Original Article

Early management of clubfoot by the Ponseti method with complete percutaneous tenotomy of tendoachillis

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Abstract

Background and Objective: As a highly common congenital deformity which can lead to serious walking problems, clubfoot has long been treated using the Ponseti method which is usually carried out without complete percutaneous tenotomy of tendoachillis. The present study was aimed at investigating the effects of early management of clubfoot by the Ponseti method with a complete percutaneous tenotomy of tendoachillis in Erbil Teaching Hospital located in Erbil, the Kurdistan Region of Iraq. **Methods:** Thirty neonates <3 months of age who had congenital idiopathic clubfoot were randomly selected. They were treated by the Ponseti method. For this purpose, successive casts were applied for them for 3 weeks, with changing the casts on a weekly basis. For those who did not respond to the first 3 weeks of casting, the classical Ponseti method was utilized along with complete percutaneous tenotomy of tendoachillis based on the theory of stem cell regeneration. Then, the casting was performed for 6 weeks, followed by foot abduction brace and maintained using a foot abduction brace (Dennis brown splint) until school age 5-6 years. The collected data were analyzed using the χ^2 test through SPSS 22.0. **Results:** The results of the present study indicated that the most prevalent type of clubfoot was the unilateral type with 73.3% prevalence rate. Treating the newborns with clubfoot by the Ponseti method along with complete percutaneous tenotomy of tendoachillis led to good results in 86.7% of the cases, medium in 3 cases (10%), and poor only in 1 case (3.3%). **Conclusion:** Ponseti method along with complete percutaneous tenotomy of tendoachillis was proved to be an efficient method to treat clubfoot during the first few weeks of life.

Keywords: Clubfoot, complete percutaneous tenotomy of tendoachillis, ponseti method

Introduction

Clubfoot, also known as congenital talipes equinovarus (CTEV), refers to a birth deformity that afflicts 1 foot or both, in which 1 foot or both are turned into the inner side.[1] This embryonic deformation is a developmental malformation which occurs in 1 out of 1000 live births during the second trimester of pregnancy.[2-4]

There are 2 types of clubfoot: congenital and acquired. The former is in turn categorized into idiopathic and nonidiopathic kinds. Idiopathic type is characterized by single skeletal deformity, being bilateral, late occurrence, and response to conservative treatment, whereas the former kind is characterized by diametrically opposite foot deformations, association with other deformities, and poor response to conservative treatment. In contrast, the acquired kind occurs as a result of neurogenic and vascular causes.[2] Nonidiopathic clubfoot has been reported to be a kind of congenital deformity that happens as a result of teratologic anomalies, known and unknown neurological disorders, genetic syndromes, and myopathies.[5] In another classification, clubfoot is categorized into positional or congenital. In the positional type, the clubfoot is because the foot has been held in an unusual position for a long time in the uterus. The congenital type, in contrast, is a fixed condition.[6]

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Received: 08-04-2019 **Revised:** 27-05-2019 **Accepted:** 09-06-2019

Access this article online

Quick Response Code:

Website: www.jfmpc.com

DOI: 10.4103/jfmpc.jfmpc_291_19

How to cite this article: Khorsheed MA, Hwaizi LJ. Early management of clubfoot by the Ponseti method with complete percutaneous tenotomy of tendoachillis. J Family Med Prim Care 2019;8:2618-22.

According to the results of relevant research, clubfoot is not associated with pain during infancy, but if it is left untreated, the afflicted individual cannot walk normally in the future.[4] Moreover, Pirani *et al.* pointed out that leaving CTEV untreated can lead to seriously disabling problems, loss of energy, and failure in education and employment.[7,8]

The first treatment of clubfoot was proposed by Ignacio Ponseti in 1963. The treatment of recurrence cases includes tibialis anterior tendon transfer and abduction bracing.[9] The Ponseti method has been evaluated and reviewed in numerous studies. A review conducted in 2011 pointed out that this method is the most effective and successful approach to treat congenital clubfoot with a primary correction rate of ~90%.[10]

A significant element of the Ponseti method while being used to treat clubfoot is complete percutaneous tenotomy of tendoachillis.[11] With regard to using complete percutaneous tenotomy of tendoachillis in the Ponseti method, it has been reported that it is safer to utilize it in in the operating room[12] or in polyclinic with local anesthesia.[13]

In this regard, the present study was carried out to examine the outcome of early management of clubfoot by the Ponseti method with complete percutaneous tenotomy of tendoachillis and its recurrence rate in relation to age, gender, education of parents, family history, and compliance of family to brace among children with idiopathic congenital clubfoot in Erbil Teaching Hospital located in Erbil, the Kurdistan Region of Iraq.

Materials and Methods

In a prospective study, 30 neonates with idiopathic clubfoot in Erbil Teaching Hospital were studied and followed up from September 2017 to March 2019. The neonates were selected using a randomized sampling method and according to the inclusion criteria (i.e. neonates of <3 months of age and both genders) and exclusion criteria (i.e. neonates of over 3 months of age, neonatal drop foot, postural clubfoot, relapse cases, and syndromic cases such as myelomeningocele, arthrogryposis, and cerebral palsy).

After the parents were provided with necessary explanations on the treatment technique, outcomes, complications, duration, and visits, informed written consent to participate in the study was obtained from them. Afterward and before the treatment, data on the neonates' age, gender, education of parents, family history, and compliance of family with a brace were collected through a checklist.

During the first 3 weeks of treatment by the Ponseti method, casts were applied for each patient once a week. Applying casts for the patients was stopped once the correction of the varus of the foot and the lateral ray of the foot was achieved. For those patients whose equinus was not corrected, complete percutaneous tenotomy of tendoachillis was performed.

After correction of lateral ray and correction of varus was performed and complete percutaneous tenotomy of tendoachillis was done, casts were applied for the patients for a duration of 6 weeks. After 6 weeks and when the last cast was removed, the maintenance phase started during which foot abduction braces (Dennis brown splint) were applied for all of the neonates 24 hours per day for 3 months. After that 3-month period, the patients wore foot abduction braces (Dennis brown splint) during the night and received physiotherapy during the day for 1 year. Moreover, once the children started walking, they were given special walking shoes, and they wore foot abduction braces over the night until school age 5-6 years.

The collected data obtained at the beginning of the study and during the treatment phases were analyzed using the Statistical Package for Social Sciences (SPSS, version 22). In so doing and to compare the proportions, the χ^2 test of association was employed. The level of statistical significance was set at $P < 0.05$ for all statistical tests.

To take the ethical considerations into account, the neonates' parents were provided with a full explanation of the study's objectives, the treatment, possible outcomes and complications, study duration, and visits. Moreover, they participated in the study quite freely and voluntarily after informed written consent was obtained from them. In addition, the study was approved by the Ethics and Scientific Committee of Kurdistan Board of Medical Specialties N. 543 on October 28, 2018, and it was according to the Helsinki Declaration of 1975, as revised in 2000.

Results

The patients' demographic characteristics are presented in Table 1. As observed, the neonates' mean age was 18 days with an SD of 2.26. Regarding their sex, 18 neonates (60%) were males and 12 (40%) were females. With regard to the types of clubfoot, 8 (26.7%) cases were bilateral, 22 (73.3%) unilateral, 10 (45.5%) right, and 12 (54.5%) left. The results also revealed that family history of clubfoot was positive in 13.3% of the cases and negative in 86.7% of them. Regarding the neonates' place of residence, 17 resided in urban cities and towns, and 13 in rural areas. In terms of the education of the neonates' parents, it was seen that 60% were educated and 40% illiterate [Table 1].

As indicated in Table 2, the casting treatment by the Ponseti method in the present study indicated that the results were good in 26 cases (86.7%), medium in 3 cases (10%), and poor in 1 case (3.3%) [Table 2].

Regarding the status of the patients during the treatment, the results indicated that clubfoot reoccurred only in 2 cases (6.7%). Moreover, noncompliance with the treatment was seen in 2 cases (6.7%). In addition, the results revealed that the treatment of clubfoot by Ponseti method along with complete percutaneous tenotomy of tendoachillis was successful in 26 cases (86.6%) [Table 3].

Table 1: Demographic distribution of the studied patients (*n*=30)

Categories		*n* (%)
Age (days), (mean±SD)		18±2.26
Sex	Male	18 (60)
	Female	12 (40)
Diagnosis	Bilateral	8 (26.7)
	Unilateral	22 (73.3)
	Right	10 (45.5)
	Left	12 (54.5)
Family history	Positive	4 (13.3)
	Negative	26 (86.7)
Place of residence	Urban	17 (56.7)
	Rural	13 (43.3)
Educational status	Educated	18 (60)
	Illiterate	12 (40)

Table 2: Results of the Ponseti method along with complete percutaneous tenotomy of tendoachillis

Results	*n* (%)
Good	26 (86.7)
Medium	3 (10)
Poor	1 (3.3)

Table 3: Status of the patients during the treatment

Status	*n* (%)
Recurrence	2 (6.7)
Noncompliance	2 (6.7)
Successful	26 (86.6)

Discussion

According to the results of the present study, all of the neonates received treatment under the age of 3 weeks with a mean age of 18 days. In this regard, the present study is in line with those investigations that have demonstrated that congenital clubfoot should be treated as soon as possible to come up with the most reliable results.[14-16] The results also revealed that clubfoot was more prevalent among male newborns than females, this finding is in line with the results of the studies carried out by Desai *et al.* (2010), Morcuende *et al.* (2003), and Dobbs *et al.* (2004).[17-19]

Regarding the types of clubfoot, it was seen that most cases (73.3%) had unilateral clubfoot and 26.7% had bilateral clubfoot. In their studies, Bhaskar *et al.* (2006) and Sami *et al.* (2010) reported that bilateral type of clubfoot was more prevalent than unilateral type,[20,21] whereas in the study carried out by McConnell *et al.* (2016), more cases had unilateral clubfoot.[22] In the present study, family history was negative in 86.7% of the cases. This finding is in good agreement with the one carried out by McConnell *et al.* (2016) who reported that 94% of the patients with clubfoot did not have a family history of the deformity.[22]

The dominance of the cases with clubfoot living in urban areas can be justified through the fact that a larger population live in cities and towns and account for a larger portion of medical clients. The results also revealed that parents of 60% of the cases were educated. No similar findings have been reported by any previous studies. Avilucea *et al.* reported that there is an association between low parental education and recurrence of clubfoot.[23]

The results of the present study indicated that the clubfoot treatment by the Ponseti method with a complete percutaneous tenotomy of tendoachillis had good results in 26 cases (86.7%), medium in 3 cases (10%), and poor in 1 case (3.3%). This finding is in line with those of the study conducted by Saini *et al.* in India who reported that treating newborns by Ponseti method led to good results in 79% of the cases, fair in 5%, and poor in 16%.[24] Similar findings were also reported by other previous studies.[25-27]

During the treatment, only 2 cases of recurrence were observed. This finding is in good agreement with numerous studies that reported very limited rate of recurrence[28-30] or no recurrent cases.[31-33] In addition, a lack of compliance with the treatment was observed in 6.7% of the patients. Furthermore the noncompliance rate of 32%–61% reported by Zionts and Dietz (2010).[34] In the study carried out by Nogueira *et al.*, noncompliance with bracing in clubfoot treatment has been contributed to systematic inequities and challenges.[35]

Furthermore, the results of this study indicated that treatment of the clubfoot cases by the Ponseti method along with complete percutaneous tenotomy of tendoachillis led to a success rate of 86.6%. Lara *et al.* also reported a high rate of successful treatment through Ponseti treatment.[36] Similar to the present study, Verma *et al.* reported a success rate of 90%.[37]

The results of the present study are in line with those of the study conducted by Scher *et al.* who pointed out that resilient cases of clubfoot do not respond to the classical Ponseti treatment, which is because of the fact that in this treatment method, equinus remains because of severe shortening of tendoachillis; therefore, it is necessary to utilize complete percutaneous tenotomy of tendoachillis along with the Ponseti method during the first few weeks of life to treat congenital clubfoot.[38] Studies have referred to complete percutaneous tenotomy of tendoachillis as a crucial technique in the Ponseti method which increases the success of clubfoot treatment.[18,39,40]

After 3 months, there was complete regeneration of tendoachillis although there was a big gap because of severe shortening of tendoachillis of the clubfoot, which proves that the theory of the stem cell regeneration of tendoachillis in the first 3 months of life is correct. The results of the study carried out by Shapiro *et al.* also proved the positive effects of stem cells on the healing of tendoachillis during the first phases.[41]

Conclusion

Ponseti method with a complete percutaneous tenotomy of tendoachillis was proved to be an efficient technique to correct

clubfoot. The effectiveness of this method was proved in this study and many other previous studies particularly if it is performed during the first weeks of life. The success rate of this method, as shown in this study, was 86.6%. Therefore, it is highly recommended that newborns with clubfoot should be provided with treatment by Ponseti treatment during the first few weeks of life if the classical Ponseti technique failed to correct the situation to come up with complete correctness and prevent future complications caused by their deformity.

The results of the present study should be interpreted and later implemented or generalized within the framework of its limitations. The first limitation of the present study was the short follow-up period of 2 years, whereas the literature suggests that braces should be utilized for 3–4 years of age to make sure that there will be no recurrence; however, the patients in the present study were followed up for 24 months.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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