Long-term results after open reduction of developmental hip dislocation by an anterior approach lateral and medial of the iliopsoas muscle

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The technique of and especially the approach to open reduction of developmental dislocation of the hip are still a matter of discussion. The anterior approach, first lateral and then medial to the iliopsoas muscle, was described by Tönnis in 1978. A follow-up investigation to adulthood has now been performed. Eighty-seven children (118 hips) out of 105 children (83%) who underwent open reduction of developmental dislocation of the hip before the age of 4 years were reinvestigated 10–21 years after the operation. An anterior approach first lateral, then medial to the iliopsoas muscle was chosen, because this offers the best access to the joint. Additional operations including transiliac osteotomy for acetabuloplasty, shortening osteotomy, and femoral osteotomies were performed as necessary. In 92 (78%) of the 118 hips studied the CE angle exceeded 25° and in 98 hips (83%) the VCA angle exeeded 25°. Critical CE angles between 20 and 25° were found in 14% of the hips, and critical VCA angles in 4%. Residual dysplasia (<20°) was found in 8 and 13% of the hips respectively. Avascular necrosis according to Hirohashi was observed after operation in grade 1 in 5.9% and grade 2 in 1.7%. No necrosis was found following shortening osteotomy of the proximal femur. The anterior approach, first lateral, then medial to the iliopsoas muscle, offers an optimal access to the medial parts of the joint with control of reduction, protects the vasculature of the femoral neck, and allows simultaneous postero-lateral capsulorrhaphy and pelvic osteotomies. *J Pediatr Orthop B* 00:000–000 © 2005 Lippincott Williams & Wilkins.

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Introduction

Due to early diagnosis of dysplasia and dislocation of the hip by neonatal screening the number of open reduction procedures has decreased and, consequently, so has the experience in this field. Therefore long-term results and reports based on a large number of patients seem necessary. Also, the technique and the approach to open reduction are still controversial. Since 1970, one of the main activities of our department has been the treatment of developmental dysplasia and dislocation of the hip. A new anterior approach for open reduction was introduced by Tönnis [1–3]. This report presents the results achieved between 1975 and 1983.

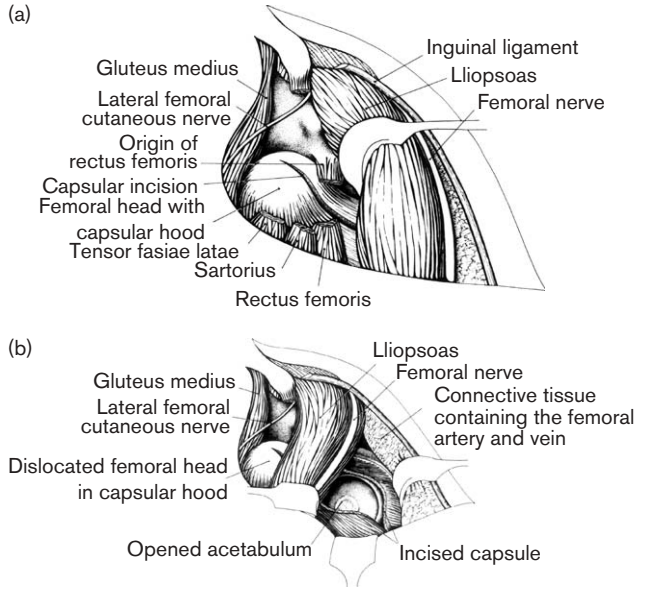
Indication for closed and open reduction

Developmental dislocation of the hip was originally investigated by palpation and radiography. In 1983 sonography was introduced [4]. In cases of dysplasia without instability treatment consisted of abduction pillows and flexion-abduction splints. In very unstable and higher dislocated or irreducible hips arthrography was performed at all ages to find out whether in 110–120° flexion and 50° abduction of the hip the acetabular introitus was constricted or obstructed [2,3,5]. If no deep closed reduction in anaesthesia could be achieved longitudinal traction with slight abduction and flexion was applied for 4 weeks. In case of failure (no progress) open reduction was indicated. Neonates with irreducible hips were sent home without treatment. In some infants closed reduction was possible a few months later. In the others open reduction was performed from the fourth month on.

Technique of open reduction according to Tönnis and indication of additional acetabular and femoral operations

A deep, concentric reduction is very often prevented by the medial portions of the capsule and labrum and the prominent transverse acetabular ligament [2,3,5]. These structures have to be incised before the head can enter the medial part of the acetabulum. However, with an antero-lateral approach identification of and access to these structures are often difficult. Therefore, we gave up the anterolateral approach and changed to an inguinal

Fig. 1



Anterior approach to the dislocated femoral head. (a) The muscles of the anterior superior and inferior iliac spine and the inguinal ligament are detached and retracted. The iliopsoas muscle is retracted medially. The capsule has been incised from the femoral head in a medial direction below the acetabular rim. (b) The psoas muscle is now retracted laterally with the femoral nerve. The incision of the capsule is continued down to the protruding medial labrum and the transverse ligament.

incision (Fig. 1a). The fascia is divided just below the inguinal ligament up to the lacuna musculorum. The muscles are detached from the superior iliac spine and the rectus femoris from the inferior iliac spine as seen in Figure 1a. The exposed joint capsule is incised parallel to the acetabular margin at least 0.5 cm below in order to avoid damage to the labrum and the apophyseal growth centres of the acetabular rim. Up to this point, the iliopsoasmuscle was retracted medially. Then it was retracted laterally so that the joint could be approached through the lacuna musculorum anteriorly (Fig. 1b). The iliopsoas tendon should be obliquely divided at the pelvic rim and not at the lesser trochanter [6] to relieve intraarticular pressure and avoid avascular necrosis. The medial soft tissue of the lacuna vasorum with femoral artery and vein has to be held medially with double curved retractors and not with sharp-edged instruments. This approach gives excellent exposure of the acetabulum and its medial border and allows assessment of the quality of the reduction by direct inspection [1–3]. If soft tissue is excised out of the acetabulum, the acetabular fossa with the acetabular artery and vein should not be touched [7,8]. Additional femoral shortening (about 1.5 cm) is required, if the femoral head is not easily reducible. The femoral head should be free from pressure when reduced into the acetabulum. A subtrochanteric osteotomy is performed by a separate short incision in order to avoid damage to the blood supply of the femoral neck (Fig. 2). A detorsion could be performed, but is rarely necessary because anteversion decreases usually when the femoral head is well covered. Also, detorsion to zero may remain and cause pain and osteoarthrosis in later years [9]. We stopped varus osteotomies when we found that about 50% caused a subcapital coxa valga deformity [10–13]. A recent reinvestigation proved that a valgus-neck-position developed normally when the acetabular coverage was complete and the acetabular index less than 15° [14].

In addition to open reduction, capsulorrhaphy with Vicryl, a resorbable material, is possible simultaneously with this approach (Fig. 3). When the femoral head has been reduced it has to be tested whether there is easy redislocation due to dysplasia of the acetabular roof. If so, and if the acetabular angle is significantly pathological (Table 1) [2] additional acetabuloplasty is necessary [2,10–15]. A plaster cast is applied, usually twice for 6 weeks, each time according to stability and the degree of residual dysplasia.

Material

The evaluation of our technique of open reduction considered only children with typical developmental dislocation of the hip. Children with teratological dislocation or neurological disorders were excluded. The age at operation ranged from 3 months to 4 years. Revision operations of pretreated infants were also excluded.

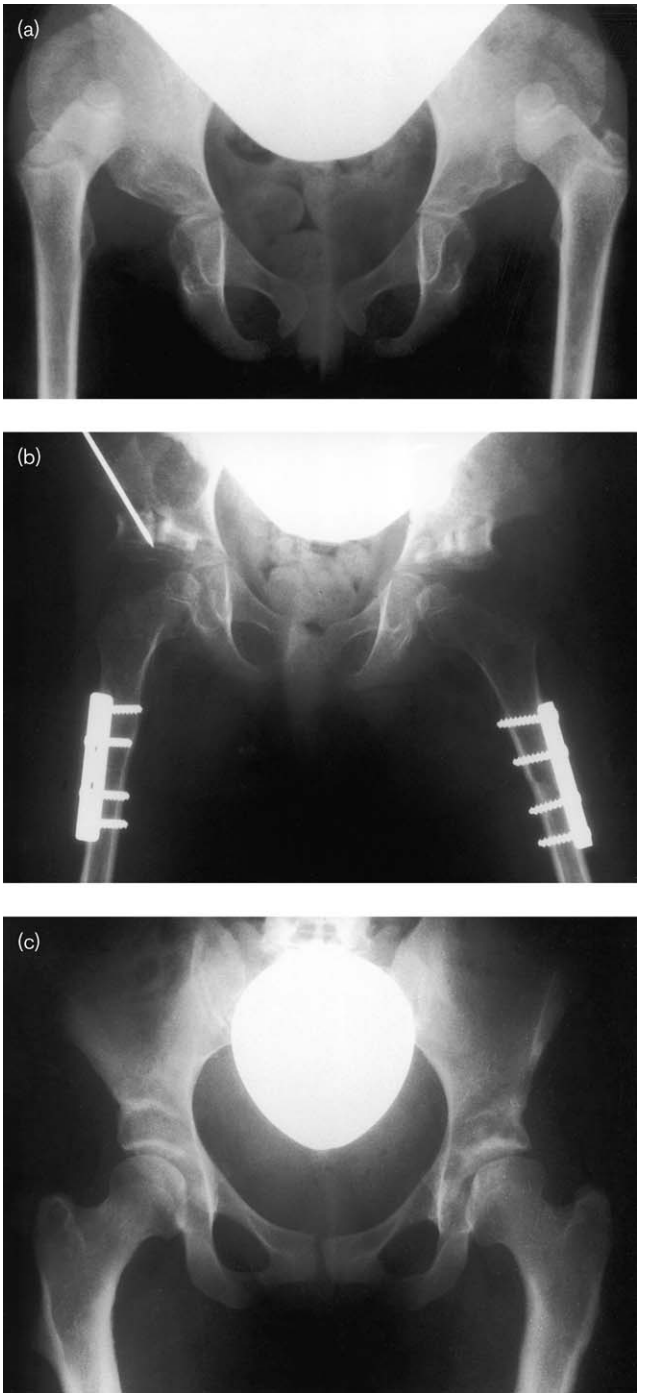
Eighty-seven (70 female and 17 male) (83%) of 105 originally operated patients attended the follow-up examination. Twenty-five patients had dislocation of the right side, 31 on the left side and 31 patients on both sides; thus, 118 hips were subject to follow-up examination. Age at operation ranged from 3 to 48 months with a mean of 14 months. Follow-up was performed 10–21 years later with a mean of 15 years and 3 months. The distribution of the dislocation grades according to Tönnis [2,16] was as follows for 118 hips: grade 1 (centre of femoral head medially to the vertical line of Perkins), 0%; grade 2 (centre of femoral head laterally to line of Perkins), 1%; grade 3 (centre of femoral head close to level of superior acetabular rim), 18%; grade 4 (centre of femoral head above superior acetabular rim), 81%. Table 2 shows the type and frequency of the conservative pretreatment of the hips which must be taken into consideration when evaluating the incidence of necrosis. The surgical procedures are shown in Table 3.

Results

Clinical findings

The clinical findings were graded according to Severin [17] and are shown in Table 4. Patients of group A show

Fig. 2



(a) Radiograph of a 4-year-old girl. High hip dislocation of grade 4 on both sides. (b) Open reduction with subtrochanteric shortening osteotomy and acetabuloplasty on both sides. Bone wedges were taken from the shortened femur. (c) At the age of 14 years, 3 months, the right hip is normally developed. The left hip shows a moderate degree of subcapital coxa valga and the CE angle is slightly decreased.

no limp, no pain and normal endurance. Patients of group B have no limp but the patient feels the hip on any great exertion. The range of motion was also investigated in detail. Only 10 hips out of 118 (9%) had less than 125° of flexion, and only six joints had a 10 or 20° deficit of extension (flexion contracture). Abduction ranged from 30 to 50° with only two exceptions and adduction from 30 to 35° with seven exceptions. Internal rotation ranged from 30 to 85° and external rotation from 30 to 65°. This is due to the syndromes of high and low anteversion, especially when acetabular and femoral anteversion both tend towards low or high grades. This was only recently investigated in detail [9]. Limping as a sign of muscular imbalance was assessed according to a classification of the Trendelenburg sign [2]. Grade 1 is defined as a mild deviation in the one-leg stance without significant sagging of the pelvis. A fatigue limp develops on prolonged walking. Grade 2 presents a moderate sagging of the pelvis in the one-leg stance. Out of 118 hips only 18 were classified as grade 1 (15%) and three hips were classified as grade 2 (3%). No hip showed grade 3 limping. In 97 hips (82%) there was no limping at all.

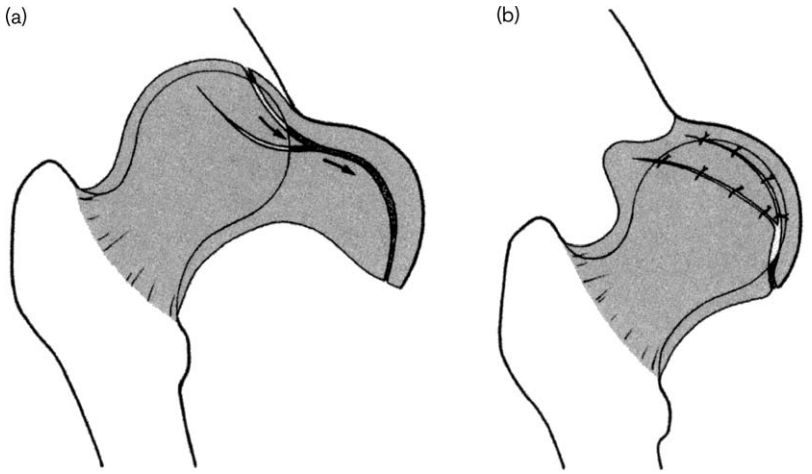
Roentgenologic evaluation

The containment of the reduced femoral head with and without acetabuloplasty was evaluated by means of the lateral CE angle of Wiberg [18] and the anterior VCA angle of Lequesne and de Sèze [19], also called the anterior CE-angle. These authors consider angles exceeding 25° as being normal. However, in adults the normal value for the CE angle we found to range between 30 and 35° [20–22]. According to our investigations the range of strict normality (maximal pain free state) starts at a CE angle of 30° at the age of 18 years [22]. Between 39 and 44° we speak of a deep acetabulum and from 45° onwards of protrusio acetabuli, which again means pathologic hips [9,22]. According to our standard, in normal values there is an average of 32° and a lower limit of 25° between the age of 8 and 18 years [2], but 30° is the borderline in adults. This fact is not common knowledge in the literature as yet. For the sake of statistical comparability we considered the angle of 25° to be a standard limit value for adolescents and adults. In 78% of the hips the CE angle and in 83% of the hips the VCA angle increased to over 25° and in an additional 14 and 4% respectively to the limit angle of 20–25°. Thus only 8% (CE angle) or 13% (VCA angle) of the hips showed a residual dysplasia with angles below 20°, that might still need a later operation.

Clinical and roentgenologic classification of the results according to Severin, Gibson and Benson, and Williamson

In order to allow a comparison with other authors a roentgenological and clinical classification of the hip joints according to Severin was performed [17]. In the original roentgenologic classification there is a further subdivision within group 1 of CE angles, namely into type a and type b. Gibson and Benson [23] as well as Williamson *et al.* [24] introduced a simplification and

Fig. 3



(a) Incision for lateral plication of the capsule and the technique for its closure. Reduction of the femoral head from its dorsolaterally dislocated position creates redundant dorsolateral tissue. (b) The problem of giving tension to the capsule to prevent redislocation is solved by creating a dorsolaterally based flap and advancing it anteriorly, as shown.

Table 1 Normal acetabular angles and grades of deviation (classification system

Age	Grade 1 Normal (°)	Grade 2 Mildly pathologic (°)	Grade 3 Moderately pathologic (°)	Grade 4 Extremely pathologic (°)
3–4 months	<30	≥ 30–<35	≥ 35–<40	≥ 40
5–24 months	<25	≥ 25–<30	≥ 30–<35	≥ 35
2–3 years	<23	≥ 23–<28	≥ 28–<33	≥ 33
3–7 years	<20	≥ 20–<25	≥ 25–<30	≥ 30
7–14 years	<15	≥ 15–<20	≥ 20–<25	≥ 25

Table 2 Conservative treatment before operation in 64 of 87 patients

Treatment	*n*
Broad diapering	5
Becker pillow	16
Pavlik harness and flexion-abduction splints	23
Traction	38
Casts in human positions	28

In 26 patients one method was applied, in 30 patients two and in eight patients three. In 25 patients of the 64 the dislocation was bilateral, in 39 it was unilateral.

Table 3 List of single open hip reductions and concomitant operations (*n*=118)

Treatment	*n*	%
Open reduction of hip dislocation	32	27
Open reduction and acetabuloplasty	37	31
Open reduction, acetabuloplasty, DVO	34	29
Open reduction, acetabuloplasty, DVO, shortening-osteotomy	6	5
Open reduction, acetabuloplasty, shortening-osteotomy	4	3
Open reduction, detorsion-varus-osteotomy	5	4

DVO, detorsion-varus osteotomy.

considered CE angles larger than 15° as normal (and not 19°) for those aged between 6 and 13 years and angles exceeding 25° as normal for those aged 14 years and above. Since most authors seem to apply the simplified classification, we also chose this classification system for our investigation. Table 4 presents the clinical results according to Severin: 83% belong to group A (asymptomatic), 15% to group B (minor discomfort in case of greater effort) and 2% to groups C and D (limping and limitation of the walking distance to 4–5 km). Table 5 shows the roentgenologic results: 62% have normal hips with a CE angle according to Wiberg [18] of more than 25° which is appropriate for their age. Group 2 also comprises hips with normal angles, but with slight changes of the femoral head or neck or the acetabulum. These 14% may also be considered good. Only 7% belong to group 3 and 4 representing residual dysplasia with CE angles of less than 20°. Severin does not specifically consider angles between 20 and 25°. We found 20 hips in this range and assessed them separately for statistical reasons (Table 5). During long-term follow-up no case of redislocation was observed (Severin group 6). Thirteen of our hips, however, were already redislocated whilst still in plaster cast. They were immediately repositioned with concomitant acetabuloplasty where necessary and were reinvestigated with the other patients.

Table 4 Clinical classification of the joints according to Severin and others (*n*=118)

Classification	*n*	%
Severin A	98	83
Severin B	18	15
Severin C+D	2	2

Table 5 Radiological classification of the joints according to Severin and others (*n*=118)

Classification	*n*	%
Severin 1	73	62
Severin 2	17	14
Severin 3+4	8	7
CE angle 20–25°	20	17 (not classified)

Outcome according to age and type of operation

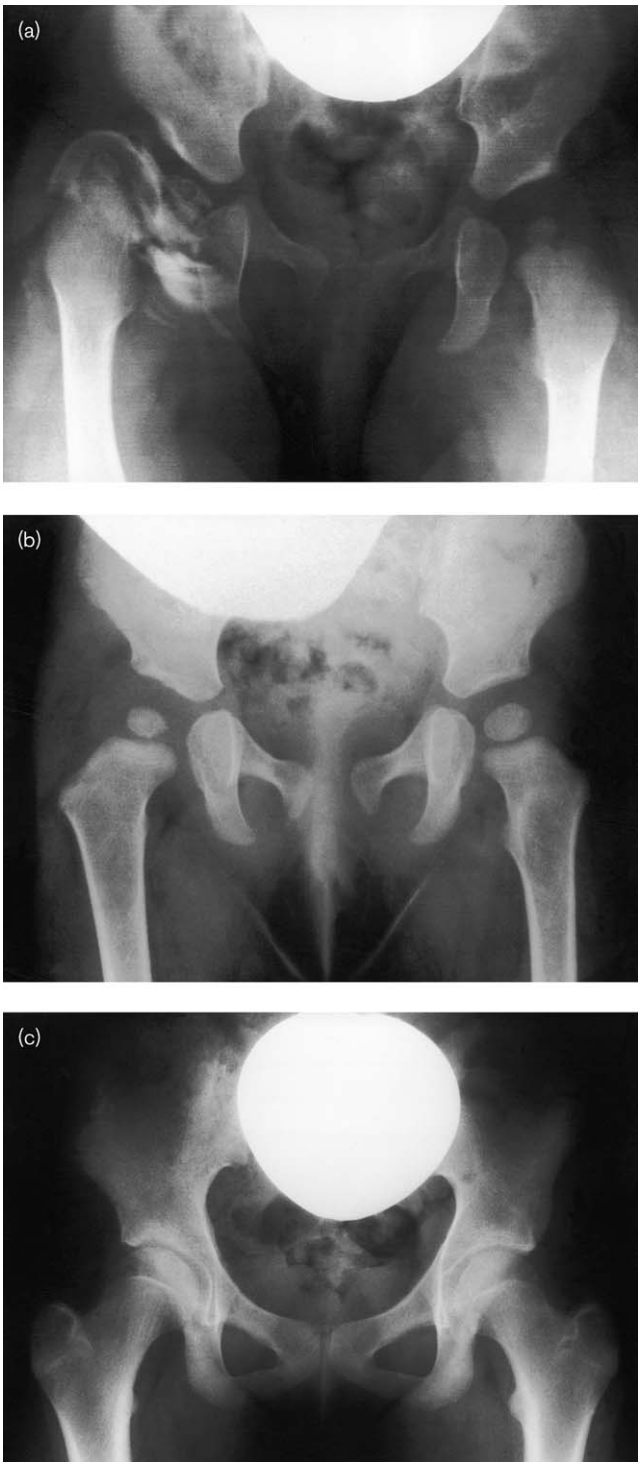
It is generally known that outcome is age dependant. The younger the child the more spontaneous acetabular development will occur (Fig. 4). For this reason Table 6 contains one group in which only surgical reduction and no other additional procedure such as acetabuloplasty or femoral osteotomy was performed. Twenty-nine of 32 hips were operated in the first year of life after the third month and only three in the second year. The mean age was 7 months. In the older age group with a mean age of 17 months, 66 joints were operated at the age of 2–4 years and only 20 in the first year of life. In 88% of those hips operated on mainly during the first year of life, a roentgenologic improvement according to Severin's group 1 could be achieved (healing) (Table 6), whereas only 71% of the hips in which treatment started in their second to fourth year of life achieved healing, although two thirds of these hips had undergone acetabuloplasty already. Apparently, after the first year of life sufficient spontaneous improvement without additional operative intervention cannot be regularly expected.

Complications

Tables 7 and 8 give an overview of the complications we observed. Coxa magna was determined by comparing the greatest diameter of the femoral heads of both sides in the horizontal plane at neutral leg position. Gamble *et al.* [25] considered an increase of more than 15% as coxa magna, whereas Imatani *et al.* [26] used a limit of 20%. In our investigation we applied the latter value of 20%.

Avascular necrosis of the femoral head was assessed according to the classification of Hirohashi *et al.* [27]. In brief, mild necrosis does not lead to permanent damage, moderate necrosis leads to partial damage and severe necrosis to complete damage. Out of 118 hips seven (5.9%) presented postoperatively with mild avascular necrosis and two (1.7%) with partial necrosis (grade 2), which adds up to a total of nine (7.6%) (Tables 7 and 8). However, five (4.2%) other hips already showed pre-

Fig. 4



(a) Hip dislocation of grade 3 at the right side in a 6.5 month-old girl. Open reduction and treatment in plastercast in slight abduction and flexion. (b) At the age of 1 year the joint is well reduced, but a moderate residual dysplasia is still present. Further treatment with a flexion–abduction splint was applied for 3 months, then spontaneous development was controlled. (c) At the age of 15 years the joint is normally developed.

Table 6 Results of open reduction alone and with additional operation

	Age at operation	CE Severin >25°	Clinical Severin Grade A+B	Residual dysplasia CE angle <20°	Avascular necrosis (Hirohashi)
Only open reduction $n=32$	7 months	88% $n=29$	94%	0%	13% grade 1 including 6% preoperative
With additional procedures $n=86$	17 months	71% $n=61$	77%	8%	12% grade 2+3 including 6% preoperative

Table 7 Complications after open reductions of hip dislocations with and without additional operations ($n=118$)

Complication	*n*	%
Coxa magna[a] ($n=54$)		
Difference in head diameter 10–20%	10	19
Difference in head diameter >20%	1	2
Avascular necrosis (Hirohashi *et al.*) only postoperative		
Grade 1	7	5.9
Grade 2	2	1.7
Grade 3	0	0
Total	9	7.6
Redislocations short after open reduction	13	11
Superficial wound infections	3	3

[a]Coxa magna was evaluated only in 54 unilateral open reductions.

Table 8 Preoperative condition in other patients ($n=5$; 4.2%)

Patient Number	Pretreatment	Ossific nucleus	Age at operation (months)	Necrosis grade
1	++	No	13	3
2	++	No	0	2
3	+	No	18	3
4	+	Small	17	1
5	++	Necrosis	14	3

+, moderate; ++, extensive.

operatively corresponding signs after a failing longer conservative treatment. In one femoral head necrosis was seen, in the others there was no ossific nucleus and a small one in one hip. All these hips except one were operated in the second year (Tables 7 and 8). The missing nucleus at that time is a sign of preoperative necrosis.

The surgical technique of shortening osteotomy, often combined with acetabuloplasty, was additionally examined (Table 9). This procedure decreases the pressure exerted on the femoral head after reduction from the high dislocation position and an additional levering down of the acetabular roof. In this group no necrosis was observed although the age at operation averaged 26 months. These children were definitely older than the rest of our patients (average age at operation of 17 months) and shortening osteotomy was performed in grade 4 dislocations only. Six joints of the first group with shortening osteotomies had ages of 1 year to 1 year and 6 months. The joints of four children were operated at the age of 2 years, 4 months, to 4 years.

In 13 hips (11%) redislocation occurred whilst still in plaster cast. These hips were immediately reoperated. As a result acetabuloplasty at the time of open reduction was performed more and more often, whereas varus and detorsion osteotomies were given up almost completely (see section on technique of open reduction). Neither joint nor deep wound infections were observed. Superficial infection occurred in only 4%.

Discussion

When we compare our results of 76% of Severin grades 1 and 2 for the radiographs and 94% for the Severin clinical grades A and B with other authors, that have follow-up times of 10 years and more in Table 6, the presented results showed an excellent outcome.

Eighty-eight percent of the children who had undergone open reduction mainly within their first year of life achieved grade 1 of the roentgenologic classification of Severin (normal) compared with only 71% of children operated on mainly in the second to fourth year of life (Table 6). For the clinical classification of Severin 83% of the cases in both groups reached the standard grade of group A. Considering group A and B as well as 1 and 2 according to Severin together, the values are 98 and 76%, respectively.

Our patients presented with 5.9% grade 1 and 2% grade 2, a very low and mild rate of postoperative avascular necrosis, especially in comparison with other approaches to the immature hip joint. This is certainly due to our anterior approach medial to the iliopsoas muscle, which is not touching the vessels of the femoral neck. No necrosis was seen after shortening osteotomies ($n=10$) (Table 9). Since then for all dislocations of higher degrees in the age group 1 year and older, reduction was performed simultaneously with a subtrochanteric osteotomy (Fig. 2).

Another possible complication that needs to be discussed is redislocation. In the literature (Table 10) [24,28–47] redislocation occurred in 4–12%. For the sake of stabilization of the femoral head a long girdle-like capsular flap was detached from the craniolateral redundant capsule, pulled anteriorly around the femoral head and sutured together with the previously incised capsule at the medial joint border.

Table 9 Results of open reduction with and without shortening osteotomies

	Age at operation	Shortening	Degree of dislocation	Avascular necrosis
Reduction + shortening $n=10$	26 months	2 cm	All degree 4	None
Other reductions $n=108$	17 months	None	Degree 4, 83% Degree 3, 3%	11.8% including 4.2% preoperative

See groups in Table 3.

Table 10 Results of reinvestigations of open reductions in developmental hip dislocations

Study	Age (months)		Mean follow-up (years)	Number of hips	Avascular necrosis (%)	Redislocations (%)	Severin radiograph	Severin clinical	Operative technique
	Mean	Range							
Berkeley [28]	ND	12–36	6.1	5.1	ND	ND	92 grade I + II	100 grade A + B	Iliofemoral approach, acetabuloplasty
Powell *et al.* [29]	16	4–26	4.3	16	25 grade I + II Salter, Gage, Winter	ND	68.8 grade I different score	ND	Anterior approach
	27	8–80	4.8	18	22.3 grade II + IV	5.6	72.2 grade I different score	ND	Anterior approach + varus osteotomy
	29	15–46	5.6	15	46.7 grade I–IV	26.7	46.7 grade I different score	ND	Anterior approach, varus + Salter osteotomy
Galpin and Wenger [30]	>2	ND	3.7	33	9.1	12.1	72.7	ND	Medial approach, Salter osteotomy
Williamson [24]	4.3	3–9.5	16.7	45	13.3	ND	51 grade I + II	80 grade A + B	Anterior approach of Sommerville
Castillo [31]	19	5–26	7	26	15	12	73 grade I + II modified	ND	Ludloff
Dhar [32]	Different groups	ND	5.6	99	23.2	4	75.8 grade I + II	100 MacKay grade I + II	Anterior approach derotation
Mergen [33]	12.1	3–33	7.1	31	9.7	0	67.7 grade I + II	100 MacKay grade I + II	Medial approach (Ferguson)
Mankey, Staheli [34]	12	2–63	6	66	11	4.6	In 33% pelvic osteotomy later		Ludloff
Sugimoto *et al.* [35]	<84	ND	>15	43	46.5 Kalamchi I + II	ND	41.2 grades I,II,III	ND	Unknown
Doudoulakis, Cavadis [36]	7	2–12	13	69	13	1.5	76.8 successful		Anterior approach (Smith-Petersen)
Gulman *et al.* [37]	ND	19.2–48	13	43	34 grade II, III, IV	71.1	78.9 grade I + II	ND	Anterior approach
	ND	48–96	9		Buchholz, Ogden		Severin		Salter osteotomy
Michiels [38]	8.8	3–21	11	21	38	0	81 grade I + II	47.6 different score	Ludloff and others
Szepesi [39]	13	6–24	6.1	113	0	ND	98 grade I + II	98 grade A + B	Anterior approach + pelvic osteotomy
Haidar [40]	25.4	18–67	7.6	37	8.1	0	83.8 grade I + II	97.3 MacKay grade A + B	Anterior approach + Salter osteotomy
Morcuende *et al.* [41]	14	2–50	11	93	24 grade II; 14 grade III; 3 grade IV; 2 no classification Buchholz, Ogden	2.2	71 grade I + II	ND	Anteromedial (Weinstein)
Koizumi *et al.* [43]	14	5–29	19.4	35	42.9 Kalamchi	ND	54.3	ND	Ludloff, 50% reoperated
Turner [44]	11.2	2–25	8.1	56	8.9	ND	98 grade I + II	ND	Medial approach 19% acetabular osteotomy
Ryan *et al.* [45]	76.8	36–108	10.6	25	44 grades I–III Salter, Buchholz, Ogden	ND	72 grade I + II	ND	Anterior approach Smith-Petersen + short osteotomy
Akagi *et al.* [46]	14	5–26	15	22	31.8 Kalamchi	ND	9.1 grade I; 54.5 garde II	ND	Smith-Petersen, no osteotomies until 15 years
Olney *et al.* [47]	29	15–117	3.6	18	5.5	0	100 grade I + II	100 grade A + B	Anterior approach short + pelvic osteotomy
Cordier *et al.*	14	3–48	15.3	118	6 Hirohashi *et al.*	11	76 grade I + II CE 20–25°, 17%	98 grade A + B	Anterior approach (Tönnis), acetabular osteotomies

ND, no data.

If the acetabular angle had a pathological grade 3 and 4 of deviation from normal according to age (Table 1) [2] in the age group of 12 months and older, acetabuloplasty with transiliac osteotomy [2,10–15] was performed in combination with the open reduction in order to lever the acetabular roof down laterally (Fig. 2). By this method, the labrum extends more laterally and distally over the femoral head and offers immediate stabilization.

In the first years acetabuloplasty was combined with varus-detorsion osteotomy. We used the femoral bone wedge to support the acetabular roof. Later, when we avoided varus osteotomies, xenogenic bone wedges of animals were introduced by Braun Co, Melsungen, Germany. Today bone wedges from allogenic femoral necks or femoral heads with a firm cortical rim are carefully examined and tested according to standardized bone bank rules and sterilized at 121°C for 20 min and then kept deep frozen in the bone bank [48].

Conclusions

As our results show, open reduction of developmental dislocation of the hip can achieve 92% normal (CE angle $> 25°$) or almost normal hips (20–25°) at the end of growth. The reduction through a ventral approach first lateral, then medial to the iliopsoas muscle, shortening osteotomy and other preventive measures to avoid ischemic necrosis are important. The advantages of the inguinal approach of Tönnis are as follows: (1) It allows optimal vision into the acetabulum before and after reduction anteriorly. When dissecting the medial labrum and transverse ligament, trauma to the acetabular artery and vein is easier to avoid. Also, the deep reduction is better controlled than by lateral approaches. (2) The operation is confined to the acetabulum and the inguinal region. The femoral neck is left covered. The iliopsoas tendon is obliqually dissected at the height of the pubis and acetabulum. Trauma to the medial femoral circumflex artery is avoided this way. (3) Simultaneously a postero-lateral capsulorraphy and acetabular osteotomies can be performed from the same incision. Only subtrochanteric shortening osteotomies need a short lateral incision at the femur. This more distal shortening does not impede the proximal femoral blood circulation. Detorsion varus osteotomies have disadvantages (see section on technique of open reduction) and became very rare with our transiliac osteotomy technique of Wiberg 1953. (4) The abductor muscles have not been damaged as the minimal rate of limping shows in the evaluation. (5) Medial approaches have a higher risk of ischemic necroses [16,29–32,49] and need a second approach for acetabular osteotomies, which are frequently necessary in the second year of life and later, but sometimes even before. Postero-lateral capsulorraphies which are important for immediate stability cannot be performed from the medial approach.

Simons [50] as well as Gabudza [51] stated that the indication for a certain operative approach should depend on the exact case. However, this does not apply to the approach described in this paper. Also, disadvantages of the ventral approach mentioned by Gabudza are not relevant for the approach laterally and medially to the iliopsoas muscle. Another advantage are the almost invisible scars in the inguinal region.

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