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Open reduction for congenital dislocation of the hip: comparison of the long-term results of the wide exposure method and Ludloff's method

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Abstract: We compared the long-term clinical and radiographic results of two methods of open reduction for congenital dislocation of the hip; a wide exposure method (360-degree circumferential capsulotomy) versus Ludloff's method (limited capsulotomy via the medial approach). Thirty-one hips in 24 patients assigned to group A received the wide exposure method and 32 hips in 27 patients assigned to group B had the Ludloff reduction. All patients were surgically reduced at less than 3 years of age. The follow-up averaged 16 years. None of the hips in group A required additional operations; however, 34.4% of the hips in group B did. At the latest review, 26 (83.9%) of the hips in group A were rated as Severin class I or II. Except for one patient, none had pain or a limp. Of the hips in group B, 18 (56.3%) were rated as Severin class I or II. Three patients had pain or Trendelenburg gait. Avascular necrosis occurred in 3.2% of hips in group A and in 21.9% of hips in group B. The wide exposure method is capable of completely releasing the posterosuperior tightness resulting from capsular adhesion to the ilium and the contracted short external rotators. Releasing the posterosuperior tightness from these structures seemed to provide a better chance of achieving an anatomically and functionally satisfactory hip.

Key words: open reduction, congenital dislocation of the hip, long-term result, wide exposure method, Ludloff's method

Introduction

The preferred method of open reduction for congenital dislocation of the hip remains controversial.

When open reduction is required because a closed method has failed or because the dislocation is detected after the patient has started to walk, we have employed two different surgical techniques since 1973. One technique is the limited capsulotomy via the medial approach, which was first described by Ludloff[11] in 1908. The procedure was popularized in the early 1970s by Mau et al.[13] and by Ferguson.[3] The other technique is a 360-degree circumferential capsulotomy through an extensive anterolateral approach (wide exposure method), devised by Tanabe et al.[22] in 1973. Each technique offers its own advantages.

Advocates of Ludloff's method[3,5,10,13,15,19,21,23] have described it as a simple method requiring minimal dissection and tissue destruction; it allows correction of the anteroinferior tightness by releasing the tight iliopsoas tendon and the constricted anteroinferior part of the capsular ligament. Advocates of the wide exposure method[1,7,16,22] acknowledge that more dissection is required, but they point out that the procedure allows for a more thorough exploration of the joint, and it permits correction of the posterosuperior tightness by completely releasing the tight short external rotators and adhesion of the posterosuperior part of the capsular ligament to the lateral wall of the ilium.

The purpose of the present study was to compare our long-term clinical and radiographic results of the wide exposure method with those of the Ludloff method, both methods having been performed in children with congenital hip dislocation.

Patients and methods

From January 1973 to December 1980, 51 patients with complete hip dislocation were treated with open reduction at either Ehime Disabled Children's Hospital (EDCH) or Kouchi Disabled Children's Hospital (KDCH). All patients were operated on when they were under 3 years of age. Forty-eight patients were followed-up to more than 15 years of age and the

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remaining 3 were followed-up to 11 or 12 years of age. In this study we excluded patients who had previous avascular necrosis, residual subluxation, or dislocation associated with neurologic disorders.

Patients operated on by the wide exposure method by one of the authors (Y.M.) at EDCH were assigned to group A (24 patients; 31 hips) (Table 1). There were five boys and 19 girls. Twenty-seven patients (32 hips) operated on by the Ludloff method by one of the authors (S.E.) at KDCH constituted group B (Table 2). There were six boys and 21 girls. The ages of the patients at their initial visits to the hospital ranged from 3 to 25 months (mean, 14 months) in group A; the ages of the patients in group B ranged from 4 to 29 months (mean, 10 months). The patients in each group were treated and followed-up independently. But, except for the surgical method, the basic policy for the presurgical treatment was the same in the two hospitals (Fig. 1). Patients less than 12 months of age had previously received various unsuccessful closed management methods in the above hospitals or elsewhere. These management methods consisted of the Pavlik harness and overhead traction, combined with manual reduction and cast immobilization under general anesthesia. Case 8 in group A had received open reduction with the Ludloff method at a different hospital. The age at the time of operation ranged from 12 to 31 months (mean, 18 months) in group A, and in group B, the age ranged from 5 to 30 months (mean, 12 months). When open reduction was required in children aged <12 months because closed management had failed, the wide exposure method was postponed until age ≥ 12 months in the hope that the operation could be performed without difficulty. The mean age at the latest follow-up was 17 years and 10 months (range, 12 years and 3 months to 19 years and 7 months) in group A, and 17 years and 7 months (range, 11 years and 10 months to 21 years and 2 months) in group B.

Operative technique

The wide exposure method. The patient was placed in the supine position with the leg in an extended position. The skin was transversely incised from the lateral border of the sartorius to the posterior edge of the greater trochanter at a level 3 cm distal to the anterior superior iliac spine. The fascia lata and the tensor fasciae latae were divided transversely at the level of the skin incision. The muscular branches of the lateral femoral circumflex artery were ligated and sectioned. The gluteus medius and minimus were transected close to their insertions of the greater trochanter and the superior capsule was exposed. The anterior capsule was exposed by retracting the iliacus medially. The psoas tendon was detached from the lesser trochanter and later transferred to the superolateral part of the vastus lateralis muscle for anchoring the reduced femoral head to the acetabulum. All of the short external rotators, except for the quadratus femoris, were transected at their insertions and the posterior capsule was exposed. At this point, the ascending branch of the medial femoral circumflex artery was protected. After the capsule was thoroughly exposed, 360-degree circumferential capsulotomy was performed close to the acetabulum. The ligamentum teres, transverse acetabular ligament, and pulvinar were excised. The inferior part of the labrum was also routinely excised, the aim being to widen the acetabular capacity. The redundant part of the capsule was trimmed away; capsulorrhaphy was unnecessary. The femoral head was then easily reduced with the hip in slight flexion, about 30 degrees abduction, and full internal rotation (Lange position). All transected muscles were reattached, except for the short external rotators. After surgery, a single hip spica cast was applied in the Lange position, and changed after 2 weeks. The hip was immobilized for a total of 8 weeks. The patient was then allowed to walk freely.

Ludloff's method. The patient was placed in the supine position with the hip abducted and flexed 90 degrees. A longitudinal skin incision was made, beginning at the origin of the adductor longus and carried distally along its tendon. After the adductor longus was transected near its origin, the interval between the adductor brevis and the pectineus was opened by blunt dissection. The psoas tendon was detached near its insertion and allowed to retract proximally. The branch of the medial circumflex artery was retracted carefully, but was ligated in four hips. After the anteroinferior part of the capsule was fully exposed, it was opened longitudinally along the femoral neck with a cruciate cut running parallel to the acetabular rim. The ligamentum teres and the pulvinar were removed. The transverse acetabular ligament was transected. The labrum was partially excised only when a concentric reduction was disturbed. The femoral head was then reduced, with both hips in 90–110 degrees of flexion and about 70 degrees of abduction and external rotation. A double hip spica cast was applied in that position after surgery. Extreme abduction was avoided in order to maintain the blood circulation in the femoral head. After 4 weeks, a Pavlik harness or flexion-abduction brace was applied, and this was used for 5–6 months.

All patients in each group were evaluated by the same method. At the latest follow-up, a clinical evaluation was made using a modification of McKay's criteria[14] (Table 3). Radiographic evaluation followed Severin's criteria.[20] We defined as satisfactory results those in Severin class I or II and as unsatisfactory results, those

Table 1. Data for patients in group A

Case number	Sex	Side	Age at initial visit (months)	Previous treatment	Age at surgery (months)	CT distance at age 3 years (mm)	Type of AVN	Subsequent surgery	Age at final visit (years + months)	Results at final visit			
										McKay's criteria	CE angle	Severin classification	RQ
1	M	L and R	3	Pavlik H.	12	9.0	—	—	18 + 2	E	48	Ia	—
					17	8.5	—	—		E	47	IIa	
2	F	L	4	Pavlik H. + OHT	14	7.0	—	—	17 + 8	E	31	Ia	105
3	F	R	5	Pavlik H. + Spica cast	12	7.5	—	—	18 + 0	F	−11	IV	130
4	F	R	5	Pavlik H.	14	8.5	—	—	18 + 8	E	28	Ia	102
5	F	L and R	7	Pavlik H.	17	6.0	—	—	17 + 9	E	23	IIb	—
					22	9.0	—	—		E	40	IIa	
6	F	L	9	Pavlik H. + Spica cast	12	6.5	—	—	17 + 9	E	11	III	118
7	F	L and R	9	—	12	6.5	—	—	17 + 11	G	36	Ia	—
					19	8.0	—	—		G	28	Ia	
8	F	L	10	Pavlik H. + OR	12	6.0	—	—	18 + 0	G	33	IIa	110
9	F	R	11	Pavlik H. + Spica cast	12	8.0	—	—	19 + 1	E	20	IIb	112
10	F	L	12	Pavlik H.	13	6.0	—	—	18 + 0	E	32	Ia	102
11	F	L	13	—	14	6.5	—	—	19 + 7	E	20	Ib	100
12	M	L	15	—	15	6.5	—	—	18 + 0	G	30	Ia	106
13	M	R	15	Pavlik H. + OHT	16	8.5	—	—	17 + 11	E	22	IIb	113
14	F	R and L	15	—	16	7.0	—	—	18 + 0	E	17	III	—
					21	6.5	No physeal damage	—		E	11	III	
15	F	L and R	17	Pavlik H. + Spica cast	17	6.5	—	—	17 + 9	E	34	IIa	—
					22	6.5	—	—		E	44	IIa	
16	F	R	17	Spica cast	18	7.5	—	—	18 + 0	E	26	Ia	100
17	F	R	18	—	19	8.0	—	—	18 + 1	E	20	Ib	107
18	M	L	18	—	19	7.5	—	—	18 + 5	G	41	Ia	108
19	M	L	19	—	19	8.0	—	—	18 + 5	G	29	IIa	108
20	F	L	20	—	21	9.0	—	—	18 + 5	E	25	IIa	112
21	F	R	20	—	21	7.5	—	—	18 + 2	E	19	III	110
22	F	L and R	21	—	21	7.5	—	—	17 + 1	E	30	Ia	—
					27	7.5	—	—		E	32	IIa	
23	F	L	21	—	22	9.5	—	—	17 + 5	E	26	Ia	107
24	F	L and R	25	—	25	7.5	—	—	12 + 3	E	21	IIb	—
					31	7.5	—	—		E	29	Ia	

Pavlik H., Pavlik harness; OHT, overhead traction; Spica cast, manual reduction and cast fixation under general anesthesia; OR, Ludloff's technique open reduction; CT distance, capital-tear drop distance; AVN, avascular necrosis; CE angle, center-edge angle; RQ, radius quotient of the affected femoral head in the unilateral patient (excluding the hips which had AVN after open reduction); McKay's criteria: E, excellent; F, fair; G, good

Table 2. Data for patients in group B

Case number	Sex	Side	Age at initial visit (months)	Previous treatment	Age at surgery (months)	CT distance at age 3 years (mm)	Type of AVN	Subsequent surgery	Age at final visit (years + months)	Results at final visit			
										McKay's criteria	CE angle	Severin classification	RQ
1	F	L	4	Pavlik H.	5	12.0	—	—	19 + 5	E	10	III	100
2	F	L	4	Pavlik H. + Spica cast	5	8.0	No physeal damage	—	16 + 3	G	17	III	—
3	M	R and L	4	Pavlik H. +	6	11.0	—	—	18 + 4	E	20	Ib	—
				OHT		11.5	—	Chiari		E	39	IIa	
4	F	R	4	Pavlik H. + OHT	7	9.0	—	—	17 + 0	E	20	Ib	102
5	M	R	4	Pavlik H. + Spica cast	8	10.0	Lateral	—	18 + 3	F	19	III	—
6	F	R	5	Pavlik H.	7	9.0	—	—	16 + 7	E	27	Ia	100
7	F	R	5	Pavlik H. + OHT	9	12.5	Lateral	Chiari	17 + 0	G	58	III	—
8	M	L	6	Pavlik H.	6	12.0	—	Salter	15 + 10	E	44	Ia	105
9	F	R	6	Pavlik H.	6	11.0	Central	—	16 + 2	F	5	IV	—
10	F	R and L	6	Pavlik H. +	6	7.0	—	—	16 + 1	E	33	Ia	—
				OHT		8.0	—	—		E	39	Ia	
11	F	L	6	Pavlik H.	7	12.0	—	Salter	18 + 8	E	25	Ia	104
12	M	R	6	Pavlik H. + OHT	7	11.0	Lateral	DVO + Chiari	18 + 4	F	35	III	—
13	F	L	7	Pavlik H.	7	10.0	—	—	19 + 1	E	26	Ia	104
14	F	L	7	Pavlik H. + Spica cast	9	13.0	—	Salter	18 + 9	E	28	Ia	100
15	F	R	9	Pavlik H.	10	8.0	Lateral	Chiari	18 + 6	E	25	III	—
16	F	R	10	Spica cast	11	10.0	—	—	18 + 10	E	8	III	105
17	F	R and L	11	Spica cast	14	12.0	—	DVO	17 + 8	G	25	IIa	—
						13.0	—	DVO		G	20	IIb	
18	F	R	13	OHT	14	11.0	—	—	11 + 10	E	4	IV	112
19	M	L	14	OHT	14	9.5	—	—	18 + 1	E	25	Ia	102
20	F	R	14	OHT	16	10.0	—	—	15 + 8	E	33	Ia	104
21	F	R and L	15	—	16	9.0	—	—	21 + 2	E	22	Ib	—
						12.0	—	—		G	1	IV	
22	F	R	16	—	16	11.0	—	DVO + Pemberton	18 + 1	E	35	IIa	100
23	F	L	18	—	19	8.5	—	—	17 + 8	E	20	Ib	100
24	F	L	19	—	19	11.5	No physeal damage	—	16 + 9	E	11	III	—
25	F	R	20	—	21	11.0	—	Pemberton	17 + 9	E	16	III	114
26	M	L	20	—	23	10.0	—	—	11 + 11	E	25	Ia	105
27	F	R and L	29	—	30	6.0	—	—	18 + 5	E	10	III	—
						7.0	—	—		E	10	III	

DVO, Derotation varus osteotomy

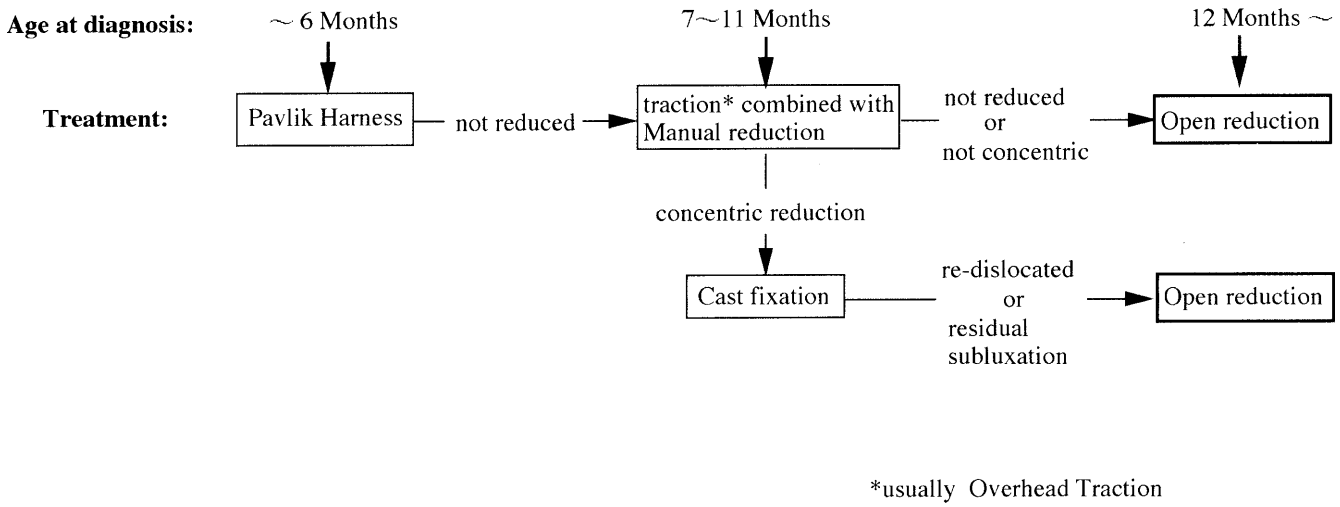

Fig. 1. Basic policy for the treatment of congenital dislocation of the hip at both hospitals. (Ehime Disabled Children's Hospital and Konichi Disabled Children's Hospital)

Table 3. Modified criteria of McKay for clinical evaluation of results

Rating	Description
Excellent	Painless, stable hip; no limp; negative Trendelenburg sign; full range of motion (110° ≤ Flex; 30° ≤ Abd. and 80° ≤ Ext.R. + Int.R.)
Good	Painless, stable hip; no limp; negative Trendelenburg sign; slight loss of motion (90° < Flex. < 110°, or 10° < Abd. < 30°, or 60° ≤ Ext.R. + Int.R. < 80°)
Fair	Minimum pain; positive Trendelenburg sign; moderate stiffness (Flex ≤ 90°, or Abd. ≤ 10°, or Ext.R. + Int.R. < 60°)
Poor	Significant pain

Flex, Flexion; Abd, abduction; Ext, external; Int, internal; R, rotation

in class III or IV. Data analyses used Fisher's exact probability test.

Using an anteroposterior radiograph of the hips taken when the patient was 3 years of age, we measured the capital-tear drop distance[12] (CT distance) to assess the concentricity of the femoral head (Fig. 2). Subluxation or lateralization was defined as having a CT distance of >10 mm, because a distance of 10 mm is the upper limit value (mean value + 2 SD) in the normal hip at this age. The presence of avascular necrosis was determined using the criteria of Salter et al.[18] In patients with unilaterally dislocated hip, the radii of both femoral heads were measured on the latest follow-up radiograph and the ratio of enlargement of the femoral head (radius quotient[17]) was calculated. Data analyses used Student's *t*-test.

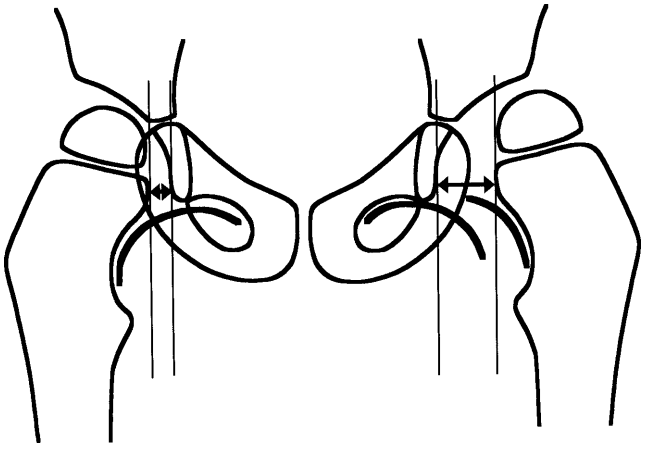

Fig. 2. Capital-tear drop distance (CT distance) is the distance between the lateral border of the teardrop and the medial border of the femoral capital epiphysis. Matsunaga[12] measured the distance in 1786 normal hips in individuals aged 1 month to 18 years. The average value at age 3 years was 7.2 mm, with an SD of 1.4 mm

Results

Clinical assessment at final review

In group A, 24 of 31 hips (77.4%) were rated as excellent; 6 (19.4%) showed restriction of internal and external rotations to 60–75 degrees, or flexion to 105 degrees, and therefore were rated as good; 1 (3.1%) had mild pain, and therefore was rated as fair, by McKay's criteria (Table 1).

In group B, 24 hips (75.0%) were rated as excellent; 5 hips (15.6%) revealed restriction of internal and external rotations to 60–75 degrees, or abduction to 20

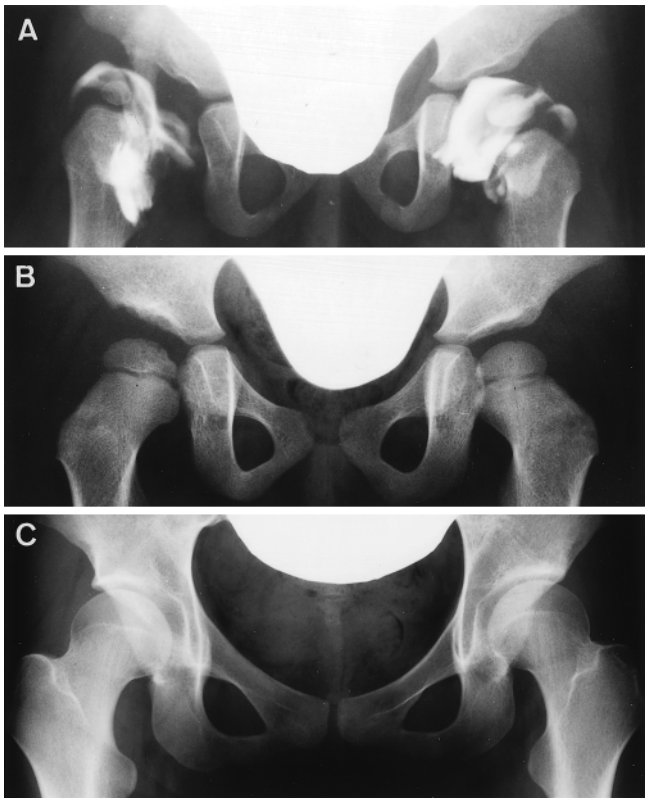

Fig. 3A–C. Case 16 in group A. **A** Arthrogram of the right hip before open reduction. **B** The right hip at age 3 years shows that a concentric reduction was achieved and maintained (CT distance, 7.5 mm). **C** At age 18 years, the radiographic result was Severin class Ia

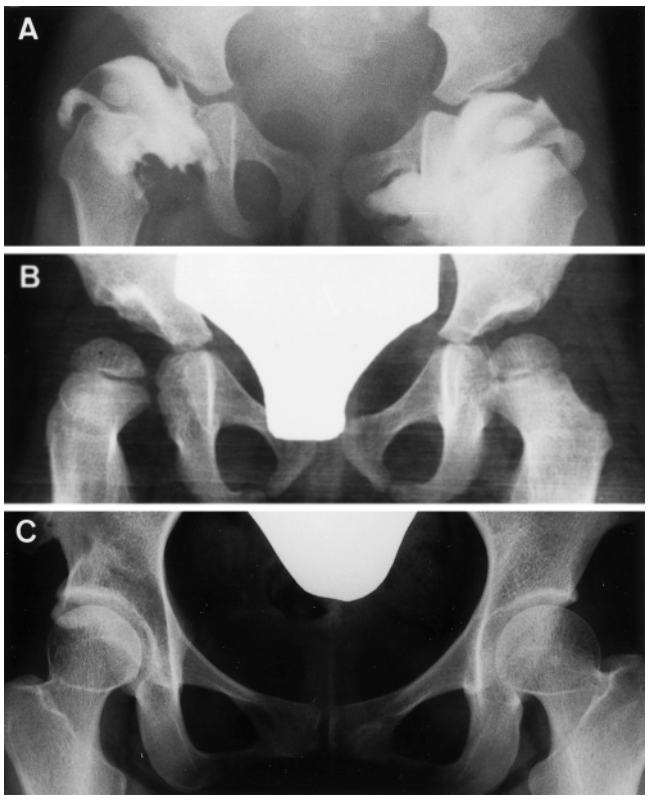

Fig. 4A–C. Case 22 in group B. **A** Arthrogram of the right hip before open reduction. **B** At age 3 years, the right hip shows subluxation (CT distance, 11.0 mm). Later, concentricity of reduction and failure of acetabular development were corrected by derotation varus osteotomy (DVO) and Pemberton osteotomy. **C** At age 18 years, the right hip was rated as Severin class IIa because of coxa valga

degrees, and therefore were rated as good; the remaining 3 hips (9.4%) presented mild pain or positive Trendelenburg's sign, and therefore were classified as fair (Table 2).

Radiographic assessment at final review

In the hips of group A patients, the average center-edge (CE) angle at the final follow-up was 27.2 degrees. By Severin's criteria, 14 hips (45.2%) were rated as class I, 12 hips (38.7%) as class II, 4 hips (12.9%) as class III, and 1 hip (3.2%) as class IV (Table 1). Twenty-six hips (83.9%) had a satisfactory result with no additional surgery.

In the hips of group B, the average CE angle at the final follow-up was 22.8 degrees. Fourteen hips (43.8%) were rated as class I, 4 hips (12.5%) as class II, 11 hips (34.4%) as class III, and 3 hips (9.4%) as class IV (Table 2); 56.3% of the hips had a satisfactory result, indicating that the results in group B were significantly inferior to those in group A ($P < 0.05$). Moreover, 11 hips (34.4%) had received pelvic or femoral osteotomy, or both, as supplementary operations. Only 11 hips had a satisfactory result with no additional surgery.

In group B we compared the results in patients younger than 12 months of age at the time of operation (Severin class I or II; 55.6%) with those in patients aged more than 12 months (class I or II; 57.1%). There was no significant difference between these two age groups.

Subluxation

In the hips of group A, the CT distance at 3 years of age ranged from 6.0 to 9.5 mm (mean, 7.5 mm) (Table 1; Fig. 3). On the other hand, the CT distance in group B varied from 6.0 to 13.0 mm (mean, 10.2 mm) (Table 2; Fig. 4). The mean CT distance in group B was significantly greater than that in group A ($P < 0.0001$). In group A, no patients showed subluxation above the normal limit of 10.0 mm, while in group B, mild or moderate subluxation was present in 16 hips (50.0%). Ten of these 16 hips received 12 additional operations when

the patients were more than 3 years old to improve the reduced concentricity and acetabular coverage of the femoral head. These operations consisted of 4 femoral derotation varus osteotomies, 3 Salter osteotomies, 2 Pemberton osteotomies, and 3 Chiari osteotomies (Table 2). Five of the remaining 6 hips that had received no additional surgery had an unsatisfactory result at the final follow-up.

Avascular necrosis

By Salter's criteria, 1 of 31 hips (3.2%) in group A showed a minor degree of avascular necrosis (Table 1). There was no demonstrable physeal damage. Later this patient developed mild coxa plana.

In group B, 7 of 32 hips (21.9%) revealed avascular necrosis; 4 showed lateral physeal damage and 1, central physeal damage; the remaining 2 were free of physeal damage (Table 2, Fig. 5). At the final follow-up, all these hips had an unsatisfactory result.

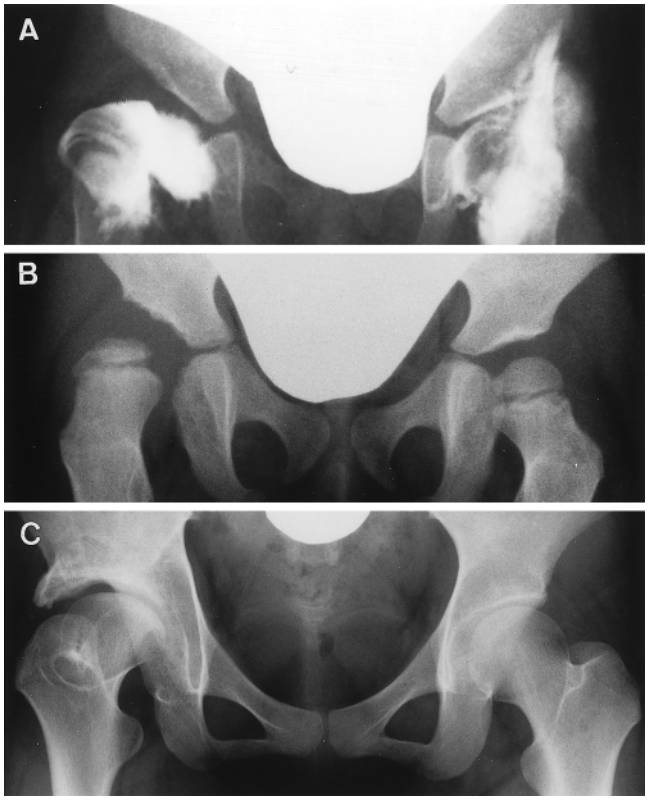

Fig. 5A–C. Case 7 in group B. **A** Arthrogram of the right hip before open reduction. **B** At age 3 years, the right hip shows subluxation and avascular necrosis with lateral physeal damage. Later, Chiari osteotomy with bone graft was performed. **C** At age 17 years, the right femoral head shows moderate deformity (Severin class III)

Enlargement of the femoral head

On final follow-up, 15 of the 17 unilaterally dislocated hips in group A revealed enlarged femoral heads; the radius quotient (RQ) ranged from 100 to 130 (mean, 108.8) (Table 1). In group B, 10 of 15 unilaterally dislocated hips without avascular necrosis showed an enlarged femoral head; the RQ ranged from 100 to 114 (mean, 103.8), which was significantly lower than that in group A ($P < 0.05$) (Table 2).

In group A, 7 hips showed a moderately enlarged femoral head, and 3 of them had an unsatisfactory result.

Discussion

In our group A, 26 of 31 hips (83.9%) were rated as Severin class I or II without additional operations. Akazawa et al.[1] reported results of their wide exposure method, in which 74.1% of hips in their series became class I or II without additional operations. Including patients with additional surgeries, the final figure improved to 81.0%. These long-term results achieved with the wide exposure method definitely surpassed those in our group B (class I or II; 56.3%) and those in other surgeons' series[2,5,10,15,21] of Ludloff operations (Table 4). In our series, the average age at the time of operation in group B was 6 months lower than that in group A. However, we consider that this difference did not worsen the final results in group B, because no significant relationship between age at the time of operation and the final result was found in group B patients.

In other series, and including our group B, 26%–85% of the patients required secondary operations (Castillo and Sherman[2] Mergen et al.,[15] Ikeda et al.,[5] Sosna et al.,[21] and Koizumi et al.[10]) (Table 4). In contrast, secondary operations were not required in our group A and were less frequently required in the patients reported by Akazawa et al.[1] Hence, the wide exposure method seems to provide a more stable, concentrically reduced femoral head and better acetabular development than Ludloff's method. In our experience, no hips in group A showed subluxation, whereas in group B, 16 hips (50%) showed definite subluxation despite prolonged postoperative treatment. Moreover, only 1 of these 16 hips had a satisfactory result without additional surgery. Our results confirm that when a femoral head is forcefully reduced without releasing the posterosuperior tension produced by the posterosuperior part of the capsular ligament and the short external rotators, these tissues act as a suspensory ligament[9] which pulls the femoral head back to the original dislocated position. Hence, it is very difficult to maintain and stabilize the femoral head at its concentric location.

Table 4. Long-term results of each method for open reduction

Method	Year	Author	No. of hips	Mean age at reduction (months)	Mean age at final review (years)	Avascular necrosis (%)	Secondary procedures (%)	Severin class I or II (%)
Ludloff	1990	Castillo and Sherman[2]	26	12	8	15	35	73
	1991	Mergen et al.[15]	31	12	9	10	26	68
	1991	Ikeda et al.[5]	57	15	14	15	44	74
	1992	Sosna et al.[21]	62	9	11	36	85	76
	1996	Koizumi et al.[10]	35	14	20	43	46	46
	1999	Current study (group B)	32	12	17	22	34	56
Wide exposure	1990	Akazawa et al.[1]	58	12–36	11	5	16	81
	1999	Current study (group A)	31	18	17	3	0	84

In the wide exposure method, the short external rotators are exposed, then separated at their insertions, with potential for injuring the medial femoral circumflex artery supplying the blood to the femoral head. Yet in group A, only 3.2% of the hips had avascular necrosis, an incidence compatible with that of Akazawa et al. (5.2%), as opposed to 21.9% in the patients in group B. Long-term results of the Ludloff operation indicated that the occurrence of avascular necrosis was generally high, ranging from 10% to 43% (Table 4). In Ludloff operations, it is sometimes necessary to ligate the branches of the medial femoral circumflex artery. In group B, 4 hips required ligature of the branch during operation. However, none of these hips developed avascular necrosis. Therefore, we agree with Salzer and Zuckriegl[19] that the occurrence of avascular necrosis does not correspond to ligature of the branch of the medial femoral circumflex artery. Excessive pressure upon the femoral head poses a serious risk for avascular necrosis.[18] Our results strongly suggest that complete dissection of stretched tissues toward the posterior and superior can relieve excessive pressure on the reduced femoral head and minimize avascular necrosis.

Regardless of the method used for surgical reduction, the femoral head frequently becomes hypertrophic.[4,6,8] In our series, femoral heads were found to be enlarged in 88% of group A and 67% of group B patients. The radius quotient in group A was significantly higher than that in group B. The surgical invasion associated with 360-degree circumferential capsulotomy is greater than that with Ludloff's method and appears to be related to the pathogenesis of femoral head hypertrophy. In addition, the inferior labrum was routinely removed in the hips of group A patients. As reported by Imatani et al.,[6] we believe this procedure overwidens acetabular capacity, resulting in an enlarged femoral head.

In group A, all eight hips showing mildly enlarged femoral heads and four of seven hips with moderately enlarged femoral heads were rated as Severin class I or II because the acetabulum sufficiently covered the enlarged femoral head. We therefore find the results satisfactory. Our experience indicates that when the femoral head is set in a concentrically reduced position, the acetabulum grows well, even with an enlarged femoral head.

Aside from one child who had marked enlargement of the femoral head, none of the patients in group A suffered from limping or pain. Temporary division of the gluteus medius and minimus close to their insertion during operation did not weaken hip abductors. None of the patients had even moderate limitation of hip motion, probably because the hips were immobilized in the cast after surgery for only 2 months, before being allowed to move freely. In contrast, three patients in group B with avascular necrosis displayed Trendelenburg's sign or mild pain.

The long-term results achieved with the wide exposure method definitely surpassed those achieved with the Ludloff method. We confirm that the posterosuperior tightness resulting from capsular adhesion to the ilium and contracted short external rotators should be completely released at the time of surgical reduction of congenital hip dislocation following late diagnosis or failure to respond to previous treatments.

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