Does the Presence of Clubfoot delay the Onset of Walking?

A presença do pé torto congênito atrasa o início da marcha?

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Abstract

Objective Congenital clubfoot (PTC) is a congenital orthopedic condition often requiring intensive treatment; little is known about the impact of such treatment on motor development. The present study assessed whether gait development is later in patients with PTC treated with the Ponseti method in comparison to a control group and analyzed possible related factors.

Methods Patients born at term, < 6 months old, not submitted to previous treatment and with a minimum follow-up period of 24 months were included. The control group consisted of patients with no musculoskeletal disorders seen during the present study.

Results The study group consisted of 97 patients, whereas the control group had 100 subjects. The mean age at gait start was 14.7 ± 3.2 months in the study group and 12.6 ± 1.5 months in the control group ($p < 0.05$). Factors related to late gait included age at beginning of treatment > 3 weeks, number of plaster cast changes > 7, recurrence and nonperformance of Achilles tenotomy. Age at beginning of treatment > 3 weeks was related to a greater number of plaster cast changes. Gender and laterality were not related to late gait development.

Conclusion Congenital clubfoot patients treated with the Ponseti method show independent walking approximately 2 months later than the control group. Delayed treatment, higher number of plaster cast changes, recurrence and nonperformance of Achilles tenotomy were related to late gait.

Keywords

- clubfoot
- gait
- congenital lower limb deformities
- orthopedic manipulation
- treatment outcome

Resumo

Objetivo O pé torto congênito (PTC) é uma das alterações ortopédicas congênitas que mais frequentemente necessita tratamento intensivo, e pouco se sabe o impacto desse tratamento no desenvolvimento motor. O presente estudo buscou avaliar se pacientes portadores de PTC tratados pelo método de Ponseti desenvolvem a marcha mais tardiamente comparado a um grupo controle e analisar possíveis fatores relacionados.

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Métodos Incluídos pacientes nascidos a termo, com < 6 meses de idade, sem tratamento prévio e com seguimento mínimo de 24 meses. O grupo controle foi de pacientes sem alterações musculoesqueléticas, atendidos no mesmo período da realização do presente estudo.

Resultados Um total de 97 pacientes formaram o grupo de estudo e 100 o grupo controle. A média de idade no início da marcha no grupo de estudo foi de 14,7 ± 3,2 meses, e 12,6 ± 1,5 meses ($p < 0,05$) no grupo controle. Fatores relacionados à marcha tardia foram: idade de início do tratamento > 3 semanas, número de trocas gessadas > 7, recidiva e não realização da tenotomia de Aquiles. Idade de início do tratamento > 3 semanas esteve relacionada a maior número de trocas de gessos. Gênero e lateralidade não tiveram relação com a marcha tardia.

Conclusão Pacientes com PTC tratados com o método de Ponseti apresentam marcha independente aproximadamente 2 meses mais tarde do que o grupo controle. Início mais tardio do tratamento, maior número de trocas de gessos, recidiva e não realização da tenotomia de Aquiles foram relacionados com atraso da marcha.

Palavras-chave
- pé torto
- marcha
- deformidades congênitas das extremidades inferiores
- manipulação ortopédica
- resultado do tratamento

Introduction

Congenital clubfoot (PTC) is a complex malformation distal to the knee and associated with hindfoot equinus deformity, forefoot cavus, subtalar varus and midfoot and forefoot adduction deformities. The incidence of PTC is 1 in 1,000 live births, with a male predominance at a 2:1 rate; bilateral involvement occurs in 50% of cases. Congenital clubfoot is one of the most frequent birth defects in the lower limbs.[1–4]

The current gold standard treatment for PTC is the Ponseti method. It involves a series of specific manipulations and plaster applications to correct deformity components. Percutaneous calcaneus tenotomy is performed in up to 90% of cases to improve the remaining equinus deformity and reach the final correction. After the foot is corrected, an abduction orthosis is used to prevent deformity recurrence. This device is used full time for 4 months and then part time (14 - hours/day) until the child is at least 4 years old.[5–8]

Despite being a low morbidity method, during initial visits, it is common for parents to express concern if the treatment or condition will affect the motor development their child, more specifically independent gait. Recent studies have suggested that walking may be delayed in children with PTC treated with the Ponseti method.[9–11] Zionts et al.[11] observed 94 patients with idiopathic clubfoot treated with the Ponseti method and noted an average delay of 2.4 months in achieving independent walking compared to healthy children from a multicenter study.[12] However, the reality of this population may be different from ours and we did not find any paper in the Brazilian literature addressing this issue.

The present study aimed to determine the age at which children with idiopathic PTC treated with the Ponseti method start walking, comparing it to a control group, and to determine other factors related to the gait start in these patients.

Methods

This was a case-control study carried out through active search in the electronic system of outpatient visits for patients with a clubfoot diagnosis (International Classification of Diseases [ICD]-10 Q660 - Congenital talipes equinovarus) and in the surgical system for procedures registered as "surgical treatment of congenital clubfoot", from July 2012 to July 2016, in a pediatric orthopedics reference hospital. The research project was approved by the institutional Medical Ethics Committee.

Medical records were evaluated according to gender, laterality, age at the beginning of treatment, number of plaster cast changes, tenotomy requirement and age in which it was performed, history of recurrence (reappearance of one or more of the characteristic deformities requiring treatment), age at gait start, supplementary surgical procedures and follow-up time at the institution. Patients with PTC born with < 37 weeks of gestation, starting treatment after 6 months of age, previously treated at another facility and presenting other orthopedic problems that might interfere with motor development were excluded. Patients followed-up for < 24 months were also excluded. Parents and/or caregivers were contacted by phone for data confirmation and were specifically asked about the exact moment of gait start. If accurate information was lacking or if the parents/caregivers did not know the answer, the subject was excluded. The sample size of the study group was defined by convenience and was formed by the total number of eligible patients during the research period.

The control group consisted of 100 walking children, with an average age of 3.5 years old, with no musculoskeletal conditions or other factors that could delay gait start, who were with their parents waiting for being seen at the pediatric emergency room of this hospital during the study period. The lack of accurate information or not knowing how

to answer was also an exclusion criterion for the control group.

Data were collected and stored in a Microsoft Excel (Microsoft Corporation, Redmond, WA, USA) spreadsheet. Statistical analysis was performed using IBM SPSS Statistics for Windows, Version 22.0 (IBM Corp. Armonk, NY, USA). For data presentation, descriptive analysis was used; categorical variables were presented as frequency and percentage mean values, whereas quantitative variables were described as mean and standard deviation values. Quantitative variables, including number of plaster cast changes and age at gait start from the study and control groups were compared with the Kolmogorov-Smirnov normality test; parametric variables were analyzed by the Student t test. A 95% confidence interval (CI) (p-value ≤ 0.05) was adopted.

Results

In total, 234 subjects were diagnosed with equinus varus deformity and treated during the study period; 128 were excluded (60 due to other diagnoses, 40 due to lack of information in the medical record and failure to contact, 16 who began treatment at another facility, 5 who began treatment after 6 months old and 7 born prematurely). Out of the 106 patients who met the inclusion criteria, 9 were excluded because their parents were unable to answer or had doubts about gait start; as such, the study group consisted of 97 patients (►**Fig. 1**). The mean follow-up time was 48.9 ± 13.3 months (ranging from 26 to 73 months).

In the study group, 64 patients (66%) were male and 51 patients (53%) had bilateral involvement. Among those with unilateral deformity, the right foot was affected in 27 cases (59%). The mean age at treatment start was 4.0 ± 3.3 weeks (ranging from 1 to 22 weeks). The average number of plaster casts applied before tenotomy was 8.1 (ranging from 3 to 26 plasters). A total of 84 patients (87%) underwent an Achilles tenotomy and the mean age at the procedure was 3.5 ± 2.1 months old. In 18 patients (19%), the deformity recurred before gait start; all of these subjects had undergone percutaneous tenotomy and at least 1 new series of manipulations

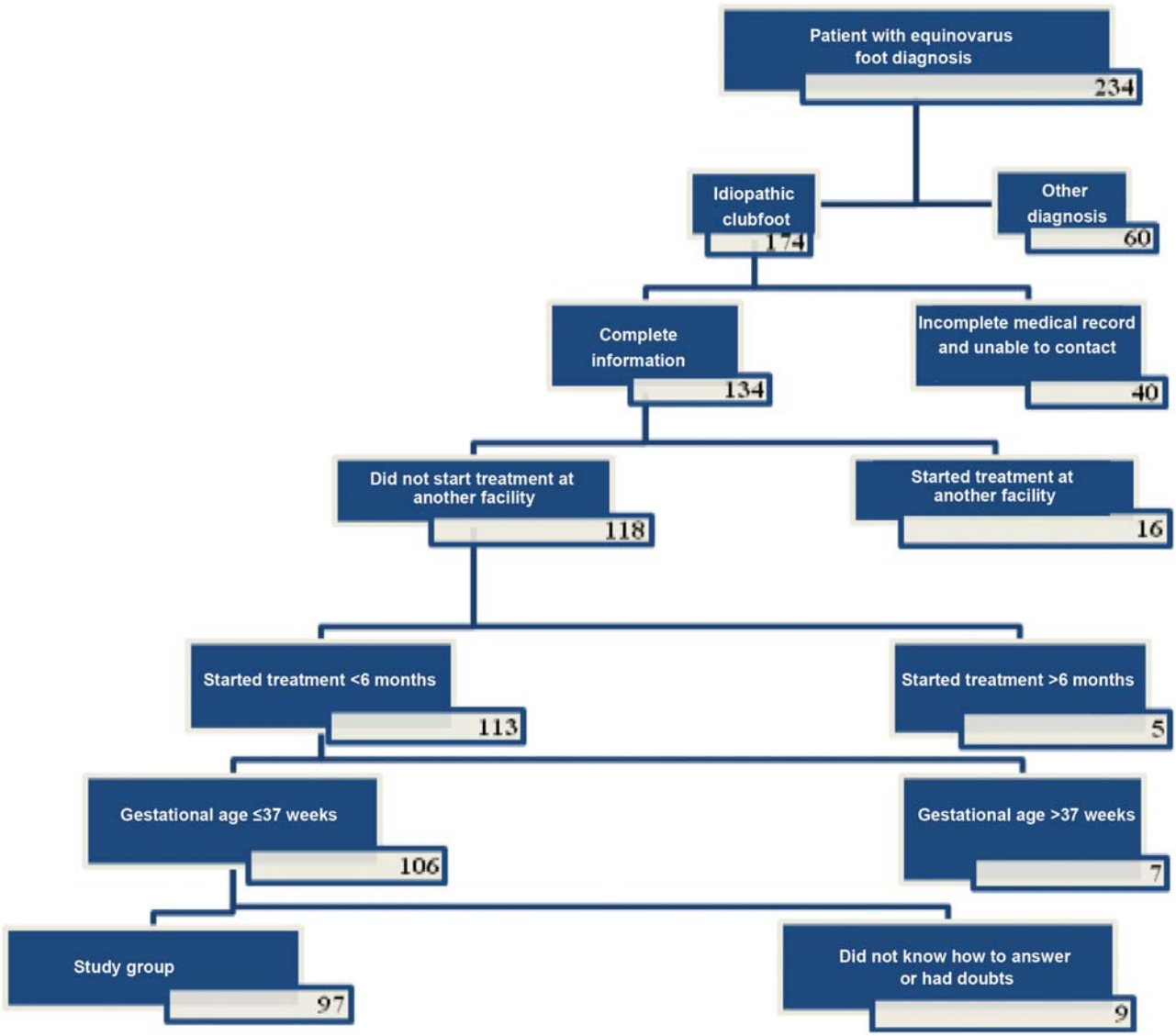

Fig. 1 Inclusion and exclusion criteria for the study.

and plasters (1 to 4 changes) followed by resuming the usage of the orthosis. Of these, three required a new Achilles tenotomy and four required surgical releases before gait start (including two posterior releases, one posteromedial release and one posteromediolateral release).

The average age at which study group patients started walking was 14.7 ± 3.2 months (ranging from 9 to 26 months). The control group, consisting of 100 children (58 females and 42 males), started walking at an average age of 12.6 ± 1.5 months old (ranging from 10 to 16 months old). The difference in mean values from each group, of 2.1 months, was significant ($p < 0.05$). Although the exclusion of patients with recurrence ($n = 18$) reduced the difference between mean values (1.7 months), it remained significant ($p < 0.05$).

►**Table 1** shows the influence of patient- and treatment-related variables on gait age in the study group. Age at the start of treatment was significantly related to late gait, with patients aged > 3 weeks at the beginning of treatment starting walking on average 1.5 months after those who started therapy earlier (mean, 15.7 versus. 14.2 months; $p < 0.05$); subjects with > 7 plaster cast changes began to walk on average 2.3 months later than those with a lower number of cast changes (mean, 15.8 versus 13.5 months; $p < 0.05$); patients who relapsed walked 2.4 months later compared to those who did not relapse (mean, 16.7 versus 14.3 months; $p < 0.05$); finally, subjects who did not undergo an Achilles tenotomy walked 1.2 months later than those who required the procedure (mean, 14.9 versus. 13.7 months; $p < 0.05$). Patients starting treatment at 3 weeks old or more required, on average, 2.2 more plaster changes than those who started earlier (8.9 versus. 6.7 plaster changes; $p < 0.05$).

Patients with bilateral involvement walked an average of 1.4 months later than patients with unilateral involvement (nonsignificant difference, $p = 0.94$). Male subjects started walking 0.1 month before females ($p = 0.13$).

Table 1 Analyzed Factors at the Congenital Clubfoot Group and Relation with Age at Gait Start

	Number of patients (%)	Age at gait start (months)*	P Value**
Total number of patients	97 (100%)	14.7 ± 3.2	N/A
Gender			
Male	64 (66%)	14.7 ± 3.1	0.13
Female	33 (34%)	14.8 ± 3.3	
Laterality			
Unilateral	46 (47%)	14.0 ± 2.8	0.94
Bilateral	51 (53%)	15.4 ± 3.3	
Age at treatment start (weeks)			
≤ 3	63 (65%)	14.2 ± 2.2	< 0.05
> 3	34 (35%)	15.7 ± 3.7	
Number of plaster changes			
≤ 7	45 (46%)	13.5 ± 2.6	< 0.05
> 7	52 (54%)	15.8 ± 3.2	
Recurrence			
Yes	18 (19%)	16.7 ± 4.0	< 0.05
No	79 (81%)	14.3 ± 2.8	
Achilles Tenotomy			
Yes	84 (87%)	13.7 ± 2.1	< 0.05
No	13 (13%)	14.9 ± 3.3	

*Values are presented as mean and standard deviation of the mean.
**N/A = not applicable.

Discussion

During the last 30 years, the Ponseti method became the treatment of choice for clubfoot. It is considered a highly effective, fast method, with low morbidity compared to previous treatments; in addition, it has been shown to provide high satisfaction, with almost normal mobility and aspect. Parents have easy access to information about this method through the internet and social media, and they frequently ask about the impact of the treatment or of the deformity on motor development, specifically gait development.

Population studies with healthy children have shown that they begin to walk at an average age ranging from 11.7 to 12.8 months old. In 2006, the World Health Organization (WHO) carried out a study with healthy children and found out that 50% walked at 12 months old and 90% at 14.4 months old. Recently, studies have evaluated the age at gait start in patients with clubfoot: Sala et al.[10] (with 51 patients) observed an average age of 13.9 months old; Zionts et al.[11] (94 patients), 14.5 months old; and Aulie et al.[13] (93 patients), 14.1 months old; these authors, however, did not present a control group for comparison.

As far as we know, no other Brazilian study has addressed this issue, and the aforementioned papers might not be applied to our population. To better understand our patients with PTC, we compared them to a control group of children with no neuromuscular conditions who were treated for nonmusculoskeletal reasons at the same institution. We found out that patients with PTC walked, on average, 2 months later than the control group (14.7 versus 12.6 months). In the study group, 50% of the patients walked at 14 months old and 90% at 18 months old.

We also studied factors that could influence age at gait start. As expected, delayed treatment start resulted in delayed gait beginning (mean, 14.2 months ≤ 3 weeks old versus 15.7 months > 3 weeks old); in addition, higher numbers of plaster cast changes were reflected in later gait (average, 13.5 months old ≤ 7 changes versus 15.8 months old > 7 changes). Relapsing patients also started walking later (mean, 16.7 months old versus 14.3 months old). This finding could be attributed to the requirement of additional plasters and extend time under full orthosis use.

Children that did not require an Achilles tenotomy tended to start walking later compared to those who required it

(mean, 14.9 months old versus. 13.7 months old). This result may not be representative due to the small number of patients who did not require tenotomy ($n = 18/97$). On the contrary, another study found a tendency of delayed gait in the group submitted to tenotomy; however, the number of patients who did not required a tenotomy was limited ($n = 5/94$).[11] There was also a relationship with younger age at the beginning of treatment and a lower number of cast changes (6.7 casts, $\leq$ 3 weeks old versus 8.9 casts $>$ 3 weeks old).

No significant gender influence or clubfoot laterality was found. These findings agree with previous studies.[10,11] Lööf et al.[14] also found no difference between clubfoot laterality when analyzing motor development until the age of 5 years old.

One patient from the study group started walking at an extreme age, at 26 months old. This patient, in addition to starting treatment after 5 months old, had recurrences and underwent a posteromediolateral release at 22 months old. Even excluding patients who needed supplementary procedures from the analysis, the significance of variables did not change.

The reasons why children with idiopathic clubfoot walk later than other children are open for speculation. Garcia et al.[9] suggested that early restrictions on lower extremities movement imposed by plasters and orthoses can change the balance or strength of certain muscle groups. They also hypothesized that PTC may be a marker for an underlying mild motor development dysfunction.

The present study was limited by its retrospective aspect, unmatching of groups according to age, nonadoption of a classification of deformity severity and possible correlation with treatment variables and outcomes, as well as the dependence on parents' report on the age at gait start, which may have influenced data accuracy. The presence of a control group was intended to minimize such influence. Despite this, the data found are consistent with the few other studies in the literature and may be used by orthopedists to guide parents on factors impacting gait development and age.

Conclusion

Patients with idiopathic clubfoot treated with the Ponseti method started to walk independently approximately 2 months later than the control group. This delay was related to later treatment start, greater number of plaster cast changes, recurrence and failure to perform an Achilles tenotomy.

Conflict of Interests
The authors have no conflict of interests to declare.

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