Original Article

POSI
IJPO

The Evaluation of Deformity Correction in Idiopathic Clubfoot During Ponseti Casting Sessions: Two Scoring Methods Depicted Graphically

Anil Agarwal[MS Ortho.][1], Prateek Rastogi[MS Ortho.][2]

Abstract

Background: We graphically analyzed correction of total Pirani and Dimeglio scores and their subcomponents at sequential casting sessions for children with idiopathic clubfeet.

Methods: Correction of scores at weekly sessions was represented graphically. Tenotomy effect was accounted for separately. We classified 1st to 3rd casts as early, 4th and 5th cast midlevel and beyond 5 as final casts to describe casting treatment.

Results: A total of 88 clubfeet (34 bilateral) in 54 patients were studied. Both total Pirani and Dimeglio graphs were characterized by a steep fall in early casts; subsequent minimal improvement in midlevel and final casts; later marked correction with tenotomy. Equinus in both scores stood as the most resistant deformity, showing full correction only following tenotomy. Dimeglio graphs captured coupling of various foot motions better than Pirani graphs during the "early casting" phase.

Conclusions: Both Pirani and Dimeglio scores can adequately guide caregivers to progressive deformity correction in clubfoot.

Keywords: Clubfoot, CTEV, Pirani, Dimeglio, Scores, graphs

Dr. Anil Agarwal

Dr. Prateek Rastogi

Address of Correspondence
Dr. Anil Agarwal
4/103, East End Apartments, Mayur Vihar Ph-1 Ext., Delhi-110096, India.
E-mail: rachna_anila@yahoo.co.in

[1]Department of Paediatric Orthopaedics, Chacha Nehru Bal Chikitsalaya, Geeta Colony, Delhi, India.
[2]Department of Orthopedics, Sharda Medical College, Greater Noida, Uttar Pradesh, India.

DOI- 10.13107/ijpo.2021.v07i02.106 | www.ijpoonline.com

Introduction

Graphical representation of deformity correction in idiopathic clubfoot during casting sessions is a well-established practice [1-6]. The visual record can readily differentiate a typical from an unusual course. Besides indicating the requirement of Achilles tenotomy, the subcomponents can be easily understood from the illustrations [5].

There are two widely accepted scoring methods for idiopathic clubfoot-Pirani and Dimeglio [7, 8]. Both have ample inter and intra-observer reliability. The training manual on Ponseti clubfoot management has described the progression of Pirani score during Ponseti casting sessions [2]. Graphical illustrations are used to highlight typical, resistant, cast off early and relapse patterns. Lampasi et al further elaborated the graphic representation of temporal variations in Pirani score and its individual subcomponents during clubfoot treatment [5]. Similar graphs for the Dimeglio scores were described by Chaudhry et al and Lampasi et al [3,4].

To be meaningful, the graphical representations for both scores should depict deformity correction in a similar manner. The aim of this study was to graphically analyze and compare the correction of both scores and their subcomponents at sequential casting sessions for our clubfoot population.

Submitted: 28 August 2020; Reviewed: 22 October 2020; Accepted: 15 December 2020; Published: 10 May 2021

Methods

A prospective study (March-December 2019) was conducted at a clubfoot clinic located in the suburb of a low-income country. Institutional ethical clearance and parental informed consent were obtained for the study. We included children up to 2 years of age with idiopathic clubfoot wherein deformity correction was done using the Ponseti technique. Patients with previous surgical intervention, syndromic or neurogenic clubfoot were excluded.

All enrolled patients were offered treatment at the weekly sessions by an experienced pediatric orthopaedic fellow trained in Ponseti technique. At each session, prior to casting, both Pirani and Dimeglio scores were recorded. Percutaneous Achilles tenotomy to correct equinus was performed when the talar head was reduced (midfoot score <1) and ankle dorsiflexion obtained was less than 10 degrees [2].

The Pirani score accounts for 6 components of deformity [7]. These are medial crease, curvature of lateral border of the foot, coverage of lateral head of talus, posterior crease, empty heel and rigid equinus. Each component is graded as 0, 0.5 or 1 based on increasing severity. Thus, a maximum of score of 6 indicates a very severe deformity whereas score 0 represents a corrected foot. There are two sub-scores for the Pirani system. Medial crease, curvature of lateral border of the foot and coverage of lateral head of talus are grouped together as midfoot score to quantify forefoot and midfoot contractures. Posterior crease, empty heel and rigid equinus are included in the hindfoot score.

The Dimeglio score has 4 major and 4 lesser individual components [8]. Equinus, heel varus, rotation of calcaneo-forefoot block, and forefoot adduction are considered major components and assessed on a 4-point scale: reducibility of 90 to 45 degrees= 4 points, reducibility of 45 to 20 degrees= 3, rreducibility of 20 to 0 degrees = 2, reducibility of 0 to -20 degrees = 1 and reducibility of <-20 degrees = 0. Medial crease, cavus, posterior crease, and abnormal musculature being lesser components, are scored as dichotomous 1 or 0. The maximum combined Dimeglio score can be 20 points indicating the stiff and severe variety of clubfoot. The 4 lesser components of the Dimeglio system were not plotted individually in our study as their graphs were not very informative because of the minor values (0 or 1). Their combined effect was, however accounted for in the total Dimeglio score graph.

Previous observers have plotted the temporal variations in the scores or their subcomponents against the cast number required for deformity correction [3-5]. This led to multiple plots in a single graph. We used a slightly different method for our graphs [6]. At each casting session, the mean total score (Pirani or Dimeglio) or mean of individual components was determined. It was then sequentially plotted to obtain a trend line against the number of casts. Post-tenotomy, the foot's count and its score were excluded from the graph calculations e.g., at the fourth casting session, if 3 feet underwent tenotomy, both their number count and the corresponding post-tenotomy score was excluded from the data point of the fifth session. The post-tenotomy total or score of the component for all feet was then averaged and placed as the last data point on the right side of the graph to record approximate influence of Achilles tenotomy. Further, we classified 1st to 3rd casts as early, 4th and 5th cast midlevel, and beyond 5 as final casts to better describe the two scores.

Results

A total of 88 clubfeet (34 bilateral) in 54 patients fulfilled our inclusion criteria. The average patient age at the time of enrollment was 59.8 ± 70.6 days. The average pretreatment Pirani and Dimeglio scores were 5.4 (range, 1.5-6) and 13.3 (range, 4-20) respectively. All feet underwent percutaneous Achilles tenotomy. Post tenotomy, the two scores reduced to 0.1 (0-1) and 0.2 (0-3) respectively. Average 3.1 ± 1.2 (range, 1 to 6) casts were used pre-tenotomy for deformity correction.

Pirani score graphs

Among the individual midfoot Pirani components, a rapid correction was noted in early casts. There was slow improvement in midlevel casts. There was no effect of tenotomy for this subgroup. Curved lateral border was already fully corrected by midlevel casts.

The hindfoot components were only partially corrected till final casts, but showed marked improvement following tenotomy. Rigid equinus was an exception and showed almost no improvement even until final cast but rapid correction followed tenotomy. When various Pirani components were plotted together (Figure 1), rigid equinus clearly stood as the most resistant deformity and also the last one to correct. Curved lateral border was the earliest deformity to correct. The

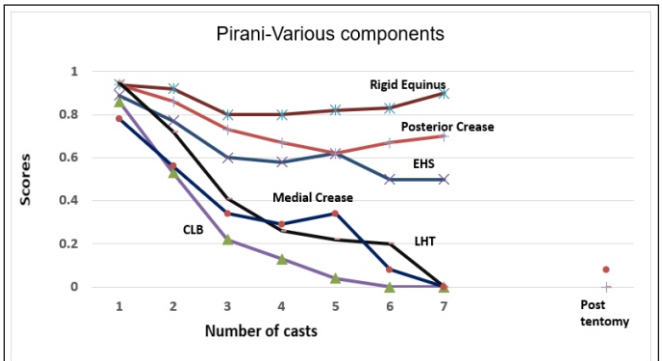

Figure 1: Pirani: Various components. Rigid equinus was the most resistant and last to correct. Curved lateral border was the earliest deformity to correct. LHT: coverage of lateral head of talus; EHS: empty heel; CLB: curved lateral border of foot

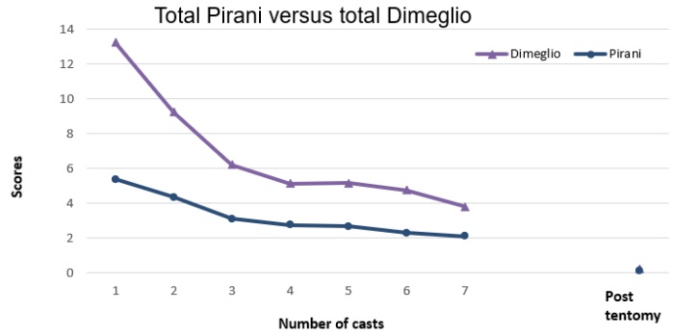

Figure 2: Pirani versus Dimeglio scores: Total. There was more rapid improvement in Dimeglio scores when compared to Pirani scores in early casts. Both score remained static or showed minimal improvement in midlevel and final casts. Both showed correction post-tenotomy.

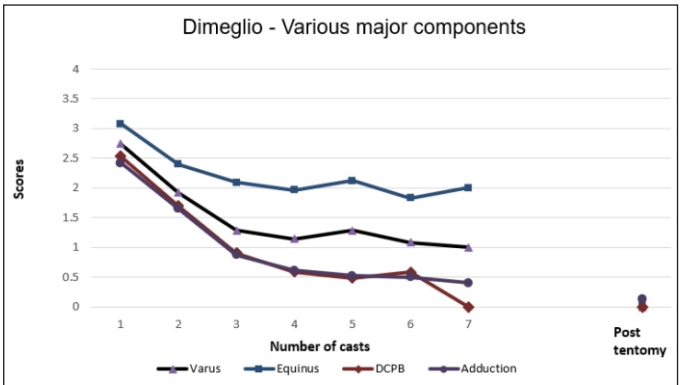

Figure 3: Dimeglio: Various major components. Equinus was the most severe deformity which persisted till final casts. For adduction and derotation of calcaneo-pedal block (DCPB), considerable correction was noted in early casts and then improvement slowed down.

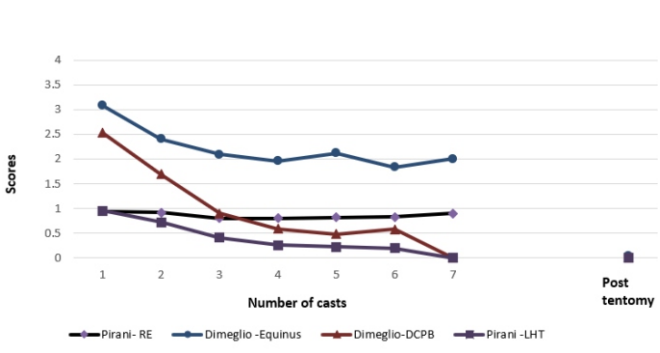

Figure 4: Comparison of Pirani's RE and Dimeglio's equinus; Pirani's LHT and Dimeglio's DCPB. Dimeglio graphs were at slight advantage to bring out the coupling of various foot motions and gradual correction occurring in ankle equinus even in early stages.

overall trend for total Pirani scores (Figure 2), showed rapid correction in early but a static pattern in midlevel and final casts. There was rapid improvement following tenotomy in the total score.

Dimeglio score graphs

The major components of Dimeglio score showed correction in early but remained static in midlevel and final casts. There was significant improvement post-tenotomy in all these components. Derotation of calcaneo-pedal block was an exception with main correction in early, static in midlevel and complete correction by final casts. There was no effect of tenotomy for this component. A combined plot of various major Dimeglio components (Figure 3) showed equinus as the most severe and persistent deformity. Adduction and derotation of calcaneo-pedal block were earliest to improve. The overall trend for total Dimeglio scores incorporating its lesser components as well (Figure 2), showed rapid correction in early but a static pattern in midlevel and final casts. There was rapid improvement following tenotomy in the total score.

Total Pirani versus Dimeglio scores

Both scores demonstrated a similar trend with steep fall noted in early casts; static or minimal improvement in midlevel and final casts. There was marked correction with tenotomy (Figure 2). For ankle equinus, Dimeglio-equinus component brought out the gradual correction occurring in early casts more precisely than Pirani-rigid equinus which showed a rather abrupt correction post-tenotomy (Figure 4).

Discussion

Principal findings

Both Pirani and Dimeglio scores, although widely used for recording and monitoring corrections in idiopathic clubfoot, differ considerably in their deformity components and quantification of severity. Despite the divergence, an interesting finding was the overall graph similarity of the total scores over successive casting sessions (Figure 2). A steep fall in early casts; subsequent static or minimal improvement in midlevel and final casts; later complete correction with tenotomy characterized both graphs.

Other major components which showed similar graphs were coverage of lateral head of talus (Pirani) with derotation of calcaneo-pedal block (Dimeglio). Both these components had significant correction in early casts, remained static in midlevel followed by a complete correction in final casts. Rigid equinus in the Pirani score was also somewhat similar to equinus in the Dimeglio system, although less sensitive during early casts (Figure 4). Equinus in both scores stood as the most resistant deformity, showing full correction only following tenotomy.

Results compared with literature

In an Italian study, Lampasi et al plotted Pirani score versus number of casts required for monitoring correction of 79 clubfeet in 47 children treated with Ponseti method [5]. The average patient's age for their study was 30.6 days. Mean number of casts required was 4.4. Tenotomy was performed in 85% of feet. Their key observations were a minimal improvement in hindfoot score and its subcomponents during initial casting sessions and then a rapid correction following tenotomy. In supple feet requiring less than 6 casts, rigid equinus corrected partially through casting, but the greatest improvement was following tenotomy. Among midfoot components, medial crease improved in early casts. Curvature of lateral border of the foot and coverage of lateral head of talus improved more gradually. Overall Pirani score showed an early improvement followed by late correction after tenotomy.

Chaudhry et al studied 185 feet in 123 patients treated with Ponseti method [3]. The mean patient age was 15.3 days and average treatment casts required were 5.1. Achilles tenotomy was performed in 58% of clubfeet. In another study, Lampasi et al investigated 124 idiopathic clubfeet in 77 patients [4]. The mean patient age was 31 days at initiation of treatment and average 4.4 casts were required. Achilles tenotomy was necessary in 85.5% of clubfeet. Both these studies plotted mean Dimeglio score and its components against total casts required for treatment. Their graphs revealed that all four major score components: derotation of calcaneo-pedal block, forefoot adduction, heel varus and equinus corrected simultaneously and gradual improvement progressed throughout the treatment course. Equinus showed marked improvement in last two casts or corresponded in most cases with Achilles tenotomy.

Our study plotted both Pirani and Dimeglio score for the same subset of idiopathic clubfeet. The findings that foot motions are coupled together and correct simultaneously while under Ponseti manipulation is echoed by our study. Dimeglio-equinus graph revealed that even ankle equinus undergoes gradual correction starting from the first cast, progressing somewhat in early casts, then plateaus followed by a major correction post-tenotomy.

Clinical implications

The initial clubfoot deformities, their subsequent recovery in serial casting sessions and the effect of tenotomy could be readily judged from the plotted graphs. By the virtue of our study design, we could compare the individual components and overall scores for our patients. Both Pirani and Dimeglio score can adequately guide the caregiver to progressive deformity correction in idiopathic clubfoot. Ankle equinus emerged as the rate limiting component for both scores. Dimeglio graphs captured coupling of various foot motions and correction of deformity (e.g., ankle equinus; Figure 4) better over early casts rather than Pirani graphs.

Research implications

The graphs for the scores could be standardized over a wider population base and used similar to growth charts in children to monitor deformity correction in idiopathic clubfoot. Availability of mobile applications can quickly project and compare graphs for the individual patient with the reference graphs. The graphs can have extended use as a quality control guide for beginners undergoing training in clubfoot casting, as well as a patient education tool.

Limitations

A limitation of this study was that it was not blinded. Additionally, initial deformity correction was chosen as the endpoint and recurrence in the long term was not available. The lesser Dimeglio components with dichotomous value were not analyzed as separate graphs; however, their contribution was accounted for in the total Dimeglio score. Additionally, there was statistical limitation of using means of the scores/components as data points as they may not be true representative of the whole cohort. One may find the succeeding data points to be higher than preceding points on some graphs (e.g., Figure 1). This effect was because of exclusion of case number and their scores from the calculations post-tenotomy. The data points on the right side of graphs may therefore represent more severe/stiff type of clubfeet utilizing more number of casts for their correction. However, this graphic method did provide a single trend line which was relatively easy to interpret and compare than multiple lines as used by previous researchers [3-5].

Strengths

Evaluation and treatment were carried out by a single trained pediatric orthopedic fellow, eliminating interobserver variation. Both scores were applied prospectively on the same group of children ensuring uniformity of assessment and treatment.

Conclusions

The initial clubfoot deformities, their subsequent recovery in serial casting sessions and the effect of tenotomy can be readily judged from graphical plots. Both Pirani and Dimeglio scores can adequately guide the caregiver to the progression of deformity correction in idiopathic clubfoot. Dimeglio graphs captured coupling of various foot motions and correction of deformity better than Pirani graphs during early casting.

Declaration of patient consent: The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given his consent for his images and other clinical information to be reported in the Journal. The patient understands that his name and initials will not be published, and due efforts will be made to conceal his identity, but anonymity cannot be guaranteed.

Conflict of interest: Nil; **Source of support:** None

References

1. Staheli L. Clubfoot: Ponseti management. Seattle, WA: Global HELP; 2009.

2. Pirani S, Naddumba E, Staheli L. Ponseti Clubfoot management: Teaching manual for healthcare providers in Uganda. Seattle, WA: Global HELP; 2008.

3. Chaudhry S, Chu A, Labar AS, Sala DA, van Bosse HJ, Lehman WB. Progression of idiopathic clubfoot correction using the Ponseti method. J Pediatr Orthop B. 2012;21: 73-78.

4. Lampasi M, Trisolino G, Abati CN, Bosco A, Marchesini Reggiani L, Racano C, et al. Evolution of clubfoot deformity and muscle abnormality in the Ponseti method: evaluation with the Dimeglio score. Int Orthop. 2016;40:2199-2205.

5. Lampasi M, Abati CN, Stilli S, Trisolino G. Use of the Pirani score in monitoring progression of correction and in guiding indications for tenotomy in the Ponseti method: are we coming to the same decisions? J Orthop Surg (Hong Kong). 2017;25:2309499017713916.

6. Agarwal A, Shanker M. Temporal variation of scores along the course of the Ponseti treatment in older children: A ready guide to progress of treatment. J Pediatr Orthop. 2020;40:246-250.

7. Pirani S, Outerbridge HK, Sawatzki B, et al. A reliable method of clinically evaluating a virgin clubfoot evaluation. In: Proceedings of the 21st SICOT World Congress, Sydney, Australia, 18-23 April 1999.

8. Diméglio A, Bensahel H, Souchet P, Mazeau P, Bonnet F. Classification of clubfoot. J Pediatr Orthop B. 1995;4:129-136.

How to Cite this Article

Agarwal A, Rastogi P | The Evaluation of Deformity Correction in Idiopathic Clubfoot During Ponseti Casting Sessions: Two Scoring Methods Depicted Graphically | International Journal of Paediatric Orthopaedics | May-August 2021; 7(2): 12-16.