Treatment of developmental dysplasia of the hip in infants aged between 12 and 18 months with open reduction surgery

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Background
Developmental dysplasia is a disorder that may affect the development and stability of the hip during the critical growth period. The term developmental dysplasia of the hip has replaced congenital dislocation of the hip because it more accurately reflects the full spectrum of abnormality that affects the immature hip. Open reduction surgeries prevent further complications.

Patients and methods
Eighteen hips (18 infants) with developmental dislocation were treated with the primary anterior open reduction approach at 12–18 months of age. We began the postoperative functional treatment using a hip spica for 3 months, followed by hip abduction orthosis used at night for 2 months.

Results
Our results were 'satisfactory' (Severin grade I, II) in 100% of the cases.

Conclusion
Open reduction surgery in the treatment of developmental dysplasia of the hip in infants aged between 12 and 18 months is a good solution with satisfactory results.

Keywords:
anterior approach, developmental dislocation of the hip, open reduction

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Introduction

The issue of surgical treatment of developmental dislocation of the hip is controversial in terms of the indication, the date [1–4], and the technique [5–10] of reduction and the performance of simultaneous, additional [11–14], and/or secondary [14–16] surgeries. We introduced our method for the early surgical treatment of dislocated hips to be performed in patients aged 12–18 months. Reduction is performed using an anterior approach and then a hip spica is used, and functional treatment is started afterward.

Patients and methods

Between September 2010 and December 2012, open reductions were performed on 20 hip joints of 19 patients aged 12–18 months. Patients with dislocation accompanied by teratological and neuromuscular diseases were excluded from the study. One patient (bilateral developmental dislocation of the hip) was lost to follow-up. Therefore, 18 hip joints of 18 patients were analyzed in the study. Eight patients suffered from right-sided dislocation and 10 from left-sided dislocation. Twelve out of 18 hips (66.6%) received ineffective treatment with a Pavlik harness started before the age of 1 year (Table 1). Surgical reduction was performed if no central stable reduction (verified by radiography) could be achieved with conservative treatment. If physical examination suggested a stable joint and the reduction could not be assessed clearly on the regular anteroposterior radiograph, we suggested that further radiographs be taken in abducted and internal rotated positions as well. If the projection of the epiphysis is more distal from the acetabulum compared with the intact contralateral hip, or if the epiphysis itself is smaller in size or cannot be seen at all, then the projection of the medial edge of the metaphysis can be seen more distally, which is evidence of the presence of an interposed element in the acetabulum, thus being an indication for surgery.

The remaining patients, comprising the six hips that underwent successful treatment, were referred to our hospital after the age of 1 year. We did not start conservative treatment for these patients. Reduction surgery was performed at an average age of 14.8 months (12–18 months). The mean follow-up time was 22.5 months after surgery.

Surgical technique

We followed essentially the description of Beaty, after Somerville [17]. Using a 'bikini' skin incision, the deeper tissues were explored according to the method by Smith-Petersen. The iliopsoas was lengthened by preserving the muscle and cutting the tendon unit. About 1 cm distal to the anterior

inferior iliac spine, the direct and oblique heads of the rectus femoris muscle were tenotomized. We separated the abductor muscles from the capsule. The capsule was opened in a T-shaped manner. The longitudinal limb on the joint capsule was positioned parallel to the acetabular edge, whereas the transverse limb was positioned along the anterior border of the femoral head and neck. The ligamentum teres and pulvinar were removed. After incision of the transverse acetabular ligament, reduction was achieved. The head could be reduced to a central position. Capsulorrhaphy was carried out by suturing the lateral flap of the T-shaped incision as far medially as possible to eliminate any redundant capsule in the region of the false acetabulum. The tendon of the iliopsoas muscle was sutured. Thereafter, the rectus femoris tendon was sutured back onto the iliac crest, and, subsequently, the fascia and the skin were sutured. A control radiographic image was taken.

Postoperative treatment

Immediately after the surgery, a double hip spica cast made from fiberglass was applied. The hips were placed in 90–100° of flexion and 40–55° of abduction with neutral internal rotation. Roentgenograms were used to confirm reduction of the femoral head into the acetabulum. The spica was applied for 3 months. The abduction orthosis had to be used at night for 2 months. Home physiotherapy was initiated after removal of the spica. The development of the joints was monitored from radiographs taken every month for the first 3 months after spica removal, followed by every 3 months until the end of the first year. Later on, radiographs were taken biannually. To evaluate the overgrowth of the treated hips, the largest diameter of the epiphysis was measured on routine anteroposterior radiograph images, and this value was expressed as a percentage by normalizing on the same diameter measured on the healthy contralateral side.

Results

Clinical results

On the basis of the assessment according to Severin as amended by Gibson and Benson [18], all our cases can be classified as grade I (excellent), with completely free and painless movements of the hip joint, walking without a limp at the end of the study.

Radiographic results

The evaluation of the radiographic results was carried out according to Severin [19] (Table 2). A total of 11 patients (61%) were of grade I (excellent) (Figs. 1–3) and seven patients (39%) were of grade II (good), thus providing a 'satisfactory' result (i.e. grade I + II). No secondary operations were performed on any of our patients. We had no cases of grade III, IV, or V.

Table 1 Data of patients

Cases	Age (presentation) (months)	Sex	Side	Age (surgery) (months)
1	8	F	Lt	12
2	7	F	Rt	13
3	6	F	Lt	15
4	9	M	Lt	18
5	13	F	Rt	14
6	14	F	Rt	15
7	8	F	Lt	15
8	7	F	Rt	14
9	5	F	Lt	13
10	16	M	Lt	17
11	13	F	Rt	14
12	8	F	Rt	13
13	15	M	Rt	17
14	7	F	Lt	14
15	9	F	Rt	14
16	16	F	Lt	18
17	8	F	Lt	13
18	10	F	Lt	13

Table 2 Radiological results based on the Severin classification

Severin grade	CE angle	Hips [*n* (%)]	Classification	Satisfactory unsatisfactory
Grade I	>20°	11 (61)	Excellent	Satisfactory
Grade II	>20° with mild head and neck deformity	7 (39)	Good	Satisfactory
Total		18 (100)		Satisfactory

Complications

No surgical complications, wound infection, redislocation, or subluxation occurred. No limb length discrepancies were observed. Because of the long duration of the spica cast usage, the children usually had mild flexion and abduction contracture for 3–4 months, but these resolved spontaneously when the children started to move freely. On the basis of the criteria of Kalamchi and MacEwan [20], only type II deformity occurred in three out of 18 (16.6%) hips among our patients. They can be classified as grade II according to the Severin classification, as deformity was only seen on the femur: the metaphysis was slightly shortened and the epiphysis tilted toward the valgus direction. However, the spherical shape of the femoral head was maintained. Acetabular development was good, as CE angles were greater than 20°. The recent literature calls this form 'lateral growth disturbance' [21].

Discussion

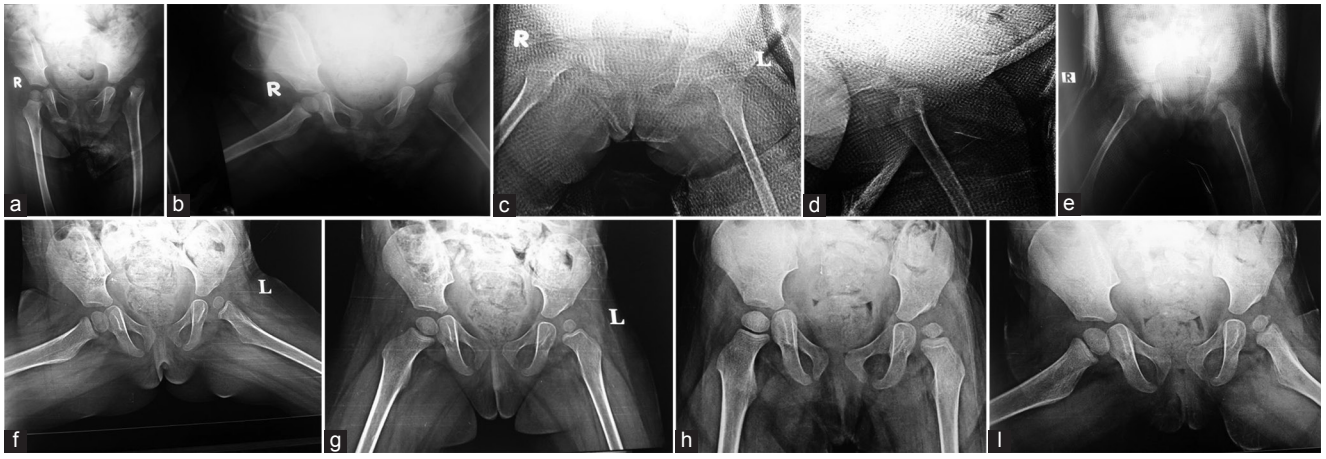
To improve the outcome of hip dislocation treatment in our hospital, we performed the central stable reduction at the earliest time possible. Plaster cast fixation was considered. We used a fiberglass spica cast instead of the ordinary Plaster of Paris because it is stronger and sustains for a longer duration (up to 3 months), thus avoiding changing of the cast.

Avascular necrosis affected three of our patients (type II) according to the criteria of Kalamchi and MacEwan. Some authors [7,9,21] emphasize that the lateral growth disturbance of the femoral neck characteristic to type II may be observed with well-developed Severin grade II acetabula as well.

Reports on the results of the treatment of the dislocated hip supported by long-term follow-up studies carried out after the completion of bony maturation are rare, as 15–16 years of follow-up is required for these [6,7,22]. In the literature, there are only 21 similar studies to which our results can be compared. We could only use the evaluation according to Severin, as other parameters to evaluate the results of the treatment were not determined in our study. Our aim was only to present and evaluate our results.

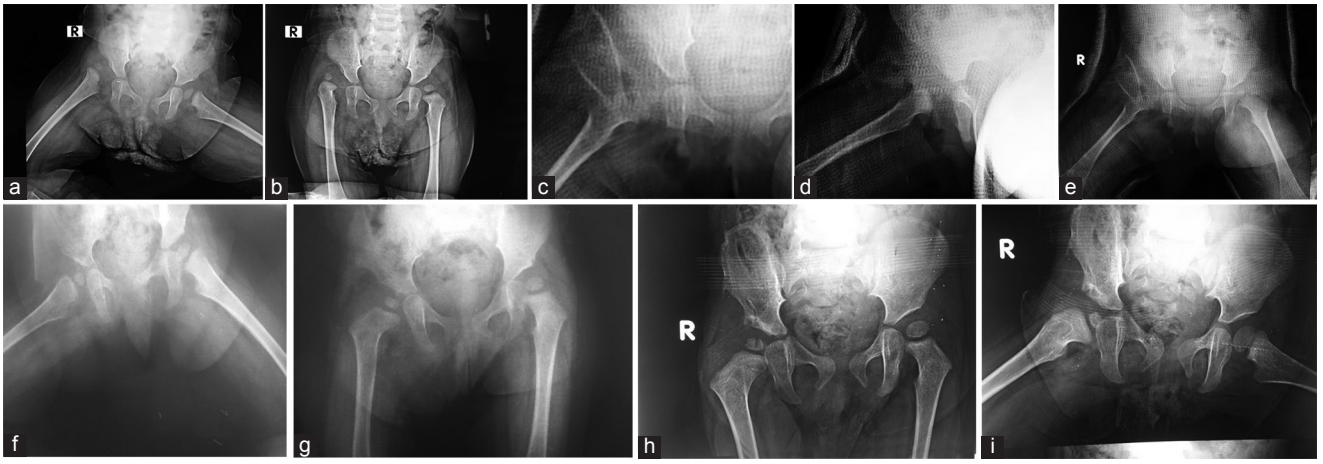
On reviewing, we found the proportion of reductions performed using the anterior approach [9,10,23,24] to be 72.9%, whereas it was 76.5% when concomitant bony surgery was performed [11–13,25]. In case of surgical reduction with concomitant surgery and a secondary operation [15] the result was 86%, and it was 96% when the reduction was combined only with secondary surgery. The average of the 'satisfactory' results of reductions performed using the medial

Figure 1



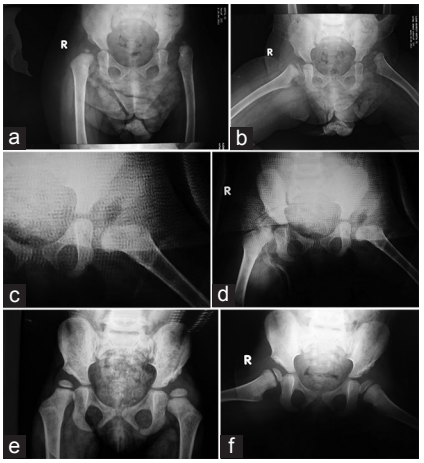
(a, b) Preoperative left-side developmental dislocation of the hip (DDH). (c, d) Immediate postoperative radiograph. (e) Postoperative radiograph at 2 months. (f, g) Postoperative radiograph at 9 months. (h, i) Last follow-up radiograph at 15 months postoperatively.

Figure 2



(a, b) Preoperative right-side developmental dislocation of the hip (DDH). (c, d) Immediate postoperative radiograph. (e) Postoperative radiograph at 3 months. (f, g) Postoperative radiograph at 10 months. (h, i) Last follow-up radiograph at 23 months postoperatively.

Figure 3



(a, b) Preoperative left-side developmental dislocation of the hip (DDH). (c, d) Immediate postoperative radiograph. (e, f) Last follow-up radiograph at 22 months postoperatively.

approach [5–7] was 65%, whereas that of closed reduction [22,26,27] was 58.2% and was 63% when combined with secondary surgeries [27]. The average of the results was 73.86% with a Pavlik harness [28–30], whereas in another study [31], the combination of a Pavlik harness with secondary surgery yielded a value of 91.5%.

In 21 long-term studies reviewed [5–7,9–14,22–33], at least 17–18% of the cases belonged to the 'unsatisfactory' result group because of the residual dysplasia irrespective of the reposition method.

These dysplastic hips can be corrected only with a secondary surgical procedure for better results. Cherney and Westin [15] performed the secondary surgery at 4–5 years of age after reduction, Wenger and Frick [16] at 5–6 years of age, whereas Nakamura *et al*. [31] performed the surgery at 3–7 years of age.

Holman *et al*. [34] revealed that 19% of hips experienced redislocations, and these hips underwent a secondary surgery, whereas 42% of hips required further surgery for dysplasia. Only nine hips developed osseous necrosis.

Bulut *et al*. [35] in their study in 2013 showed that only 25.8% of hips needed a secondary surgery, and there were fewer limb length discrepancies, lower amounts of blood loss, shorter surgery durations, and fewer surgeries.

The limitations of the present study include the small number of patients and the short duration of the study (2 years).

Conclusion

On the basis of the results obtained using the early anterior reduction approach, followed by functional postoperative treatment, we can conclude that our method is highly favorable and safe and is recommended in children aged 12–18 months.

Acknowledgements

Conflicts of interest

There are no conflicts of interest.

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