Anterior hip dislocation in children with neurological disorders. A retrospective study of ten operated hips

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ABSTRACT

Introduction: Patients with neurological disorders often exhibit dislocation or subluxation of the hip. Anterior dislocation is rare, little known, and often associated with deformities. Its surgical treatment has rarely been studied.

Hypothesis: Hip surgery (with open reduction, femoral and pelvic osteotomy, and adapted tenotomies) could provide a centered hip that is supple and painless.

Materials and methods: Ten hips (seven dislocated, three subluxated) in six patients with a mean age of 8.3 years were operated between 1995 and 2009 and revised with a mean follow-up of 6.5 years. The deformities comprised four cases of abduction, extension, and external rotation and six cases of adduction, extension, and external rotation. Four patients had lost the ability to walk or maintain the sitting position. Intraoperative findings were an increased neck-shaft angle, anterosuperior acetabular dysplasia, and in only one case increased femoral anteversion. In all cases of dislocation, open reduction was necessary, and all hips underwent pelvic and femoral osteotomy.

Results: At the longest follow-up, hips were centered on X-rays. Five patients could walk or sit as they had done before and hips were supple, with no deformities.

Discussion: The study of deformities and intraoperative findings is mandatory for surgical management, whose mid-term results are encouraging. Femoral anteversion does not seem to be excessive, but the increase of femoral valgus is constant, as is anterosuperior acetabular dysplasia. We propose a decision tree for the management of these patients.

Design of study: Retrospective.

Level of scientific evidence: IV.

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1. Introduction

The frequency of acquired hip dislocations or subluxations in patients with neurological disorders is high, with greater frequency with more severe neurological impairment. Depending on the severity of the disorder [1], the incidence varies from 2% to 70% of dislocations, among which anterior dislocation is rare and poorly known. It is the cause of pain and poor position in children, and carries a risk of loss of autonomy (prohibiting walking and sitting), which is dramatic in these patients who already have severe neurological impairment. Neurological hip dislocations occur most often between the ages of 7 and 8 years. It is important to treat the sitting and lying positions early, because beginning at 12 years of age, pain becomes a predominant factor if the hips are not treated [2]. Associations between these dislocations and pre-existing clinical contracture is often found, requiring adaptation of the treatment to the observed contractures.

The literature on this subject is scarce, and a single article published in 1998 reports a series of 27 hips divided into three groups according to pre-existing clinical contracture [3]. Clinical contracture, the consequences of muscle imbalance and severe muscle-tendon retractions, can require soft-tissue release [4]. The objective of this study was to evaluate the medium-term effect of these surgical treatments in young patients with neurological disorders who presented anterior hip dislocation. The working hypothesis was that hip surgery (with surgical reduction, femoral and pelvic osteotomies, and adapted tenotomies) would make it possible to obtain a centered hip (the main objective) that was also supple and painless.
2. Material and methods

2.1. The series

All patients (three girls and three boys) who had been operated for anterior hip dislocation (seven hips) or anterior subluxation (three hips) with an underlying neurological disorder were included in this study between 1995 and 2009 (Table 1). Patients who had already undergone surgery on this hip were excluded.

The diagnosis of acquired anterior hip dislocation in an immature hip was made based on the analysis of AP pelvic X-rays and CT scans of patients who showed clinical dislocation (hip pain, inability to walk or maintain the sitting position, shortening of one limb compared to the other, and palpation of the femoral head in the groin [Fig. 1]).

The mean age at the time of surgery was 8.3 years (range, 4.4–14.9 years). This series was composed of:

- two nonwalking quadriplegic patients with cerebral palsy (subjects 1 and 2);
- one patient with spastic diplegia who had lost ambulation (subject 6);
- one ambulatory child with psychomotor delay, paraparesis, associated with dysmorphia (subject 3);
- one nonambulatory patient with quadriplegic encephalopathy (Aicardi-Goutières syndrome: [5]) (subject 5);
- one ambulatory child with spina bifida (partial paraplegic at level L4) (subject 4).

We classified these patients using the classification published by Selva et al. [3]:

- type 1 including patients presenting a hip position in extension, external rotation, and retraction in adduction and the knee in extension (six hips in the present series);
- type 2 including patients presenting external rotation, retraction in abduction of the hip, and flexion of the knee (four hips);
- type 3 including patients presenting no retraction of the hip or knee (0 hips in this series).

Four patients in this series (subjects 1, 2, 4, and 5) presented kyphosis due to loss of hip flexion. One patient had lost ambulation (subject 6), three had lost the sitting position (subjects 1, 2, and 5), and two children had preserved indoor ambulation that was more unstable than the ambulation acquired earlier (subjects 3 and 4). The severity of the clinical contracture in extension and rotation limited the range of motion (most notably internal hip flexion and rotation).

The median follow-up was 6.5 years, ranging from 5.1 to 19.6 years.

2.2. Surgical intervention

In all cases, the intraoperative observations showed an excessive neck-shaft angle, anterosuperior acetabular dysplasia, and in a single case, excessive femoral anteverision (subject 5) associated with trophic impairment of the femoral head.

In the nonambulatory children (subjects 1, 2, and 5), hamstring release was proximal, near the ischium. All patients underwent a shortening femoral varus osteotomy, bringing the neck-shaft angle to 110°. An innominate pelvic osteotomy (Fig. 2) or triple osteotomy (Fig. 3) was performed depending on the acetabular deformities observed on the preoperative radiographic exams and on intraoperative observations. For the seven cases of dislocation, surgical reduction with capsulorrhapy was required. The operations performed and the corrections obtained in terms of neck-shaft angle, femoral anteverision, acetabular dysplasia, and muscle release are presented in Table 1.

At the postoperative stage, a hip spica cast with slight hip and knee flexion and neutral rotation was placed for a duration of 6 weeks. This circular immobilization was replaced by progressive traction lasting nearly 1 month. Once the flexibility of the hip had been obtained, the child was placed in a symmetrical hip position, in both a molded seat in the seated position and a night time splint in the supine position. The symmetric position was maintained until the last follow-up for the three nonambulatory patients. For the pelvic osteotomy patients, the wires were removed 6 weeks after the intervention, and the femoral plates placed for the femur osteotomies were removed at 18 months after the initial surgery.

2.3. Clinical and radiological assessment

The following data were studied:

- the functional repercussions of the deformities observed (whether or not the sitting position was acquired, whether or not ambulation was possible);
- pain was assessed based on the discomfort expressed by the child during hip mobilizations and using a pre- and postoperative visual scale, when the child's participation allowed evaluation (data not collected because only subject 6 participated);
- anatomic and radiological data:
  - dislocation was clear on the standard preoperative X-rays. Subluxations were identified by the rupture of Shenton's line and the cervical-iliac line on standard AP pelvic X-rays and in some cases confirmed by axial CT views:
    - neck-shaft angle was calculated preoperatively based on standard AP X-rays of the pelvis, hip in internal rotation equal to the clinically estimated anteverision. When the amplitude of the internal rotation was zero or negative, the neck-shaft angle was calculated on intraoperative images after release of the contractures;
    - preoperative femoral anteverision was assessed clinically if the contractures allowed or by CT measurement comparing the transversal axis of the proximal extremity of the femur with the transversal axis of the femoral condyles. Femoral anteverision was evaluated visually during arthroscopy using the morphology of the proximal extremity of the femur compared to the condyles and during femoral osteotomy using the landmark of the Kirschner wire placed on the ventral side of the neck of

Table 1
Data of patients at baseline, operations and corrections made.

<table>
<thead>
<tr>
<th>Patient</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td>Female</td>
<td>Male</td>
<td>Female</td>
<td>Male</td>
<td>Male</td>
<td>Female</td>
<td>Male</td>
</tr>
<tr>
<td>Side</td>
<td>Right</td>
<td>Left</td>
<td>Right</td>
<td>Left</td>
<td>Right</td>
<td>Left</td>
<td>Right</td>
</tr>
<tr>
<td>Neurologic disease</td>
<td>Nonwalking quadriplegic cerebral palsy</td>
<td>Nonwalking quadriplegic cerebral palsy</td>
<td>Dysmorphia, psychomotor delay, spastic paraplegia</td>
<td>Spina bifida (paraplegic at L4)</td>
<td>Aicardi-Goutières syndrome, nonwalking</td>
<td>Nonwalking</td>
<td>Cerebral palsy, spastic diplegia</td>
</tr>
<tr>
<td>Preoperative contractures</td>
<td>Hip ABD EXT ER, subluxation</td>
<td>Hip ABD EXT ER, subluxation</td>
<td>Hip ADD EXT ER, subluxation</td>
<td>Hip ADD EXT ER</td>
<td>Hip ADD EXT</td>
<td>Hip ADD EXT</td>
<td>Hip ADD EXT</td>
</tr>
<tr>
<td>Functional repercussion</td>
<td>Sitting position impossible, limited hip flexion, kyphosis</td>
<td>Sitting position impossible, limited hip flexion, kyphosis</td>
<td>Indoor ambulation</td>
<td>Sitting position disturbed, indoor ambulation, kyphosis</td>
<td>Sitting position impossible, kyphosis</td>
<td>Loss of walking, hip pain</td>
<td></td>
</tr>
<tr>
<td>Age at surgery</td>
<td>8.0 years</td>
<td>8.1 years</td>
<td>4.4 years</td>
<td>4.5 years</td>
<td>7.0 years</td>
<td>7.2 years</td>
<td>5.2 years</td>
</tr>
<tr>
<td>Surgery performed</td>
<td>PO FO SR proximal hamstring release</td>
<td>PO FO proximal hamstring release</td>
<td>PO FO SR proximal hamstring release</td>
<td>PO FO SR tenotomy of the adductors</td>
<td>PO FO SR tenotomy of the adductors</td>
<td>PO FO SR tenotomy of the adductors</td>
<td></td>
</tr>
<tr>
<td>Last follow-up</td>
<td>8.5 years</td>
<td>8.4 years</td>
<td>6.4 years</td>
<td>6.4 years</td>
<td>6.1 years</td>
<td>5.9 years</td>
<td>5.1 years</td>
</tr>
<tr>
<td>Clinical evaluation at last follow-up</td>
<td>Sitting posture recovered and contractures removed</td>
<td>Sitting position recovered, improved sitting posture</td>
<td>Improvement of indoor ambulation</td>
<td>Improvement of indoor ambulation</td>
<td>Sitting posture recovered and contractures removed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>X-ray at last follow-up</td>
<td>Hip centered 110°</td>
<td>Hip centered 110°</td>
<td>Hip centered 110°</td>
<td>Hip centered 110°</td>
<td>Hip centered 110°</td>
<td>Hip centered 110°</td>
<td></td>
</tr>
<tr>
<td>Preoperative neck-shaft angle</td>
<td>140°</td>
<td>140°</td>
<td>145°</td>
<td>150°</td>
<td>155°</td>
<td>140°</td>
<td>140°</td>
</tr>
<tr>
<td>Postoperative neck-shaft angle</td>
<td>110°</td>
<td>110°</td>
<td>110°</td>
<td>110°</td>
<td>110°</td>
<td>110°</td>
<td>110°</td>
</tr>
<tr>
<td>Neck-shaft angle at last follow-up</td>
<td>125°</td>
<td>127°</td>
<td>137°</td>
<td>120°</td>
<td>140°</td>
<td>130°</td>
<td>120°</td>
</tr>
<tr>
<td>Intraoperative femoral anteversion</td>
<td>30°</td>
<td>30°</td>
<td>10°</td>
<td>10°</td>
<td>30°</td>
<td>20°</td>
<td>80° (20° postoperative)</td>
</tr>
<tr>
<td>Preoperative acetabular slope: AI angle</td>
<td>16°</td>
<td>14°</td>
<td>15°</td>
<td>27°</td>
<td>41°</td>
<td>28°</td>
<td>30°</td>
</tr>
<tr>
<td>Acetabular angle at last follow-up: AI angle</td>
<td>8°</td>
<td>7°</td>
<td>9°</td>
<td>6°</td>
<td>18°</td>
<td>18°</td>
<td>20°</td>
</tr>
<tr>
<td>Preoperative VCE angle</td>
<td>23°</td>
<td>26°</td>
<td>25°</td>
<td>15°</td>
<td>13°</td>
<td>12°</td>
<td>16°</td>
</tr>
<tr>
<td>VCE angle at last follow-up</td>
<td>47°</td>
<td>52°</td>
<td>32°</td>
<td>31°</td>
<td>28°</td>
<td>29°</td>
<td>17°</td>
</tr>
</tbody>
</table>

ABD: abduction; ADD: adduction; AI: acetabular index; ER: external rotation; EXT: extension; FO: femoral osteotomy (with systematic 1–1.5 cm shortening); PO: pelvic osteotomy (Salter-type); SR: surgical reduction; TPO: triple pelvic osteotomy; VCE: vertical center angle.
Fig. 2. A and B. An 8-year-old quadriplegic spastic child (subject 1), with an extension-abduction contracture and anterior dislocation of the right femoral head. A. Preoperative X-ray. B. Preoperative CT. C. Results 4 years after hip surgery: right hip had undergone surgical reduction associated with proximal release of the hamstrings, femoral and innominate osteotomies. Left subluxated hip underwent the same treatment, without surgical reduction.

Femur in the transverse plane to the bicondylar axis. Femoral anteversion was considered excessive if greater than 30°:
- Acetabular dysplasia was assessed on standard X-rays based on the acetabular slope (acetabular index [AI] angle), the degree to which the femoral head was covered by the acetabulum (vertical edge [VE] angle), and by visualizing the relation of the anterior and posterior bone edges of the acetabulum. Overall acetabular dysplasia was assessed on 2D and 3D CT scans.

These data were compared to the pre-existing contractures in correlation with muscle imbalances and intraoperative observations.

3. Results

At the last follow-up:
- Nine hips were flexible, with no deformity:

Fig. 3. A. A 14.5-year-old girl losing ambulation, with pain, having undergone an extension-external rotation and adduction contracture (subject 6). B. Preoperative CT showing anterior dislocation. C. Two years after surgical treatment: surgical reduction, triple pelvic osteotomy, femoral osteotomy, and adductor tenotomy. Courtesy of M. Robert.
• one patient was able to resume walking (subject 6), two preserved and improved their indoor ambulation (subjects 3 and 4) and the three other patients recovered their earlier ability to maintain a sitting position (subjects 1, 2, and 5);
• none of the patients expressed discomfort during positioning or passive mobilization of their hips;
• the femoral head was always centered on the X-rays, with good acetabular coverage (lower AI angle and greater VCE angle) in the seven cases of dislocation and the three cases of subluxation (Table 1).

In one case, in patient 2, a contracture in external rotation of the hip at 40° required surgical revision 4 years after the initial surgery to redirect the femur with derotation osteotomy. No other postoperative complication was identified.

4. Discussion

This study presents several limitations. First, it examined a limited number of cases given the rarity of this deformity and therefore is inappropriate for statistical analysis. All the data were collected retrospectively, but exhaustively. In addition, the causal neurological disease was not homogenous, but the consequences in terms of muscle imbalance and contractures were identical. Finally, intraoperative measurement of angles can be imprecise, even if done by a single operator. However, our initial working hypothesis was reinforced by the radiographic measurements.
In the comparison with the Selva classification [3], all the patients were types 1 and 2 and none presented type 3 characteristics (muscle hypotonia or laxity). All presented muscle imbalance, with spasticity in four patients (subjects 1, 2, 3, and 6). The severity of these contractions should raise the discussion of a local and/or general antispastic treatment.

The literature review located descriptions of clinical cases in patients presenting syndromic symptoms [6–9]. However, even if the original syndromes in these cases were far from the cases in the present study (with, most particularly, recurrent dislocations [7]), the radiographic and surgical observations were identical:

- femoral anteversion did not seem excessive;
- excess femoral valgus was constant;
- anterosuperior acetabular dysplasia was frequent and clearly visible on the X-rays.

In the series reported by Selva et al. [3], 19 of the 27 patients had a femoral varus osteotomy, confirming the excess neck-shaft angle. Femoral anteversion was not mentioned. In 13 cases, a pelvic osteotomy (in ten cases a Pemberton osteotomy and in three cases a Dega acetabuloplasty) was associated with the femoral osteotomy.

In the present series, all the patients had a pelvic osteotomy (for eight hips a Salter osteotomy and for two hips a triple pelvic osteotomy, in the oldest of our patients), because of insufficient anterior and lateral coverage of the femoral head that could not be resolved with a simple acetabuloplasty, but rather by an overall reorientation osteotomy. A Salter osteotomy was the most frequently performed in young children. The hamstrings were always released when it was impossible to flex the hip without hyperflexion of the knee. In the nonwalking child, this release was done proximally, in the walking child distally (so as not to compromise walking). A deformity in adduction was always associated with release of the adductors.

Preoperative radiological and clinical analysis allowed us to adapt surgery as best possible with the following successive sequences:

- adapted soft-tissue release (depending on the above-mentioned criteria retained);
- capsule exposure and arthroscopy;
- adapted femoral osteotomy (shortening and varus);
- pelvic osteotomy.

Two cases of anterior dislocations after multiple surgical treatments were not included in this study because we found it difficult to classify the cause of the anterior dislocations between neuromuscular disorders and the surgeries performed earlier. However, these two patients suffered from central neurological impairment and were therefore reoperated and showed similar results at the last follow-up.

5. Conclusion

The study of contractures and pre- and intraoperative 3D observations is important for appropriate surgical treatment, so as to define the best strategy to propose to these patients.

Femoral anteversion is most often not excessive and therefore should not be corrected, in contrast to the moderate coxa valga that is regularly present.

Surgical reduction with capsulorraphy is necessary to stabilize the dislocated hip as best possible.

Overall pelvic reorientation osteotomy is vital because of the insufficient anterior and lateral coverage.

After this study, we propose a decision tree (Fig. 4) to adapt surgical indications and techniques, even if these very particular patients should be treated on a case-by-case basis.

The intermediate-term results of this small series are encouraging.

Disclosure of interest

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

References