Assessment of the ponseti method for clubfoot deformity management in newborns

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Abstract

This research seeks to establish the efficacy of ponseti technique when using it to manage congenital talipes equinovarus (CTEV) deformities amongst newborns. The ponseti method was used in treating neonates with CTEV. Neonates who had other conditions like meningocele, meningomyelocele, arthrogryposis or other neuromuscular conditions were not included. A standardized form was used to collect the data; this form contained demographic data, physical examination findings, management history (including pirani scoring) and complications. Therapy consisted of soft foot manipulation, then serial casting, and percutaneous achilles tenotomy as needed. Among these, 37 feet (63.8 percent) were rigid, and 21 feet (36.2 percent) were non-rigid. The pre-treatment pirani score had an average of 5.57 and the average number of casts that were applied per foot was 3.75. In 86.2% of the feet percutaneous tenotomy was carried out. The treatment success rate was 96.6 percent. The complications were few and included three instances (5.2%) of skin excoriations and blister formation. The average post treatment pirani score was 0.36 0.43. Ponseti technique is a minimally invasive, less expensive, and effective in the treatment of ctev among neonates. It headed excellent anatomical and functional outcomes with minimal complications. The best results rely on early start of treatment and on bracing protocol compliance. This method can be applied in both resource-permitted and resource-restricted settings and offers success rates that are high and low invasive surgical intervention.

Keywords: ponseti method, clubfoot deformity, neonates, non-surgical treatment, ctev (congenital talipes equinovarus)

Introduction

One of the most common and complicated congenital deformities is congenital talipes equinovarus (ctev), which is widely referred to as clubfoot. Idiopathic clubfoot is known to exist in about 1 -2 per 1,000 live births. This is a condition that presents four main components, which include ankle equinus, hindfootvarus, forefoot adductus, and midfootcavus [1-3]. The main goal of therapy is to fix all these deformities, to end up with a painless, flexible and plantigrade foot that is both functionally and aesthetically acceptable and to spend as little time as possible to achieve the correction and to minimalize the interference with the socio-economic lives of the child and of its family [4-6]. There is a general consensus that non-surgical treatment must be used as the first-line management of clubfoot irrespective of the severity of the deformity. In case of inadequate improvement, a large number of surgeons will choose postero-medial release (pmr) of the soft tissue. Nevertheless, pmr is associated with immense disadvantages such as high complication rates (up to 27.2%), recurrence (13-50%), and the challenge of dealing with recurrence. A lot of specialists have concluded that ctev should not be treated with the help of extensive surgery [7-12]. Over the past 20 years, ponseti technique has become a very effective

non-surgical correction of ctev and has become the gold standard of treatment in the global community. This method includes sequence of corrective manipulations, usage of plaster casts and restricted surgical treatment, including percutaneous achilles tenotomy [13-18]. The ponseti method has been described to have a success rate of 90-96% both short-term and long-term follow-up. Compared to the traditional surgical treatments, ponseti casting method has always provided improved results with minimal complications. In recent years, there has been increased interest in this approach and many medical centers are now realizing that the ponseti technique is better than surgery in most cases of clubfoot. This technique is particularly useful in areas where surgery is not easily accessible since trained healthcare professional using the ponseti method can effectively treat the condition through cast treatments without the need of surgery [19-21]. This paper seeks to evaluate the results of ponseti casting method that has been used within 2 years to manage congenital clubfoot among newborns in our institution.

Materials and methodology

All the neonates with the diagnosed ctev and addressed to the department of pediatric surgery were treated according to the ponseti casting method. This study excluded neonates with clubfoot that was complicated by conditions such as meningocele, meningomyelocele, arthrogryposis multiplex congenital or other neuromuscular diseases [1-3]. The written informed consent of the parents of the participants was obtained. A pre-designed data sheet, containing demographic details, physical examination details, management history (with pirani severity scoring system as initial assessment and post-treatment evaluation), number of casts applied before tenotomy, and complications in the form of plaster sores and skin excoriation, blister formation, excessive bleeding after tenotomy, etc. [4-7]. Were relevant data obtained from each patient. The treatment was carried out by use of gentle manipulation of feet and serial casting of above-knee plaster casts at weekly intervals without anesthesia as recommended by ponseti. The final cast was vital in full correction and prevention of early recurrence as the foot was abducted to 70 degrees without pronation (through combination of abduction, extension and eversion movements). In case varus deformity of the heel was corrected, and there was still equinus remaining after adduction of the feet, a simple percutaneous achilles tenotomy was done under local anesthesia [8-14]. Following the tenotomy, a second above-knee cast with the knee flexed at 90 was applied and maintained during three weeks to provide tendon healing. Since the tenotomy wound was small (less than 0.5 cm), and it was percutaneously done and essentially unsutured, the cast was not made with a window. After cast removal, relapse was prevented with the help of denis-browne bar and shoes (d-b splint). The d-b splint was either worn all the time (day and night) or a minimum of 23 hours a day during the first three months, and thereafter 12 hours at night and 2-4 hours during the day, to add up to 14 to 16 hours out of any 24 hours [15-19]. The routine was maintained till the age of 3 to 4 years. Patients were followed up on weekly basis during the first stages of treatment. Follow-up visits were made monthly during the first three months after the application of the d-b splint, followed by visits every three months until the child attained the age of 3 years. The parents were to bring the child in follow-ups after every 6 months to 1 year until the child attained the age of 5 years, and every 1-2 years until skeletal maturity was attained. The result was measured by pirani score which was the main variable of the study to measure the extent of correction. The pirani score assesses six clinical findings- three midfoot and three hindfoot [20,21]. Each sign has a grade of 0-3. A pirani score of 0 is a normal foot, 3 is a moderately abnormal foot and 6 is a severely abnormal foot. The end result in our study was classified as either excellent, good or poor. A pirani score of 0 was deemed excellent, a score of

0.5 to 1 was good and a score of more than 1 was deemed poor. Good and excellent results were linked with effective management whereas poor results were related to a failure of treatment and such patients were suggested to undergo additional surgical exploration.

Results

This study involved an analysis of the distribution of pirani scores in rigid and non-rigid clubfoot deformities in 150 feet as illustrated in table 1. Out of 87 rigid type feet, 62.07 percent (54 feet) had a pirani score of 6, and 62.07 percent (54 feet) of rigid feet received the highest category of severity. A lesser percentage, 5.75 (5 feet) had a pirani score of 5 indicating moderate deformity. Of the non-rigid feet (n=63), a small proportion, 19.05% (12 feet) had a severe pirani score of 6, with most, 50.79% (32 feet) being assigned a pirani score of 5.5. The remaining feet demonstrated a lesser degree of lower pirani scores with 0% of non-rigid feet having the lowest category. The treatment result of the 150 feet was also analyzed as demonstrated in table 2. Success rate was very high, 44 percent (66 feet) of the feet had an excellent result (pirani score 0), which means a fully corrected foot. An excellent result was obtained in 62.07 percent (54 feet) in the rigid type, whereas only 19.05 percent (12 feet) of the non-rigid feet got an excellent result. An overall good result (pirani score 0.5 - 1) was observed in 26.67 percent (40 feet) of all feet, 21.84 percent (19 feet) of rigid type and 33.33 percent (21 feet) of non-rigid type. There were poor outcomes (pirani score > 1) in only 12.67% (19 feet) with 16.09% (14 feet) in the rigid type and 7.94% (5 feet) in the non-rigid type. Table 3 shows the distribution of the pirani score in more detail. Of the rigid type feet, 48.28 percent (42 feet) had a pirani score of 0.5 which represents moderate correction. Within the non-rigid group, 76.19 percent (48 feet) had a pirani score of 0, indicating a major correction. This emphasizes the need of early and regular treatment with the ponseti method. Finally, table 4 assessed the cost analysis of clubfoot treatment. The calculated total cost of treating 150 patients amounted to usd 8,250, of which most of the expense was taken up by the plaster and hospital charges, then tenotomy and d-b bar shoes. The cost of treatment used indicates how comprehensive the treatment given is but the outcome shows that ponseti technique is an effective and cost-efficient way of treating clubfoot deformities.

Table 1: pirani score distribution in rigid and non-rigid clubfoot deformities (n=150)

Pirani score	Rigid type (no. = 87)	Non-rigid type (no. = 63)	Total feet (no. = 150)
06	54 (62.07%)	12 (19.05%)	66 (44%)
5.5	20 (22.98%)	32 (50.79%)	52 (34.67%)
05	5 (5.75%)	6 (9.52%)	11 (7.33%)
4.5	5 (5.75%)	0 (0%)	5 (3.33%)
04	3 (3.44%)	3 (4.76%)	6 (4%)
3.5	0 (0%)	2 (3.17%)	2 (1.33%)
03	0 (0%)	2 (3.17%)	2 (1.33%)

Table 2: outcome distribution based on pirani scores in rigid and non-rigid clubfoot types (n=150)

Result	Rigid type (no. = 87)	Non-rigid type (no. = 63)	Total feet (no. = 150)
Successful			
- **excellent** (pirani score 0)	54 (62.07%)	12 (19.05%)	66 (44%)
- **good** (pirani score 0.5 - 1)	19 (21.84%)	21 (33.33%)	40 (26.67%)
Unsuccessful			
- **poor** (pirani score > 1)	14 (16.09%)	5 (7.94%)	19 (12.67%)

Table 3: pirani score distribution in rigid and non-rigid clubfoot types (n=150)

Pirani score	Rigid type (no. = 87)	Non-rigid type (no. = 63)	Total feet (no. = 150)
1.5	5 (5.75%)	0 (0%)	5 (3.33%)
1.0	10 (11.49%)	0 (0%)	10 (6.67%)
0.5	42 (48.28%)	15 (23.81%)	57 (38%)
0	30 (34.48%)	48 (76.19%)	78 (52%)

Table 4: cost breakdown for clubfoot treatment per patient and total cost for 150 patients

Items	Cost per patient (usd)	Total cost for 150 patients (usd)
Plaster & others & hospital charge	75	75 * 150 = 3,750
Tenotomy	35	35 * 150 = 1,650
D-b bar shoes	40	40 * 150 = 2,850
Total cost	**150**	**150 * 150 = 8,250**

Figure 1: pirani score distribution analysis, rigid vs non-rigid clubfoot deformities (n=150)

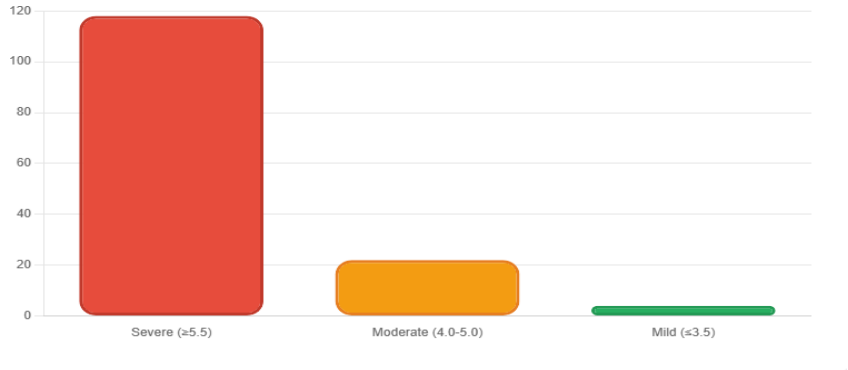
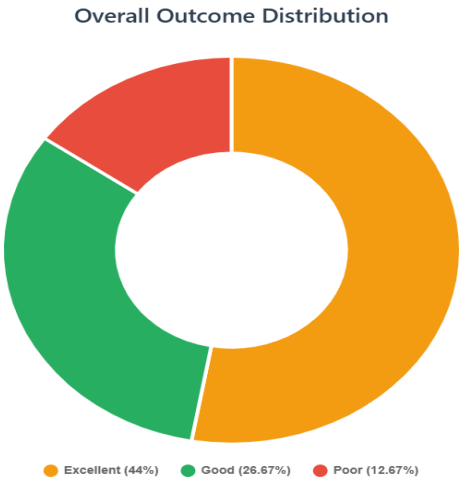


Figure 2:treatment outcome analysis, pirani score results - rigid vs non-rigid clubfoot (n=150)



Discussion

The process of correction of congenital talipes equinovarus (ctev) deformity requires careful and long-term work of both the health professional and the parents. The major goal of therapy is to lessen or eradicate the deformities, and the patient must end up with a functional, pain-free, plantigrade foot with excellent motion that does not require modified footwear or calluses [1-5]. Ponseti method of correcting ctev consists of serial corrective casts, after which correction is maintained by long term wearing of braces. It is important that treatment should start as early as possible, and monitoring should be carried out constantly during the process. Ponseti method shows a satisfactory anatomical and functional result and offers a simple, effective, minimally invasive, and cost-effective treatment that is versatile and can be applied to different regions and cultures [6-11]. This is backed up in the literature where it is seen that the earlier the treatment is undertaken the better the outcome would be preferably due to commencing treatment immediately after birth. The mechanisms that cause the clubfoot deformities operate during the 12th to 20th fetal life and its effects are seen on the foot until the child is 3 to 5 years old. In our series, over fifty percent of the ctev patients came in during the neonatal period and this is an indication of the rising awareness of the disease by the parents. Our study pirani score mean before treatment was similar to other studies published previously. The mean plaster casts per foot in our research was 3.75 that is quite low as compared to other research probably because our research concentrated on neonates alone. Also our study and others have demonstrated uniformly that rigid feet take more casts than non-rigid feet to correct the deformity. Percutaneous tenotomy was necessary in 86.2 percent of the feet (35 rigid and 15 non-rigid) in our study [12-18]. This is in line with other study results, in which tenotomy was needed in a considerable number of cases. In severe deformities tenotomy is usually necessary. Studies have shown that feet that take several casts to correct the position are feet that have high chances of further surgery in future. Due to the fact that our study involved exclusively neonates and early start of treatment, tenotomy was required less often. We have shown a high success rate (96.6

percent) in the treatment of ctev with the low complication rate. Only a single neonate that had rigid feet needed postero-medial release (pmr) later on. The outcomes satisfied all the parents of patients whose corrections were successful. In associated studies success has been between 78-96.7 percent. The most difficult parts about the ponseti technique are the compliance with bracing protocol. Parents participating in our study stated that the initial two or three days were the worst, because the patients were irritable, and tried to take off the splint. But following this initial adaptation phase, the patients got more adaptive to the splint. We agree with other researchers that successful outcome of ponseti technique relies heavily on accurate and rigid usage of the brace. Informing the parents about the necessity of bracing and possible consequences of improper bracing can also help a lot in increasing the compliance. The other problem that we experienced in our study was follow-up [17-21]. Despite the necessity of the initial foot correction, a few parents develop a wrong idea that the hard phase of treatment is over, which results in the sporadic follow-up visits. To work on this, we motivated the parents and their families to remain adherent to the follow-up process. There were no patients who dropped out of the treatment protocol; however, the follow-up of one of the patients was irregular. But this patient later on needed further operation. In line with other researchers, we observed that this mode of treatment is highly cost-effective as the benefits are huge as compared to the cost, which is relatively low.

Conclusion

Ponseti technique is a highly successful, less invasive and cheap method of correcting congenital talipes equinovarus (ctev) among infants. The present study indicates the great effectiveness of the ponseti method with a success rate of 96.6% and low rate of complications. This non-surgical management consisting of gentle manipulation of the feet, serial casting, and long-term bracing has produced great anatomical and functional results. Such outcomes are aligned with the current body of literature on the topic that emphasises the need to start treatment as early as possible, preferably at birth, in order to achieve the most favourable outcomes. The result of our study agrees with the past research, indicating that rigid feet usually necessitate additional casts and tenotomy in comparison to non-rigid feet. The fact that our study had a relatively low number of casts (3.75 on average) especially because of concentrating on neonates emphasizes the efficacy of early intervention. Moreover, the proportion of feet that needed percutaneous tenotomy was as high as 86.2%, which is why early intervention is essential in order to minimize the number of invasive procedures. This is opposed to other reports where more percentages of patients were in need of tenotomy indicating that the treatment of neonates solely and early onset treatment can greatly reduce the necessity of tenotomy. Bracing protocol is an essential success factor of the ponseti technique. In our study we have put emphasis on the fact that the compliance with proper bracing is key in preventing the recurrence and ensuring long-term correction. By instructing the parents about the necessity of the brace and possible complications of poor bracing, one can achieve significantly better results with patients. Despite a couple of issues associated with follow-up visits, the majority of parents in our study followed the treatment plan. But the ones that did not, eventually needed another operation which clearly shows that it is imperative to have a follow up in order to make sure that the correction is not lost and to prevent any complications. The ponseti technique is effective, reliable, and cost efficient in the management of ctev in neonates; it has high success rates and few complications. It is an effective therapy which could be implemented in different medical care backgrounds, even where surgical

facilities are restricted, and is essential in allowing the caregivers to give the best attention to the young ones with congenital clubfoot deformities.

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