

Physiotherapists and Paramedics Led Decentralized Ponseti Services: An Effective Model for Low-resource Environments?

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Introduction: Idiopathic clubfoot is the most common congenital physical disability, and the Ponseti method is the gold standard for treatment. In our settings, most patients present from rural communities with no or very little access to health services. Decentralized Ponseti makes services locally available and reduces treatment costs. The present study was designed to assess whether the Ponseti technique can be transferred to physiotherapists and paramedics to make services locally available.

Methodology: This retrospective study with prospective follow-up was conducted at Hospital and Rehabilitation Centre for Disabled Children (HRDC), a non-profit pediatric orthopedic hospital in Nepal that sees over 500 club feet every year. About 60% of clubfoot are treated in one of the HRDC's four regional satellite clinics. The patient's treatment outcomes at HRDC hospital (central clinic) were compared with the patients treated at one of our Regional Rehabilitation Centers (RRCs). The study was conducted among 423 (636 feet) clubfoot cases, of which 111 (149 feet) were treated at HRDC hospital (central clinic), and 312 (487 feet) patients were treated at one of its peripheral clinics. The Pirani score, Demiglio score, Manual Muscle Test (MMT), and ankle Range of Motion (ROM) scores were used to assess and compare treatment outcomes. The initial treatment was graded as successful if a plantigrade foot was achieved without the need for an extensive soft-tissue release and/or osseous procedure. Data were analyzed in SPSS 20 version.

Results: The average age at treatment was three years (6 months to 5 years), and the average follow-up was 8 years (6 to 10 years). Sixty percent of the study participants were male. The

average Pirani scores were comparable between the patients treated at HRDC (central clinic) and those treated at Regional Rehabilitation Centers (RRCs) (table 1). An average of 7 casts were required for the deformity correction at all centers. Heel Cord Release (HCR) was required among 95 percent of patients at HRDC hospital and 97 percent at Regional Rehabilitation Centers (RRCs). A plantigrade foot was achieved in 95% (142 of 149 feet) at HRDC Hospital and 93% (453 of 487 feet) at the regional clinics. The average pre-Pirani score at HRDC, Hospital was 4.34 (3-6) and 4.52(3-6) at HRDC hospital central and Regional Rehabilitation Centres (RRCs), and post scores were 0.23(0-3.5) and 0.4(0-1.5) respectively. Ninety-four percent of the patients treated at regional centers reported being completely satisfied with the services.

Conclusion: In low and middle-income countries where many patients have little access to health services, decentralized Ponseti services through trained physiotherapists and paramedical workforce can positively impact the lives of patients with clubfoot.

Keywords: clubfoot, decentralized ponseti service, low-resources environment, paramedics.

The Ponseti method for clubfoot treatment is minimally invasive, can be successfully performed by non-surgeons (enabling task shifting or sharing),¹ is cost-effective,² and has been associated with superior clinical outcomes compared with extensive soft-tissue releases using a variety of outcome measures.³⁻⁸ Treatment of idiopathic

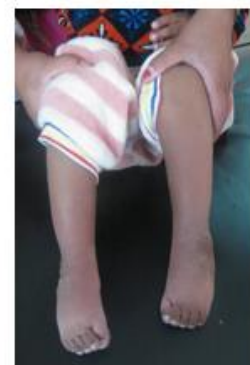
clubfoot by extensive soft tissue release is often complicated by stiffness, recurrence, and the need for additional procedures. Thus, many treatment centers have adopted the minimally invasive Ponseti method, which has achieved excellent results in economically developed and underdeveloped regions.¹⁰ Since most of our patients present from rural communities



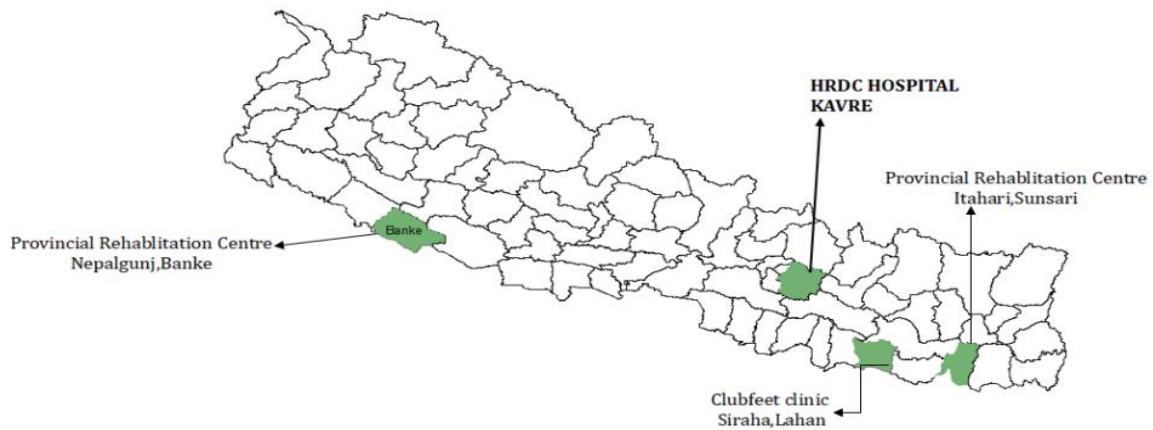
1)Before treatment



2)During treatment
Using Ponseti Method



3)After treatment



Graph 1: Decentralizing Clubfoot Services

with little access to health services, decentralized Ponseti makes services locally available and helps reduce treatment costs. The present study assessed whether the Ponseti technique could be transferred to physiotherapists and paramedics to make services locally available without compromising treatment outcomes.

Materials and Methods

A retrospective study with a prospective follow-up was conducted at the Hospital and Rehabilitation Centre for Disabled Children (HRDC). Clubfoot treatment outcomes at HRDC hospital (central clinic) were compared with those treated at one of our Regional Rehabilitation Centers (RRCs). The study was conducted among 423 (636 feet) clubfoot cases, of which 111 (149 feet) were treated at HRDC hospital (central clinic), and 312 (487 feet) patients were treated at one of its peripheral clinics (Graph 1). The Pirani score, Demiglio score, Manual Muscle Test (MMT), and

Range of Motion (ROM) were used to assess the treatment outcomes. The initial treatment was graded as successful if a plantigrade foot was achieved without the need for an extensive soft-tissue release and/or osseous procedure. Data were analyzed in SPSS 20 version. Inclusion criteria for this study were an untreated idiopathic clubfoot, less than or equal to the age of 5 years, who were treated with the Ponseti method having an initial Pirani score of more than 3. At the hospital center, Ponseti serial casting with long leg plaster of-Paris casts was performed at 5 to 7-day intervals by trained orthopedic surgeons and physiotherapists with more than 5 years of experience with the Ponseti method, and at the regional center, it was performed by physiotherapists and/or paramedics who have received at least 3 months of rigorous training on the Ponseti method at the center. Foot abduction orthosis was prescribed until 5 years of age, or for older children, until 3 years after treatment completion.

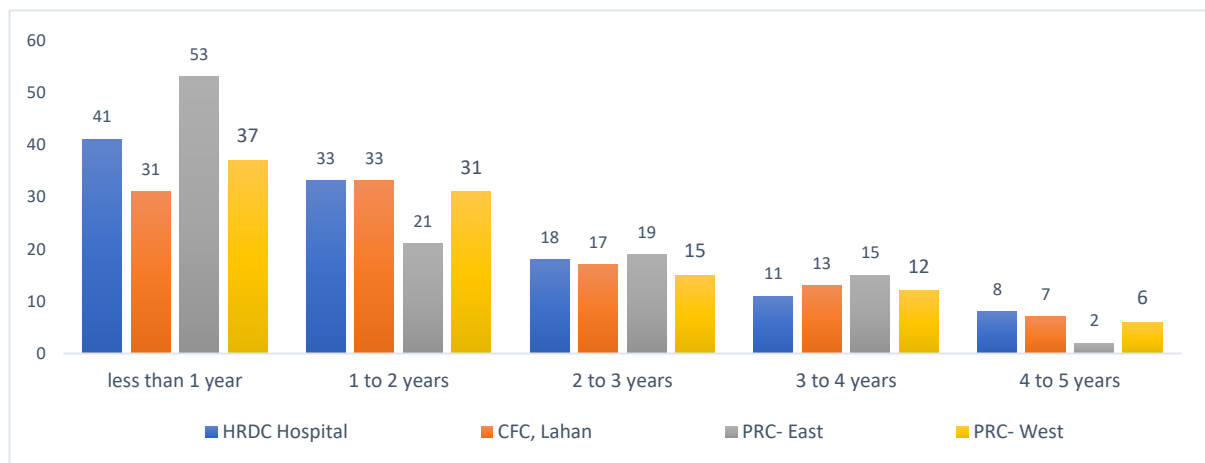
Most of our patients treated at the hospital were treated as inpatients due to logistical challenges, whereas those treated at regional centers received services on an outpatient basis.

A retrospective review of medical records was performed for demographic information (age, sex, districts), the Pirani and Dimeglio scores before and after treatment, the number of casts required to achieve correction, and whether a surgical procedure (usually a heel cord tenotomy) was required to achieve initial correction. We measured the following parameters to assess the outcome: (1) passive & active range of motion in dorsiflexion and abduction measured in degrees with a

goniometer; (2) muscles strength- graded manually on a scale of 1 to 5; (3) weight-bearing digital images of the foot from the front, rear, and sides; and (4) digital image of the patient squatting (over the age of 2 years). Since this was a time-bound study, all primary idiopathic clubfoot cases coming to one of our centers in 2018 (who met our inclusion criteria) were enrolled in the study. Secondary clubfeet and those who received any prior treatment (surgery or conservative), were excluded.

Results

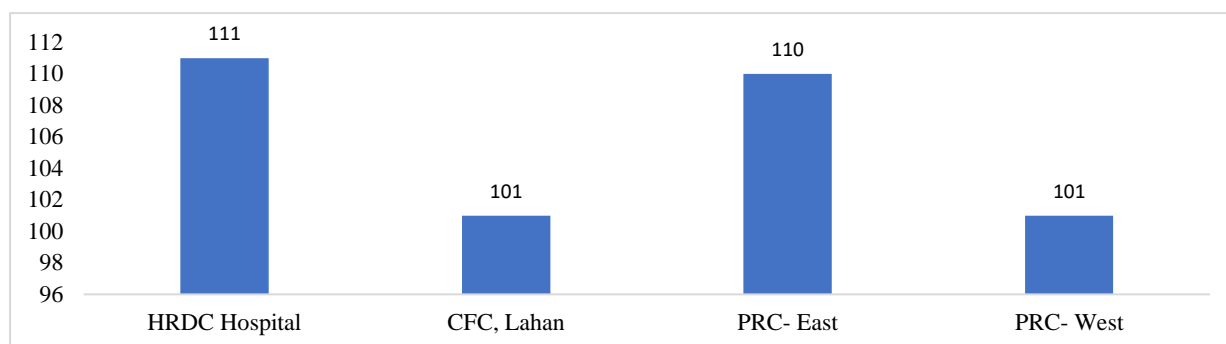
The average age at treatment was three years (6 months to 5 years) age distribution of the children is shown in graph 2. The



Graph 2: Age Distribution

	HRDC	RRC-East	RRC-West	Lahan
Pirani Score: Pre-casting	4.34	4	5	4.5
Pirani Score- Post-casting	0.23	0.25	0.5	0.31
DiMiglio Score: Pre-casting (n= 143 cases, 213 feet)	18	20	19	20
DiMiglio Score: Post-casting (n=143 cases, 213 feet)	3	3	5	3
Post-treatment Dorsiflexion (Passive)	16	16	16	14

Table 1: Standard scores at central and regional centers



Graph 3: Centre wise distribution of the study participants

SCORES	HRDC	Regional Centers	P-Value
Pirani Score: Pre-casting	4.34	4.52	<0.05
Pirani Score- Post-casting	0.23	0.4	<0.05
DiMiglio Score: Pre-casting (n= 143 cases, 213 feet)	18	20	0.05
DiMiglio Score: Post-casting (n=143 cases, 213 feet)	3	4	0.05
ROM: Dorsiflexion (Passive)	16	15	<0.05

Table 2: Association with Standard scores at central and regional centers

post-treatment scores were measured after casting (and HCR) completion and before the foot abduction brace was started. 60% of the study participants were males. 213 patients had bilateral clubfeet, while 123 had involvement of the right side and 87 had involvement of the left. Twenty- six percent (26%) were treated as an inpatient at HRDC hospital (average hospital stay 46 days, range 7 to 120 days), and 74 percent were treated as an outpatient at one of the regional centers (graph 3). The average pretreatment Pirani score was 4.34 (ranged from 3 to 6) at HRDC hospital and 4.52 (ranged from 3 to 6) at the regional centers.

The average post-treatment Pirani scores were comparable between HRDC and the regional centers (table 1). An average of 7 casts were required for the deformity correction at all centers. Heel cord release (HCR) was required in 95% of feet treated at HRDC and 97% of those treated at regional centers. The initial treatment with the Ponseti method successfully achieved plantigrade foot in 95% (142 of 149 feet) at HRDC and 93% (453 of 487 feet) at the regional centers. The average dorsiflexion (active & passive) and abduction (active & passive) of patients treated at HRDC were comparable with those treated at the

S. No.	Factors
1.	Early Diagnosis
2.	High volume Ponseti casting centers
3.	Employing non-physician health workers
4.	Engaging families
5.	Addressing barriers to access: transportation, knowledge and community awareness, family and cultural attitudes about the condition
6.	Providing follow up within the child's community

Table 3: Factors that facilitate the delivery of successful clubfoot services in LMICs (16):

regional centers (**Table 1**). All of the patients had a modified squat. Ninety-five percent of the patient claimed to have used the foot abduction orthosis as recommended. 94% of the patients treated at regional centers reported complete satisfaction with services as they were locally available, reduced the cost of travel and logistics and avoided hospital admission. 97% of the patients treated at HRDC hospital said they would opt for treatment from a regional center had it been available in their area.

On further questioning, 87 percent of the parents said that locally available treatment benefits would include indirect savings from transportation and food expenses, admission charges at the hospital, a continuation of their daily work and wages, and continuation of their children's schooling. Analysis shows that there is a significant association between the pre-casting and post-casting Pirani scores at

HRDC and regional centers (P-Value<0.05), Dimiglio scores at HRDC and regional centers (P-Value:0.05). There is also a significant association between passive ankle dorsiflexion achieved at the HRDC and regional centers (P-Value<0.05) as shown in **Table 2**.

Discussion

Clubfoot is a highly treatable condition that has received very little attention globally.¹⁰ It is estimated that each year around 133,000 children with clubfoot receive no treatment at all, the major burden of this falls on LMICs,¹⁰ and that universal access to clubfoot treatment could prevent lifelong disability for 200,000 children each year.¹⁰⁻¹⁴ Proper treatment could see more than 95% of children with clubfoot achieve full correction and mobility.^{5,10} Even conservative estimates show that at least one in 800 babies are born with clubfoot.^{2,10,11} Even though clubfoot has

been included in the World Health Organization's congenital anomaly surveillance and monitoring guidance, WHO strategies are yet to prioritize targeted clubfoot interventions.¹⁵ Given the population distribution and limited access to healthcare, the significant burden of all this falls on low and middle-income countries (LMICs). This is compounded by a lack of resources and skilled personnel to address this problem. Thus, an approach of developing a skilled paramedical workforce through rigorous training on the non-invasive Ponseti method, coupled with decentralizing service delivery through establishing regional satellite centers capable of delivering clubfoot care, has been a model of delivery that our institution has adopted to reach clubfoot cases which may otherwise have been deprived of treatment.

While this model has worked well in delivery and anecdotal outcomes, it was necessary to scientifically compare and see how outcomes from regional clinics compared to that with the central hospital. The results of the present study show that not only comparable outcomes can be expected for primary idiopathic clubfeet from decentralized clubfoot service delivery by physiotherapists and paramedics trained in the Ponseti method, but also some added advantages may follow, such as logistical savings, a

continuation of job for the parent and schooling for the children.

At HRDC and its regional clinics, all Ponseti providers have undergone extensive training for at least 3 months and a mandatory one-day Ponseti refresher workshop every year. This mandatory ongoing education helps us keep the technique original, ensuring similar delivery across our centers. We have found this model to effectively deliver Ponseti treatment for primary idiopathic clubfeet in a low-resource environment like ours and feel that it can be replicated in similar environments. Certain important factors that facilitate successful clubfoot services in LMICs have been identified.¹⁶ Addressing these factors in our program has helped us decentralize our Ponseti services for idiopathic clubfoot and achieve comparable outcomes between our various clinics delivering clubfoot care. It has been shown that factors such as early diagnosis, employing non-physician health workers, addressing barriers to access: transportation, knowledge and community awareness, family and cultural attitudes about the condition, and providing follow up within the child's community in the high volume Ponseti casting centers, facilitate the delivery of successful clubfoot services in LMICs.⁶

Our study has some important limitations. It is a retrospective study comparing

clubfoot scores and not validated patient-reported outcome measures (PROM). Our study was also limited to patients under 5 years of age with a pretreatment Pirani score of more than 3. A prospective comparative study using validated PROMs may be a topic for future research.

Conclusion

Primary idiopathic clubfeet treated at regional centers by physiotherapists and paramedics trained in the Ponseti method can produce comparable outcomes to those treated by experienced practitioners at the hospital center and may also carry some added logistical and financial advantages.

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