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Expanded Age Indication for Ponseti Method for Correction of Congenital Idiopathic Talipes Equinovarus: A Systematic Review

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ABSTRACT

The deformity known as congenital idiopathic talipes equinovarus (CTEV) is probably the most common (1 to 2 in 1000 live births) congenital orthopedic condition requiring intensive treatment. With the perception that the treatment of idiopathic CTEV by extensive soft tissue release is often complicated by stiffness, recurrence, and the need for additional procedures, the minimally invasive Ponseti method has been accepted as the first line of treatment, which has achieved excellent results globally. The Ponseti method has achieved excellent results in children with idiopathic CTEV aged ≤2 years. However, the upper age limit for the Ponseti treatment has not yet been defined. We reviewed the published data to determine the efficacy of the Ponseti method in older children with neglected CTEV.

As E. H. Bradford (1) so prophetically noted in 1889, treatment of congenital idiopathic talipes equinovarus (CTEV) has often been described in "glowing terms," with very satisfactory results in the short term. However, in practice, recurrent or persistent deformity has been common, having defied correction and, ultimately, resulting in a less than good outcome. The CTEV deformity is complex and has continued to be perplexing problem for orthopedic surgeons to treat successfully. Treatment of CTEV has mainly remained nonoperative. The Ponseti technique has been available for >50 years but has come into vogue only during the past few decades. Ponseti's manipulation has been established as the first line of treatment for idiopathic CTEV. Although most of the published data on the Ponseti method has concerned infants presenting at <1 year of age, several studies have investigated the use of this method for patients of walking age (2,3). The Ponseti method of casting has gained wide popularity during the past few decades and is now considered the initial method of choice for treatment of CTEV by most orthopedic surgeons. This popularity has resulted from the observation that surgery in the form of posteromedial or complete subtalar release often resulted in stiffness, residual deformity, and the need for further surgery (4). Patients with CTEV treated using the Ponseti method have had better mobility and functional outcomes than those treated using extensive surgical release (5–9). Recent evidence has suggested that the Ponseti method might be appropriate treatment for older patients (2), and the upper age limit for the Ponseti method remains uncertain. In recent years, an increase has been reported in the treatment of older patients owing to patient referral from peripheral areas and unsuccessful nonoperative treatment at other centers (10).

Materials and Methods

The following criteria were used to determine the eligibility of a study to be included in the present review. A literature search was performed on PubMed, Embase, and Cochrane for studies reported from January 2002 until January 2017 on the topic of the Ponseti method for neglected CTEV in older children.

The following search terms were used in different combinations: "Ponseti method," "neglected CTEV," "adolescents/children of walking age/toddlers," and "untreated CTEV." The search was limited to reports in English. The studies of Ponseti treatment for deformities other than neglected CTEV (as per definition) were excluded. The references of the selected studies were also pursued for studies that might have been missed in the electronic search.

One of us (S.D.) examined the title and abstract of all identified studies. Next, the entire report was obtained and assessed for suitability by 2 of us (V.D., J.D.). Any issue pertaining to eligibility of studies was solved by discussion with the senior author (V.D.). This resulted in 10 relevant studies (Table), which were included in the present review.

Review of Published Studies

Neglected CTEV is primarily a problem in developing nations, where social stigma, the lack of education, poverty, and the lack of proper healthcare services hinder the early presentation and treatment of a child with CTEV. The deformity becomes worse

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Table
Summarized overview and comparison of included studies

Study	Year	Feet (n)	Mean Follow-Up	Mean Age at Presentation (y)	Mean Casts Required for Correction (n)	Mean Period of Immobilization		Clinical Evaluation*		Radiographic Evaluation† (°)		Recurrence During Follow-Up		Failure Definition
						Cast	Brace	Before Correction	After Correction	Before Correction	After Correction	Period; Reason	Correction	
Lourenco et al (2)	2007	24	3.1 y	3.9	9	3.9 mo	11.7 mo	P, 4.5	NR	<10	42	3.7 mo; NR	Surgical	NR
Spiegel et al (15)	2009	260	NR	3	7	7 wk	≤5 y	P, 5.15	P, 2.07	NR	NR	NR; NR	Surgical	PMSTR
Khan et al (16)	2010	25	4.7 y	8.9	NR	NR	2 y	D, 14.2	D, 0.18	<8	55	16 mo; noncompliance	Surgical	NR
Yagmurlu et al (17)	2011	31	3.5 y	1.7	7	7 wk	≤3 y	D, grade 3	D, grade 1	NR	NR	NR; NR	NR	NR
Verma et al (18)	2012	55	30 mo	2.1	10	13.9 wk	1 y	P, 4.95	P, 0.76	NR	NR	15 mo; noncompliance	Surgical	NR
Banskota et al (19)	2013	55	31.5 mo	7.4	9.5	10 wk	1 y	P, 5.1; D, 15.9	P, 2.1; D, 5.9	NR	NR	NR; NR	Surgical	NR
Ayana et al (20)	2014	32	3 y	4.4	8	16 wk	NR	NR	P, 0.0	NR	NR	NR; NR	NR	NR
Faizan et al (21)	2015	28	2.7 y	2.7	8	8 wk	NR	P, 4.84; D, 12.96	P, 0.55; D, 2.32	NR	NR	NR; NR	Surgical	NR
Bashi et al (22)	2016	18	15 mo	11.2	9	27 wk	3 mo	NR	NR	NR	NR	NR; NR	Surgical	NR
Sinha et al (23)	2016	41	2.6 y	3.02	12.8	3.6 mo	1 y	P, 5.41; D, 15.9	P, 0.12; D, 2.07	10.34	51.39	2.6 y; severity, noncompliance	Surgical	No response for 3 casts

Abbreviations: D, Dimeglio; NR, not reported; P, Pirani; PMSTR, posteromedial soft tissue release.
* Mean Pirani and Dimeglio scores.
† Mean Beatson-Pearson index.

by walking, because the weightbearing occurs on the side or dorsum of the foot, causing further contracture of the medial soft tissues and plastic deformation of the bones (11).

By definition, a child with CTEV who has not received any treatment during the first 2 years of life is considered to have neglected CTEV (12). Neglected CTEV is a common occurrence in developing countries. The treatment options for these patients have been limited with poor functional outcomes (13). The usual treatment offered for neglected CTEV is surgical correction and includes extensive soft tissue releases, bony osteotomies, and correction using the ring (Ilizarov) fixator (13,14). The availability of the wide array of surgical options suggests the lack of a single definitive procedure that which can produce reproducible and satisfactory results.

Treatment of neglected CTEV in an older child has been challenging owing to the rigidity of foot (unlike in infants), the altered gait pattern and its consequences, and noncompliance with treatment. Lourenco and Morcuende (2) retrospectively reviewed the data from 17 children (24 feet) with idiopathic CTEV who had presented after walking age and had undergone no previous treatment. All were treated using the method described by Ponseti, with minor modifications (2). Their mean age at presentation was 3.9 (range 1.2 to 9.0) years, and the mean follow-up period was 3.1 (range 2.1 to 5.6) years. The mean period of immobilization in a cast was 3.9 (range 1.5 to 6.0) months. A painless plantigrade foot was obtained in 16 feet without the need for extensive soft tissue release and/or bony procedures. Four patients (7 feet) developed recurrent equinus and required a second tenotomy. Failure was observed in 5 patients (8 feet), who required posterior release for full correction of the equinus deformity (2).

Spiegel et al (15) retrospectively reviewed the records of 171 patients (260 feet) to determine whether the initial correction of the deformity (to a plantigrade foot) could be achieved using the Ponseti method for untreated idiopathic CTEV in patients presenting at age 1 to 6 years. A mean of 7 casts was required, and no differences were found in the number of casts needed among the different age groups (15). Of the 260 feet, 250 were treated surgically for residual equinus after a plateau had been reached with casting. The procedures included percutaneous tendo-Achilles release (n = 205), open tendo-Achilles lengthening (n = 8), posterior release (n = 21), and extensive soft tissue release (posteromedial release, n = 16). The mean amount of dorsiflexion after removal of the last cast was 12.5° for the entire group and was greater in those aged 1 year than in those aged 3 years. All patients achieved a plantigrade foot. Finally, extensive soft tissue release was avoided for 94% of the patients using the Ponseti method (15).

Khan and Kumar (16) evaluated the efficacy of the Ponseti technique for neglected CTEV in children aged >7. They evaluated the results with the Ponseti method in 21 children (25 feet) with neglected club feet. The patients were evaluated using the Dimeglio scoring system. All the patients underwent percutaneous tenotomy of the Achilles tendon. Their mean age at treatment was 8.9 years. The mean follow-up period was 4.7 years. The average Dimeglio score at the start of treatment was 14.2 and was 0.95 at the end of treatment at the 1-year follow-up examination. Of the 25 feet, 18 (85.7%) achieved full correction. Recurrence developed in 6 feet (24%). At the 4-year follow-up examination, the average Dimeglio score for 19 feet was 0.18 (16).

Yagmurlu et al (17) evaluated the corrective effect of the Ponseti method on different components of CTEV after patients had reached walking age to determine how patient age related to this correction. They treated 31 feet in 27 patients with CTEV with a mean age of 21 (range 12 to 72) months using the Ponseti method. The average follow-up period was 42 months. All the patients were evaluated before and after treatment using the Dimeglio scoring system. The patients in the first group, aged <20 months, were compared with those in the second group, aged >20 months. The corrections for each component of the deformity were analyzed separately. They found significant correction of all deformities. However, patients aged >20 months improved less for the components of varus, medial rotation of calcaneopedal block, and adductus compared with the corrections in the younger patients (17).

Verma et al (18) prospectively evaluated 55 cases of CTEV (37 patients) to determine clinically whether the Ponseti method is effective in the management of CTEV in older children aged 12 to 36 (mean 24.8) months. All the patients were considered to have moderate or severe grades of deformity using the Pirani scoring. Painless, supple, plantigrade, and cosmetically acceptable feet were achieved in 49 of the clubfeet. However, 7 patients (7 feet) developed recurrence of adduction, varus, and equinus deformity, and 3 patients (5 feet) developed isolated recurrence of the equinus deformity. These 7 patients responded to repeat treatment and obtained satisfactory outcomes. Of these 7 patients, 4 required tibialis anterior transfer to the third cuneiform to achieve dynamic supination. The 3 patients (5 feet) who had developed isolated equines deformity recurrence underwent repeat tenotomy. Of the 5 feet, 1 achieved a satisfactory amount of dorsiflexion, 3 underwent tendo-Achilles lengthening, and 1 required posterior release to obtain satisfactory dorsiflexion. The mean number of casts required to obtain correction of the CTEV deformities was 10 (range 6 to 12). The mean period of immobilization in a cast was 13.9 (range 10 to 15) weeks.

Banskota et al (19) evaluated the use of the Ponseti method, with minor adaptations, in the treatment of idiopathic CTEV presenting in children aged 5 to 10 years. A retrospective review was performed of 36 children (55 feet) with a mean age of 7.4 (range 5 to 10) years, supplemented by digital images and video recordings of gait. The mean follow-up period was 31.5 (range 24 to 40) months. The mean number of casts was 9.5 (range 6 to 11), and all children required surgery, including percutaneous tenotomy or open tendo-Achillis lengthening (49%), posterior release (34.5%), posterior