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FEMORAL VARUS DEROTATION OSTEOTOMY IN MANAGEMENT OF PERTHES' DISEASE

A.W Al-Mukhtar[*] & M.J Kareem[@]

[*]FRCS, Consultant Orthopaedic Surgeon, [@] M.B.Ch.B. Registrar, Orthopaedic Department, Hammad Shihab Military Hospital, Baghdad; IRAQ.

Summary

This is a prospective study done on 27 hips in 25 patients presented with Perthes' disease between December 1999 and August 2002. Fourteen hips were treated operatively by mean of upper femoral osteotomy (group A), and the other remaining 13 hips were treated conservatively by mean of Scottish Rite abduction brace (group B). All hips were classified preoperatively as Catterall group III and IV, furthermore, two or more "head at risk signs" were seen in all hips with particular emphasis placed on lateral uncovering of the femoral head. Of the 25 patients, 20 (80%) were boys and 5 (20%) were girls, the left side was affected in 18 hips (66.7%), while the right side was involved in 9 hips (33.3%), two patients had bilateral involvement and were encountered in group A. The average time between onset of symptoms and time of treatment for group A and groups B was 9 months and 8.5 months respectively, while the mean duration of follow up was 2.2 years and 1.8 years respectively. It was concluded that group A showed better results than B regarding hip pain (100% vs 15.4%), hip motion (85.7% vs 7.6%), gait (28.5% vs 7.6%), limb-length discrepancies (93.6% vs 30.7%) and centre-edge angle (100% vs 15.4%). Femoral varus derotation osteotomy was found to be the treatment of choice for containment of Perthes' disease with Catterall group III and IV. Both age and sex at the time of the treatment, influences the final outcome, however, longer period of follow-up may allow better final evaluation.

Introduction

Perthes' disease is osteochondrosis of upper femoral epiphysis, limited sharply to young children, characterized by pathological changes in the ossific centre of capital femoral epiphysis resulted apparently from loss of adequate blood supply for at least part of the femoral head, which is ultimately resorbed and replaced by normal bone, resulting in variable degrees of femoral head deformity and restricted hip joint motion[2]. Its aetiology, classification, prognosis and treatment has been a maze of controversy[6]. The treatment options vary from doing nothing to non-operative and operative treatment. Currently, treatment by containment is recommended to direct and guide remodeling of the softened femoral head as it evolves from fragmentation through reossification. Containment may be done by non-operative methods (cast or brace)

Correspondence to:
Dr. A. W. Al-Mukhtar
Department of Orthopaedics,
Hammad Shihab Military Hospital,
Baghdad; IRAQ

or by operative methods consisting of femoral osteotomy, innominate osteotomy or a combination of both[3]. No evidence can be traced as regard incidence of this condition in our country, however, the incidence varies, as an example within the city of Liverpool in U.K. variation in incidence was found from 0-29/10.000, this variability may correlate with low social class[2].

The aim of this paper is to evaluate the results of management of Perthes' disease by varus derotation osteotomy with special reference to Catteral group III and IV.

Patients and Methods

This is a prospective study of 27 hips in 25 patients presented with Perthes' disease at Hammad Shihab military hospital. University Hospital - Saddam College of Medicine, Al-Shaheed Adnan Hospital and A1-Yarmouk Hospital. Between December 1999 and August 2002 inclusive.

For each patient, anteroposterior and frog lateral radiographs of both hips were obtained. Investigations excluded other causes of hip pathology, all hips in this study classified as

Catterall group III and IV, furthermore two or more head at risk signs were seen in all hips with particular emphasis was placed on lateral uncovering of the femoral head. Of the 25 patients, 20 (80%) were boys and 5 (20%) were girls, the left side was affected in 18 hips (66.7 %), while the right side was involved in 9 hips (33.3%), two patients had bilateral involvement and were encountered in group-A. Age of onset in 16 patients (64%) was from 5-8 years, and 9 patients (39%) were above 8 years.

The average time between onset of symptoms and time of treatment for group-A and B was 9 months and 8.5 months respectively, while the mean duration of follow-up was 2.2 years and 1.8 years respectively.

Patients were divided into two groups:

1. Operatively treated patients (Group-A).
2. Conservatively treated patients (Group-B).

Operatively treated patients (Group-A)

Femoral varus derotation osteotomy used to treat 12 patients with 14 hips (2 bilateral with Perthes' disease.

A radiographic examination was performed with the affected hip abducted and internally rotated, on the basis of this examination, hips were assessed as contained or not and if contained a trace paper pattern was prepared and the precise wedge was determined in that position.

Operative technique

Under general anasthesia, and through lateral approach, the proximal part of the femur is exposed subperiosteally, is held in flull internal rotation, a small 4 holed Sherman bone plate is chosen, two long 2.7 Kirschner wires inserted through the two proximal plate holes and through both femoral cortices and left there, the plate removed and then prebent in the middle to the desired osteotomy angle, then either lateral opening or medial closing or reversed wedge osteotomy was performed.

Lateral opening wedge osteotomy was done for 9 hips, while the extremity is held in internal rotation and abduction, the bone is divided with an oscillating saw at the previously marked level, the proximal fragment is held in internal rotation and abduction then the distal fragment externally rotated until the patella points straight forward while reaching the desired wedge that is preoperatively planned.

For the other 3 hips, reserved wedge osteotomy was done by removing half of the height of the desired wedge with its base medially then the wedge is turned

180 degrees and inserted into the osteotomy site with its base laterally, and for the last 2 hips, a medial closing wedge osteotomv was done. After that, the prebent plate slipped over the drill points and fixed to the proximal and distal fragments by 4 screws. A suction drain used double spica plaster cast applied with at least 20 degrees of hip abduction and drain removed after 48-72 hours. A systemic antibiotic used in all cases in form of cephaboridine before induction of anasthesia and continued for 72 hours with doses determined according to age and body weight.

Postoperative follow up:

P.O.P. spica is applied for 6-8 weeks then it is discarded and patient is allowed to resume gradual weight bearing as tolerated. The patients were evaluated by clinical examination every one month for the first 3 months, radiological assessment every 3 months till one year, and then every 6 months after one year. The plate is removed one year later after complete healing of osteotomy site.

Cheilectoiny[18] was used to treat 2 patients (2 hips) who were treated conservatively and had malformed femoral head with severe limitation of abduction under general anasthesia, and through lateral approach, hip capsule is opened longitudinally along the antero-superior surface of the femoral neck, the entire protuberance is excised with a sharp osteotome, range of motion is checked especially abduction two weeks postoperatively active motion exercises, especially hip abduction is encouraged.

Conservatively treated patients (Group -B)

Weight - bearing abduction brace (Scottish Rite type) was used to treat 13 patients (1 3 hips) with Perthes' disease. This orthosis permits normal activities while containing the femoral head by abduction of the hips. It consists of a pelvic band, single-axis hip joints, thigh-lacers, and an abduction bar consisting of two parts connected together by bolt fixed loosely to allow some degrees of telescoping. In the orthosis, the hips are held abducted, externally rotated, and flexed, and the knees have a full-unconstrained range of motion (Fig 1,2,3).

Three patients had less than 30 degrees of abduction of hips were treated with bed rest and skin traction for 1-2 weeks, once the patients could abduct the hips 40-45 degrees in extension, they were placed in the orthosis, the remaining 10 patients were placed directly in the orthosis because of good range of' hip motion. To determine whether containment was adequate, an anteroposterior radiograph of the pelvis was made with the patient standing while wearing the orthosis. The patients were then permitted to walk while wearing the orthosis without restriction.

Follow-up

The patients were evaluated by clinical and radiographic examinations every one-month for the first 3 months and then every 3 months, and when there was evidence of revascularization of femoral head on radiographs of the pelvis, the use of the orthosis was discontinued (a minimum of 6 months of wearing the brace). If the range of motion had decreased, traction was instituted, either at home or in the hospital until the range of motion had been restored to its previous level. The patients were asked to use the orthosis for at least 22 hours each day.

For both groups, the clinical and radiological results were assessed.

I. The Clinical assessment includes:

1. General complication:

2.Hip pain [21]:

Good-If there is no pain.

Fair-If there is minimal pain on weight

bearing.
Poor- If there is severe pain on weight bearing.

3.Hip motion [21]
Good- If there is unrestricted hip motion.
Fair- If there is slight restriction, especially medial rotation.
Poor- If there is gross limitation of hip motion.

4.Limb - length discrepancies:
The clinical assessment of the limb-length discrepancies in this study measured as:
Excellent- If there is no limb-length discrepancies.
Good- if there is shortening up to 1 cm.
Fair-If there is shortening between 1 -2 cm.
Poor-If there is shortening more than 2 cm.

5.Gait: [21]
Good- If there is normal gait with negative trendelenburg sign.
Fair- If there is limp with negative trendelenburg sign.
Poor- If' there is abductor lurch with positive trendelenburg sign.

II. The Radiological assessment includes:
The radiological parameters used to evaluate changes in the femoral head was based on:
1.Wiberg's center-edge angle[22]:
Good- if it is greater than 25 degrees.
Fair-if it is between 20-25 degrees.
Poor-if it is less than 20 degrees.

2.Neck-shaft angle[22]:
Good-if it is greater than 120 degrees.
Fair-if it is between 100-120 degrees.
Poor-if it is less than 100 degrees.

Diagnostic instruments: x-ray, MRI, U/S

Bio-statistical measurement: chi-square of independence, P.value of <0.05 was regarded.

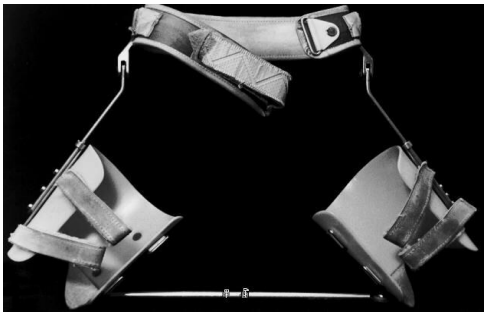
Figure 1. Scottish Rite Abduction Brace


Figure 2. Anteroposterior radiograph of the pelvis, made with the patient standing while wearing the orthosis.

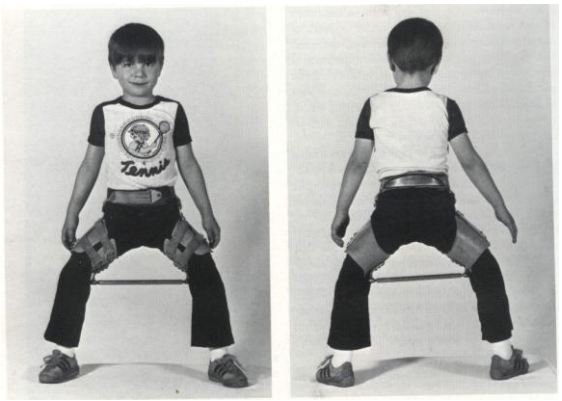
Figure 3. Patient wearing the Scottish Rite Abduction Brace [19].

Results

These results depend on the last follow-up.

I-The clinical results:
1.General complication:
For the group-B, most patients had

minor problems with the skin, including rubbing of the thigh cuff or around the pelvic band, these usually resolved without treatment, in 4 patients it was necessary to discontinue use of the brace temporally because of persistent problems with the skin. Furthermore 3 of the patients discontinued wearing of the orthosis because of psychological problems.

2.Hip pain:

For the group-A, no hip pain has been present in any of them, while for the group-B, it was good in 2 hips (15.4%), fair in 9 hips (69.2%) and poor in 2 hips (15.4%). There is a statistical significant association between the hip pain and the way of management (P<0.005) (Table I and Figure 4).

Table I. Hip pain in the groups A and B.

	Good		Fair		Poor		Total	
	No.	%	No.	%	No.	%	No.	%
Group A	14	100	0	0	0	0	14	52
Group B	2	15	9	69	2	15	13	48
Total	16	59	9	33	2	8	27	100

X2 = 20.08, df=2, p<0.005

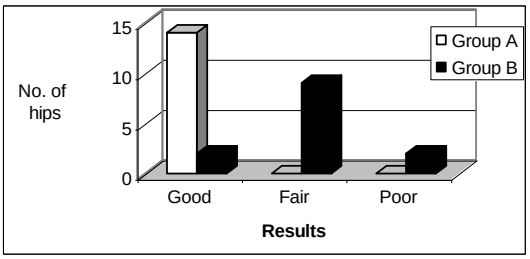

Figure 4. Hip pain

3.Hip motion:

For the group A, it was good in 12 hips (85.7%) and fair in 2 hips (14.3%. While for the group B, it was good in 1 hip (7.6%), fair in 9 hips (69.2%) and poor in 3 hips (23.2%). There is a statistical significant association between the hip motion and the way of management (P<0.005) (Table II and Figure 5).

Table II. Hip motion in the groups A and B.

	Good		Fair		Poor		Total	
	No.	%	No.	%	No.	%	No.	%
Group A	12	85.7	2	14.3	0	0	14	51.8
Group B	1	7.6	9	69.2	3	23.2	13	48.2
Total	13	48.2	11	40.7	3	11.1	27	100

X2 = 16.92, df=2, p<0.005

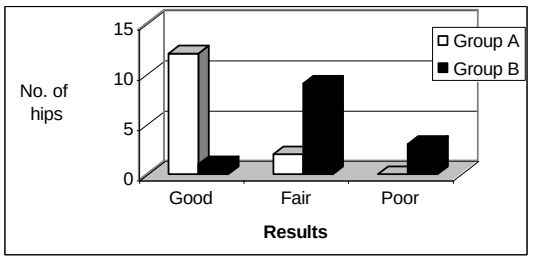

Figure 5. Hip motion

4.Gait:

For the group A, it was good in 4 hips (28.5%) and fair in 10 hips (71.5%), while for the groups B, it was good in 1 hip (7.6%), fair in 8 hips (61.5%), and poor in 4 hips (30.9%). There is a statistical significant association between the gait and the way management (p<0.05) (Table III and Figure 6).

Table III. Gait in the groups A and B.

	Good		Fair		Poor		Total	
	No.	%	No.	%	No.	%	No.	%
Group A	4	28.5	10	71.5	0	0	14	51.8
Group B	1	7.6	8	61.5	4	30.9	13	48.2
Total	5	18.5	18	66.6	4	14.9	27	100

X2 = 5.99, df=2, p<0.05

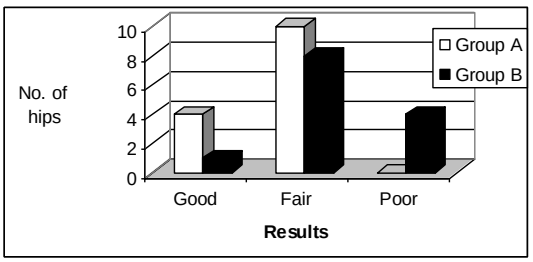

Figure 6. Gait

5.Limb-length discrepancies:

For the group A, reversed wedge technique was employed in 3 hips and their average residual shortening was 0.5cm as compared with 1 cm in 2 hips in whom medial closing wedge resection was used, while the open wedge technique resulted in the smallest average residual shortening of 0.3cm (Table IV). So it is excellent in 6 hips (42.1%), good in 6 hips (42.1%) and fair in 2 hips (14.4%).

Table IV. The relationship of operative technique to residual shortening

Operative technique	No.	%	Average of residual shortening (cm)
Lateral opening wedge	9	64.4	0.3
Reversed wedge	3	21.4	0.5
Medial closing wedge	2	14.2	1

While for the group B, it was good in 4 hips (30.7%), fair in 7 hips (53.8%) and poor in 2 hips (15.5%). There is a statistical significant association between the limb-length discrepancies and the way of management ($p<0.025$) (Table V and Figure 7).

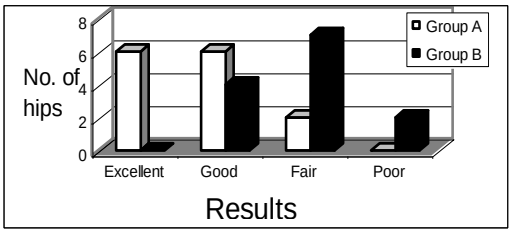

Figure 7. Limb length discrepancies

II. The radiological results

1.Wiberg's center edge angle:

Initially, the mean center edge angle was 18.1 degrees (range, 15 to 22) for the group A and 17.5 degrees (range, 15 to 20) for the group B.

After the treatment, for the group A, it was good for all hips, while for the group B it was good in 2 hips (15.3%), fair in 7 hips (53.8%) and poor in 4 hips (30.9%). There is a statistical significant association between the radiological findings of Wiberg's canter edge angle and the way of management ($P<0.005$) (Table VI and figure 8).

Table VI. CE angle in the groups A and B

	Good		Fair		Poor		Total	
	No.	%	No.	%	No.	%	No.	%
Group A	14	100	0	0	0	0	14	51.8
Group B	2	15.3	7	53.8	4	30.9	13	48.2
Total	16	59.2	7	25.9	4	14.9	27	100

$X2 = 26.97$, df=2, $p<0.005$

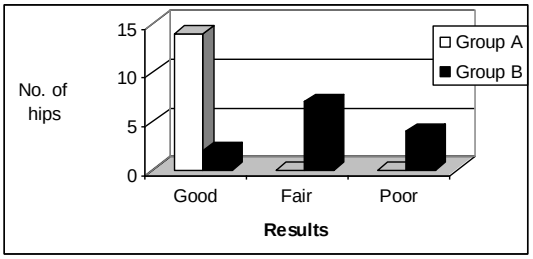

Figure 8.Wiberg's centre edge angle

2.Neck-shaft angle:

Initially the mean neck-shaft angle for the group A was 135 degrees (range, 125 to 140), and after surgery it became 110 degrees (range, 105 to 115).

The neck-shaft angle didn't fall below 105 degrees in any of the patients, while for the group B, the neck-shaft angle remains the same.

The following are series of x-rays of patients with Perthes' disease treated by varus derotation osteotomy.

Table V. Limb length discrepancies in the groups A and B.

	Excellent		Good		Fair		Poor		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
Group A	6	42.8	6	42.8	2	14.4	0	0	14	51.8
Group B	0	0	4	30.7	7	53.8	2	15.5	13	48.2
Total	6	22.2	10	37	9	33.3	2	7.5	27	100

Fig. 9(A). 9 years old boy with left side Perthes' disease

Fig. 9(B). 1 year after varus derotation osteotomy

Fig.10(A). 6 years old girl with left side Perthes' disease

Fig. 10(B). 3 years after varus derotation osteotomy

Fig.11(A). 10 years old boy with left side Perthes' disease

Fig.11 (B). 1 year after varus derotation osteotomy

Fig. 12(A). 8 years old boy with left side Perthes' disease

Fig.12 (B). 1 year after varus derotation osteotomy

Fig.12(C). The same patient at age 10 years developed Perthe's disease in the right side

Fig.12(D). 1 year after varus derotation osteotomy for the right side.

Fig. 12(E). At age of 11 years removal of implants from both sides

Discussion

The treatment of Penthes' disease remains controversial, the aim of the treatment is to achieve normal or near normal functioning hip joint and to prevent further osteoarthritis, this could only be possible with centralization of the femoral head into the acetabulum.

Many authors theorized that containment of the femoral head during the initial or fragmentation stage of Perthes'

disease lead to reossification of the proximal femur in a round and contained shape [16].

Both Stulberg et al and Lioyd-Robert et al reported that they have prevented the development of osteoarthritis in Catterall group III and IV Perthes' patients by successful containment [14,17].

Although many authors suggested conservative treatment to achieve containment, this type of treatment has some disadvantage like prolonged immobilization, limiting the daily activities of the patients, low success rate and causing social and educational problems, while the beneficial effects of surgical containment include permanent femoral head coverage and less restriction of morbidity[9].

It is generally agreed that, the younger the patient is at the time of onset, the more benign condition is, and this is attributed to that, the younger children have a greater growth potential after healing of the disease, and although the initial results at the time of healing is only fair, the end result may be good and this agreed by almost all of the other authors [4,6,10,13,16].

In our study most of the patients age belonged to 5-8 years age group and this is possibly explain the good results far group A.

Boys had a more favorable prognosis than girls, this is clear from the results of our study and this was agreed by Catterall who found that the overall poor results are found in the girls[4], this may be due to shorter time available for remodeling in female till the age of skeletal maturity which is younger in female, however another long term follow up study is needed to document that.

For the group A, all patients were satisfied with their hip function and no 1- cases of non-union, infection or post operative complication, this is comparable with Costa Kaniklides et al results [5]. 2- While for the group B, many complications were encountered including skin, educational and psychological problems. This was noticed by Meehan et al.[15] and this was the Cause for discarding the orthosis, and associated with less favorable outcome.

Immediate postoperative, pain at the site of surgery, was noticed, this was disappeared after 6-8 weeks, with physiotherapy, this may be due to denervation, decompression and reduction of subluxated femoral head. This result goes with Karpiniski et al. results[12] and dose not go with Costa Kaniklides results [5], where immobilization in a hip spica cast was not used, and he had hip pain in 5 out of 16 hips during strenuous physical activity.

The range of hip motion for the group A was almost universally good with only 2 hips having slight restriction especially medial rotation (Table II), and this goes with the results of Fixsen et al .[7] and this may be due to the disturbance of growth in the femoral head as noted as a feature of Perthes' disease (Catterall 1971)[4].

While for the group B, 3 patients had poor results, cheilectomy was done for 2 of them to improve hip function, while the third patient refused surgery.

Baren's stated that gait varied according to the amount of shortening and the presence of absence of trendeling sign[1], and this is behind the fair results of group A (Table III) that goes with the results of most of the studies.

Present evidence shows that both brace and operative treatment for Perthes' disease can result in leg length discrepancy. For patients treated by orthosis, the length discrepancy was greater than that in our osteotomy group. The amount of residual shortening of the affected lower limb in Perthes' disease, depend on following factors [8]:

The severity of inhibition of endo-chondral ossification in the proximal femoral growth plate.

Age at onset of symptoms (less if under 8 years).

3- Type of osteotomy (less in open-wedge technique).

In this series, lateral opening gave the smallest average residual shortening, and this is behind the excellent and good results (Tables IV and V), this agrees with the results of Karpiniski et al[12]. A reversed valgus osteotomy was done for one of the two fair results in the group A, in order to gain length of the affected limb, because the patient age was 12 years with less likely to have remodeling during the remaining years of growth. Older patients have diminished potential for varus remodeling and therefore increased limb-length discrepancy[12].

The coverage of the femoral head by the acetabulum measured by the centre-edge angle, was significantly better in hips subjected to femoral osteotomy than conservative treatment (Table VI) and this goes with the results reported by most of the authors [11,12,20,21].

The neck shaft angle diminished after surgery and it did not fall below 105 degrees in any of the patients, but there was not enough follow up time to evaluate the remodeling potential and the results in long term.

Karpinski et al stated that the surgical varus remodeling is possible, especially when the patient's age is younger than 10 years[12].

Conclusions

1- Femoral varus derotation osteotomy provides permanent femoral head coverage and less restriction of mobility.

2- The results of containment be femoral osteotomy were superior to those treated by conservative methods for patients with severe Perthes' disease (Catteral group III and IV).

3- The good results yielded by femoral osteotomy can be partly attributed to mechanical factors.

4- On the basis of our results, we do not recommended the use of a weight-bearing brace for the treatment of severe Perthes' disease (Catterall group III and IV), however, longer period of follow up may allow better final evaluation.

5- Both age and sex at the time of surgery influence the final outcome.

6- Varus osteotomy is criticized because it is believed to cause some un-acceptable shortening, but this may be reduced by lateral opening wedge osteotomy whenever applicable. Reversal to valgus type is under consideration for future study to eliminate this complication.

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