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REVIEW ARTICLE

Congenital dislocation of the hip, with late diagnosis after 1 year of age: Update and management

C. Morin[a], P. Wicart[b,*], the French Society of Pediatric Orthopaedics[1]

[a] Calot Institute, rue du Dr Calot, 62608 Berck-sur-Mer, France
[b] Necker-Sick children hospital, AP—HP, Paris Descartes University, 149, rue de Sèvres, 75015 Paris, France

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Summary When congenital dislocation of the hip (CDH) is diagnosed only after walking age, management is greatly complicated. In view of the increasing number of such cases treated by members of the French Society of Paediatric Orthopaedics (SOFOP) in recent years, a 3-part study was conducted within the Society to shed light on the reasons for late diagnosis, to give an update on treatment strategies currently implemented in France, and to report long-term outcomes.

Prospective epidemiological study of congenital dislocation of the hip diagnosed after 1 year of age

Congenital dislocation of the hip (CDH) management is made easier and results are improved by early diagnosis.

A screening campaign was launched in 1985 by the Pediatric Orthopedics Study Group (GEOP), with a very positive impact on quality [1]. Subsequently, the feeling is that screening quality has deteriorated, with, in particular, a rise in late diagnosis (after 1 year of age). A preliminary study focused on late diagnosis in 20 French centers over the last 20 years. Results (Fig. 1) confirmed a very significant ($P = 0.0000001$) increase in late diagnosis as of 2003.

The present study provides an update on CDH diagnosed after the age of 1 year in France in 2010.

Materials and methods

The results reported below are from a prospective study by the French Society of Paediatric Orthopaedics (SOFOP). A questionnaire on late diagnosis of CDH was sent to Society members. The inclusion criterion was idiopathic CDH diagnosed in 2010 in French-born children aged more than 1 year.

Results

Forty-four centers responded, recruiting 66 children. The sex ratio was very predominantly female (83%). Three cases (4.3%) were bilateral. Involvement was 51.5% right hip. Mean age at diagnosis was 20 ± 10.2 months, a large majority of the children being born in 2008 or 2009 (Table 1).

* Corresponding author.
E-mail address: p.wicart@nck.aphp.fr (P. Wicart).
[1] 149, rue de Sèvres, 75743 Paris cedex 15, France.

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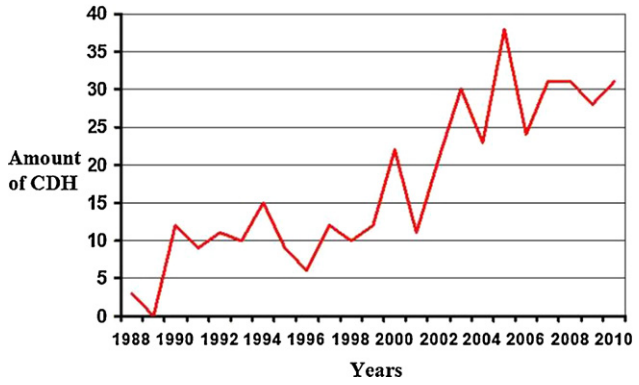

Figure 1 Evolution in cumulative annual total of congenital dislocation of the hip (CDH) diagnosed later than 1 year in 20 French centers.

Table 1 Birth years of children diagnosed with congenital dislocation of the hip (CDH) in 2010.

Birth year	Number ($n = 70$)	%
2005	2	3
2006	0	0
2007	7	10
2008	34	48.5
2009	27	38.5

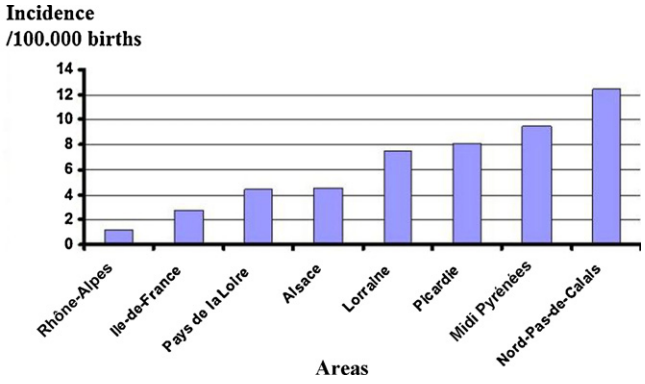

Figure 2 Number of congenital dislocation of the hip (CDH) cases diagnosed later than 1 year in 2010 in children born in 2009.

The incidence of late-diagnosed CDH in children born in metropolitan (European) France in 2009 was 2.9/100,000 (Fig. 2). Incidence was zero in the following administrative Regions: Aquitaine, Auvergne, Bourgogne, Brittany, Champagne-Ardenne, Corsica, Franche-Comté, Languedoc-Roussillon, Limousin, Provence-Alpes-Côte d'Azur, Normandy, Poitou-Charentes, and the Overseas *Départements* and Territories.

In 2008, incidence was 4/100,000 births (Fig. 3) and zero in Aquitaine, Auvergne, Bourgogne, Brittany, Champagne-Ardenne, Corsica, Franche-Comté, Languedoc-Roussillon, Limousin, Normandy, Poitou-Charentes, and the Overseas *Départements* and Territories.

Distribution was fairly homogeneous according to parental occupation and also to type of Maternity structure (private or public sector, University or General Hospital).

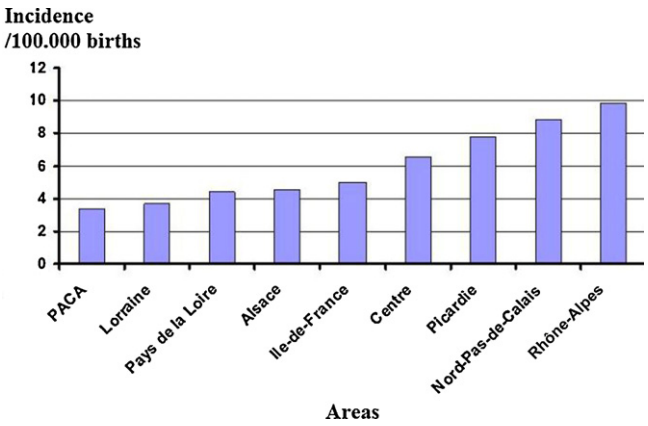

Figure 3 Number of congenital dislocation of the hip (CDH) cases diagnosed later than 1 year in 2010 in children born in 2008.

The alert was given by the parents or child-minder, worried about a limp, in 85.9% of cases. In only 14.1% of cases did a physician discover CDH on systematic hip examination.

CDH risk factors are a major component of screening. Abnormality was noticed on initial clinical examination in the maternity ward in 7% of cases. Interview found familial history in one in 10 cases. The rate of associated breech-birth was 14%. Orthopedic examination during the first days of life found associated ''postural'' orthopedic abnormality in only two cases (3%). In all, 27.4% of cases showed one risk factor and one child showed two: i.e., 28.8% with at least one risk factor. Most children (71.2%), on the other hand, showed no risk factors. Minor risk factors (primiparity or birth-weight greater than 4 kg) were observed in respectively 38.6% and 5.6% of cases.

All children were examined in the maternity structure, 90% by a physician. Only one of the two regulatory examinations, however, was performed in 67% of cases. Diagnosis was of ''normal hip'' in nine cases out of 10. A clinical abnormality was detected in only 7% of cases, with diagnoses of suspect hip ($n = 1$), cracking ($n = 1$), click ($n = 1$) or hip liable to dislocation ($n = 2$).

During the first 3 months after maternity discharge, 20 children (28%) did not undergo any clinical examination of their hips. Most were followed by their GP, often with several examinations, without CDH being suspected.

Sixty-four percent of children had no clinical examination of their hips after the age of 3 months.

Only seven children (10.9%) had ultrasonography, one having two scans. Results were: normal hip ($n = 4$), flat acetabulum ($n = 1$), clicks ($n = 1$) or not stated ($n = 2$). Only 2.8% of children had a pelvic X-ray.

Discussion

The present series has certain notable features. The sex ratio was comparable to that usually reported in neonates [2]. This fact argues against implementing ultrasound screening exclusively in girls, as recommended by Tréguier et al. [3]. The high rate of right CDH was unusual. It may be that right hips are examined by the left hands of mainly right-handed examiners, making the diagnostic maneuver less sensitive. A Canadian report was in agreement with

the present findings [4]. However, it was also reported that screening quality was unaffected by the side of a unilateral dislocation and the examiner's handedness [5]. The very low rate of bilateral CDH, which could have been expected to be 50%, is astounding. An even lower rate was reported by Dunn et al. [6]. The sign of limited hip abduction may be less sensitive in case of bilateral dislocation; the present contrary finding may be because the chances of clinical or ultrasound diagnosis being made are doubled in bilateral CDH [7].

The annual rates of CDH diagnosed after the age of 1 year for 2008 and 2009 in France were respectively 4 and 2.9 per 100,000 births, or 32 and 24 children per year, for an annual birth-rate of around 800,000. These figures should be very close to reality, given the exhaustiveness of the data. Comparison with literature series is limited by the rarity of such studies, and by the fact that the Scandinavian teams, who are mainly involved, consider diagnosis to be late as of the age of 3 months [8]. Only Diméglio et al. [9] reported an annual incidence of 6/100,000, for the Languedoc-Roussillon Region between 1990 and 2002. Incidence was non-zero in 2008 and 2009 in 7 Regions: Alsace, Lorraine, Ile de France, Pays de Loire, Picardy, Nord-Pas de Calais and Rhône-Alpes. It was zero for these 2 years in 12 Regions: Aquitaine, Auvergne, Bourgogne, Brittany, Champagne-Ardenne, Corsica, Franche-Comté, Languedoc-Roussillon, Limousin, Normandy, Poitou-Charentes, and the Overseas *Départements* and Territories; these are not the Regions with the highest birth-rates in France. It is noteworthy that incidence was zero in Regions where CDH is reputed to be the most frequent, such as Brittany and Auvergne.

The failure of screening is undeniable in the present series. The mean age at diagnosis triggered by family worries about limping is the proof of this. Socioeconomic level (as indicated by parental occupation) did not affect the risk of this happening. Farming as an occupation was not associated with elevated risk, unlike in two Australian reports [10,11]; the isolation of Australian farmers in the bush is probably greater than in the French countryside. The type of maternity structure also was irrelevant. The elements at our disposal do not allow the technical quality of screening to be assessed; previous reports, however, highlighted quantitative short-fall at various stages: maternity stay, the first 3 months, and then up to 1 year. The study does not allow other elements to be assessed that have been reported to impair screening quality, such as maternity stay of less than 4 days [10,11] or falling in a period of reduced medical presence, such as holiday periods or public holidays [7]. At least one CDH risk factor was found in 28.8% of cases, in agreement with Gul et al. [12]. Thorough screening [1] would have enabled diagnosis in these cases. The ''developmental'' nature of CDH [13] may not apply to all of the series.

The figures for 2010 are part of a downward trend in screening efficacy, as seen in Fig. 1. The incidence reported for 2003, considerably more satisfactory than subsequently, corresponds to the application of the 1985 GEOP guidelines [1]. Renewed application should at least enable a return to 2003 levels.

These GEOP guidelines are worth specifying [1]. Screening is based on clinical examination. Quantification of hip abduction (normal greater than 60°) on an appropriate method shows acceptable (70%) or high (90%) sensitivity [5]. Instability on Barlow and Ortolani maneuvers is the characteristic sign to be looked for, although more difficult to demonstrate than limited abduction.

The clinical examination should be made twice in maternity (at birth and at discharge), then monthly for the first 3 months, then at each clinical examination during the first year. It is up to the SOFOP to arrange with the relevant administrative authorities for this clinical screening to be made mandatory. Any risk factor (limited abduction, breech-birth, other orthopedic postural abnormality, 1st-degree familial history) entails supplementing the clinical examination with ultrasonography at 1 month and radiography at 4 months. Analysis of the literature suggests that the role of ultrasonography should not be extended, as its sensitivity would be no greater than that of the clinical examination and would lead to poorly adapted treatment [14].

Current treatment strategies in France, as practiced by French Society of Paediatric Orthopaedics (SOFOP) members

The second aspect of the symposium is a report on the survey of the techniques used by SOFOP members in their departments to manage late-diagnosed dislocation and of the short-term results observed.

Materials and Methods

Twenty-five departments reported their practices. To reduce dislocation, 10 of the 25 performed surgical and the other 15 closed reduction, before the age of 3 years in all cases and for hips without previous history of treatment.

Closed reduction

Traction is more often performed in the plane of the bed than at 30°. Duration varies between 2 weeks and 2 months, according to severity of dislocation and patient age. Tenotomy (adductors, psoas) is not performed to facilitate the descent of the femoral proximal epiphysis. A mean 3 (range, 0 to 8) radiographs are performed.

A cast is fitted, under general anesthesia, at the end of reduction, usually covering both thighs and sometimes both feet. It is kept for a mean 3 months, sometimes being renewed after 45 days. Reduction is checked on AP pelvic X-ray and, in a quarter of cases, by hip arthrography and, more rarely, on CT or MRI.

After reduction, acetabular dysplasia is treated, when necessary, usually by Salter pelvic osteotomy or, more rarely, by Pemberton or Dega acetabuloplasty. The operation is performed on cast removal by only one team in four (Morel technique) and is more often delayed until it is clear that the acetabulum is not going to develop sufficiently. Femoral osteotomy is seldom associated, and is always a derotation osteotomy in case of very severe femoral antetorsion.

Following treatment, splinting in abduction (Petit's splints), usually leaving the hip free, is almost systematically maintained for 2 to 6 months, usually round the clock.

Surgical reduction

In half of the cases, surgery is performed after 48 hours' to 1 month's traction in hospital, usually on a Smith Petersen or,

more rarely, a Watson Jones or Ludloff approach; associated femoral procedures impose variants depending on whether there is a single skin incision or not. Capsulorraphy and psoas tenotomy are almost systematically associated in the same step, as is pelvic osteotomy (usually Salter). Femoral shortening is performed with lateral derotation and even, in half of cases, with varization.

Immobilization uses a cast rather than traction, with shorter duration than in closed reduction: a month and a half on average. Postoperative splinting is very exceptional.

Results

Short-term in closed reduction

In the 15 centers using closed reduction, 222 hips were treated over the last 20 years, with 5.3% reduction failure, 8% recurrent dislocation or subluxation and 4.7% osteochondritis.

Short-term in surgical reduction

One hundred and twenty surgical reductions were performed over the same period, with no reduction failures, 7% recurrent dislocation or subluxation and 13% osteochondritis.

Discussion

This survey found a certain homogeneity in strategy, with two main attitudes: surgical and closed reduction. There is virtual unanimity that surgery is appropriate in cases discovered after 3 years of age and in case of failure of closed reduction. In cases without previous treatment and detected before the age of 3 years, closed and surgical reduction are equally common, with no difference in the present short-term results: it is the medium and, above all, long-term results that may differentiate the two reduction techniques.

Long-term results in the management of congenital hip dislocation

The third aspect of the symposium concerns long-term (greater than 20 years) outcome.

The literature on medium-to-long-term results was reviewed. There are some series followed up until the end of the growth period, but series with 20 or 30 years' follow-up are few and far between. The most complete are those of Somerville [15] and Salter [16]: their results will be compared to those found in the SOFOP survey.

Patients and methods

In the two series, CDH reduction was surgical. Somerville's method comprised a period of progressive abduction traction followed by labrum resection, then femoral derotation varization osteotomy 1 month later. Salter associated 1-step surgical reduction and the pelvic osteotomy which bears his name. Patient ages were 12 months to 3 years for Somerville and 18 months to 5 years for Salter.

Hundred and fourty-seven of Somerville's 224 patients (65%) were followed up in 2005 at a mean age of 36 years 5 months (range, 25—48 years), and 60 of Salter's 76 patients (79%) in 2007 at a mean age of 43 years 3 months (range, 40—48 years).

The only medium-term (end of growth period) results for progressive closed reduction have been published by French teams. Reduction was associated, either systematically or exclusively in case of residual acetabular dysplasia, to pelvic osteotomy. These series are those of the St Vincent de Paul Hospital (Paris) [17] and the Calot Institute (Berck) [18,19]. Like Salter and Somerville, they focused exclusively on dislocation (excluding subluxation and dysplasia) without previous treatment, in children aged between 12 or 18 months and 5 years.

The SOFOP's 3rd survey sought to extend these short-term results for closed reduction of late-diagnosed CDH, with results at more than 20 years' FU. It was a very time-consuming survey, as patients were very hard to track down, having often changed both name and address. This doubtless accounts for the low response rate on this 3rd survey, which in fact comprised only patients treated in Berck between 1964 and 1985. Forty-three of the 53 patients (77%) could be questioned (those lost to follow-up were born in North Africa), and had a mean age of 35 years 10 months (range, 22 years 6 months to 46 years 4 months).

Results

Osteochondritis rates with progressive closed reduction compared favorably with surgical reduction (although Somerville's results were seen as a real progress at the time) (Tables 2 and 3).

There were reduction failures with both closed reduction (revised by surgical reduction) and surgical reduction (revised by iterative surgery).

At end of growth, the number of hips graded Severin 1 (excellent hip with regular and well-covered femoral head) was greater for closed than for surgical reduction. A large number of hips treated using the Somerville technique

Table 2 Short and medium term results.

	Osteochondritis (%)	Reduction failure (%)	End of growth (Severin 1) (%)	End of growth (Severin 3) (%)
Saint Vincent de Paul Hospital	2.1	4.3	91.5	2.1
Calot Institute	3.3	9.3	85.4	4.4
Somerville	13	5.8	18	28.5
Salter	5.7	5.6	65.4	1.8

Table 3 Long-term results.

	Patients followed up/patients treated	Mean age at end FU	Long FU THR (%)	Long FU OA (%)	Long FU Severin 1 (%)	Long FU Severin 2 (%)
Calot Institute	41/53	35 yrs 10	1.7	1.7	79	8
Somerville	147/224	36 yrs 5	14	40	15	10
Salter	60/76	43 yrs 3	20	32	16	52

OA: osteoarthritis.

ended up with a dysplastic acetabulum (Severin 3), which was not the case with Salter's osteotomy without labrum removal.

In both surgical reduction series, signs of osteoarthritis were frequent on radiography. Almost one third of the hips treated by Salter required total hip replacement. His survivorship curve clearly shows deterioration in results as of 30 years' follow-up. In the closed reduction series, on the other hand, only one hip required replacement. Only one of the 45 ''surviving'' hips showed signs of osteoarthritis. There were many more nearly normal (Severin 1) surviving hips in the closed reduction group, and many fewer threatened with osteoarthritis due to significant femoral head deformity (Severin 2).

Conclusions

Only results from long-term follow-up can decide between surgical and closed reduction. Survivorship, with total hip replacement as end-point, is a useful indicator of durability of results. It is thus noteworthy that, in Salter's series, deterioration set in only after 30 years postoperatively, but then became progressive, with one third of hips requiring total replacement for osteoarthritis 15 years later.

In the progressive closed reduction series with Salter's osteotomy, where follow-up was somewhat shorter, there was no such deterioration over time. This is likely due to the fact that any arthrotomy alters, however slightly, the trophicity of the femoral head, any irregularity in which at the end of growth will result in osteoarthritis after 20 or 30 years.

Disclosure of interest

The authors declare that they have no conflicts of interest concerning this article.

References

[1] GEOP. Rapport du groupe de travail sur la luxation congénitale de hanche. 1985:9 p.
[2] Seringe R, Cressaty J, Girard B, Francoual C. L'examen orthopédique de 1 500 nouveau-nés en maternité. Rev Chir Orthop 1981;22:365—87.
[3] Tréguier C, Chapuis M, Branger B, Grellier A, Chouklati K, Bruneau B, et al. Luxation congénitale de la hanche. J Radiol 2011;92:481—93.
[4] Haasbeek JF, Wright JG, Hedden DN. Is there a difference between the epidemiologic characteristics of hip dislocation diagnosed early and late. Can J Surg 1995;38:437—8.
[5] Jari S, Paton RW, Srinivasan MS. Unilateral limitation of abduction of the hip. A valuable clinical sign for DDH? J Bone Joint Surg Br 2002;84:104—7.
[6] Dunn PM, Evans RE, Thearle MJ, Griffiths HED, Whiterow PJ. Congenital dislocation of the hip: early and late diagnosis and management compared. Arch Dis Child 1985;60:407—14.
[7] Sanfridson J, Redlund-Johnell I. Why is CDH still missed? Analysis of 96891 infants screened in Malmö 1956-1987. Acta Orthop Scand 1991;62:87—91.
[8] Danielsson L. Late diagnosed DDH — A prospective 11 years follow-up of 71 consecutive patients (75 hips). Acta Orthop Scand 2000;71:232—42.
[9] Diméglio A, Bertrand M, Canavese F. Les politiques de prévention de alluxation congénitale dans le monde. In: Fenoll B, Senah C, Chapuis M, Guillard-Charles S, editors. Luxation congénitale de la hanche. Montpellier: Société française d'orthopédie pédiatrique. Sauramps Médical; 2006. p. 139—48.
[10] Azzopardi T, Van Essen P, Cundy PJ, Tucker G, Chan A. Late diagnosis of developmental dysplasia of the hip: an analysis of risk factors. J Pediatr Orthop B 2011;20:1—7.
[11] Sharpe P, Mulpuri K, Chan A, Cundy PJ. Differences in risk factors between early and late diagnosed DDH. Arch Dis Child Fetal Neonatal Ed 2006;91:F158—62.
[12] Gul R, Coffey JC, Khayyat G, Mc Guinness AJ. Late presentation of DDH. Irish J Med Sci 2002;171:139—40.
[13] Raimann A, Baar A, Raimann R, Morcuende J. Late developmental dislocation of the hip after initial normal evaluation. J Pediatr Orthop 2007;27:32—6.
[14] Rosendahl K, et al. Ultrasound screening for developmental dysplasia of the hip in the neonate: the effect on treatment rate and prevalence of late cases. Pediatrics 1994;94:47—52.
[15] Anglis R, Fujii G, Pickvance E, Wainwright A, Benson M. Surgical treatment of late developmental displacement of the hip. Results after 33 years. J Bone Joint Surg [Br] 2005;87:384—94.
[16] Thomas S, Wedge J, Salter R. Outcome of forty-five years after open reduction and innominate osteotomy for late-presenting developmental dislocation of the hip. J Bone Joint Surg [A] 2007;89:2341—50.
[17] Rampal V, Sabourin M, Erdeneshoo E, Koureas G, Seringe R, Wicart P. Closed reduction with traction for developmental dysplasia of the hip in children aged between one and five years. J Bone Joint Surg [Br] 2008;90:858—63.
[18] Morel G. Le traitement de la hanche luxée de l'âge de la marche à 5 ans. Acta Orthop Belg 1990;56:237—49.
[19] Morin C, Bisogno J, Kulkarni S, Morel G. Treatment of late-presenting developmental dislocation of the hip by progressive orthopaedic reduction and innominate osteotomy. Our results with more than 30 years of follow up. J Child Orthop 2011;4:251—60.