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Original Research

Orthosis Treatment for Patients with Congenital Hip Dislocation

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ABSTRACT

Background: Congenital dislocation of the hip is currently a public health and socioeconomic problem. Delayed treatment impairs the functional prognosis of the affected hip and increases the need for surgical treatment.

Aim: To evaluate the therapeutic results of the treatment by orthosis and the cost of the treatment.

Material and Methods: This retroprospective descriptive study was carried out at the CHUAM of Antananarivo and the CRMM of Antsirabe on patients with congenital hip dislocation treated with braces; from January 2017 to August 2021.

Results: Forty-eight cases were retained during this study. A female predominance was mentioned with a sex ratio of 0.45 and an average age of 7.8 ± 5.5 months at the beginning of the treatment. A left dislocation was observed in 27.1% of cases. Twenty-nine patients were treated with abduction pants. A recentered femoral head showing a good result was present in 37 patients. Five dislocations were observed at follow-up, and 5 residual subluxations. No cases of avascular necrosis of the femoral head have been reported. The total cost of orthosis treatment was on the average of 138.554,5 ± 51.678,8 Ariary.

Conclusion: The age at the start of treatment and the duration of treatment influence the therapeutic outcome. The cost of orthosis treatment was affordable. If the treatment started earlier, the functional prognosis would be better.

Keywords: *Complication, Congenital hip dislocation, Orthosis, Therapeutic outcome, Treatment.*

Introduction

Congenital hip dislocation (CHD) is defined as "an abnormality in hip development that manifests itself as hip instability, i.e. an abnormal mobility between the pelvis and the femur," according to the French National Authority for Health.[1]

It's a very frequent orthopedic condition in pediatric wards[2] and is currently a public health problem. One in 1000 newborns has a dislocated hip, and 10 in 1000 have an unstable or subluxated hip.[3] Hip dysplasia affects 1-3% of newborns, 20% of cases are bilateral.[4] Cases of late congenital hip dislocation (after 12 months of age) are estimated at 10 out of 100,000 cases per year in France.[5] During the neonatal period and early childhood, the most commonly used therapeutic means for the treatment of congenital hip dislocation are orthoses.[6,7] Delayed treatment impairs the functional prognosis of the affected hip and increases the need for surgical treatment.

The main objective of this study was to evaluate the different therapeutic outcomes of orthotic treatment in patients with congenital hip dislocation. It will also allow us to evaluate the cost-benefit ratio of the treatment with braces in order to improve the management of the patients.

Material and Methods

A two-center descriptive retrospective study was conducted at the Centre Hospitalier Universitaire d'Appareillage de Madagascar (CHUAM) located in Antananarivo, and the Centre de Rééducation Motrice de Madagascar (CRMM) in Antsirabe. These two centers were chosen for the study because they both have a workshop for the manufacture of orthopedic devices.

Patients with congenital hip dislocation, treated with an orthopaedic device and observed for at least two years, from January 2017 to August 2019, were seen in their evolution. All patients with non-consenting parents were excluded from this study, also those with incomplete records, without contact or unreachable by phone, and patients lost to follow-up during treatment. All children with congenital hip dislocation and not treated with brace are not included, as well as patients with a non-congenital hip dislocation.

The treatment of congenital hip dislocation was different according to the reducibility of the hip. In case of reducible hip, the treatment consisted of several steps: physiotherapy to recenter the femoral head, followed by full-time bracing day and night, then bracing only at night.

Four types of braces were undertaken:

- abduction pant,
- Pavlik harness,
- abduction splint,
- and Petit splint.

A radiographic check-up was carried out every six months, while evaluating treatment and clinical signs. Surgical treatment was required in case of complications. If the hip was irreducible, it would be treated surgically, followed by rehabilitation sessions and bracing. The clinico-radiographic evaluation in this study was carried out at the last check-up.

Results

Forty-eight patients, with a total of 72 hips dislocated met the inclusion criteria when the study was performed out of 233 cases of congenital hip dislocation seen at CHUAM and CRMM. The mean age was 42.4 ± 12.8 months [23 - 75] at the follow-up, with a median age of 40 months. Fifteen patients (31.3%) started their treatment with orthosis earlier (less than four months). The average age of onset was 7.8 ± 5.5 months [1 - 25]. Our study population consisted of 33 female patients (68.8%) and 15 male patients (31.2%), with a sex ratio of 0.45 (Table 1).

Table 1. Socio-demographic characteristics

Socio-demographic characteristics	N = 48	
	n	**%**
Current age (months)		
Mean ± SD	42.4 ± 12.8 [23 - 75]	
Age at the start of the treatment (months)		
Mean ± SD	7.8 ± 5.5 [1 - 25]	
< 4 months	15	31.3
≥ 4 months	33	68.7
Sex		
Female	33	68.8
Male	15	31.2
Sex-ratio	0.45	
Associated pathology	18	37.5
Case of familial CHD	40	83.3
Primiparity	14	29.8
Twin pregnancy	0	0
Prematurity	8	16.7
Breech presentation	6	12.5
Birth weight (grams)		
Mean ± SD	2923 ± 538.9 [1500 - 3800]	
CHD topography		
Right		22.9
Left	11	27.1
Bilateral	13	50
	24	

Thirty patients (62.5%) had no associated pathology with congenital hip dislocation. These malformations were of neurological and orthopedic origin: two cerebral palsies (4.2%), two spina bifida (4.2%), four club foot varus equinus (8.3%), five arthrogryposis (10.4%), two congenital torticollis (4.2%). Almost all the patients (83.3%) had no family history of congenital hip dislocation. Fourteen children (29.8%) were born from primiparous mothers. No twin pregnancies were found. Prematurity was observed in eight children (16.7%); and breech presentation in six patients (12.5%).

The average birth weight was 2923 ± 538.9 grams [1500 - 3800]. There were no reports of birth weights greater than 4000 grams during the study.

Bilateral dislocation was found in 24 patients (50%), 15 of whom were girls and nine boys (Image 1). Thirteen patients (27.1%) had left hip dislocation.

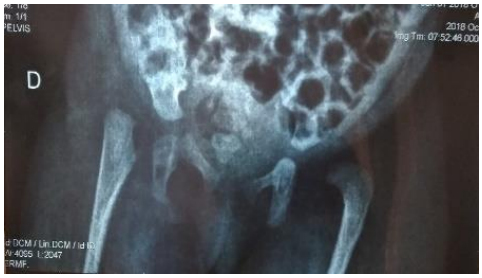

Image 1. Hip x-ray showing bilateral hip dislocation in a 20-day-old child

Image 2. Right unilateral CHD in a 12-month-old child

One orthosis was used in 38 patients (79.2%) throughout the course of treatment. More than half of the patients (60.4%) received an abduction brace as their first treatment (Image 3). Only 10 patients (20.8%) had a second brace, including one abduction brace substitution (Image 5). One patient used a combination of an abduction brace at night and a walking brace during the day (Image 6).

Image 3. Abduction pants in a 7-month-old child

Image 4. Petit splint in a 12-month-old child

Image 5. Abduction splint in a 2-year-old child

Image 6. Abduction splint for walking

Secondary treatment with physiotherapy was found in 25 patients (52.1%), during or after the treatment with orthosis.

On average, the duration of the first orthosis was 7.7 ± 5.4 months [1 - 25] and the second orthosis was 11.8 ± 15.6 months [2 - 47]. The duration of the second orthosis was on average 11.8 ± 15.6 months [2 - 47]. The average daily wearing time was 20.9 ± 4.5 hours, ranging from six hours to 23 hours over 24 hours. A median of 23 hours was observed. A treatment duration of less than six months was found in 21 patients (43.8%). Ten patients (20.8%) stopped wearing orthosis during treatment. The duration of the discontinuation of the use of aids during treatment was an average of 3.2 ± 2.8 weeks [1 - 8]. Only three out of 10 patients (30%) resumed their treatment after discontinuation (Table 2).

Four patients (8,3%) presented pain, three of whom were treated with abduction braces and one with abduction pants. Sixteen patients (33.3%) presented limping on walking: 11 treated with abduction braces and five with abduction pants. Lower limb length inequality was the most frequent sign during inspection in 28 children (58.3%), including inequality of less than 1 cm in 16 patients (59.3%). A normal hip was observed in 39 patients (81.3%) on palpation. Hip stiffness was found in seven patients (14.6%) with limited abduction and flexion. An unstable hip was present on palpation in four patients (8.3%). The average Postel-Merle d'Aubigné score was 16.4 ± 2.9 points [7 - 18].

Table 2. Braces use

Characteristics	n	%
Brace type		
Abduction pant	29	60.4
Pavlik harness	1	2.1
Petit splint	2	4.2
Abduction splint	16	33.3
Length of use per day		
Mean ± SD	20,9 ± 4,5 [6 – 24]	
Duration of the first use		
Mean ± SD (months)	7,7 ± 5,4 [1 – 25]	
< 6 months	21	43.8
≥ 6 months	27	56.2
Discontinuation of bracing		
Mean ± SD		
Yes	10	20.8
No	38	70.2
Resume (n = 10)	3	30
Second brace	10	20.8
Secondary treatment		
Physiotherapy	25	52.1
Surgery	3	6.3
Traction	2	4.2
Plaster	12	25
None	6	12.4

No patient presented avascular necrosis of the femoral head at follow-up. Almost all patients (79.2%) had a normal hip on x-ray after treatment with a brace.

A normal radiographic appearance of the hip was found in 22 left hips (59.5%) and 16 right hips (45.7%), with a Severin score equal to 1. A score of 1 was associated with a normal hip. Moderate deformity of the femoral head, neck, or acetabulum associated with Severin score 2 was observed in eight left hips (21.6%) and 11 right hips (31.4%). Seven cases of moderate left (18.9%) and five right (14.3%) hip subluxation associated with Severin score 4 were present. Three cases of complete recurrence of right hip dislocation (8.6%) or Severin score 6 were mentioned during this study, and no cases for the left hip (Table 3). According to the centration of the femoral head, 38 patients (79.2%) had a favorable outcome.

Ten patients (20.8%) failed their treatment, including five dislocations and five residual subluxations (Table 4). Regarding the outcome at the end of treatment, 40 patients (83.3%) discontinued wearing the orthosis. Four patients (8.3%) needed surgery, and four patients (8.3%) were still undergoing treatment with orthosis.

The total cost of the treatment with an appliance, from the first consultation till the end of the treatment, ranged from 41,000 Ariary to 277,000 Ariary, with an average of 138,554.5 ± 51,678.8 Ariary. The price of the equipment was on average 14.175,8 ± 10.116,5 Ariary.

Table 3. Clinico-radiographic evaluation during the last check-up

Characteristics	**N**		**%**	
Pain	4		8.3	
Limping	6		33.3	
Leg length discrepancy	28		58.3	
< 1cm	16		59.3	
≥ 1cm	12		40.7	
Hip stiffness	7		14.6	
Unstable hip	4		8.3	
Postel-Merle d'Aubigné score	16.4 ± 2.9 [7 – 18]			
Mean ±SD				
	Left hip	Right hip	Left hip	Right hip
Severin score	22	16	59.5	45.7
1	8	11	21.6	31.4
2	7	5	18.9	14.3
4a	0	3	0	8.6
6				

Table 4. Failure in brace treatment

Type of brace	**Failure (N = 10)**	
	Dislocation n (%)	**Subluxation n (%)**
Abduction pant	3 (30)	3 (30)
Abduction splint	2 (20)	2 (20)
Pavlik harness	0	0
Petit splint	0	0

Discussion

A congenital hip dislocation is often discovered between six to eight weeks of life. The earlier the diagnosis and treatment, the better the therapeutic result. This early management was divergent among different authors.[5,8,9] The financial problems encountered by the parents would lead to a delay between the date of diagnosis and the beginning of the treatment in developing countries. Agostiniani et al.[10] stated in 2012 that treatment with congenital hip dislocation braces was not guaranteed beyond six weeks of life. The constitution of a contraction of the hip adductor muscles is the cause.

The female predominance of congenital hip dislocation has been

unanimously accepted in the majority of publications.[6,9,11-13] Maternal hormones influence the development of congenital hip dislocation in females by increasing ligament laxity. Several studies [6,8,11] have mentioned dislocation of the left hip. This part is often in contact with the maternal spine in utero. This positioning mechanically limits hip abduction, and thus favors acetabular insufficiency.

Specht [14] states that a case of congenital hip dislocation in the first-degree family constitutes a risk factor for congenital hip dislocation. Primiparity is a risk factor for the occurrence of congenital hip dislocation. Swarup et al.[15] state that decreased uterine elasticity is involved in the process of congenital hip dislocation during gestation. In twin pregnancies, one of the fetuses could also compress the hip of the other.

The different types of orthosis are indicated according to the age of the child at the time of diagnosis. The ease of use of abduction brace may be the reason for the high frequency of its use compared to other types of orthosis. In contrast to these results, most studies[16-18] preferred the use of the Pavlik harness. However, the complications found with this harness were as important as with the other orthosis. The complexity of application and the accessibility of the Pavlik harness straps would be a barrier to its use in the present study. The wrong adaptation of these straps will promote the development of complications. The appropriate indications for the child's age and size define the performance of each orthosis.

Petit splint is currently being abandoned in the management of LCH. In a 2012 study conducted in 25 French departments, Morin et al.[19] found 5.3% of dislocation reduction failures with 8% of recurrence of dislocation or subluxation, in patients treated with traction or plaster and then relayed by Petit splinting for 2 - 6 months. The present study found no cases of recurrence with the use of the Petit splint. The size of the study population in this study was smaller than in the study by Morin et al., which included 222 diseased hips.

Warners et al. reported three cases (18.69 %) of dislocated hips in patients treated with Pavlik harness.[20] This dynamic splint needs regular follow-up by orthopedist or physiatrist to be adjusted and to prevent complication such as avascular necrosis and femoral nerve palsy.

Regarding the use of the abduction brace, two cases of residual dysplasia (11%) were found by Wahlen et al. An improved orthosis has been designed as close as possible to a dynamic positioning orthosis by them. It therefore differs from the anterior abduction splints, which completely immobilize the hips and, therefore, cause a high rate of avascular necrosis.[21]

No cases of reluxation or subluxation were reported by Bikond in Madagascar in 2010 in patients treated by abduction pants.[8]

A meta-analysis reported that dynamic splinting for developmental dysplasia of the hip represents a valid therapeutic option in cases of instability and dislocation, especially if applied within 4–5 months of life. Dynamic splinting has a low contraindication. Static bracing is an effective option too, but only for stable hips or residual acetabular dysplasia.[22]

Braces prescription should consider the reducibility and the evolution of the hip. Any failure to refocus the hip should be thought of as stopping the equipment to prevent anatomical and mechanical sequelae.

Currently, no management protocol has been yet developed for patients with congenital hip dislocation, which may explain the differences of opinion regarding the duration of the treatment. This duration influences the therapeutic outcome. In the International Hip Dysplasia Institute's report[23], the duration of permanent daily wear (23 hours out of 24) is 6 to 12 weeks. Then it should be limited to part-time overnight wear for 4 to 6 weeks. However, some studies[24,25] have shown that the use of the brace is systematically prolonged even after the hip was stabilized for 2 to 3 months. The risk of recurrence of the dislocation would justify this attitude. The combination of the appliance with other therapeutic methods such as physiotherapy or surgery could be beneficial. However,

certain methods and postures used in physical therapy foster the occurrence of complications if not controlled. Hip reducibility plays an important role in the indication of these secondary treatments, and the use of surgery often corresponds to the cases of non-reducible dislocation.

Inadequate or poor-quality equipment explains the presence of pain or limping on clinical examination, as well as poor centering of the femoral head on radiography. The choice of each orthosis should be made with caution and with the appropriate indications.[26] The risk of developing various complications such as osteochondritis and avascular necrosis of the femoral head will be limited. An age-inappropriate orthosis, either according to its indication or its inappropriate size, and biomechanically unsuitable, is one of the factors that contribute to a poor prognosis. The use of the orthosis on a non-centered femoral head increases the risk of complications.[27-28] The fabrication techniques of each brace could compromise the therapeutic results. Abduction and rotation angles may not be respected during fabrication. Compliance with therapy and rigor in treatment are key tools for obtaining a better result.

Cashman et al.[29] state that monitoring up to five years of age is necessary for every patient with congenital hip dislocation treated with orthosis. The presence of long-term residual dysplasia was noted in their study. The regular follow-up of the treatment of congenital hip dislocation allows the early detection and management of the various complications.

The total cost of management with an orthosis could be higher. As the child grows up, they will need frequent replacement of the orthosis, or in case of wear. No study has been done in Madagascar before regarding the cost of a congenital hip dislocation brace. In Switzerland in 2014, the price of a Pavlik harness was around 400 euros and the abduction splint around 600 euros according to Wahlen and H et al.[30] state that the cost of brace management is affordable compared to orthopedic traction treatment. The cost of traction is $3300 per patient including hospitalization costs.

Sewell and Eastwood [10,31] state delay in diagnosis and management will lead to invasive treatment of congenital hip dislocation, often to poor outcomes as well as impaired functional prognosis of the hip.

Conclusion

Congenital hip dislocation is currently a public health and socioeconomic problem. A better result would be possible with each orthosis. Ten patients failed treatment, including five dislocations and five residual subluxations. No avascular necrosis of the femoral head was found. The earlier congenital hip dislocation is diagnosed, the better the outcome and the functional prognosis of the hip.

The total cost of treatment with a brace is quite affordable with an average of 138,554.5 Ariary. However, what about the functional prognosis of the hip of patients with congenital hip dislocation and not treated with an orthosis? Is the cost of management of congenital hip dislocation by orthosis the same in other rehabilitation centers in Madagascar?

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