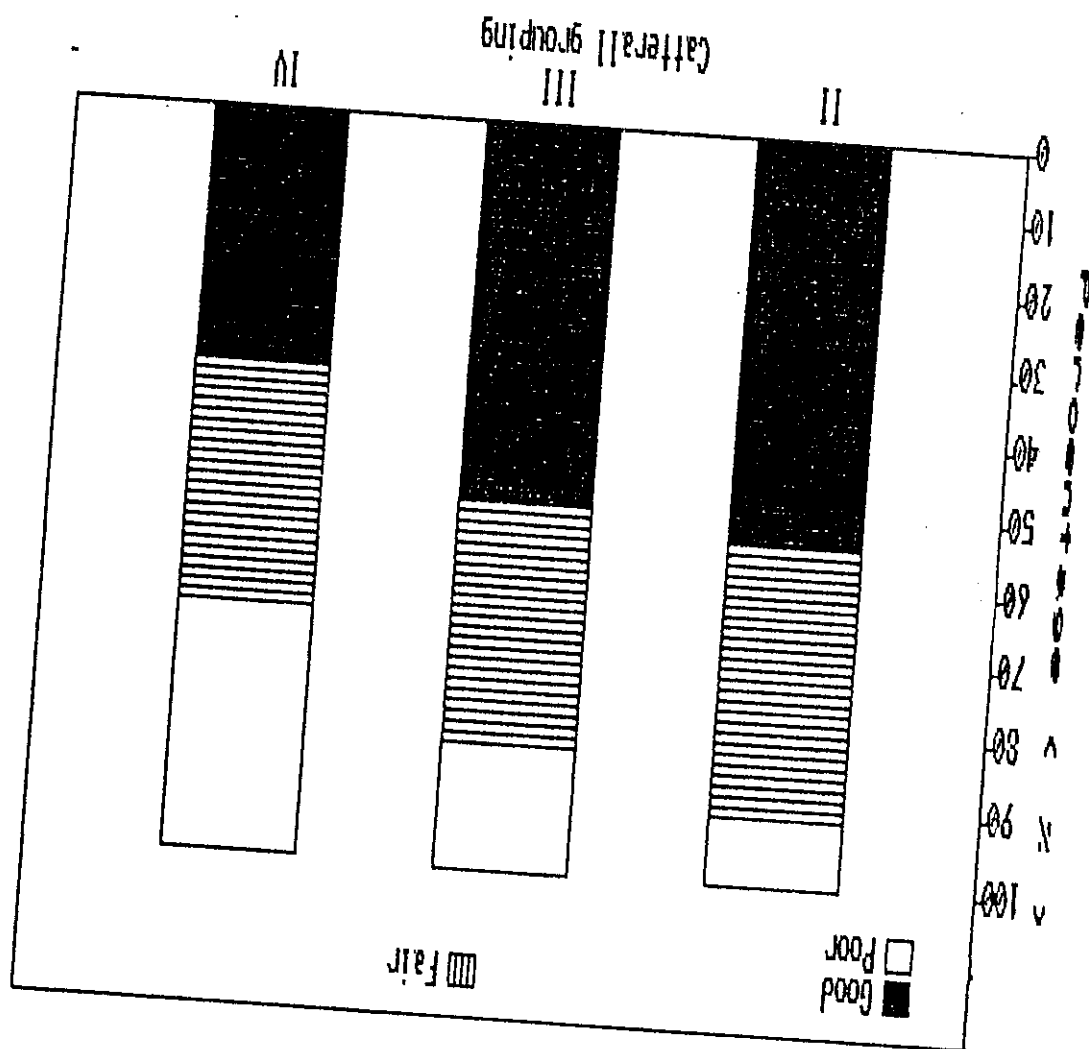


Table (25): The relation between Catterall grouping and the final outcome of osteotomies.

Catterall group	No. of hips	No.			No.	%
		Good	Fair	Poor		
II	11	6	4	1		
III	6	3	2	1		
IV	3	1	1	1		
Total	20	10	7	3		
		54.5%	36.4%	9.1%		
		50%	33.3%	16.7%		
		33.3%	33.3%	33.3%		
		100%	100%	100%		

Epiphyseal extrusion index:
When we analyzed epiphyseal extrusion, we found that the greater the extrusion, the poorer the prognosis (fig. 91).
Table (26): Epiphyseal extrusion index versus the outcome of osteotomies.

Epiphyseal extrusion index	No. of hips	No.			No.	%
		Good	Fair	Poor		
< 20	13	8	5	0		
> 20	7	2	2	3		
Total	20	10	7	3		
		61.5%	38.5%	0%		
		28.5%	28.5%	43%		
		100%	100%	100%		

When the epiphyseal extrusion was less than 20%, the results were 62% good, 38% fair. Whereas in the presence of more than 20% extrusion, the results were good in 28.5%, fair in 28.5%, and poor in 43%.

Distribution of the studied patients according to the epiphyseal extrusion and the result of operative containment.

Fig. 91

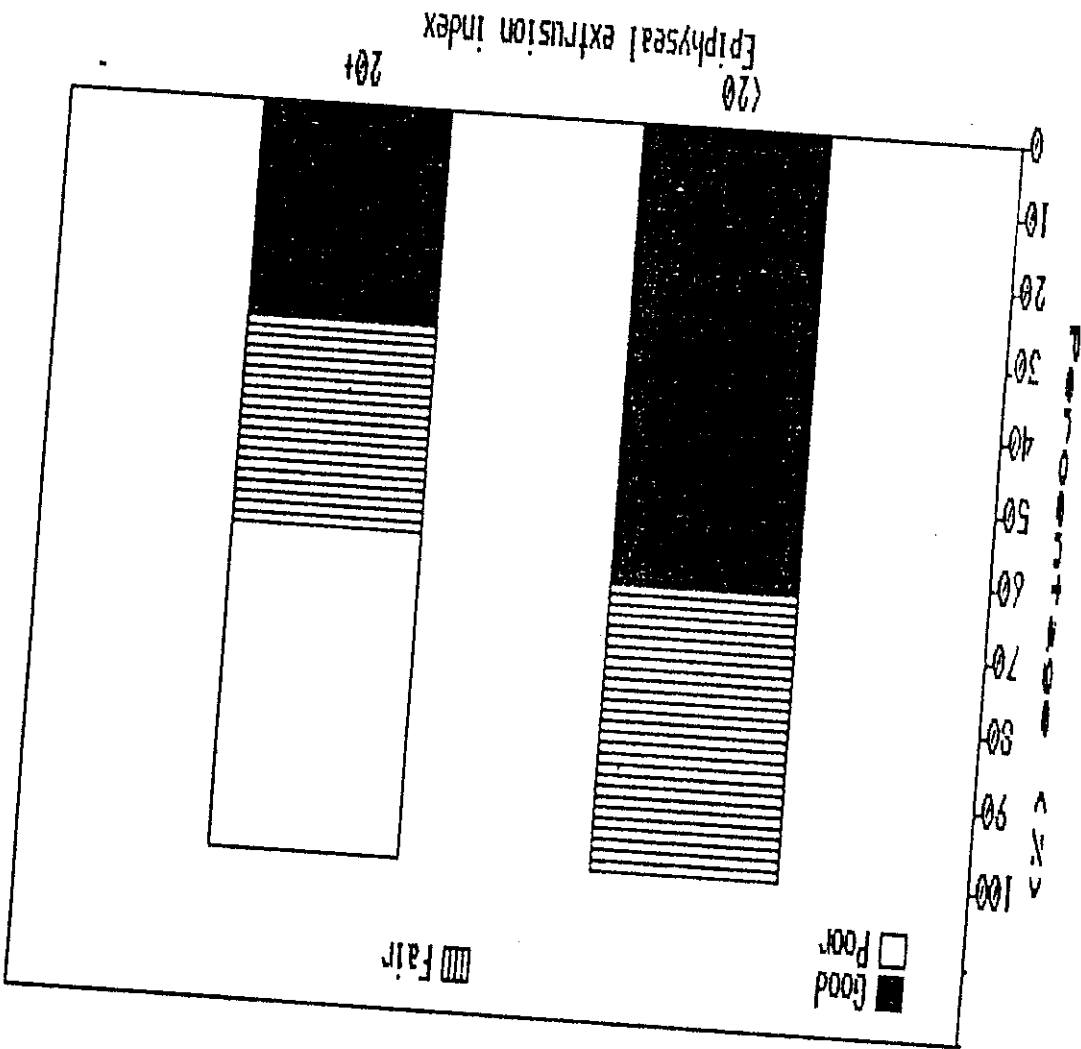


Table (27) shows a negative relationship between age, epiphyseal extrusion index as well as Catterall grouping and the outcome of containment osteotomies.

Table (27): Correlation - Coefficient(r) and probability value (p) of the factors related to the outcome of containment osteotomies.		
Age (Years)	Epiphyseal extrusion index	Catterall grouping
	- 0.476	- 0.558
	- 0.320	< 0.05
		< 0.05
		< 0.05
	r	p

REPRESENTATIVE CASES



A



B

Fig. 92

Male child aged 6 years.

(A) Initial anteroposterior radiograph: Left hip showing:

-- lateral group IV -- head at risk signs: lateral subluxation and metaphyseal reaction. The patient

was treated by FVDO.

(B) Clinical outcome: good.

The patient had good range of motion, shortening $\frac{1}{2}$ cm and negative Trendelenburg's test.

Good result (Mose).

C-E angle = 28°

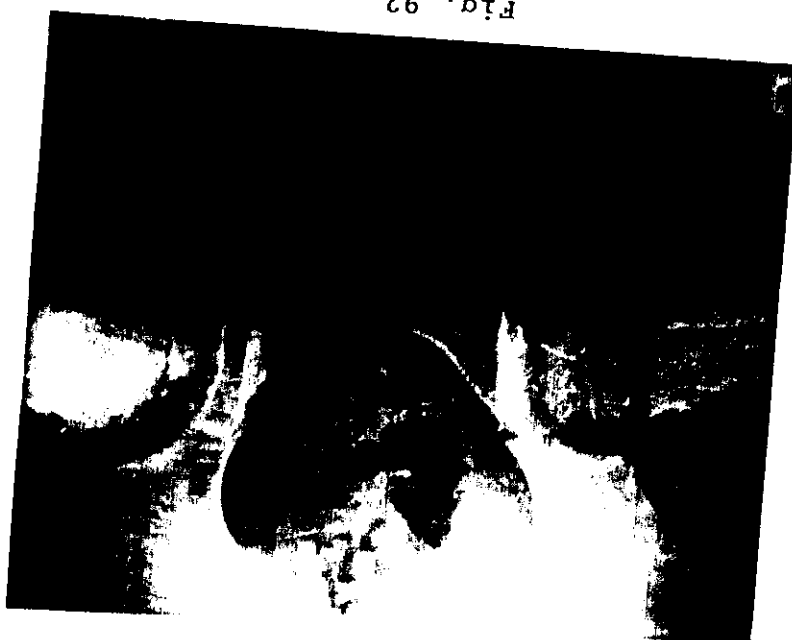
ATD=9mm.

The head is well contained.

FVDO showing:

(C,D) Anteroposterior and lateral radiographs 43 months after

Fig. 92



D



C

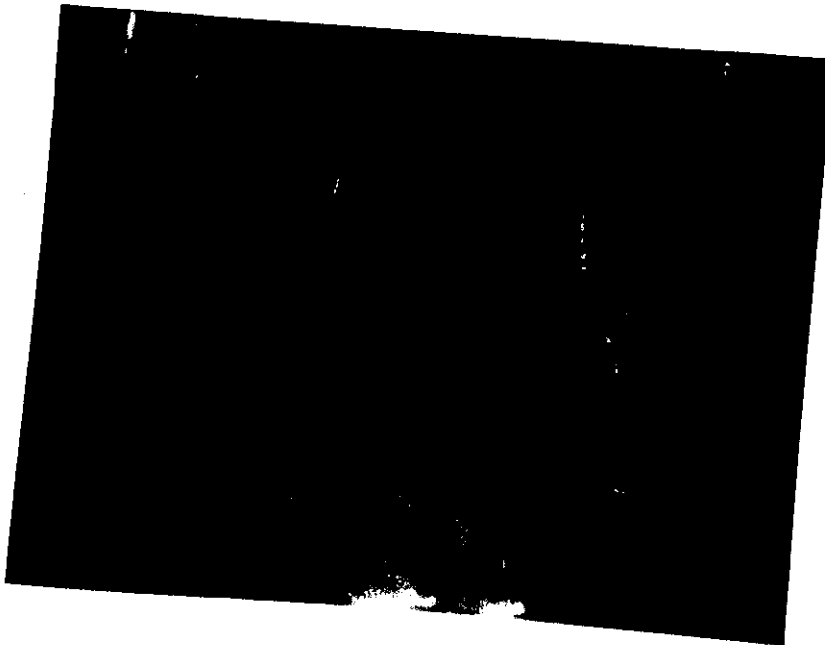
Male child aged 7½ years.

(A) Anteroposterior radiograph (preoperative) showing:
 - Catterall group II. - 2 head at risk signs: well-defined metaphyseal cyst and horizontal growth plate.
 - The patient was treated by FVO.
 (B) Clinical outcome : good, good range of hip movements, shortening= ½ cm, and negative Trendelenburg's test.

Fig. 93



B



A

Good result (Mose).

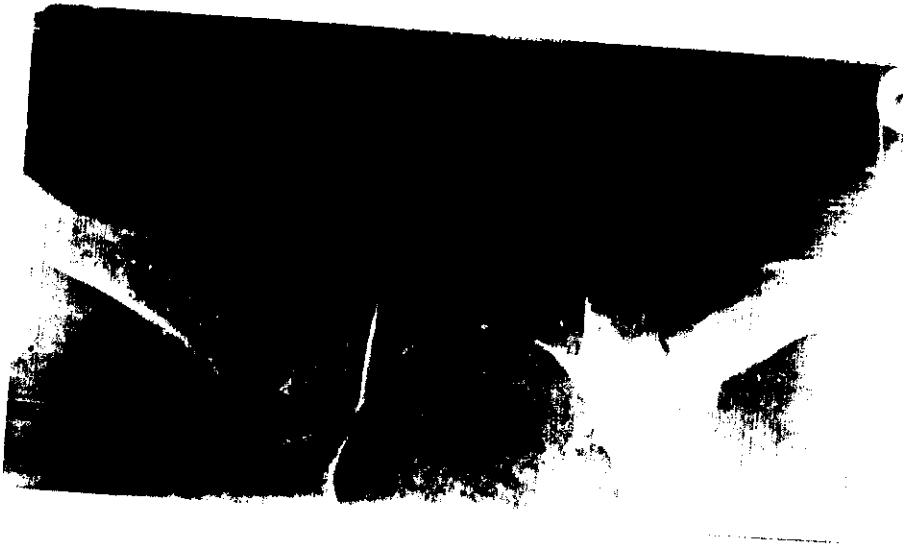
- C-E angle = 28° .

- The left femoral head is well contained.

after FVDO showing:

(C and D): Anteroposterior and lateral radiographs 24 months

Fig. 93



Male patient aged 9 years.
 (A) Preoperative anteroposterior radiograph showing:
 Catterall group III. - 3 head at risk signs: Lateral subluxation, metaphyseal reaction and
 classification lateral to the epiphysis.
 - The patient was treated by FVDO.
 (B) Clinical outcome: good. The patient has good range of right hip movement, shortening: 4cm and
 negative Trendelenburg's test.

Fig. 94



A

B

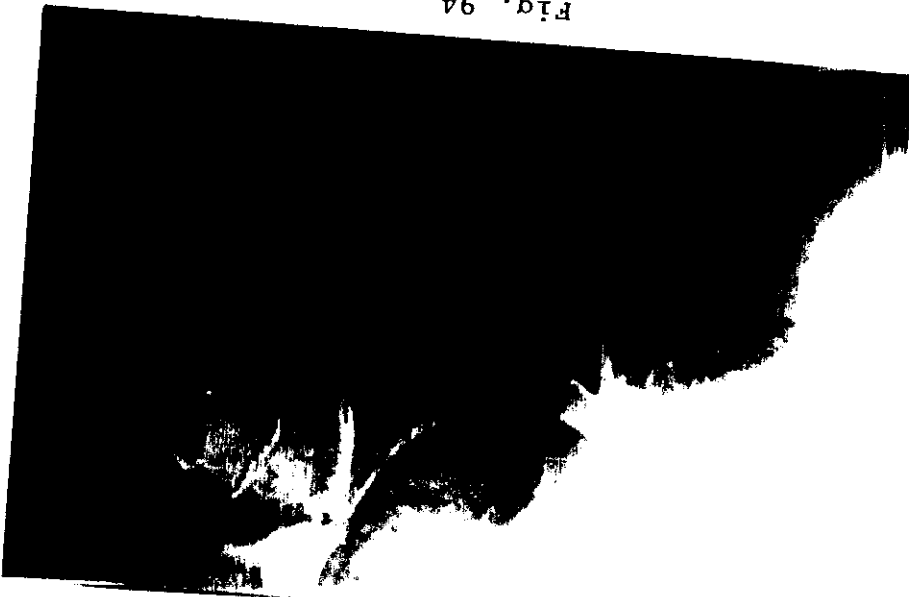
Good result (Mose).

- C-E angle = 22°.
- The right femoral head is well contained.
- ATD = 8 mm.

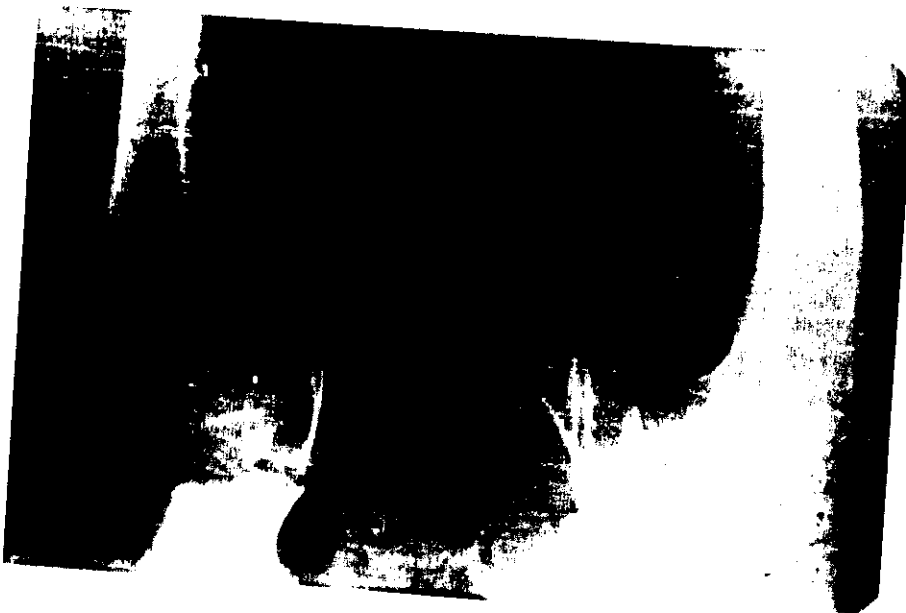
after FVDO showing:

(C and D): Anteroposterior and lateral radiographs 32 months

Fig. 94



D



C

- Shortening: 1cm, and negative Trendelenburg's test.
- (B) Clinical outcome : good, good range of right hip movement.
- The patient was treated with FVDO.
- epiphysis.
- Catterall group III. - 2 head at risk signs: lateral subluxation and clacification lateral to the
- (A) Anteroposterior radiograph (pre-operative) showing:
- A male child aged 10½ years.

Fig. 95



B

A

- Good result (Mose).

- C-E angle = 30°.

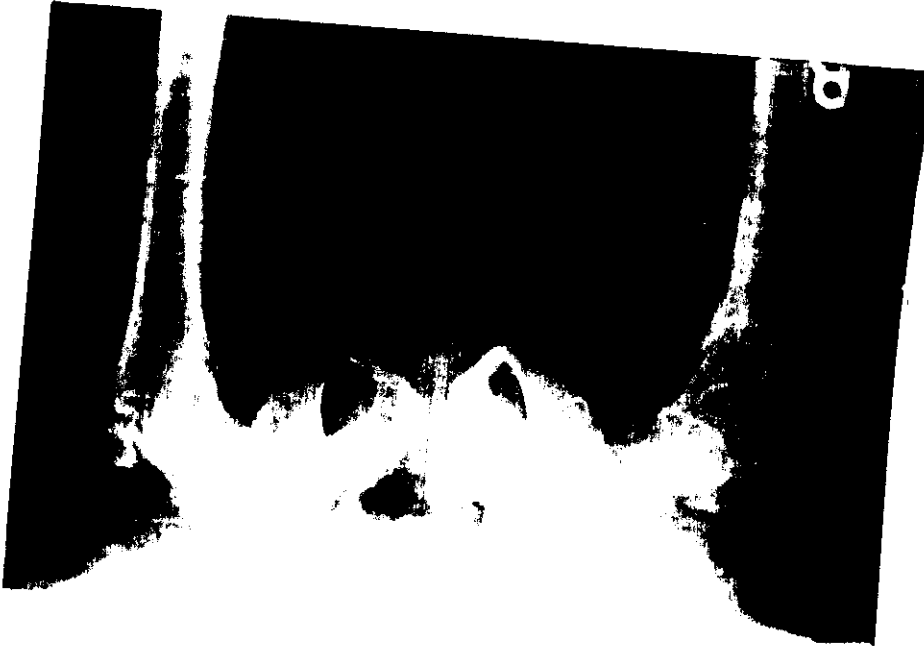
ATD = 5mm.

- The right femoral head is well contained.

after FVDO showing:

(C and D): Anteroposterior and lateral radiographs 16 months

Fig. 95



C

D

A male child aged 7 years.
 (A) Pre-operative anteroposterior radiograph showing:
 Catterall group II. - 2 head at risk-signs: Lateral subluxation and metaphyseal reaction.
 - The patient was treated by FVDO.
 (B) Clinical outcome : fair.
 The patient had a fair range of hip movement with limitation of
 external rotation of the right hip,
 shortening: 1 cm and Negative Trendelenburg's test.

Fig. 96



B

A

Fair result (Mose).

C-E angle = 28°

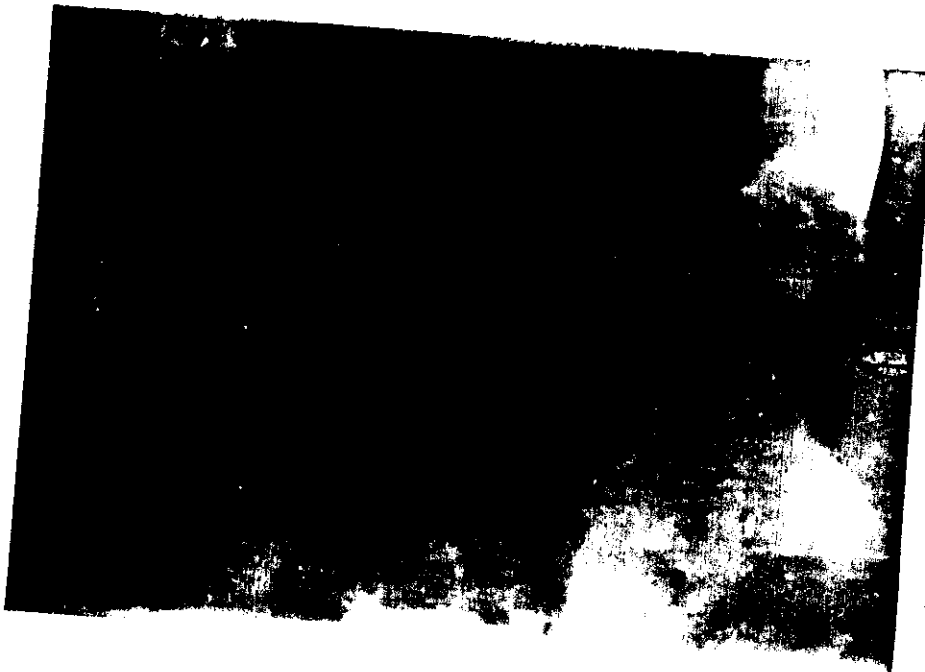
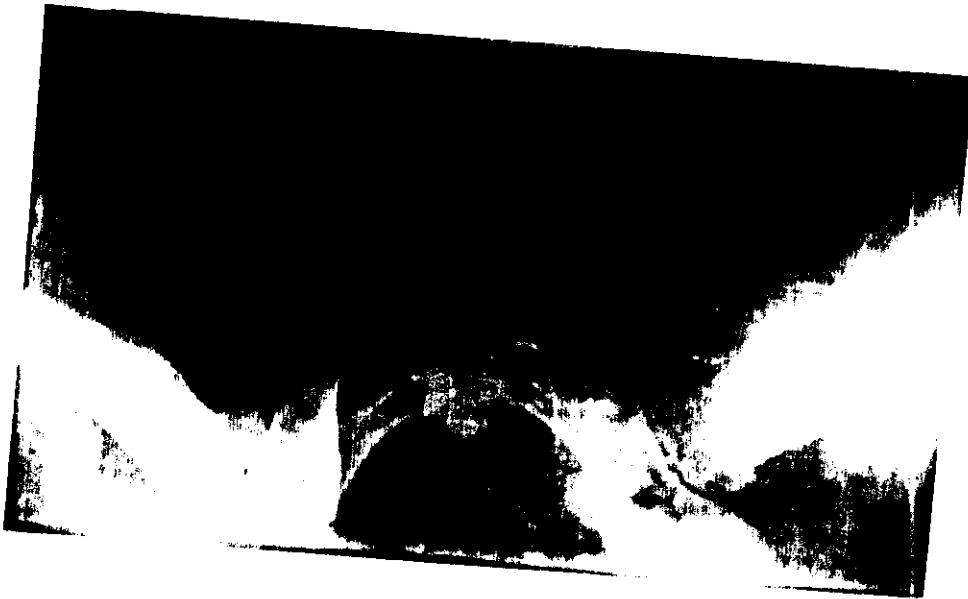
The head is well contained.

after RVDO showing:

(C and D :) Anteroposterior and lateral radiographs 12 months

Fog. 96

ATD=9mm.



- showing that the right head was well contained.
- (B) Post-operative A-P radiograph after removal of cast
- The patient was treated by FVDO.
- subluxation and Gage's sign.
- Catterall group II. - 2 head at risk signs: Lateral
- (A) Pre-operative anteroposterior views showing:
- A male child aged 10 years.

Fig. 97



B

A

(head was well contained and C-E angle was 28°).

obtained in spite of the good immediate post-operative results which may explain the poor clinical and radiological results (pre-operatively) was large (23) in addition to the age factor

♦ It is important to note that the epiphyseal extrusion index Trendelenburg's test.

♦ The clinical outcome of the same patient was poor with poor range of right hip movements, shortening: 2 cms and positive

- Poor result (Mose).

- The C-E angle = 18°

- The right femoral head is subluxated.

showing:

(C) Anteroposterior radiograph 47 months following FVDO

Fig. 97



A female child aged 6½ years.
 (A) Anteroposterior view (pre-operative) showing:
 3 head at risk signs: Lateral subluxation, clacification lateral to the epiphysis and metaphyseal reaction.
 - The patient was treated by combined femoral and innominate osteotomies.
 (B) Clinical outcome : fair. The patient has fair range of left hip movement with slight limitation of external rotation, shortening: 1 cm and negative Trendelenburg's test.

Fig. 98



- Note the excessive ossification at the osteotomy site (but the patient has satisfactory range of abduction).

ATD = $9\frac{1}{2}$ mm.

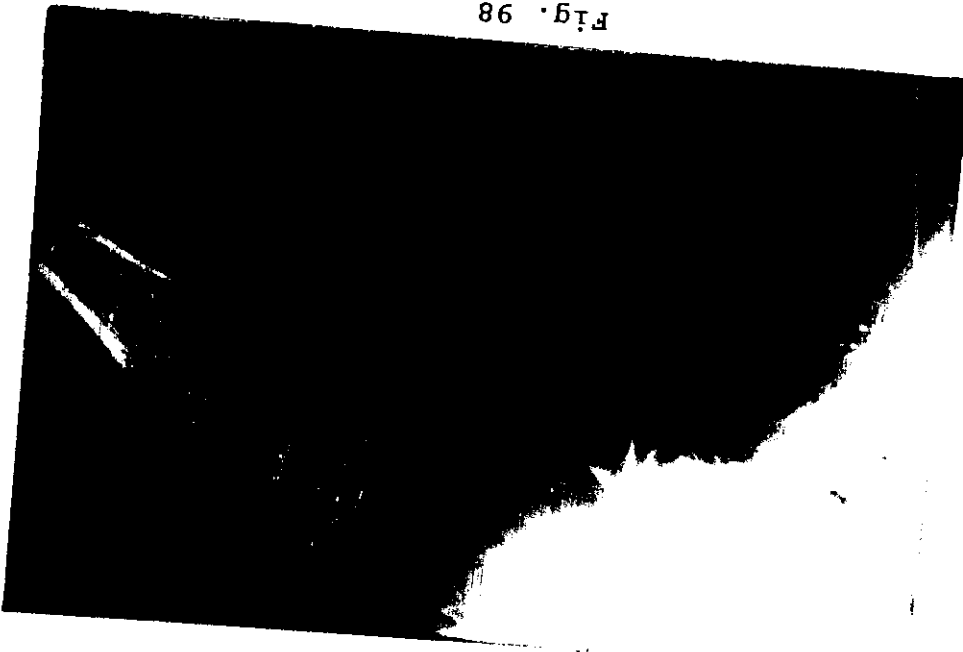
- C-E angle = 20°

Fair result (Mose).

after operation showing:

(C and D :) Anteroposterior and lateral radiographs 43 months

Fig. 98



C

D

- The patient was treated by Salter innominate osteotomy.
- subluxation and metaphyseal reaction.
- Catterall group II. - 2 head at risk signs: lateral
- (A) A pre-operative radiograph showing:
- A male child aged 8½ years.

Fig. 99



B



A

(C and D): Antero-posterior and lateral radiographs 36 months after Salter innominate osteotomy showing a good result (Mose).

Fig. 99



D



C