

Original article

Surgical treatment of developmental dysplasia of the hip in the periadolescent period

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Abstract The surgical management of patients with neglected developmental dysplasia of the hip (DDH) after the age of 6 years has been the subject of controversy. We present 11 cases (16 hips) of neglected DDH that were treated operatively by means of open reduction and derotational subtrochanteric osteotomy. Patient age ranged between 10 and 17 years (mean, 12 years). Follow-up ranged from 5 to 13 years (mean, 8.7 years). The results have been satisfactory both clinically (evaluated using the modified Harris hip score) and radiographically (evaluated using Severin's classification). Our data suggest that neglected DDH cases, not only during early childhood, but also in the periadolescent period, should be considered for surgical treatment.

Key words Hip · Developmental dysplasia · Periadolescence

Introduction

Treatment of developmental dysplasia of the hip (DDH) varies depending on the instability of the hip joint, the quality of reduction achieved with conservative means, and the age of the patient. Surgical treatment, when necessary, is usually reserved for children from 18 months to 4 years of age.^{14,16} After the age of 4, the pathological features do not change but the secondary changes become more marked, because the head of the femur does not grow at the normal rate and assumes an abnormal shape because of its articulation with the false acetabulum.^{14,16,17} A cadaveric pelvis of a young patient aged 13 at the time of death shows the shape of the acetabulum as it appears in neglected DDH cases (Fig. 1). Operative treatment in older children is uncommon and requires extensive knowledge of the condition. Some authors suggest that reduction of the hip after the age of 10 is not advisable^{10,17} and that the

condition should be treated with skilled neglect until the hip is painful and the patient old enough to undergo total hip replacement. After surveying the literature on the subject, we were able to find a handful of studies that would support surgical treatment.^{1,2,5–8,13}

Materials and methods

We present 11 patients with neglected DDH (Table 1) who were treated surgically during their periadolescent period. The age of the patients ranged between 10 and 17 years (mean, 12 years); the mean follow-up was 8.7 years. One patient was a male and 10 were female. In 5 cases, neglected DDH was bilateral. In the unilateral cases, 3 hips were affected on the right and 3 on the left (Table 1).

The surgical procedure was a combination of open reduction and derotational varus osteotomy. The surgical incision we used was the Smith–Petersen approach. We prefer the incision in the bikini line parallel to the iliac crest, which produces a more cosmetically acceptable scar. Once the deep fascia was encountered, the skin and subcutaneous fat were removed to expose the anterior portion of the iliac crest and proximal anterior thigh. The interval between the sartorius and tensor fascia latae was then deepened to expose the deeper fascia layer. This was opened and the rectus femoris exposed and retracted medially. Dissection was then carried proximally to the anteroinferior iliac spine down to the attachments of the gluteal muscles and tensor fascia latae. The sartorius and the gluteus medius were split longitudinally over the iliac crest and a subperiosteal dissection was carried out. To improve the exposure, the rectus femoris was released from the anteroinferior iliac spine and the soft tissues were stripped off the inferomedial capsule. The space between the detached muscles and the iliac bone was retracted and the dislocated hip was exposed. The thick

joint capsule was opened by a “T” incision and the femoral head was exposed. The femoral head was found to be covered with normal hyaline cartilage.¹¹ The iliopsoas tendon was found to be loose. The long ligamentum teres, which was thinner than in younger patients, was the guide to the true acetabulum. The true acetabulum was found to be covered by fibrous tissues and to be

large enough to contain the femoral head. The tissue covering the acetabulum was cleared to prepare it to accept the femoral head. Then, using a separate incision, a derotational and varus osteotomy was performed. The femoral head after the reorientation inserted easily into the prepared acetabulum.

The wound was closed in layers and an abduction brace was applied for 6 weeks postoperatively. Thereafter, the patient was allowed only partial weight-bearing for 2 months. One year postoperatively, the implant was routinely removed.

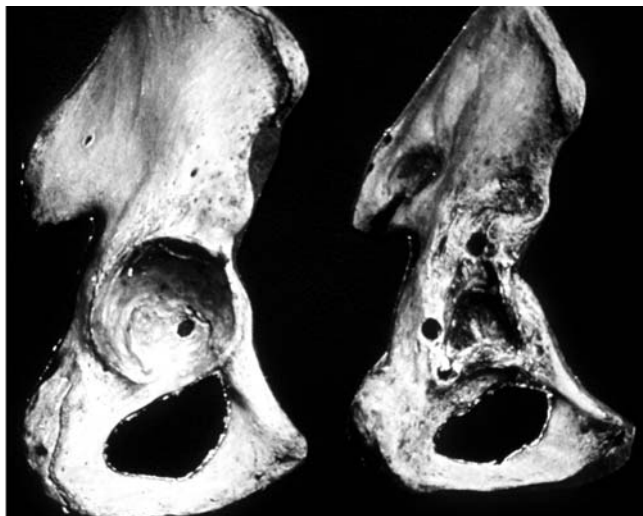


Fig. 1. Shape of the acetabulum (normal and false) in a cadaveric pelvis in neglected developmental dysplasia of the hip (DDH)

Case presentations

Case 1

In a 12-year-old male patient with unilateral neglected DDH (Fig. 2a,b), it was necessary to shorten the femur by 2.55 cm at the subtrochanteric area to accomplish a stable reduction of the femoral head. The harvested bone was then used in a way similar to that in the “shelf” operation. It was placed under the detached false acetabulum. The process of incorporation of the bone graft under the detached false acetabulum was slow but successful (Fig. 2c,d). The recent (Fig. 2e,f) three-dimensional (3D) computed tomography (CT) reconstruction in two projections clearly demonstrates the progress and the improvement of this hip joint.

Table 1. Patient data and surgical technique

Case	Gender	Age at initial presentation (years)	Affected hip	Year treated	Length of follow-up (years)	Surgical technique
1	Female	10	Bilateral	Left: 1989 Right: 1990	13	Open reduction with derotational varus osteotomy
2	Female	17	Right	1990	12	Open reduction with derotational varus osteotomy
3	Female	16	Left	1990	12	Open reduction with derotational varus osteotomy
4	Female	12	Bilateral	Left: 1992 Right: 1993	10	Open reduction with derotational varus osteotomy
5	Male	12	Right	1993	9	Open reduction with derotational varus osteotomy and shortening of the femur
6	Female	11	Bilateral	Left: 1993 Right: 1994	9	Open reduction with derotational varus osteotomy
7	Female	12	Bilateral	Left: 1995 Right: 1996	7	Open reduction with derotational varus osteotomy
8	Female	12	Bilateral	Left: 1995 Right: 1996	7	Open reduction with derotational varus osteotomy
9	Female	11	Right	1996	6	Open reduction with derotational varus osteotomy
10	Female	11	Left	1996	6	Open reduction with derotational varus osteotomy
11	Female	11	Left	1997	5	Open reduction with derotational varus osteotomy

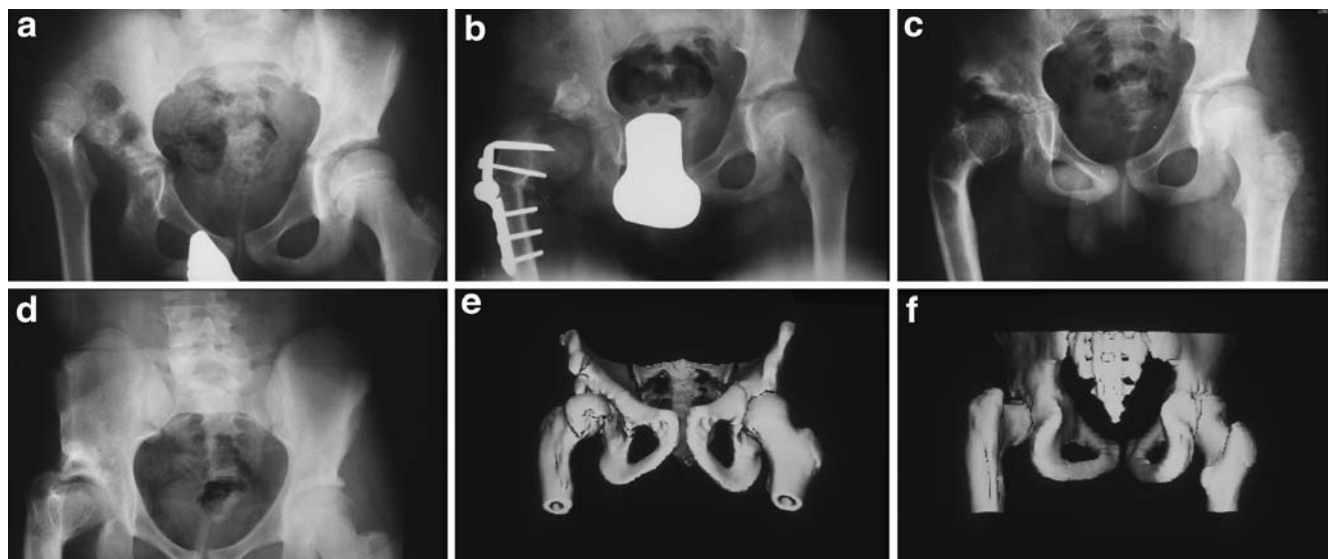


Fig. 2. **a** Anteroposterior (AP) pelvis radiograph in neutral position shows the affected right hip. **b** The open reduction is completed after removal of 1 in. of femoral bone graft, which is placed under the detached false acetabulum. **c,d** Radio-

graphs taken at different stages show the slow incorporation of the bone graft. **e,f** The three-dimensional computed tomography (3-D CT) reconstruction shows good coverage of the femoral head

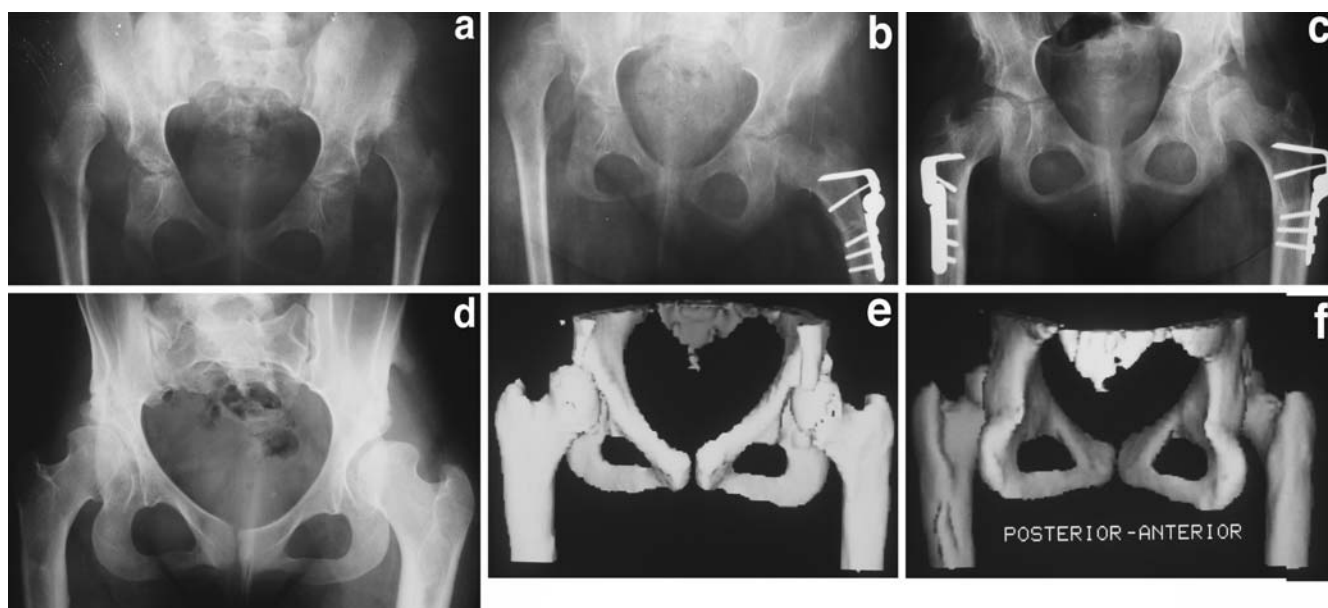


Fig. 3. **a** Anteroposterior pelvis radiograph shows high position of the femoral head with a molded false acetabulum bilaterally. **b** One year postoperatively, the left hip shows progress of the reduction. **c** One year postoperative for the right side and 2 years for the left. **d** Recent radiographs in

neutral position after 12 and 13 years postoperatively for the left and right hip, respectively. **e,f** Anteroposterior and posteroanterior 3-D CT reconstruction reveals good appearance of both hips

Case 2

A 10-year-old girl was admitted to our department in 1989 for bilateral neglected DDH (Fig. 3a). The left hip was operated first in 1989, and 1 year later, the right side

was treated. The postoperative radiograph 1 year later shows the progress of reduction for the left hip joint (Fig. 3b). The postoperative radiograph taken in 1992, before the removal of the implants, shows a well-molded acetabulum with good concentrated femoral

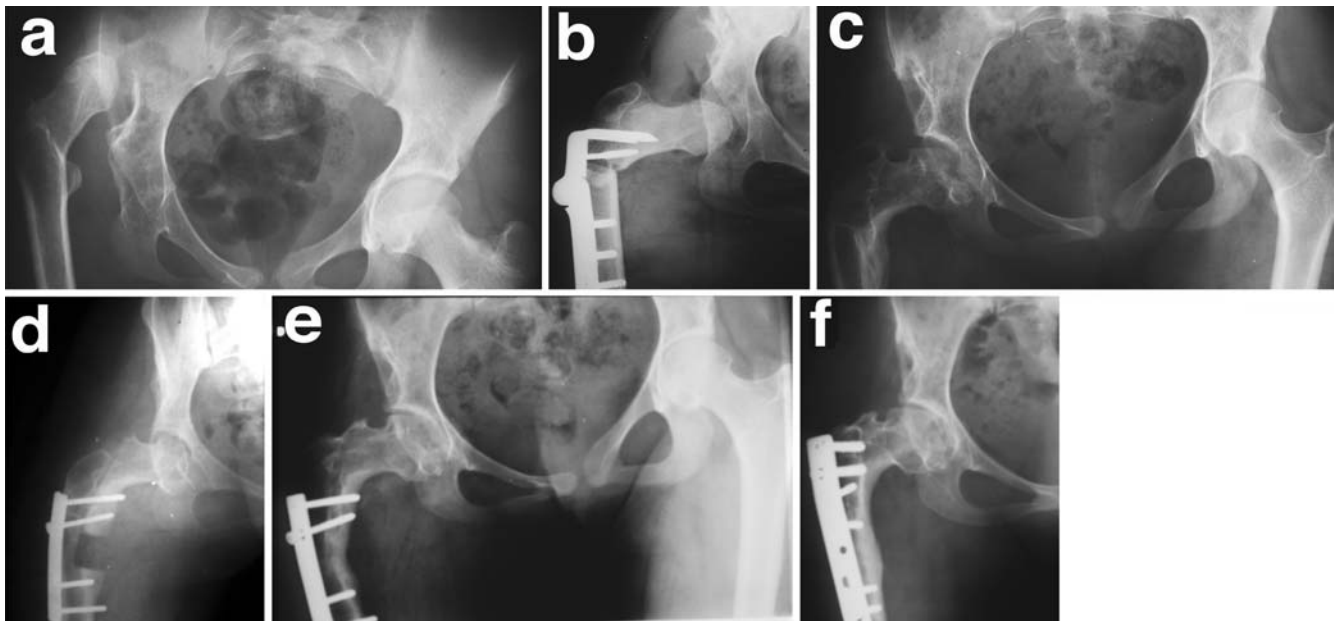


Fig. 4. **a** Anteroposterior radiograph of the pelvis shows high dislocation of the right hip. **b** Reduction of the hip accompanied with subtrochanteric derotational osteotomy. **c** Good reduction is shown but the femoral head and neck are in varus

position. **d** Elongation of the femoral neck and the shaft of the femur. **e** Six months after elongation of the femoral neck and shaft. **f** Hip joint appearance 12 years after operation

heads and reasonably good congruity for both hips (Fig. 3c). The most recent films show good appearance for both hips (Fig. 3d). A recent 3-D CT reconstruction reveals a satisfactory bony anatomy (Fig. 3e,f). The patient at the time of the follow-up was 23 years of age, married, has one child, was able to work, and upon clinical examination there were no limitations in hip movement. Clinically, the Trendelenburg sign for each side was negative.

Case 3

A 17-year-old girl was admitted in 1990 because of severe limping on the right. The anteroposterior films of the pelvis show high dislocation of the femoral head on the right side and a clearly molded false acetabulum (Fig. 4a). The postoperative films show a reasonably good reduction of the operated hip (Fig. 4b). The varus position of the femoral neck 2 years postoperatively gives a biomechanical disadvantage to the hip joint and a 1.5-cm limb shortening (Fig. 4c). The surgical elongation of the femoral neck and the femur, as a second-stage operation, restored some of the anatomy and the limb length¹² (Fig. 4d). Films taken 6 months postoperatively revealed the healed osteotomy (Fig. 4e). Soon after the second operation, the patient was lost to follow-up. The contact was reestablished years later and she was asked to send us some recent radio-

graphs and photos standing on the operated side to assess the Trendelenburg sign. The radiographs reveal a satisfactory congruity of the hip joint (Fig. 4f). The films and her brief medical records that were sent along from her adopted country also show a healed femoral fracture that she sustained in 1998 in a road traffic accident (8 years postoperatively). The Trendelenburg sign was positive. The patient at the time of follow-up was 29 years old; she had three children and remains active.

Results

It is difficult to accurately estimate and quantify the results of this series of patients and compare their progress because the group consists of patients operated at different ages with different degrees of severity in clinical symptoms and radiologic appearances on admission. However, all these patients share one common characteristic, which is severe hip disability at a very young age if left untreated or neglected.

An effort was made for all 11 patients (16 operated hips) to be followed up clinically and radiographically in clinic every 6 months. Three patients (patients 2, 3, and 6) were lost in follow-up for some time due to emigration of their families abroad. In 2002 we were able to reestablish contact with all 11 patients and reassess them clinically and radiographically. In one case (pa-

tient 6), the patient was unable to attend and the local clinic provided us with radiographs and clinical examination results.

The results so far have been very satisfactory. To quantify our results, we used a modified Harris hip score.⁴ Only one patient was found to complain of slight occasional pain to her right from the bilaterally operated hips (see Table 3). All patients were able to work and participate in physical activities. Two hips had fixed flexion deformity and two leg length discrepancies of 2 and 2.5 cm that were treated successfully with orthotic devices. Three patients had positive Trendelenburg (patients 3, 5, 6) on the operated side. The average modified Harris hip score was 90.3 (range, 72–101).

The main complication (Table 2) in our series was avascular necrosis of the femoral head in an 11-year-old girl who presented at our department in 1993 with bilateral neglected DDH (Fig. 5a). The left side was operated first in 1993 and the right side in 1994. During the initial follow-up, early signs of avascular necrosis of both femoral heads were noted (Fig. 5b). Four years postoperatively, the left hip had fully recovered but the right (3 years postoperatively) did not show any signs of recovery (Fig. 5c). This girl was one of the patients who were lost in follow-up. In 2002, when contact was reestablished, the right hip had established avascular necrosis radiographically (Fig. 5d,e). Clinically, she had fixed flexion deformity, positive Trendelenburg, 2.5 cm shortening, and limited range of motion (Table 3) in internal and external rotation and abduction. The pa-

tient, aged 20 in 2002, did not wish any further surgical treatment because her disability and pain were limited.

Radiographically the results were also satisfactory (Table 2). In 2002, using Severin's¹⁵ classification, 4 hips had excellent results, 9 good, and 3 fair.

Discussion

Management of neglected DDH for children 10 years and older is a field of great controversy. Most of the modern literature only briefly discusses this topic, probably because there are so few cases of the condition in the developed world. The problem, however, is still very much present, and in the past decade we have noticed an increasing incidence of this condition, probably due to the increased immigration from Third World countries. It is highly probable that this problem will become even more dominant with the increase of immigration in the years to come.

A few authors have suggested that operative treatment in neglected cases is not advisable or is even dangerous, but without presenting strong clinical evidence to support this view.^{10,14,16,17} A number of authors do accept the surgical option but suggest that the results worsen as age increases.^{1,5,9} The only large series of neglected DDH were presented by Ashley et al.,¹ Klisic et al.,⁷ and Galpin et al.,³ who advocate open reduction with concurrent shortening of the femur and report satisfactory results in comparison to the alternative, which

Table 2. Severin's classification and complications

Case	Operated side	Radiographic results using Severin's classification ^a	Complications
1	Left	2	—
	Right	1	—
2	Right	2	—
3	Left	3	—
4	Left	1	—
	Right	3	
5	Right	2	Rotational and shortening discrepancy
6	Left	1	—
	Right	3	Avascular necrosis/limp, shortening
7	Left	2	—
	Right	2	—
8	Left	2	—
	Right	1	—
9	Right	2	—
10	Left	2	—
11	Left	2	—

^a Class 1 (excellent): no deformity, normal CE angle (<20°); class 2 (good): minimum deformity, normal CE angle; class 3 (fair): moderate dysplasia of femoral head or acetabulum, or a CE angle <20°, but no subluxation; class 4 (poor): subluxation of the femoral head; class 5 (failure): dislocation

Table 3. Modified Harris hip scores in patients

Case number	Operated Side	Pain	Function	Deformity	Range of motion	Total score
1	Left	None (44)	47	None (4)	Within normal limits (6)	101
	Right	None (44)	47	None (4)	Within normal limits (6)	101
2	Right	None (44)	47	None (4)	Within normal limits (6)	101
3	Left	None (44)	33	10° fixed flexion contracture (0)	2/3 restriction in I.R. (4)	81
4	Left	None (44)	47	None (4)	Within normal limits (6)	101
	Right	None (44)	47	None (4)	Within normal limits (6)	101
5	Right	None (44)	33	Limp length discrepancy less than 3.2 cm (0)	2/3 restriction in I.R. (4) 1/3 restriction in E.R. 1/2 restriction in abduction (3)	80
6	Left	None (44)	47	None (4)	Within normal limits (6)	101
	Right	Slight (40)	30	Less than 30° fixed flexion contracture and limp length discrepancy less than 3.2 cm (0)	Loss of E.R. 1/2 restriction in abduction 1/3 restriction in E.R. with flexion or extension 2/3 restriction in I.R. (2)	72
7	Left	None (44)	47	None (4)	Within normal limits (6)	101
	Right	None (44)	47	None (4)	Within normal limits (6)	101
8	Left	None (44)	47	None (4)	Within normal limits (6)	101
	Right	None (44)	47	None (4)	Within normal limits (6)	101
9	Right	None (44)	47	None (4)	Within normal limits (6)	101
10	Left	None (44)	47	None (4)	Within normal limits (6)	101
11	Left	None (44)	47	None (4)	Within normal limits (6)	101

Pain (44 points); function (47 points) [A, gait (33 points); B, activities (14 points)]; absence of deformity (4 points); range of motion (6 points); I.R., internal rotation; E.R., external rotation

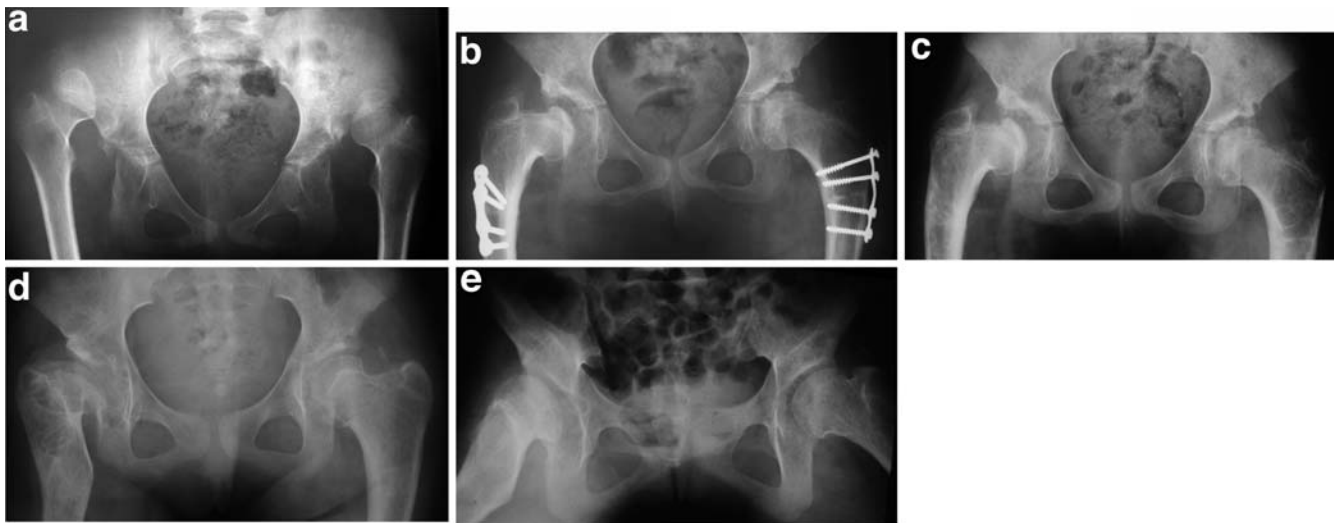


Fig. 5. **a** Bilateral dislocation of the hip in an anteroposterior radiograph. **b** On the right side, there are signs of avascular necrosis of the femoral head 1 year postoperatively; the left is slightly affected (2 years postoperatively). **c** Four years

postoperatively the right hip shows some improvement while the left hip has completely recovered. Plane anteriolateral radiograph of the hip in neutral position (**d**) and in abduction position (**e**) shows the stabilized deformities on the right side

is skilled neglect. Finally, Ryan et al.¹³ suggest that a one-stage operative procedure consisting of open reduction, femoral shortening, and pelvic osteotomy (when indicated) in neglected DDH cases in children between 3 and 10 years of age can result in remodeling of the acetabulum and the formation of a functional hip joint.

It is our experience that the strong skeletal traction that has often been used to position the femoral head into the acetabulum by relaxing the muscular or ligamentous tension is not useful. This experience is shared by many authors.^{1,2,9,13}

The great caution regarding operative treatment in older children with neglected DDH is that the patient, clinically, has very good gait, albeit with limitations with regard to abduction. However, the gait will deteriorate as the height and weight of the patient increase, leading to early degenerative arthritis and disability. Total hip replacement in such young patients is only a temporary solution, and arthrodesis has its inherent limitations. Such considerations have prompted us to attempt open reduction with derotational varus osteotomy on periadolescent patients, with satisfactory results. The operation can be the first step to improve the outcome of this condition.

Conclusion

There are two major advantages in operative treatment of DDH in the periadolescent period. Firstly, it gives these patients a mobile and painfree hip. Secondly, it restores hip anatomy and thus increases the probability of a successful hip replacement operation in adult life. Our results show that surgical reduction in neglected DDH cases in the periadolescent period provides a satisfactory solution to this problem.

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