Radiographic hip disorders and associated complications in severe cerebral palsy

Boldingh, E.J.K.; Jacobs-van der Bruggen, M.A.M.; Bos, C.F.A.; Lankhorst, G.J.; Bouter, L.M.

published in
Journal of Pediatric Orthopedics Part B
2007

DOI (link to publisher)
10.1097/01.bpb.0000228389.39807.b4

document version
Publisher's PDF, also known as Version of record

Radiographic hip disorders and associated complications in severe cerebral palsy

Eric J.K. Boldingh[a], Monique A.M. Jacobs-van der Bruggen[c], Cees F.A. Bos[b], Gustaaf J. Lankhorst[d,e] and Lex M. Bouter[e]

We performed a cross-sectional study of 160 adult patients with severe cerebral palsy to study the relationship between radiographic hip disorders (migration and deformity of the femoral head), on the one hand, and complications such as handling problems, seating problems, decubitus ulcers, fractures and contractures, on the other hand. Both migration and deformity were positively related to the need for a special seat in the wheelchair and adduction contractures of the hip. We conclude that migration and deformity of the femoral head, if possible, should be prevented in patients with severe cerebral palsy. *J Pediatr Orthop B* 16:31–34 © 2007 Lippincott Williams & Wilkins.

Journal of Pediatric Orthopaedics B 2007, **16**:31–34

Keywords: cerebral palsy, complications, hip, luxation

[a]Sophia Rehabilitation Center, [b]Pediatric Orthopedic Department, Juliana Children's Hospital, Den Haag, [c]National Institute of Public Health and the Environment (RIVM), Bilthoven, [d]Department of Rehabilitation Medicine and [e]Institute for Research in Extramural Medicine, VU University Medical Center, Amsterdam, The Netherlands.

Correspondence and requests for reprints to Dr Eric Boldingh, MD, Sophia Rehabilitation Center, Vrederustlaan 180, 2543 SW Den Haag, The Netherlands
Tel: +31 70 3593 503; fax: +31 252 2240 28;
e-mails: e.boldingh@sophiarevalidatie.nl; e.boldingh@wanadoo.nl

Sponsorship: The Johanna Children Fund and the Dr W.M. Phelps Foundation in the Netherlands funded this research.

The study was carried out at the VU University Medical Center in Amsterdam.

Introduction

In approximately 60% of patients with severe cerebral palsy (CP), the femoral head subluxates from the acetabulum [1]. Subluxation is defined as at least 30% of migration, as described by Bagg [2] and Reimers [3], dislocation as migration $>100\%$. No clear answer can be found in the literature as to whether or not there is an association between radiologically assessed subluxation or dislocation of the hip and complications. Well-known problems experienced by patients with severe CP are pain, difficulties in care-giving, seating problems, decubitus ulcers, fractures and contractures [4–6]. The determinants of hip pain in patients with severe CP have been described, indicating that migration and deformity of the hip should be prevented to avoid pain [7].

Problems with perineal hygiene are mentioned most frequently in the literature [8] and it is known that seating problems often occur in patients with severe CP [9]. Decubitus ulcers are reported in patients who are totally bed-bound [8]. Patients with severe CP are also prone to fractures [10]. Contractures of the lower extremities have been found in 64% of non-walkers [5].

The few publications that report on the relationship between radiographic findings and contractures demonstrate that there is no association [3,11].

The objective of our research was to study the relationship between subluxation and deformity of the hip, on the one hand, and handling problems, seating problems, decubitus ulcers, fractures and contractures on the other hand, in patients with severe CP.

Methods

Patients

We conducted a cross-sectional study in 160 adult patients (age ≥ 16 years) with severe tetraspastic CP. They were all on level 5 on the GMFCS (gross motor function classification system) scale [12]. Fifty-eight percent of the patients lived in a nursing home. Patients with CP were included if they had a minimum mental age of 4 years according to the Columbia Mental Maturity Scale [13]. These patients were also recruited for a study on the determinants of hip pain [7]. The Medical Ethics Committee of the VU University Medical Center approved the study protocol.

Methods

Both the usual care-giver and the physiotherapist of each patient were asked to rate the difficulties in handling of the patient on a scale from 1 to 5 (Table 1). This produced a score ranging from 4 to 20. Handling problems were defined as a score of >12 out of 20 (at least four items rated as moderate). Patients without a regular care-giver or physiotherapist are indicated as 'missing'. Both these scales were developed for this study.

The chair was classified on a six-point scale indicating progressive adaptation (1 – standard, no addition;

1060-152X

Table 1 Questions on handling problems

Question: Do you experience difficulties in handling because of limited motion or stiffness in:	
(Care-givers)	(Physiotherapists)
1. Washing perineum	1. Lifting from the bed to couch
2. Drying after washing	2. Lying on the couch
3. Putting on trousers	3. Moving legs in hip joint
4. Lifting from bed to wheelchair	4. Transfer from prone to sitting

Score: 1=none; 2=minimal; 3=moderate; 4=many; 5=serious; 9=missing data.

2 – standard with additions; 3 – special molded seat back, regular seat; 4 – special molded seat, regular seat back; 5 – special molded seat and seat back; 6 – special molded seat and seat back, integrated). In the analysis, two categories were distinguished: no special seat (scores 1–3) and special molded seat (scores 4–6). Subsequently, the patients were examined, for decubitus ulcers and contractures in the hip region and lower extremities, by our research physiotherapist (M.J.). For fractures, the patients' files were examined and the patients' doctor was interviewed. The standard classification was used for decubitus ulcers [14], and the sagittal, frontal, transverse, rotation system for the recording of angles [15] and a standard goniometer [16] to measure contractures. Patients were assessed while lying flat on a bed. Abduction of less than 30° of at least one of the hips was considered as hip adduction contracture. A hip and knee flexion contracture was defined as a limitation of 30° or more of extension of one of the hips or knees, respectively. Fractures were considered to be present if detectable on a radiograph of the lower extremity that was made within the previous 3 months.

An anterior–posterior radiograph of the pelvis was taken, unless there was one available that was made within the previous 5 years. We measured the migration percentage (MP [3]) on the anterior–posterior radiograph. Femoral head deformity was scored on a three-point scale: categories absent (normal shape of the femoral head), moderate (femoral head not round but flattened in some parts) and severe (femoral head flattened, or with sharp edges as in 'Napoleons' cap' or otherwise deformed).

The radiographs of 20 patients showed an abnormal configuration of the femur and pelvis, in which the MP could not be calculated. The femoral head was either absent, obviously totally disintegrated or impossible to identify. Direct aberrant contact between (parts of) the femur and the pelvis was also classified as an abnormal configuration. Details on this group have been published separately [7]. We excluded these patients in the analysis regarding MP. The remaining 140 patients had a femoral head that was clearly recognizable. The radiographs were subdivided, on the basis of the maximal MP, into four groups, according to the standard method: 0–29%, 30–59%, 60–89%, 90–100% [17].

One author (E.B.) scored all the radiographs, without any knowledge of patient characteristics. Differences in the mean MP were analyzed with *t*-tests for independent samples. Associations between hip deformity and complications were analyzed with χ^2 tests for trend. In addition, the associations between the outcome variables (complications) and radiographic findings (MP and deformity) were modelled with linear regression (for handling problems) or logistic regression (seating problems and contractures) adjusted for age and sex (SPSS version 10.0; SPSS, Chicago, Illinois, USA).

Results

Patient characteristics, prevalence of complications and results of radiography

A brief description of the patient characteristics and the prevalence of complications is shown in Table 2.

Correlation between radiograph results and complications

Results of radiography and handling problems

No significant difference was found in mean MP between patients with or without handling problems (Table 3). Handling problems were also not significantly associated with the level of hip deformity (Table 4). Regression analysis, with adjustment for age and sex, also showed no significant associations.

Results of radiography and seating

A clear relationship was found between migration and deformity of the femoral head, on the one hand, and the use of a special seat in the wheelchair, on the other hand

Table 2 Patient characteristics

Mean age (SD) (*n*=160)	36 (15.7)
Percentage male	54
MP (*n*=160)	
Mean MP (SD)	44 (42.9)
MP <30 (%)	55.6
MP 30–59 (%)	21.9
MP 60–89 (%)	5.6
MP 90–100 (%)	4.4
Abnormal configuration	12.5
Hip deformity (*n*=140) (%)	
No	29.3
Moderate	41.4
Severe	29.3
Handling problems physiotherapist (*n*=125)	
Mean score (SD)	9.0 (3.6)
% with score >12	23
Handling problems care-giver (*n*=146)	
Mean score (SD)	10.0 (4.0)
% with score >12	14
Seating problems	
% special molded seat in chair	61
Decubitus ulcers (%)	3
Using anti-epileptic medication (%)	11
Fractures (*n*)	1
Contractures (%)	
Hip adduction contracture	58
Hip flexion contracture	14
Knee flexion contracture	32

SD, standard deviation; *n*, number of patients; MP, migration percentage.

Table 3 Differences in mean migration percentage (MP) between patients with and without problems, *n*=140

Item	Mean MP (SD) in patients without problems	Mean MP (SD) in patients with problems	Mean difference (95% CI)
Handling problems physiotherapist (score >12)	30.3 (20.6)	27.9 (20.9)	−2.4 (−11.6 to 6.8)
Handling problems care-giver (score >12)	32.3 (25.0)	28.9 (22.3)	−3.5 (−15.3 to 8.4)
Seating problems (yes/no)	25.9 (15.5)	35.2 (27.3)	9.3 (2.0 to 16.6)[c]
Hip adduction contractures[a]	23.6 (17.2)	37.3 (26.3)	13.7 (6.4 to 21.0)[c]
Hip flexion contractures[b]	31.6 (23.9)	28.1 (22.1)	−3.5 (−15.6 to 8.6)
Knee flexion contractures[b]	29.9 (22.1)	34.4 (26.8)	4.5 (−4.1 to 13.1)

SD, standard deviation; CI, confidence interval. [a]Left or right < 30°; [b]Left or right > 30°; [c]Significant at $P < 0.05$ level.

Table 4 Frequency of problems (%) in patients with different levels of hip deformity, *n*=160

Item	No hip deformity (%)	Moderate hip deformity (%)	Severe hip deformity (%)	Abnormal configuration (%)	χ^2trend
Handling problems physiotherapist	16.1	21.3	33.3	28.6	$P=0.135$
Handling problems care-giver	20.0	12.0	16.7	15.0	$P=0.71$
Seating problems (yes/no)	51.3	51.8	87.2	78.9	$P=0.001$
Hip adduction contractures[a]	39.0	53.4	75.6	75.0	$P=0.000$
Hip flexion contractures[b]	9.8	10.3	17.1	30.0	$P=0.33$
Knee flexion contractures[b]	22.0	31.1	36.6	45.0	$P=0.05$

[a]Left or right <30°; [b]Left or right >30°.

(Tables 3 and 4). The relationship between deformity of the femoral head and the need for a special molded seat remained significant in logistic regression analysis, after correction for age and sex ($P = 0.01$). The association between MP and the use of a special seat was borderline significant after adjustment for age and sex ($P = 0.08$).

Results of radiography and decubitus ulcers and fractures

Owing to the low prevalence of these problems (Table 2), no associations could be investigated.

Results of radiography and contractures

The mean MP was significantly higher in patients with hip adduction contractures than patients without contractures (Table 3). The prevalence of hip adduction contractures increased as the level of hip deformity increased (Table 4). In logistic regression analysis, after correction for age and gender, the associations remained significant.

Discussion

Patients with severe cerebral palsy suffer from a wide range of complications, which is confirmed by the results of our study. We found some aspects of care to be in accordance with reports in the literature, such as the need for a special seat and the prevalence of contractures, but decubitus ulcers and fractures were rare in our population. The high level of care that is provided in the Netherlands for these patients could explain these findings. Deformity of the hip was strongly associated with the need for a special molded seat and limited abduction of the hip. Especially, the relationship between femoral head deformity and the need for a special seat is remarkable: only 51% of the patients with no deformity of the femoral head had a special molded seat whereas 87% of the patients with a serious deformity needed one. The need of adapting a special seat means a considerable amount of time and money and decreases the possibility of interchanging chairs. The relationship between migration and deformity of the femoral head and limited range of hip abduction is also prominent. Hip flexion contractures are not significantly related to hip deformity, but in patients with an abnormal configuration of the hip the prevalence of hip flexion contractures increases considerably. This illustrates the impact of hip abnormality on handling possibilities of these patients.

In conclusion, handling problems, seating problems and contractures are common in adults with severe CP. The need of providing a special molded chair and limited abduction of the hip are strongly related to deformity of the femoral head. Abnormal configuration of the femur head and pelvis decreases the possibility to extend the hips. It is therefore recommended that these orthopedic abnormalities are prevented or treated as they develop.

Acknowledgement

Data were analyzed with the help of Mr J. Kuik from the Department of Clinical Epidemiology and Biostatistics, VU University Medical Center, Amsterdam, The Netherlands.

References

1 Howard CB, McKibbin B, Williams LA, Mackie I. Factors affecting the incidence of hip dislocation in cerebral palsy. *J Bone Joint Surg Br* 1985; **67**:530–532.
2 Bagg MR. Long term follow up of hip subluxation in cerebral palsy patients. *J Pediatr Orthop* 1993; **13**:32–36.
3 Reimers J. The stability of the hip in children. *Acta Orthop Scand Suppl* 1980; **184**:1–100.
4 Knapp DR, Cortes H. Untreated hip dislocation in cerebral palsy. *J Pediatr Orthop* 2002; **22**:668–671.
5 Murphy KP, Molnar GE, Lankasky K. Medical and functional status of adults with cerebral palsy. *Dev Med Child Neurol* 1995; **37**:1075–1081.
6 Noonan K, Jones J, Pierson J. The natural history and function of the hip in adult patients with cerebral palsy. *J Bone Joint Surg Br* 2003; **85-B (Supp III)**:263–264.
7 Boldingh EJK, Jacobs-van der Bruggen MAM, Bos CFA, Lankhorst GJ, Bouter LM. Determinants of hip pain in adult patients with severe cerebral palsy. *J Pediatr Orthop B* 2005; **14**:120–125.
8 Moreau M, Drummond DS, Rogala E, Ashworth A, Porter T. Natural history of the dislocated hip in spastic cerebral palsy. *Dev Med Child Neurol* 1979; **21**:749–753.

9 Pritchett JW. Treated and untreated unstable hips in severe cerebral palsy. *Dev Med Child Neurol* 1990; **32**:3–6.
10 Pritchett JW. The untreated unstable hip in severe cerebral palsy. *Clin Orthop* 1983; **173**:169–172.
11 Bar-On E, Malkin C, Eilert RE, Luckey D. Hip flexion contracture in cerebral palsy. The association between clinical and radiologic measurement methods. *Clin Orthop* 1992; **281**:97–100.
12 Wood E, Rosenbaum P. The gross motor function classification system for cerebral palsy: a study of reliability and stability over time. *Dev Med Child Neurol* 2000; **42**:292–296.
13 Burgemeister B, Blum L, Lorge I, editors. *Columbia mental maturity scale: manual*. New York: Yonkers; 1954.
14 Keuzenkamp T. [Conservative treatment of decubitus]. *Ned Tijdschr Geneeskd* 1984; **128**:1470–1473.
15 Gerhardt JJ. Clinical measurements of joint motion and position in the neutral-zero method and SFTR recording: basic principles. *Int Rehabil Med* 1983; **5**:161–164.
16 Brosseau L, Balmer S, Tousignant M, O'Sullivan JP, Goudreault C, Goudreault M, Gringras S. Intra- and intertester reliability and criterion validity of the parallelogram and universal goniometers for measuring maximum active knee flexion and extension of patients with knee restrictions. *Arch Phys Med Rehabil* 2001; **82**:396–402.
17 Miller F, Bagg MR. Age and migration percentage as risk factors for progression in spastic hip disease. *Dev Med Child Neurol* 1995; **37**:449–455.