PREDICTIVE FACTORS FOR UNSATISFACTORY EVOLUTION OF UNSTABLE HIPS IN BRAIN PALSY SUBMITTED TO JOINT RECONSTRUCTION

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SUMMARY

Objective: To evaluate potential prognostic factors that would indicate an unsatisfactory treatment evolution of hip sub-dislocation and/or spastic dislocation in patients with Brain Palsy submitted to surgical reconstruction, upon soft parts, adductors and iliopsoas release, and Dega's pelvic osteotomy combined to outer-rotation and shortening varusing sub-trochanteric femoral osteotomy. Case Series and Methods: 58 patients (78 hips) with sub-dislocation/ spastic dislocation submitted to surgical reconstruction were retrospectively assessed, both clinically and by X-ray studies, from October 1994 to August 2005. The minimum follow-up time was 12 months and the average was 53.6 months. Hips were classified into satisfactory and unsatisfactory according to the analysis of late postoperative acetabular index (AI) and Reimers index (RI). The following variables were statistically analyzed: patient's age at surgery time, postoperative follow-up period, and AI, RI X-ray parameters, cervicodiaphyseal angle (CD) at preoperative, early postoperative and late postoperative periods. Results: From the 78 hips assessed, 13 were classified as unsatisfactory because they presented a late postoperative AI higher or equal to 20 degrees, and a late postoperative RI higher or equal to 25%, and, after the statistical analysis of data, significance was reported only at early postoperative AI, late postoperative AI, late postoperative RI, and late postoperative CD. Conclusion: There is no variable that can predict an unsatisfactory postoperative evolution on joint reconstruction in cases of hip sub-dislocation and/ or spastic dislocation, but it was evidenced that stronger efforts must be employed when correcting the acetabular index during a surgical procedure.

Keywords: *Cerebral palsy; Hip dislocation; Osteotomy*

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INTRODUCTION

Hip deformities in children affected by spastic Brain Palsy is frequent, ranging from 25 to 75%, being directly related to the severity of neurological damage, thus being more prevalent in quadriparetic and non-ambulating patients [1-8].

The etiology of deformities is multifactorial, that is, an association of factors predisposing changes, initially postural, up to the so-called deformities, namely: muscle unbalance, acting in a peculiar anatomy with fetal patterns, represented by valgusing and femoral anteversion, and neurological deficit degree, affecting patients' function, once the delay or absence of ambulation does not favor physiological correction of the regional anatomy [3,6-8]. Changes range from sub dislocation to full dislocation of the joint. Combined factors are young age, the high growth potential, and bone remodeling [8,9].

The results of deformities in sub dislocations and dislocations are the reduced joint motion, positioning difficulties, sitting ability reduced or lost, perineal hygiene problems, and the emergence of pressure sores [3,5,8,10-13]. It is believed that, despite of the difficulties on evaluating those severely compromised patients, approximately one third to half of these evolve with pain at hip motion if left untreated [1,4,8].

It is a consensus in literature that the optimal treatment for those spastic patients with changes on hip joint is the preventive one, when those present clinically with motion restraints at abduction and flexion, the so-called "hips at risk", upon release of spastic musculature causing muscle unbalance. After that phase, the way is surgical reconstruction, aiming to fix the so-called deformities by combining soft parts release to pelvic and femoral osteotomies [1,2,5,7,8,11,13]. The outcomes of such treatment are, according to most of the authors, satisfactory, but it presents the challenge of finding uniform groups of patients for better evaluating and possibly comparing outcomes, with the major reason for this difficulty being the fact that those patients show spasticity.

The objective of the present study is to identify which factors presented by patients would be indicative of an unsatisfactory development in the treatment of spastic hip sub dislocation and/ or dislocation when submitted to surgical reconstruction.

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CASE SERIES AND METHODS

Within the period of October 1994 to August 2004, 58 patients (78 hips) of spastic Brain Palsy, with hip sub dislocation and/ or dislocation were submitted to surgical reconstruction at the Neuromuscular Diseases Group, of Santa Casa de Misericórdia's Department of Orthopaedics and Traumatology - "Fernandinho Simonsen" Building, in São Paulo, Brazil. The study was appraised and approved by the Committee on Ethics and Research under the number 292/05.

Among the 58 operated patients, 38 were unilateral, and 20 were bilateral cases, totaling 78 hips.

All patients, with a follow-up period of at least 12 months, were reassessed clinically and radiographically for the present study in August 2005.

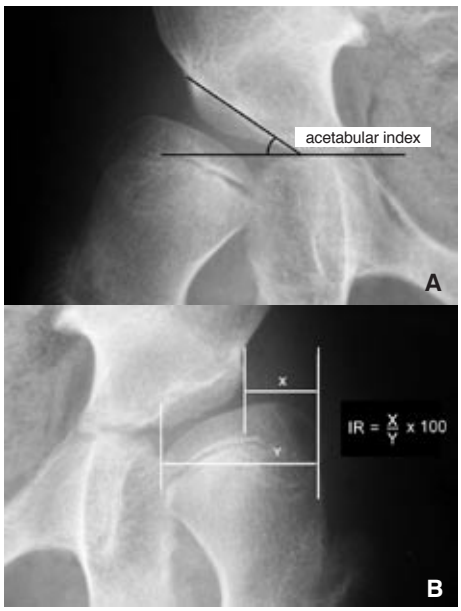
At clinical evaluation, the following were recorded preoperatively: age by the time of surgery, gender, kind of involvement of Brain Palsy, functional status, and presence of pain at hip joint manipulation. Postoperatively, the presence/ absence of hip pain, functional status changes/ improvement, and follow-up time were assessed.

In the X-ray studies performed centrally at pelvic anteroposterior plane, the following have been measured: the acetabular index (AI) [7], the femoral head migration rate (Reimers' index - RI)[14], and the cervical-diaphyseal angle (CD)[7], at preoperative, early and late postoperative periods (Figures 1A e B).

All patients were submitted to soft parts, adductors and psoas release, bloody reduction of hip joint, outer-rotation, shortening varusing proximal femoral osteotomy, fixed with infantile and/or juvenile angled plate at 90º (AO-ASIF), combined to Dega's periacetabular osteotomy [15].

Patients' ages at surgery time ranged from one year and five months to 14 years and three months, with an average of seven years and seven months. Distribution concerning gender was 30 male patients and 28 female patients. All the 58 patients had spastic Brain Palsy, with 48 quadriparetic patients, eight biparetic, and two hemiparetic. Functionally, 56 patients were non-ambulating, one ambulating at physical therapy and one communitarian.

The average preoperative AI, early postoperative AI, and late postoperative AI were 30.87, 12.33 and 12.74 degrees, respectively. The average preoperative RI, early postoperative RI, and late postoperative RI were 66.73%, 2.57% and 8.14%, respectively. The averages for preoperative, early postoperative, and late postoperative were, respectively: 158.7, 120.7 and 129.7 degrees (Table 1).



Figures 1 A and B - *Illustration of X-ray analysis for acetabular index (A) and Reimers´ index (B).*

Table 1 - *Patients with Brain Palsy and spastic hip sub dislocation submitted to surgical reconstruction. Minimum, maximum and average values and data regarding age at the time of surgery, and X-ray parameters: acetabular index (AI) in degrees, Reimers´ index (RI) in percentage, cervical-diaphyseal angle (CD) in degrees measured at preoperative, early postoperative and late postoperative periods, and postoperative follow-up time.*

Variable	Min.	Max.	Average
Age at surgery time (months)	17	171	91.04
Preoperative AI	14	55	30.87
Early postoperative AI	0	35	12.33
Late postoperative AI	0	35	12.74
Preoperative RI	0	100	66.73
Early postoperative RI	0	45	2.57
Late postoperative RI	0	54	8.14
Preoperative CD	130	180	158.7
Early postoperative CD	80	152	120.7
Late postoperative CD	90	162	129.7
Follow-up time (months)	13	105	53.76

Results were rated as satisfactory when clinical and functional improvement was reported, as well as normalization of X-ray parameters. Unsatisfactory results corresponded to those patients evolving with or without pain, whose hips presented an AI equal or above 20 degrees and/or RI equal or higher than 25% of femoral head migration at the last outpatient assessment (Figures 2 and 3).

The average follow-up period was 53.68 months, ranging from 13 to 105 months.

From a total of 58 patients (78 hips) assessed, 46 patients (65 hips) were rated as satisfactory and 12 patients (13 hips) as unsatisfactory. Thus, two groups were formed and the variables were statistically compared, according to the Mann-Whitney method and the Fisher's Exact test [16,17]. Clinical variables: age at surgery time, functional status; X-ray variables: preoperative AI, early postoperative AI, late postoperative AI, preoperative RI, early postoperative RI, preoperative CD, early postoperative CD, and late postoperative CD (Tables 2 and 3).

RESULTS

From the 12 patients (13 hips) evolving unsatisfactorily postoperatively, five were females and seven males, not showing any statistical differences, as well as for age of patients at surgery time, which was, in average, 80.7 months (31 - 156 months).

Concerning the kind of Brain Palsy, 83.4% of the hips considered as unsatisfactory were from quadriparetic patients, totaling 10 patients, 8.3% corresponded to a hemiparetic patient, and 8.3% to a biparetic patient.

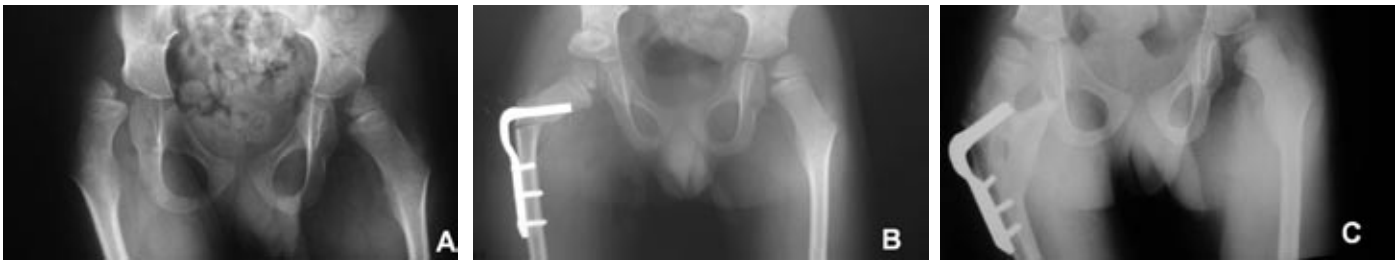
Regarding the functional status, only one patient presenting an unsatisfactory hip functionally evolved from non-ambulating to ambulating at physical therapy, after surgical reconstruction of the hip sub dislocation/ dislocation. However, all patients managed to keep sit on a wheelchair postoperatively.

The X-ray variables presenting statistical significance ($p<0,05$) were: early postoperative AI, late postoperative AI, late postoperative RI, and late postoperative CD with averages and intervals of 19.38 degrees (8-35 degrees), 25.38 degrees (10-35 degrees), 32.75% (0-54%) and138.38 degrees (116-162 degrees), respectively (Table 3).

DISCUSSION

For treating a spastic hip, when "at risk", the release of soft parts has its major indication in very young patients with femoral head migration rates below 30%, presenting long-term benefits of this

Figures 2 A, B and C - *12-year and 2-month old patient submitted to bilateral hip joint reconstruction, with satisfactory evolution. A: preoperative. B: early postoperative. C: late postoperative.*



Figures 3 A, B and C - *5-year and 9-month old patient submitted to right hip joint reconstruction, with unsatisfactory evolution. A: preoperative. B: early postoperative, presenting adequate correction of the acetabular dysplasia and cervical-diaphyseal angle. C: late postoperative, hip sub dislocation recurrence, acetabular dysplasia and valgusing of the femoral proximal third are noted.*

intervention in the vast majority of patients [4,7,8].

Subsequently, in the presence of the so-called deformity, the most important factors leading to a satisfactory postoperative outcome are, in addition to young age, the magnitude of sub dislocation/ dislocation and preoperative acetabular deformity[2,8]. A major failure on surgical intervention is related to an AI higher than 30 degrees and a RI above 60% [2,4,8]. The combination of sub dislocation early detection and soft parts release may reduce the number of unsatisfactory outcomes [4,8].

Surgical correction of spastic hip sub dislocation/ dislocation comprehends a combination of techniques targeting the correction of all existent changes: muscle unbalance, the so-called sub dislocation and dislocation, the cervical-diaphyseal valgusing, femoral proximal anteversion, and acetabular dysplasia. Therefore, the following are required: soft parts, adductors and psoas release, the bloody reduction of the joint, Dega's acetabular osteotomy, and the outer-rotation, shortening varusing proximal femoral (sometimes necessary for reduction without joint tension).

The adoption of Dega's osteotomy [15] is due to the special advantage provided by this technique, which is the potential to fix the anterior, lateral and posterior acetabular dysplasia,

Table 2 - *X-ray parameters for patients presenting spastic hip sub dislocation submitted to surgical reconstruction with satisfactory results. Statistical analysis of: early postoperative acetabular index (AI-epost), late postoperative acetabular index (l-AI), late Reimers´ index (l-RI), and late cervical-diaphyseal angle (l-CD).*

Satisfactory	Min.	Max.	Average	Standard Deviation	p
Early postoperative AI (AI-epost)	0	32	10.923	6.027	0.0007
Late postoperative AI (l-AI)	0	20	10.215	4.983	0
Late RI	0	23	3.214	6.708	0
Late CD	90	162	127.98	15.34	0.0269

Table 3 - *X-ray parameters for patients presenting spastic hip sub dislocation submitted to surgical reconstruction with unsatisfactory results. Statistical analysis of: early postoperative acetabular index (AI-epost), late postoperative acetabular index (l-AI), late Reimers´ index (l-RI), and late cervical-diaphyseal angle (l-CD).*

Unsatisfactory	Min.	Max.	Average	Standard Deviation	p
Early postoperative AI (AI-epost)	8	35	19.38	8.16	0.0007
Late postoperative AI (l-AI)	10	35	25.38	9.13	0
Late RI	0	54	32.75	16.37	0
Late CD	116	162	138.38	12.62	0.0269

which does not occur with the other pelvic osteotomies usually indicated for children, such as the Salter and Pemberton's osteotomy apud Miller and Murabak et al.[8,13].

The indication to surgical reconstruction for pelvic and femoral osteotomies is provided to children with unsuccessful soft parts release, RI higher than 40%, and dislocated painful hips at most in the past two years [1,4,8]. The combination of early release of the soft parts and hip reconstructive osteotomy yields normal hips to most of the children at late growth stages[4,8,9,13,18]. The recurrence rate for dislocation is higher in cases where only soft parts release was used, which corroborates the indication for surgical reconstruction of the hip [10].

Many authors agree that this method is efficient, emphasizing that the reconstruction of a spastic hip lead to painless, moving and stable hips, however, few studies have emphasized which factors could lead to an unsatisfactory outcome, which would help on determining its indications and restraints on the use of the method [9].

According to Józwiak et al.[19], who assessed 30 hips with paralytic dislocation in patients with Brain Palsy, there was a statistically significant difference between femoral head migration degree and pain complaint, in addition to a trend to deformity recurrence during

follow-up, a fact also observed when data of the present study were assessed. More interestingly, these authors noticed an apparent trend to femoral valgusing on serial X-ray analysis, considering this as one of the major recurrence factors and associating it to a higher prevalence of non-vascular necrosis of the femoral head [19]. We didn't observe, after statistical analysis, any difference between preoperative and early postoperative cervical-diaphyseal angle regarding satisfactory and unsatisfactory groups, but it indeed occurred with the late postoperative cervical-diaphyseal angle, which emphasizes the observation that femoral valgusing is higher in cases of unsatisfactory development, and may contribute to deformity recurrence (Table 2). There was no difference regarding follow-up time, since for cases with up to 24 months of follow-up or after 24 months up to 171 months, the statistical analysis did not evidence significance.

A higher degree of femoral varusing leads to a better accommodation of the femoral head to the acetabulum, as well as prevention of hip dislocation recurrence, as suggested by Pope et al.[20]. Data for early postoperative CD angle did not show statistically significant differences between satisfactory and unsatisfactory hips groups, thus, being impossible to state that a lower degree of femoral varusing could lead to a higher recurrence rate and unsatisfactory results.

The percentage of treatment failure due to dislocation recurrence, considered unsatisfactory, was 19.23%, which is similar to reports in literature, although lower rates have previously been reported [9,10,21].

Studies evaluating the natural development of spastic dislocation of the hip have evidenced the interdependence between hip dislocation, pelvic obliquity and scoliosis [8,12,22]. We report only two patients requiring spine arthrodesis for scoliosis treatment.

Age is an important analysis factor for a paralytic hip. Some authors suggest a higher rate of surgical treatment failure in patients with severe spasticity and older by the time of surgery [6,11,20]. The observation by Brunner and Baumann[9] that before the age of four to eight years, due to a higher remodeling potential, dislocation recurrence is higher, is not the same realized in the analysis of our patients, who, even after groups stratification (one below the age of eight years - 108 months - and the other, above eight years - 108 months - did not present statistical significance when compared between satisfactory and unsatisfactory groups. We believe that the distribution and severity of Brain Palsy contribute for correction failure, once 61.5% of the patients in this study were quadriparetic, and 86.7% of the unsatisfactory cases were also quadriparetic [9,11,12].

Dislocation recurrence is associated to severe acetabular failure, deformity recurrence in inner rotation and contraction in adduction [4]. This exaggerated inner rotation would be provided by a strong action of the anterior gluteus muscle, both median and minimum, which reaches to a mechanical advantage after femoral varusing, worsening clinical picture, which can be seen by an improved outer rotation when this musculature is released.

The difference between early postoperative AI in satisfactory and unsatisfactory groups is associated to a lower level of acetabular dysplasia correction at surgical procedure, and that certainly favored deformity recurrence and the resultant unsatisfactory outcome.

Despite of being a frequent complication, the fracture around the knee, probably associated to osteoporosis due to immobilization, was low in this study, with only 4 patients presenting supracondylar fracture of the femur and 1 patient presenting subtrochanteric fracture after synthesis material removal [2,20].

CONCLUSION

After objective analysis of data, no variable was noted that could predict an unsatisfactory evolution after the reconstruction of sub dislocated/ dislocated spastic hips. The fact of the existence of statistical significance regarding early postoperative acetabular index between satisfactory and unsatisfactory cases infers that little correction was provided during surgical procedure, due to the severity of acetabular dysplasia regarding preoperative acetabular index, and this was probably one factor that led to worse results. Also, the statistical relevance of the late cervical-diaphyseal angle suggests that, during the development of unsatisfactory hips, there is a trend to femoral valgusing and this could be a structural factor responsible for a worse prognosis. Therefore, we believe that major efforts must be focused to the surgical procedure in order to fully fix all deformities of hip joint, particularly the acetabular failure.

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