2014

The therapeutic efficacy of the Ponseti method of serial casting for children with clubfoot

Jamie Ford
Pacific University

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Title: The therapeutic efficacy of the Ponseti method of serial casting for children with clubfoot.

Overall Clinical Bottom Line: Based on the results of Andriesse and Hagglund, and Aurell et al. there is moderate evidence to suggest that the Ponseti method is better than the Copenhagen method at reducing the need for extensive surgical intervention in infants with congenital idiopathic clubfoot. Both studies showed a statistically significant difference within groups and between groups at p=.05, with the Ponseti method requiring less extensive surgery than the Copenhagen method to achieve adequate correction of the clubfoot deformity. Neither study had a strong PEDro score, but both studies are similar to my clinical PICO in population and outcome measures. Generalizing these outcomes should be done with caution due to the poor internal validity of these studies, small sample sizes, and lack of randomization and blinding. Further research is needed to investigate the long-term effects both these conservative treatments as well as surgical intervention alone. Future studies should include larger sample sizes, blinding, and randomization into groups.

Clinical Scenario: I am currently completing internship number 3/III at Maitland Cottage pediatric hospital in Newlands South Africa. Children diagnosed with clubfoot at multiple stages are seen weekly by a team of surgeons and physiotherapists. I have noted that the surgeons, as a group, are keen to initiate non-surgical, conservative intervention of Ponseti serial casting as compared to immediate *theater* surgical intervention. This led me to ask why a surgeon would choose an intervention of stretching, manipulations and serial casting over surgical tendon and soft tissue releases.

Clinical Question: Does the Ponseti method of serial casting reduce the need for extensive surgery when used as an intervention to treat children with congenital talipes equinovarus (CTEV) compared to the Copenhagen method?

Population: Children Birth-4 y.o. with congenital equinovarus (clubfoot)

Intervention: Ponseti method of serial casting

Comparison: Copenhagen method

Outcome: Surgical posterior medial release (PMR), posterior release

Search Terms: Ponseti, Copenhagen, physical therapy, clubfoot, congenital talipes equinovarus, serial casting

Appraised By:
8/14/13
Jamie Ford
School of Physical Therapy

Collage of Health Professions
Pacific University
Hillsboro, OR 97123
Ford0950@pacificu.edu

Rational for Chosen Articles: I was able to find numerous articles on the Ponseti method of serial casting; however, many were merely an advertisement for Ponseti or did not have a comparison group. I found a few articles comparing the Kites method to the Ponseti method; however, these two methods were very similar and there was minimal differentiation between the two techniques. I narrowed my selection to four articles. Articles by Andreiesse and Hagglund and Aurell et al. compared the Ponseti method to the Copenhagen method and the other two compared Ponseti to the French Functional method. After further analysis, only one French Functional method article described the clinical trial in detail; therefore, I decided to compare the two Copenhagen articles for consistency. None of the articles I found had strong PEDro scores. Andreiesse and Hagglund had a PEDro score of 5/10 and Aurell et al. had a PEDro score of 3/10. Although not ideal scores, the population and outcome measures very closely matched my clinical PICO, and the comparison groups were consistent.

Full Article Reference:

1. Andriesse H and Hagglund G. Comparison of serial casting and stretching technique in children with congenital idiopathic clubfoot. *Acta Orthopaedica, 2008; 79 (1): 53-61.*

PEDro Score: 5/10

Article PICO:

Population: Thirty-two children birth to two years of age with idiopathic congenital clubfoot, which is similar to my clinical scenario in age and diagnosis.

Intervention: Ponseti method

Comparison: Copenhagen method

Outcomes: Need for surgical interventions, Clubfoot Assessment Protocol (CAP), Dimeglio classification system (DCS).

2. Aurell Y, Andriesse H, Johansson A, Jonsson K. Ultrasound assessment of early clubfoot treatment: A comparison of the Ponseti method and a modified Copenhagen method. *Journal of Pediatric Orthopedics B 2005, 14: 347-357.*

PEDro Score: 3/10

Article PICO:

Population: Twenty-eight infants between 1-21 days old with idiopathic clubfoot and without any other congenital syndromes. This is similar to my clinical PICO in age and diagnosis.

Intervention: Ponseti method of serial casting

Comparison: Copenhagen method

Outcomes: Need for surgical intervention

3. Chotel F, Parot R, Seringe R, Berard J, & Wicart P. Comparative study: Ponseti method versus French physiotherapy for initial treatment of idiopathic clubfoot deformity. *Journal of Pediatric Orthopedics 2011, 31: 320-325.*

PEDro Score: 4/10

Article PICO:

Population: Included patients similar to my clinical PICO in age, 1-3 years old, and diagnosis of idiopathic clubfoot.

Intervention: Ponseti method of serial casting

Comparison: French physiotherapy method

Outcomes: Need for surgical interventions

Table 1. PEDro Score Comparison

	Andriesse and Hagglund	Aurell et al	Chotel et al
Random Allocation	0	0	0
Concealed Allocation	0	0	0
Baseline Comparability	1	1	1
Blind Subjects	0	0	0
Blind Assessors	0	0	0
Blind Therapist	0	0	0
Intention- to-Treat Analysis	1	0	0
Between Group Comparison	1	1	1
Adequate Follow Up	1	0	1
Point Estimates and Variability	1	1	1
Total Score	**5/10**	**3/10**	**4/10**

Based on the above comparison, I have chosen to write this clinically appraised paper on the articles by Andreisse and Hagglund and Aurell et al.

Article 1.
Andriesse H, Hagglund G. Comparison of serial casting and stretching technique in children with congenital idiopathic clubfoot. *Acta Orthopaedica, 2008; 79 (1): 53-61.*

Clinical Bottom Line: Based on the results of this study, there is moderate evidence to suggest that the Ponseti method of treating congenital idiopathic clubfoot requires less surgical intervention than the Copenhagen method, which leads to better long-term outcomes. These long-term outcomes include; better mobility, less pain, and higher function compared to extensive soft tissue release. It has also been reported that extensive surgery results in early arthritic changes to the foot and ankle. This study confirms these observations at the 2-year follow up; however, longer follow-up is needed to assess onset of arthritic changes.

In this study 32 infants (<8 days old) were treated for congenital idiopathic clubfoot. The first 16 patients admitted received the Ponseti method and the last 16 received the Copenhagen method. All children were assessed at baseline, 1 month, 2 months, 4 months, and 2 years of age. At 2 months a single surgeon used standardized measurements to determine the need for complementary surgery. No inter-rater reliability could be assessed, and the validity of the standardized measurements is not mentioned. This same surgeon took active part in the treatment of the subjects creating a major threat to the studies validity.

Both the Ponseti and Copenhagen groups had a statistically significant difference within groups. There was also a statistically significant difference between groups at p=0.05 with the Ponseti method requiring less extensive surgery than the Copenhagen method to achieve adequate correction of the clubfoot deformity. Although this study has a low PEDro score it fits closely with my clinical scenario for population and outcome measure. The relatively low cost and minimal treatment time also leads me believe the Ponseti method has therapeutic efficacy in the treatment of infants with congenital idiopathic clubfoot.

Article PICO:
P: Thirty-two children (45 feet, 13 bilateral) birth to two years of age with idiopathic congenital clubfoot
I: Ponseti casting technique group (PCT-G) followed by KAFOs and then AFOs
C: Modified Copenhagen group (CPH-G) followed by KAFOs and the AFOs.
O: Need for surgical intervention

Blinding: There was no blinding in this study. The therapists had to be aware of which treatment they were giving in order to apply the method correctly. This is a major threat to the validity of the study because the physiotherapists were also the assessors. This could lead to a possible rater bias. The subjects were not blinded either; however, being that they were infants one could argue that they were unaware of which treatment they were given. The more important factor would be that the parents were not blinded, which could lead to a Hawthorne of Rosenthal effect.

Controls: The control group received the Modified Copenhagen method (CPH-G) during the first 2 month period, or phase I of treatment. Control subjects were then assessed for surgery and given the same orthosis treatment, phase II, as the intervention group. There was no true control in this study. It is likely that differences between groups were due to the intervention since all other variables were the same; however, without a true control, change over time cannot be ruled out.

Randomization: Sixteen subjects were consecutively treated with the Ponseti method (PCT-G) and then 16 children with the Copenhagen method (CPH-G). Therefore, the assignment to groups was not randomized, creating a potential threat to internal validity.

Study: This is a longitudinal study consisting of the first 32 infants admitted to the Lund University Hospital with idiopathic congenital clubfoot. The first sixteen infants (23 feet, 7 bilateral) were treated with the Ponseti method (PCT), and the last 16 infants (22 feet, 6 bilateral) were treated with the Copenhagen method (CPH). Treatment began within eight days after birth and lasted for 2 months. The casts of the subjects in the Ponseti casting technique group (PCT-G) were changed every 5 days during the first 2 weeks followed by once a week until 2 months. This equaled a total treatment time of 2-4 hours per week. The Modified Copenhagen group (CPH-G) received a total hospital treatment time of 10 hours as well as home program of 10 hours per week. The hospital program consisted of daily stretching to the shortened soft tissues, manipulations of contracted joints, and stimulation to weak muscles. Parents were also instructed in stretching technique to be done twice daily, and a splint was used to maintain any correction obtained.

After the initial correction, at the 2-month mark, subjects in both groups were given any complementary surgery needed. If the subject's equinus still persisted with less than 5 degree dorsiflexion, an Achilles tendon lengthening was performed, and if necessary, was combined with a posterior capsulotomy. If the varus-adduction component was not mobile into at least 15 degrees of valgus-abduction a tibialis posterior lengthening and capsulotomy of the talo-navicular joint was done. Lastly, if toe-flexion persisted, a lengthening of flexor hallucis longus and/or flexor digitorum tendon was performed. Once at least 15 degrees of dorsiflexion and eversion were achieved via initial treatment method alone or with surgery, all children continued on to phase II.

Phase II is the maintenance of correction phase. This phase is the same for all subjects in order to insure stable research conditions. All subjects received a dynamic knee ankle foot orthosis (KAFO) followed by a dynamic ankle foot orthosis (AFO) once stable independent walking was achieved. Parents were instructed to leave the KAFO on for at least 18 hours a day, all through the night, and no more than 2 hours free in the morning and before bed. They were also given a home exercise program to keep plantar flexion and toe flexors mobile, and came into the physiotherapist for regular checkups. The KAFO was positioned to keep the foot in outward rotation, and the knee flexed in order to inhibit rotation at the knee and hip level. The dynamic ankle orthosis allowed for motion during the day, but was tightened at night in order to elongate the Achilles tendon. The orthosis was gradually weaned off based on muscle function, ankle mobility, and motor development of each subject. By 8 months all subjects wore the orthoses for 12 hours a day and throughout the night and any naps. The AFO was set to 15 degrees of outward rotation and was worn for at least 10 hours a night until 4 years of age.

<u>Outcome measures:</u> All subjects were assessed by the same assessor when they were newborn (before treatment), at 1 month, 2 months, 4 months, and at 2 years of age. At the 2-month assessment, subjects were given surgery, if needed, to complete the correction stage of treatment. According to Dobbs, patients with more extensive surgery experienced more severe foot ankle osteoarthritis. Richards et al. explains that the posteromedial release is more extensive than a posterior release, with both

being far more extensive than an Achilles tenotomy. Therefore, it is important to record not only the number of patients requiring surgery, but also the surgery extent needed in order to more accurately determine the potential benefit of the intervention. Andreisse and Hagglund recorded operation type and frequency. They also discussed standardized measurements used to determine surgical necessity; however, the need for surgery was based on one surgeon's measurements and opinion. This surgeon was aware of the subjects' treatment group and actively participated in their treatment, which could be a possible threat to the study's validity.

Study losses: Of the 32 subjects (45 collective feet exhibiting deformity) included in this study, all were assessed at each time point with regard to surgical necessity. It is therefore unnecessary to perform an intention to treat analysis.

Summary of internal validity: I determined that this study has fair internal validity (PEDro 5/10). Physiotherapist, surgeons, and parents followed strict protocol with regard to intervention and external conditions were kept as stable as possible. The treatment groups were equal at baseline, and an appropriate comparison and tests were performed. With that being said, I found 2 major threats and 4 minor threats to the study internal validity. The sample size (n= 45) was small and no power analysis was performed creating a risk for a type II error. The groups were not randomly allocated and there was no true control group. The feet of study subjects with bilateral clubfeet were treated as independent statistics. It is possible that there is a correlation between feet of the same subject that may cause an over or under estimation. However both groups had an almost equal distribution of bilateral clubfeet (PCT-G = 6, CPH-G = 7). Although each of these creates a threat I found it to be minor in regards to the study's validity. The major threats are the lack of blinding and validity of the surgical assessment. There were no standard measurements given to determine need for surgery, and no inter-rater reliability since there was only one assessor. This assessor also took an active part in treatment leaving the possibility of rater bias.

Evidence: Subjects were assessed at baseline, 1 month, 2months, 4 months and 2 years using the Clubfoot Assessment Protocol (CAP), Dimeglio classification system (DCS), and the surgeon's experienced opinion. Progress was noted at each time point and surgery was performed based on the surgeon's opinion at the 2 month time period. At each follow up the doctor then assessed if any further surgery was needed. The type and amount of surgical intervention were most useful in determining efficacy of the treatment and are shown below in Table 2.

Table 2: Comparison of surgical intervention procedure at 2 months

	No surgery	Achilles tenotomy	Achilles tenotomy + Posteromedial release
PCT-G	5	14	4
CPH-G	2	3	17

PCT-G= Ponseti casting technique group
CPH-G= Modified Copenhagen group

A Chi squared 2X3 analysis was performed using Dr. Bush's statistical analysis calculator. The results showed that the calculated Chi squared value of 16.437 was greater than the critical value of 5.99 at a p value of 0.05. This supports the author's conclusions' that results were not due to chance. There is a statistically significant difference between the Ponseti method and the Copenhagen method with regard to surgical intervention in favor of the Ponseti method. Only four subjects treated with the Ponseti method needed a posteromedial release compared to 17 subjects in the Copenhagen group. This data suggest the Ponseti method requires less extensive surgery than the Copenhagen method to provide adequate correction of the clubfoot deformity.

Applicability of study results:

Benefits vs. Costs: Based on the results of this study the Ponseti method has statistically significant effects both within and between groups for patients with idiopathic congenital clubfoot. The study also shows significantly better quality of motion at 2 years follow-up. This may be because the proprioceptive nerve system is intact since there were fewer disturbances from surgery. The study did not report any adverse effects in its subjects, but upon further research I found that skin irritation, macerations, and pressure soars with infection are possible risks (Baindurashvili et al.). Dr. Ponseti recommends the use of plaster casts instead of fiberglass because it is cheaper and more precisely molded (Staheli, L). The only material costs include, gauze, plaster, and gloves making this a relatively inexpensive treatment. It is necessary for the physiotherapist or doctor to be trained in the Ponseti method, but once learned the treatment time is a mere 2-4 hours a week. The Copenhagen method on the other hand can take 10 hours a week with the therapist and another 10 hours with the parents. In both groups, subjects wore some form of an orthosis for 24 hours. This is required for maintenance even if surgery is the intervention of choice. The evidence supporting Ponseti method, along with the relatively low material cost and treatment time leads me to recommend the use of this treatment for my patient.

Feasibility of treatment: The Ponseti method is a feasible option for treatment of infants presenting with congenital idiopathic clubfoot. The data shows a decrease in extensive surgical intervention after application of the Ponseti method. The treatment time of 2-4 hours a week for 2 months is reasonable for patients, parents, therapists, and insurance coverage. Although the Ponseti method was not described

in detail in the article, a reference was cited, and precise instructions are easily attainable. Long term, patients and parents must adhere to strict orthosis management in order to maintain the correction. Although this may be challenging, both conservative and surgical treatments require this long-term orthosis management, as currently there is no better alternative.

Summary of external validity: The results of this study can be applied to newborns presenting with congenital idiopathic clubfoot. Generalizing these outcomes should be done with caution due to the small treatment size, lack of randomization and blinding of assessors. It should also be noted that older children and those where clubfoot is a secondary complication were not included in this study.

Article: Aurell Y, Andriesse H, Johansson A, Jonsson K. Ultrasound assessment of early clubfoot treatment: A comparison of the Ponseti method and a modified Copenhagen method. *Journal of Pediatric Orthopedics B 2005, 14: 347-357.*

Clinical Bottom Line: Based on the results of this study, there is moderate evidence to suggest that the Ponseti method for the treatment of congenital idiopathic clubfoot requires less surgical intervention than the Copenhagen method. It has been reported that extensive surgery results in early arthritic changes to the foot and ankle. Therefore, in theory the Ponseti method will also result in better long term outcomes; however, this study did not provided an adequate follow-up to determine the validity of this argument.

This study evaluated the efficacy of the Ponseti method of serial casting compared to the Copenhagen method for infants with congenital idiopathic clubfoot. All subjects received treatment for 2 months beginning in the first weeks of life and were evaluated at baseline, 2 months (preoperatively), and 1-2 months postoperatively. The Dimeglio-Bensahel classification system was used in determining the success of treatment and/or surgery. This system classifies clubfoot into severe, moderate, and benign. The validity of this test is not stated and reliability is poor due to minimal communication between examiners.

Surgical intervention was based on one surgeon's professional opinion, eliminating any inter-rater reliability. Both groups made statistically significant differences within groups; however, the Ponseti method made these gains quicker and with less surgical intervention. There was a statistically significant difference between groups at p=0.05 with the Ponseti method requiring less extensive surgery than the Copenhagen method to achieve adequate correction of the clubfoot deformity. The internal validity of the study was poor due to a lack of blinding, lack of randomization, and small sample size. With that being said, the Ponseti method has relatively low cost, requires a small amount of the therapist time, and has no reported adverse effects in this study. This, along with the studie's comparability to my clinical scenario, leads me to conclude that the therapeutic efficacy of the Ponseti method in the treatment of congenital idiopathic clubfoot is clinically useful.

Article PICO:
P: Twenty-one infants (28 feet, 7 bilateral) between 1-21 days old with idiopathic clubfoot and no other congenital syndromes.
I: Ponseti method
C: Copenhagen method
O: Need for surgical Intervention

Blinding: The therapists, subjects, and their parents were not blinded which could lead to a Hawthorne and Rosenthal effect. The clinical investigators and the ultrasound examiners were unaware of each other's results. The radiologist was unaware of the interventional procedure, and the pediatric orthopedic surgeon who was determining the type of surgical intervention was unaware of the ultrasound results. It is not stated whether the surgeon was blinded to treatment group or not which could create a possible rater bias.

Controls: The control group, consisting of 14 subjects and 19 clubfeet, was given the modified Copenhagen method, which included repeated manipulations followed by an adjustable plexidur splint to maintain correction. All children were treated with either the Ponseti or Copenhagen method, meaning there was no true control, and change over time could be a threat to the studies validity.

Randomization: Subjects were consecutively included in this study over a three year period. No randomization was performed creating a threat to the studies internal validity.

Study: Twenty-one subjects (13 boys and eight girls) with idiopathic congenital clubfoot were admitted to two hospitals over a three-year period. Patients with congenital syndromes or cerebral palsy in conjunction with clubfoot were not included in this study. Group A was treated at the Halmstad County Hospital using the Ponseti method, and had seven subjects with nine total clubfeet (two bilateral). Group B was treated at the Lund University Hospital using the Copenhagen method and had 14 subjects with 19 clubfeet (five bilateral). The Ponseti group began treatment between the 1st and 12th day of life with the average being at 6.9 days. Subjects received manipulations and plaster casts once a week for 4-6 weeks and then once every two weeks until two months. The Copenhagen method performed repeated manipulations followed by an adjustable plexidur splint. Manipulations were performed four to five times a week during the 1st month and once or twice a week during the second month. Parents were also instructed to stimulate foot and leg activity.

<u>Outcome measures:</u> All subjects were clinically and sonographically assessed during the neonatal stage (first weeks of life), preoperatively (~2months) and postoperatively (1-2 months after first surgery). At the preoperative assessment the same pediatric orthopedic surgeon determined each subject's need for complementary surgery. Procedures were categorized from least to most invasive as:

1. No interventional procedure
2. Achilles tenotomy
3. Posterior release
4. Posteriomedial release
5. Posteriomedial release with capsulotomy of the talo-navicular joint.

All subjects were first considered for an Achilles tenotomy if the equinus deformity remained. If the degree of correction was unsatisfactory after the tenotomy, further surgical intervention was considered. The authors did not discuss standardized measures used to determine need for surgery and it is unclear whether the surgeon was blinded to the treatment group. This could lead to a possible threat to the studies validity.

Study losses: Of the 21 subjects (28 feet) included in this study, all were assessed at each time point with regard to surgical necessity. It is unnecessary to perform an intention to treat analysis.

Summary of internal validity: I determined that this study has poor internal validity (PEDro 3/10). All subjects were chosen on precise inclusion and exclusion criteria and there was no statistically significant difference in age at baseline. There was a statistically significant difference in Dimeglio-Bensahel classification at baseline with a tendency for the Ponseti group to be slightly more severe. There also was no assessment of inter-observer error and the observers did not discuss how to utilize the instrument prior to classification, which may account for this difference. In any case this difference only strengthens the findings that the Ponseti method is more effective than the Copenhagen method at reducing the risk for extensive surgery. The study also lacked an adequate follow-up with the last assessment occurring 1-2 months post-op. After further analysis it was noted that one subject required additional surgery at 10 months of age implying that follow up continued. Nowhere does it state how long after subjects were monitored. The major threats to this study's validity are the small sample size, lack of randomization, and lack of blinding.

There was a small sample size (n=28) with no power analysis creating a risk for a type II error. The treatment groups were also uneven in size with only nine clubfeet in the Ponseti group and 19 clubfeet in the Copenhagen group. The male to female ratio for each group was not stated. Subjects were not randomized, and treatment of each group was done at two separate institutions (which ever hospital subjects presented to determined which treatment they would receive). Subjects, parents, physiotherapists and surgeons were all aware of each subject's treatment group creating the possibility for the Hawthorne and Rosenthal effect and rater bias.

Evidence: Subjects were assessed at neonatal (baseline), preoperative (~2 months), and postoperative (1-2 months after initial surgery) using the Dimeglio-Bensahel classification system. Initial surgery was performed based on the surgeon's opinion at the 2 month time period. If minimally invasive surgery was not sufficient a secondary procedure was performed when deemed necessary. The type and amount

of surgical intervention were most useful in determining efficacy of the treatment and are shown below in table 3.

Table 3: Comparison of surgical intervention procedures

	Ponseti method	Copenhagen method
No initial procedure	0	2
Achilles tenotomy	9	4
Posterior release	1*	1
Posteriomedial release	1*	3
Posteriomedial release with capsulotomy of talo-navicular joint	0	9

*complementary surgery performed at 10 months due to reoccurrence of deformity.

According to the authors there is a statistically significant difference between groups regarding choice of surgical intervention analyzed using the Chi squared and Mann-Whitney U-test. The Ponseti group and the Copenhagen group both experienced a statistically significant difference, within groups, in number of complementary surgeries post intervention. The Ponseti group requiring fewer complementary surgeries and achieved correction of clubfoot deformity quicker. Using Dr. Bush's statistical analysis calculator I was able to confirm the data provided by the authors regarding statistical significance. Table 4 presents the Chi squared 2X3 analysis I performed. I grouped the dependent variables in this analysis as: no initial procedure, Achilles tenotomy, and extensive complementary surgery (posterior release, posteriomedial release, posteriomedial release with capsulotomy of the talonavicular joint). I chose these surgical groupings to provide continuity with the Andriesse H, Hagglund G. article, and createa clear differentiation between minimally invasive and extensive procedures.

Table 4: Comparison of the number of subjects requiring surgery between the Ponseti and Copenhagen methods.

	Ponseti method	Copenhagen method
No initial surgery	0	2
Achilles tenotomy	9	4
Extensive complementary Surgery	2	13

The results show that the calculated Chi squared value, with Yates correction of 7.3178, was greater than the critical value of 5.99 at a p value of 0.05. This supports the authors' conclusions that results were not due to chance. There is a statistically significant difference between the Ponseti method and the Copenhagen method with regard to surgical intervention in favor of the Ponseti method. The Ponseti method yielded two extensive surgeries compared to the Copenhagen method, which required 13 extensive surgeries. This data suggests the Ponseti method requires less

extensive surgery than the Copenhagen method in providing adequate correction of the clubfoot deformity.

Applicability of study results:

Benefits vs. Costs: Based on the results of this study, the Ponseti method has statistically significant effects both within and between studies for patients with idiopathic congenital clubfoot, and corrects deformity in less time than the Copenhagen method. The authors did not report any adverse effects; however, Baindurashvili et al. found that plaster casting for clubfoot can lead to skin irritation including macerations and pressure soars. The only material costs for the Ponseti method include, gauze, plaster, and gloves making this a relatively inexpensive treatment. It is necessary for the physiotherapist or doctor to be trained in the Ponseti method, but once learned the treatment time consists of only one visit per week. The Copenhagen method requires 4-5 treatment sessions per week and additional stretching by the parents at home. Therefore, this method has increased cost as compared to the Ponseti method. The evidence supporting the Ponseti method, along with the relatively low material cost and treatment time leads me to recommend the use of this treatment with my patient.

Feasibility of treatment: The Ponseti method is a feasible option for treatment of infants with congenital idiopathic clubfoot. The results of this study show a decrease in extensive surgical intervention with application of the Ponseti method as compared to the Copenhagen method as well as a more rapid deformity correction. The treatment time was reasonable, consisting of manipulations and casting done once a week for 4-6 weeks, and once every other week up to 2 months of age. Due to fewer therapist visits, fewer subsequent surgical procedures, and fewer material costs, the Ponseti method is more cost effective for insurance companys and/or parents. The authors do not describe the treatment procedures of the Ponseti method in this study. Ponseti methods are taught in continuing education courses and are available in the literature. Therefore, reproduction of this treatment is feasible given the specific methodology of this treatment. Long term, patients and parents must adhere to strict orthosis management in order to maintain the correction. These difficulties are, however, inherent to both conservative and surgical interventions, as currently there is no better alternative.

Summary of external validity: The results of this study can be applied to newborns presenting with congenital idiopathic clubfoot. Generalizing these outcomes should be done with caution due to the small treatment size, lack of randomization and blinding of assessors. It should also be noted that older children and those with congenital syndromes, or cerebral palsy in conjunction with clubfoot, were not included in this study.

Synthesis/Discussion: The purpose of this paper was to determine if the Ponseti method is an effective conservative treatment for infants with congenital idiopathic clubfoot. The two chosen articles evaluated subjects in the first weeks of life, applied

either the Ponseti method or the Copenhagen method for 2 months, and then evaluated the subjects for complementary surgery. Aurell et al. performed a follow up 1-2 months postoperatively; whereas, Andriesse and Hagglund continued on to phase II, orthotic management, and continued check-ups until 2 years of age.

The Ponseti method had minor differences in application between studies. In Andriesse and Hagglund's study, subjects received manipulations and casting once every five days for the first 2 weeks, followed by once a week until 2 months of age. Aurell et al. performed manipulations and casting once a week for the first 4-6 weeks and once every two weeks until 2 months. In both groups the Copenhagen group received approximately 10 hours of treatment a week and parents were educated in a home stretching program.

Both studies based surgical necessity on the surgeon's clinical opinion; however, Andriesse and Hagglund described standardized measurements used in this process. Both studies recorded surgical type and frequency, and both found statistically significant differences in favor of the Ponseti method at $p=0.05$. Andriesse and Hagglund grouped procedures into no surgery, Achilles tenotomy, or posteromedial release with Achilles tenotomy, with the later being the most invasive option. In Aurell et al., the Ponseti group only required four posteromedial releases and the Copenhagen group required 17. Aurell et al. categorized procedures into no surgery, Achilles tenotomy, posterior release, posteromedial release, or posteromedial release with capsulotomy of the talo-navicular joint. In this study the posterior release, posteromedial release, and posteromedial release with capsulotomy were considered severe. The Ponseti method only required two invasive surgical procedures after casting, and the Copenhagen method required 13. Although both studies show strong evidence for the Ponseti method in the treatment of infants with clubfoot, generalizing these results should be done with caution due to the poor internal validity.

Both study populations had small sample sizes, were not randomized into groups, and lacked blinding of the subjects, therapist, and assessor. With that being said Ponseti method takes less time and money then the Copenhagen method or extensive surgical intervention, and offers a less invasive option than surgery. This analysis is a step in a positive direction for advocating conservative PT services as an alternative to surgery. Physical therapy can and should be the profession of choice for treatment of congenital idiopathic clubfoot. If a child is unable to make the gains necessary through serial casting they should then be referred to an orthopedic specialist for the least invasive corrective foot surgery. Surgery should be followed up with PT for optimal return to function.

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