



## Open reduction of developmental hip dysplasia using a medial approach : A review of 24 hips

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The results of the Ferguson medial approach for reduction of developmental hip dysplasia were reviewed for 24 hips. The mean age at surgery was 4.8 months and the mean length of clinical follow-up was 59 months. Clinically all hips were normal in follow-up and radiologically the acetabular index was within normal limits. There was the need for further surgery in two cases with loss of concentric reduction. There were two cases showing evidence of vascular insult post operatively according to the classification of Kalmachi and MacEwan.

We conclude that the Ferguson medial approach is a safe and effective form of treatment for open reduction of developmental hip dysplasia in cases where closed reduction either has failed or is inappropriate. The age of the child or the presence of the upper femoral ossific nucleus does not appear to affect outcome. The procedure can safely be performed before six months of age.

**Keywords :** developmental dysplasia of the hip ; medial approach ; open reduction.

There are also a small number of children that miss post-natal detection and will present later requiring open reduction.

The surgical approach used in open reduction remains a contentious issue. Avascular necrosis (AVN) of the femoral head and damage to the physis are the main complications following such surgery, with a variable reported incidence, ranging from 0 to 67% (3,6).

An antero-medial approach to the hip was first described in 1908 by Ludloff who explored the interval between the adductor longus and the pectineus (8). Ferguson later modified this approach using the interval posterior to the adductor longus (3). This approach is advantageous in that it gives direct access to the structures that prevent concentric reduction, i.e. the stricture of the caudal capsule and the iliopsoas tendon. The disadvantages

### INTRODUCTION

The early diagnosis greatly improves the outcome in developmental hip dysplasia (DDH) (15), but despite the instigation of early corrective treatment there is still a small percentage of hips that are resistant, or indeed it is dangerous to perform closed reduction techniques upon (1,10).

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are the risk of damaging the medial circumflex femoral artery (MCFA) (6) and the inaccessibility of other parts of the joint.

We present our experience with open reduction using the medial approach in developmental hip dysplasia in 24 hips where presentation has been late or where other closed methods had failed.

### PATIENTS AND METHODS

All patients that had undergone a Ferguson type medial open reduction of the hip for developmental hip dysplasia at our centre between 1993 and 2004 were identified using the hospital records. Patients were excluded if there was less than one year of clinical and radiological follow-up.

Thirty one hips in twenty-nine patients that had undergone a medial open reduction were identified. Three patients were excluded as there was less than one year of follow-up at the time of this study. A further four were excluded as three had cerebral palsy and one arthrogyposis. In the remaining twenty-two patients, there were twenty girls and only two boys. There were two patients with bilateral dislocations, one of each sex.

The patient's antero-posterior radiographs were assessed by two independent reviewers. The Severin (11) classification was adopted to assess the hip at final follow-up. We defined Severin groups I or II as excellent or good results and those in Severin groups III, IV and V as poor results.

The acetabular angle was also measured using Caffey's (9) method in the affected hip and a comparison was made to the unaffected side at final follow-up if not bilateral. The radiographs were assessed using the PACS digital imaging software and the angles were measured using the digital goniometer provided on the software package. The measurements were made by two independent reviewers at two separate sittings. An attempt to reduce the effect of intra-observer error was made by taking the average of the two separate recordings.

Any evidence of vascular insult and avascular necrosis was classified according to the classification of Kalamchi and MacEwan (5).

Data was collected from the notes using a standard proforma. Details of the patient's medical history, existing medical conditions and treatments received prior to and following open reduction were recorded. Clinical assessment at final follow-up with regards to gait and hip mobility were also noted along with the existence of any complications or the need for further surgery.



*Fig. 1.* — Left hip dislocation presenting late in a girl of eleven months.



*Fig. 2.* — Intra-operative arthrogram revealing medial pooling of the contrast. The deep inferior indentation from the iliopsoas can be clearly seen.

### Operative technique

All the patients had received an arthrogram prior to surgery to assess the dislocation and the structures that were blocking reduction (fig 1 & 2). All but three of the patients were kept at least one week in bilateral overhead leg traction with the angle of abduction gradually increasing in increments daily until abduction of 30° in



*Fig. 3.* — Post-operative radiograph showing that reduction is maintained within plaster spica.

each hip was achieved. A bilateral adductor tenotomy either prior to open reduction or intra-operatively was also performed.

The technique used was almost identical to that described by Ferguson in his original paper. The surgery was performed by the senior author.

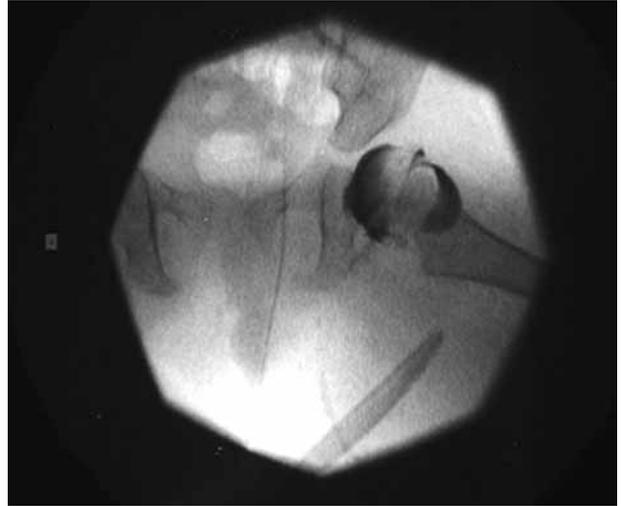
A transverse groin incision was used and dissection proceeded posterior to the adductor longus, the psoas tendon being approached from behind the adductor brevis. Care was taken to protect the vessels adjacent to it and to protect the posterior branch of the obturator nerve. The psoas tendon was released at its insertion and allowed to retract proximally. This exposed the infero-medial hip capsule.

Unlike Ferguson's description, a capsulotomy was performed with the incision being made at the outer edge of the acetabulum, thus avoiding the femoral neck vessels.

The femoral head was reduced and the ligamentum teres and pulvinar were left undisturbed. An adductor tenotomy was performed at this point bilaterally if it had not already been performed.

The patients were immobilised in a bilateral hip spica with both hips flexed to 30°, abducted to 40° and internally rotated by 5° to maintain reduction but avoiding excessive internal rotation and pressures within the joint.

Post operative reduction was assessed with either a radiograph (fig 3) or a magnetic resonance imaging to ensure reduction within the spica. Immobilisation in the spica was maintained for twelve weeks. At removal



*Fig. 4.* — Following removal of the plaster spica a follow-up arthrogram reveals concentric reduction of the femoral head in the acetabulum.



*Fig. 5.* — 54 months post surgery in follow-up. The left acetabulum and femoral head have developed normally with no evidence of vascular insult.

of the spica an arthrogram was made to evaluate the concentric reduction (fig 4).

The patient was followed up carefully with repeat clinical examinations and antero-posterior radiographs of the pelvis (fig 5).

## RESULTS

The mean age at the time of the procedure was 4.8 months (range 2-11). Eleven of the patients had

Table I. — Details of the 24 hips. (AI : acetabular index)

Case	Sex	Presence of femoral capital epiphysis	Age at Operation (months)	Follow-up (months)	AI final follow-up affected hip	AI final follow-up unaffected hip	Severin Group at final follow-up	Avascular Necrosis (Kalamchi Group)
1	F	Yes	9	25	27.7	17.9	II	
2	F	No	4	12	23.1	17.5	II	
3	F	No	3	52	14.1	13.5	I	
4	F	Yes	11	54	21	11	I	
5	F	No	3	26	24.3	17.4	II	
6	F	No	2	41	22.4	bilateral	I	
7	F	No	2	41	20.4	bilateral	I	
8	F	Yes	5	47	19.8	14	II	
9	F	No	3	41	21.5	19	I	
10	F	No	4	31	19.6	18.7	II	
11	F	Yes	5	75	30.1	21.7	I	
12	F	Yes	6	80	15.5	9.1	III	
13	M	No	4	70	12.3	14.9	I	
14	F	No	6	64	15.8	15	I	
15	F	No	3	44	17.6	14.7	II	
16	F	Yes	7	58	18.5	13.9	III	
17	M	No	3	53	22.3	bilateral	II	
18	M	No	4	53	22.3	bilateral	II	I
19	F	No	3	42	22.3	16.4	II	
20	F	No	4	98	13.3	11.1	II	
21	F	No	4	125	4.2	2.5	III	
22	F	No	5	97	21.3	11.7	II	I
23	F	No	5	97	14.6	9.5	II	
24	F	No	5	92	15.8	12.4	I	

received treatment prior to the procedure with a Pavlik harness which had failed. One of these patients had subsequently been treated unsuccessfully with closed reduction prior to surgery. In the remaining eleven, the operation was the primary procedure.

The ossific nucleus was not present pre-operatively in eighteen of the affected hips and a false acetabulum had begun to form in nine.

Post operatively one patient developed a minor superficial wound infection which cleared with oral antibiotics. All tolerated the plaster spica well. The mean length of follow-up was 59 months post surgery (range 12-125). At final follow-up, clinically all of the hips were normal, even those discussed below with evidence of vascular insult.

Radiologically the acetabular index as measured at final follow-up had a mean value of  $19.1^\circ$  (SD : 5.44) on the affected side, as compared to  $14.0^\circ$  (SD : 4.32) on the unaffected side. The acetabular

index on the affected side remained significantly higher than on the unaffected side ( $p < 0.05$ , CI 3.89) although within normal limits (table I).

The centre edge angle at final follow-up had a mean value of  $28.2^\circ$  (SD : 7.38) on the affected side. Again this was significantly different ( $p < 0.05$ , CI 4.32) from the unaffected side but also within normal limits.

Twenty one of the hips achieved an excellent or good result and were classified Severin Class I or II, three were classified Severin Class III and presented therefore a poor result (table II).

There was evidence of a vascular insult post operatively in two hips. These were classified as Group I according to the Kalmachi and MacEwan classification. The ossific nucleus was not present in either of these cases which were operated upon at 3 and 4 months. Both cases had received treatment in the form of a Pavlik harness and had gone on to receive traction prior to surgery.

Table II. — Severin Classification at final follow-up

Severin Class	I	II	III	IV	V	VI
Number of hips	9	12	3	0	0	0

Only two hips in the poor group went on to require further surgery. One child had a proximal femoral osteotomy performed for lateral subluxation at the age of five ; another had a Salter type pelvic osteotomy for poor anterior acetabular coverage aged six.

## DISCUSSION

The ultimate aim of treatment of DDH is to obtain a stable concentric reduction at the earliest possible age, so that the femoral head and acetabulum can grow and reach their full potential. This however must not be achieved at the expense of inducing avascular necrosis in the femoral head, which clearly is the main risk factor of intervention.

The medial approach has been criticised owing to two main potential problems : the first is the inability to improve the stability of the hip after reduction due to lack of access to the lateral hip capsule and limbus (12). The second is the potential risk of damage to the medial circumflex femoral artery and resultant increased risk in the development of avascular necrosis (13).

Our series shows that there is a low incidence of lateral subluxation in these cases and a re-operation rate of only 8%. A revision rate of 19% (13) to 27% (2) has been described with the Ferguson procedure.

Similar outcomes as in our study have been found by other authors using the medial approach for open reduction (7). In previous studies, however, the medial approach had been reserved for patients older than six months after which the femoral capital epiphysis is present. This is thought to reduce the incidence of avascular necrosis (3,7).

The frequency of vascular disturbances to the head of the femur can be explained by the terminal nature of the subsynovial branches of the MFCA (4). We believe that by performing the capsulotomy at its insertion superiorly into

the acetabular rim the risk of damage to these vessels is minimised. The MCFA is potentially at risk when performing a medial approach, but similarly when performing a release of the iliopsoas tendon via any approach.

Pre-operative traction has not been clearly established as a way of decreasing the incidence of AVN or altering outcome (14). In our series, however, three of the twenty-four hips did not receive pre-operative traction for a variety of reasons. Two of these were classified as poor at final follow-up using the Severin classification. This number of cases was however not sufficient for statistical analysis. These failures may suggest that preoperative traction helps prevent residual deformity. They may however just reflect the severity of the pathology initially presented.

The position of the spica has also been shown to be critical in preventing the incidence of AVN (10). The operative technique allows safe reduction but also maintenance of reduction with a margin of safety where the surgeon's judgement and skill is as important. Performing bilateral adductor tenotomies increases this relative position of safety and reduces the risk of developing AVN in the unaffected side during the period of spica immobilisation.

No matter which operative approach is used there still is a considerable incidence for the need of revision surgery. Following a medial approach, revision surgery via a lateral approach is considerably easier through fresh tissue planes.

The advantage of the medial approach over the lateral approach is that there is considerably less dissection involved. Operative time is less ; blood loss is less, thus potentially enabling simultaneous bilateral procedures to be performed. The medial approach also avoids damage to the iliac apophysis and the scar is more cosmetically acceptable.

Although follow-up is limited, this series shows that the Ferguson medial approach to the hip can be safely and effectively used in patients below the age of one year and irrespective of the presence of the femoral capital epiphysis. Clearly this could be a useful tool in the treatment of DDH in patients in whom other non-operative measures have failed and who are too young to consider a lateral approach or bony corrective surgery.

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