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ORIGINAL ARTICLE

Prospective Analysis of Relapse Patterns in Clubfoot Treated with the Ponseti Technique in Peshawar, Pakistan

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Author`s Contribution

[1]Substantial contributions to the conception or design of the work for the acquisition, analysis or interpretation of data for the work, [2] Drafting the work or reviewing it critically for important intellectual content, [3] Final approval of the version to be published, [1 2 3] Agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Article Info.

Received: March 02, 2024
Acceptance: July 15, 2024

Conflict of Interest: None
Funding Sources: None

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Cite this article as: Manzoor, Ullah U, Shah A. Prospective Analysis of Relapse Patterns in Clubfoot Treated with the Ponseti Technique in Peshawar, Pakistan. JRCRS. 2024;12(3):149-153.
https://dx.doi.org/10.53389/JRCRS.2024120308

A B S T R A C T

Background: Clubfoot relapse is a common occurrence following the Ponseti technique, potentially progressing from flexible to rigid deformity if untreated.

Objective: This study aimed to analyze the patterns of relapse observed in clubfeet treated with the Ponseti method.

Methodology: A prospective study involving 250 patients were conducted at the clubfoot department in Peshawar. Patient data, including age, initial Pirani score, number of casts required, gender, and affected foot, were taken from hospital records. Statistical analysis was performed using SPSS version 22, with significance set at a p-value of less than 0.05.

Results: The study involved 151 cases of bilateral relapse clubfoot and 99 cases of unilateral relapse clubfoot. Patients with bilateral relapse clubfoot had a mean age of 11.20 days, whereas those with unilateral relapse clubfoot had a mean age of 9.60 days. The mean Pirani score for bilateral relapse clubfoot was 5.67, slightly higher than the score of 5.5 for unilateral cases. On average, patients with bilateral relapse clubfoot required 6.4 casts, while those with unilateral relapse clubfoot needed slightly fewer casts, with a mean of 6.3. Analysis of relapse patterns revealed similar trends in both groups, with decreased ankle dorsiflexion (DF) up to neutral, dynamic forefoot adduction/supination, and rigid equinus being the most common patterns observed.

Conclusion: This study identified five distinct subsets for classifying relapsed clubfoot deformities such as decreased ankle dorsi-flexion (DF) (28.1%), Rigid Equinus (16.8%), Dynamic forefoot supination/adduction (34.4%), fixed adduction of midfoot and forefoot (9.98%), and complete relapse pattern (10.9%). Early identification and intervention of relapses are crucial to mitigate the need for major soft tissue surgeries.

Keywords: Clubfoot, Ponseti Method, Relapse Pattern.

Introduction

Over the past decade, the Ponseti management has gained significant attractiveness for its extraordinary achievement rate of more than 90% in achieving initial improvement of clubfoot deformity.[1-3] However, despite its effectiveness, relapses are common, with prevalence rates between 10% and 30%.[4-7]

Many authors often described "relapse" as any foot demanding additional treatment following improvement with the Ponseti method.[8-10] Other used the terms, such as adductus (A), varus (V), equinus (E), or combinations thereof, to define the relapsed foot morphology. A few utilized scoring systems like Pirani or Dimeglio scoring system to level the severity of relapse.[4-7] Various factors responsible for relapse were; non-compliance to FAbB, low level of parents' education, stretching exercises, initial Pirani score, and high initial Pirani score.[11] Additionally, clubfoot relapses had been categorized as minor or major, conditional on the range of invasive surgeries essential.[12]

Nevertheless, a standardized and definitive classification for grading clubfoot relapses after Ponseti management is currently lacking. Research findings have unveiled a discernible pattern in the relapse progression of clubfeet treated using the Ponseti method. Primarily, relapses often apparent as supple defects attributed to muscle discrepancies, causing in dynamic defects. However, without rapid treatment, these dynamic defects can switch into static or rigid conditions. Furthermore, this relapse pattern may also be predisposed by the use of FABs, which contain a key element of Ponseti Technique till the age of 3 to 4 years.[1, 13-16]

Accepting the patterns of relapse in clubfeet cured with the Ponseti procedure was essential for improving long-term results in Peshawar, Pakistan. Regardless of initial positive improvement, relapse persevere a major challenge, resulting to functional restrictions and lessened quality of life for affected persons. By studying relapse patterns, therapists might adapt post-treatment procedures to lessen its manifestation, assign healthcare assets more proficiently, and participate in mutual decision-making with patient families. Thus, the main aim of this study was to examine the relapse pattern succeeding Ponseti technique for idiopathic clubfoot and introduce a simple classification structure to group these feet.

Methodology

This prospective study was completed between December 2018-December 2023, emphasized on babies facing relapse clubfoot afterward one year of Ponseti treatment, including both uni-lateral and bi-lateral clubfoot. The study was ethically approved by Khyber medical university (DIR/KMU-AS&RB/PR/001967).

Exclusion criteria comprised cases lacking regular follow-up and adherence to brace protocols, as well as those with Syndromic, neurogenic, atypical, or non-Ponseti-treated clubfoot. Out of 1100 patients treated at the clubfoot department, 950 met the inclusion criteria, having received Ponseti management at Lady Reading Hospital Peshawar and utilized foot abduction braces. The remaining 150 patients were excluded due to Syndromic or neurogenic clubfoot. So, total sample size was 250.

Follow-up for at least one year post-Ponseti treatment completion was conducted for all fully corrected clubfoot deformities. Relapse was defined as Pirani scores greater than zero during follow-up.[11] Detailed histories were obtained from parents regarding deformity onset and treatment history, with general examinations conducted to rule out Syndromic and neurogenic clubfoot.

Analysis included initial treatment records, such as age at first presentation, initial Pirani score, number of corrective casts, and tenotomy. We conducted separate analyses for both bilateral and unilateral groups. Each patient underwent assessment for various deformities, including relapses in the forefoot or hindfoot, dynamic or fixed deformities, and the mobility of the ankle and foot. Furthermore, we evaluated the pattern of relapse concerning static deformities, such as equinus, varus, adduction, and cavus, in addition to dynamic supination.

Objective measures of brace compliance were lacking, thus reliance was placed on parental reports. Relapsed cases underwent repeated Ponseti casting followed by foot abduction orthosis (FAO). Weekly cast applications were supervised in the clubfoot clinic using the Ponseti classical two-hand technique.

SPSS 22 version was used for descriptive and statistical analysis using chi-square test. P-value less than 0.05 was taken as significant.

Results

Among the 950 included children, 250 experienced relapse, with 151 cases exhibiting bilateral clubfoot relapse and 99 cases showing unilateral clubfoot relapse. The average age of those with bilateral relapse was 11.20 days, while for unilateral relapse, it was 9.60 days. The mean Pirani score for bilateral relapse was 5.67, compared to 5.5 for unilateral relapse. In terms of total casts required, bilateral relapse averaged 6.4 casts, while unilateral relapse averaged 6.3.

Variables	Side	*n*	Mean	*P*-value	Significance
Age (days)	B/L	151	11.20	0.69	No
U/L 99	9.60				
Initial Pirani score	B/L	151	5.67	0.05	Yes
U/L 99	5.5				
Cast required	B/L	151	6.4	0.60	No
U/L 99	6.3				

Regarding gender distribution, among bilateral relapse cases, there were 116 males and 35 females, constituting 76.8% and 23.2% of total cases, respectively. For unilateral relapse, there were 69 males and 30 females, making up 69.7% and 30.3% of total cases, respectively. Initial Pirani score showed significance, while gender, age, and number of casts required did not.

Table II illustrates the distribution of relapse patterns in bilateral and unilateral clubfoot, along with the total number of cases for each relapse type. In bilateral clubfoot, the percentages for various relapse patterns were: decreased ankle dorsi-flexion (DF) up to neutral (28.1%), Rigid Equinus (16.8%), Dynamic forefoot supination/adduction (34.4%), fixed adduction of midfoot and forefoot (9.98%), and complete relapse pattern (10.9%). In the unilateral group, these percentages were: decreased ankle dorsi-flexion (DF) up to neutral (32.4%), Rigid Equinus (14.4%), Dynamic forefoot adduction/supination (34%), fixed adduction of forefoot and midfoot (10.4%), and complete relapse pattern (8.8%). Statistical analysis yielded a p-value of 0.850, indicating that relapse patterns were not significant.

Table II: Relapse pattern.

Relapse pattern	B/L	U/L	Total
Decreased ankle DF			
Count	43	38	81
% within side	28.1%	38.5%	32.4%
Rigid Equinus			
Count	25	11	36
% within side	16.8%	1.1%	14.4%
Dynamic forefoot adduction/supination			
Count	52	33	85
% within side	34.4%	33.3%	34%
Fixed adduction of fore-foot and mid-foot			
Count	15	11	26
% within side	9.98%	11.1%	10.4%
Complete Relapse			
Count	16	6	22
% within side	10.9%	6.06%	8.8%
Total	**151**	**99**	**250**

Discussion

The Ponseti management for clubfoot modification had significantly reduced the need for surgical interventions and the associated difficulties compared to traditional surgical approaches.[17-21] Relapses following surgical correction of clubfoot can be accompanied by skin issues, foot rigidity, bony defects, and scarring of soft tissue.[20] On the other hand, relapses after the Ponseti management are extra subtle, and the foot tends to remain supple due to minimal surgical treatment.[22] Relapse clubfoot again treated by Ponseti method in clubfoot department, however Ponseti method reduced surgical intervention and relapse in this department.

To evaluate the extent of deformity and track the progress of foot correction, the Pirani and Dimeglio scoring system had proven beneficial.[23, 24] Both scoring systems could calculate the number of casts needed the need for tenotomy and the likelihood of relapses. However, they do not account for the crucial factor of patient compliance with the FAbB, which is essential for achieving long-term successful outcomes. [8, 15, 18-27] The number of casts required for casting phase was determined by Pirani score in our study.

Currently, there is no specific classification system available to assess and rate the relapse clubfoot following Ponseti correction. Some studies had described relapse as any defect that occurs after the initiation of the FAbB and requires further treatment. One such study observed that higher initial Pirani scores were related with late relapses.[13] Another classification system divides recurrences into minor and major categories based on the need for additional surgical procedures like tendon transfers or Achilles tendon lengthening for posteromedial release.[12]

Masrouha and Morcuinde conducted a review to assess the relapse rate in clubfoot treated with the Ponseti technique after undergoing Tibialis Anterior Tendon Transfer (TATT). They defined relapse as the presentation of one or more elements of the deformity (e.g., equinus, hind-foot varus, fore-foot adduction, and cavus) that required further treatment. Among 66 children with a total of 102 clubfeet, ten children (15 feet) experienced a relapse. Out of these clubfoot, six required casting, and one clubfoot necessitated a cuboid osteotomy, while others were managed with bracing.[7]

Porecha et al. also conducted a study involving 49 children with clubfeet who were treated using the Ponseti technique and followed up for an average of five years. Among these children, 14 (28%) experienced relapses, with the main cause attributed to poor compliance with the FAbB. Recognizing and addressing relapse early on with prompt treatment was crucial for achieving the best long-term results.[28]

Despite the significance of relapse in the Ponseti technique, there exists a lack of consensus in the field due to various authors using different terms to define it. This lack of standardization makes it challenging to interpret and compare results across different studies.[29] Early relapse is typically characterized by a decrease in ankle dorsiflexion (Group I-A), where the hind-foot may lack posterior creases. In such cases, the heel may be easily palpable, leading to a lower score on the Hind-Foot Score (HFS) component of the Pirani score, potentially underestimating dynamic in-toeing. Additionally, with rigid equinus defect (Group II-A), the heel may not be entirely empty, resembling a clubfoot that has not undergone previous treatment (virgin clubfoot). In cases where the HFS score ranges between 2 or 3, there might not be a significant difference and may necessitate similar treatment approaches. It's worth noting that the HFS comprises components such as deep posterior creases, an empty heel, and decreased dorsiflexion, which might essentially capture similar information. Furthermore, not all elements of the Pirani score may carry equal weight in assessing the severity of relapse.[30]

In a study conducted by Bhaskar A et al, a total of 74 children with clubfoot (146 feet) were analyzed following treatment with the Ponseti technique. They classified relapse into five groups or grades: Grade I-A, Grade I-B, Grade II-A, Grade II-B, and Grade III. In the bilateral (B/L) group, the distribution of children across various relapse patterns was as follows: Grade IA, 28.57% exhibited reduced dorsiflexion; Grade IB, 34.58% showed dynamic adduction during walking; Grade IIA, 16.5% had fixed equinus; Grade IIB, 9.7% displayed fixed adduction;

and Grade III, 10.5% presented with both fixed equinus and adduction deformity. In the unilateral (U/L) group, the relapse patterns of Grade I-A, Grade I-B, Grade II-A, Grade II-B, and Grade III were 29.8%, 34.43%, 15.89%, 9.90%, and 9.93%, respectively.[13] These findings are similar to those observed in our study. In the B/L clubfoot group, the percentages for rigid equinus, reduce ankle dorsiflexion up to neutral, fixed adduction of midfoot and forefoot, dynamic forefoot supination/adduction, and complete relapse pattern were 28.1%, 16.8%, 34.4%, 9.98%, and 10.9%, respectively. In the U/L group, the percentages for these relapse patterns were 32.4%, 14.4%, 34%, 10.4%, and 8.8%, respectively.

One drawback of this study was its single-center, which may bind the relevancy of the results to other people or centers. The study's emphasis on babies treated at a clubfoot unit in Peshawar may also bind the applicability of the findings to wider inhabitants with diverse demographics. Additionally, the research dependence on the Pirani score only to evaluate clubfoot severity might oversee other significant medical aspects that might affect relapse patterns.

To control over these limits, implementing a multi-center method outside Peshawar and adding the Pirani scoring with Dimeglio score will enhance the assessment of clubfoot severity and management results. Lengthening follow-up period and piloting sub-group examines based on demographics would compromise deep visions into treatment efficiency and relapse patterns through diverse people. Applying these modifications would strengthen the research relevance and clinical consequence.

Conclusion

This study delivered valued understandings into the patterns and forecasters of relapse in clubfoot babies cured with the Ponseti technique. With a vigorous sample size of 151 cases of bi-lateral relapse clubfoot and 99 cases of uni-lateral, we detected separate subgroups of relapse patterns, emphasizing the difficulty of this disorder. Particularly, age, casts, and gender did not appear as major forecasters of relapse, highlighting the essential part of the initial Pirani score in prediction.

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