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## Long-term Functional Outcomes and Quality of Life Assessment in Children with neurogenic Clubfoot: A Prospective Cohort Study.

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### ABSTRACT

Neurogenic clubfoot presents complex challenges in pediatric orthopedics, necessitating comprehensive management strategies. Understanding long-term functional outcomes and quality of life (QoL) in affected children is crucial for optimizing care. A prospective cohort study was conducted over one year, involving 40 children with neurogenic clubfoot. Baseline assessments included clinical evaluations and functional outcome measures. Follow-up assessments were conducted at 3-, 6-, and 12-months post-enrolment. Baseline assessments revealed moderate impairment in foot alignment, range of motion, and muscle strength. Children exhibited limitations in mobility, self-care, and social function, with reported pain and discomfort. Significant improvements were observed in functional outcomes over time, with enhancements in global function, upper extremity function, and basic mobility. Happiness and satisfaction scores also increased, reflecting subjective QoL improvement. Multidisciplinary management approaches can lead to significant improvements in functional outcomes and QoL in children with neurogenic clubfoot. Early intervention and ongoing monitoring are essential for optimizing long-term outcomes and promoting overall well-being.

**Keywords:** Neurogenic clubfoot, pediatric orthopedics, functional outcomes, quality of life.

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## INTRODUCTION

Neurogenic clubfoot presents a complex challenge in pediatric orthopedics, characterized by abnormal muscle tone and nerve dysfunction affecting foot alignment [1]. Despite advancements in treatment modalities, the long-term functional outcomes and quality of life (QoL) of children with neurogenic clubfoot remain underexplored. This prospective cohort study aims to address this gap by comprehensively evaluating the functional outcomes and QoL in this population over an extended period [2].

Understanding the trajectory of functional impairment and its impact on daily activities and psychosocial well-being is crucial for optimizing management strategies and enhancing patient-centered care. By elucidating the multifaceted aspects of neurogenic clubfoot beyond initial correction, this study contributes valuable insights to clinical decision-making, rehabilitation protocols, and resource allocation [3-5]. Ultimately, our findings seek to improve the holistic management approach for children with neurogenic clubfoot, promoting better long-term functional outcomes and enhancing their overall QoL [6].

## METHODOLOGY

A cohort of 40 children diagnosed with neurogenic clubfoot was included for our prospective study, spanning duration of one year. Participants were identified through orthopedic clinics and hospitals specializing in pediatric neurology and orthopedics. Inclusion criteria encompassed children aged 2 to 10 years with a confirmed diagnosis of neurogenic clubfoot, irrespective of previous treatment history. Exclusion criteria comprised children with other congenital foot anomalies or neurological conditions unrelated to neurogenic clubfoot.

Baseline assessments were conducted at the onset of the study, comprising detailed clinical evaluations, including foot alignment, range of motion, muscle strength, and neurological status. Additionally, demographic information and relevant medical history were documented for each participant. Functional outcomes were measured using standardized assessment tools, such as the Gillette Functional Assessment Questionnaire (FAQ) and the Pediatric Outcomes Data Collection Instrument (PODCI), focusing on mobility, self-care, and social function domains.

Throughout the one-year follow-up period, participants underwent regular assessments at predetermined intervals, including 3-, 6-, and 12-months post-enrolment. These assessments included clinical examinations to monitor foot alignment, muscle tone, and neurological status, alongside repeated administration of functional outcome measures to track changes over time. Any additional interventions or treatments received during the study period were documented to account for potential confounding variables. Compliance with follow-up visits was ensured through regular communication with participants and their caregivers, minimizing attrition and maximizing data completeness.

## RESULTS

**Table 1: Baseline Characteristics of Participants**

Characteristic	Mean $\pm$ SD (Range) / n (%)
Age (years)	5.8 $\pm$ 2.3 (2-10)
Gender	
- Male	25 (62.5%)
- Female	15 (37.5%)
Laterality	
- Right	20 (50%)
- Left	20 (50%)
Previous Treatment	
- Yes	18 (45%)
- No	22 (55%)

The study cohort comprised children with a mean age of 5.8 years ( $\pm$ 2.3), ranging from 2 to 10 years old. Gender distribution showed a slight predominance of males, accounting for 62.5% (n=25), with

females making up the remaining 37.5% (n=15). Laterality was evenly split, with 50% (n=20) of participants identified as right-handed and an equal proportion as left-handed.

**Table 2: Clinical Assessment at Baseline**

Assessment	Mean ± SD (Range) / n (%)
Foot Alignment (Ponseti Score)	4.2 ± 0.8 (2-6)
Range of Motion	
- Dorsiflexion	25.4 ± 7.2 (10-40) degrees
- Plantarflexion	10.8 ± 4.5 (0-20) degrees
Muscle Strength (MRC Scale)	3.6 ± 0.9 (2-5)
Neurological Status	
- Sensory Function	7.9 ± 1.2 (5-10)
- Motor Function	8.2 ± 1.5 (5-10)

The assessment results revealed a mean Foot Alignment (Ponseti Score) of 4.2 ± 0.8, indicating moderate alignment with a range of 2 to 6. Range of motion assessments demonstrated an average dorsiflexion of 25.4 ± 7.2 degrees, ranging from 10 to 40 degrees, and plantarflexion of 10.8 ± 4.5 degrees, varying between 0 and 20 degrees. Muscle strength, evaluated using the MRC Scale, averaged at 3.6 ± 0.9, indicating generally good strength with scores ranging from 2 to 5. Neurological status assessments showed satisfactory sensory function with a mean score of 7.9 ± 1.2 and motor function with a mean score of 8.2 ± 1.5, both falling within the range of 5 to 10, suggesting adequate neurological health in the cohort.

**Table 3: Functional Outcomes at Baseline (Gillette FAQ)**

Domain	Mean ± SD (Range) / n (%)
Mobility	45.6 ± 12.3 (20-65)
Self-care	38.9 ± 9.6 (20-50)
Social Function	28.5 ± 7.8 (15-40)
Pain	3.2 ± 1.5 (1-6)
Comfort	4.1 ± 1.2 (1-7)

In terms of domain assessment, participants exhibited a mean Mobility score of 45.6 ± 12.3, indicating moderate mobility levels within a range of 20 to 65. Self-care capabilities were reported with a mean score of 38.9 ± 9.6, ranging from 20 to 50, suggesting generally independent self-care skills. Social function scores averaged at 28.5 ± 7.8, reflecting satisfactory social interaction abilities within a range of 15 to 40. Pain levels were relatively low, with a mean score of 3.2 ± 1.5, indicating mild to moderate discomfort on average. Comfort levels were generally high, with an average score of 4.1 ± 1.2, suggesting a reasonable level of physical and emotional comfort among participants.

**Table 4: Functional Outcomes at 6-Month Follow-Up (PODCI)**

Domain	Mean ± SD (Range) / n (%)
Overall Function	67.8 ± 9.2 (55-80)
Upper Extremity	72.3 ± 8.5 (60-85)
Transfers & Basic Mobility	65.4 ± 7.6 (50-75)
Sports & Physical Function	58.9 ± 6.8 (45-70)
Happiness & Satisfaction	76.5 ± 10.1 (60-90)

The overall function of participants was assessed with a mean score of 67.8 ± 9.2, indicating generally good functional capacity within a range of 55 to 80. Upper extremity function scored an average of 72.3 ± 8.5, reflecting strong capabilities within a range of 60 to 85. Transfers and basic mobility exhibited a mean score of 65.4 ± 7.6, suggesting adequate ability in these fundamental movements, ranging from 50 to 75. Sports and physical function scores averaged at 58.9 ± 6.8, indicating moderate performance in these areas within a range of 45 to 70. Happiness and satisfaction levels were notably high, with a mean score of 76.5 ± 10.1, reflecting contentment and fulfillment among participants, with scores ranging from 60 to 90.

**Table 5: Functional Outcomes at 12-Month Follow-Up (PODCI)**

Domain	Mean ± SD (Range) / n (%)
Overall Function	72.5 ± 8.4 (60-85)
Upper Extremity	76.9 ± 7.3 (65-90)
Transfers & Basic Mobility	70.2 ± 6.5 (55-80)
Sports & Physical Function	64.3 ± 5.9 (50-75)
Happiness & Satisfaction	79.2 ± 9.8 (65-90)

In the domain assessments, participants displayed robust scores across various areas. Overall function averaged at 72.5 ± 8.4, showcasing strong functional abilities within a range of 60 to 85. Upper extremity function scored notably higher, with a mean of 76.9 ± 7.3, indicating excellent capabilities within a range of 65 to 90. Transfers and basic mobility exhibited a mean score of 70.2 ± 6.5, suggesting proficient movement skills spanning from 55 to 80. Sports and physical function scores averaged at 64.3 ± 5.9, indicating moderate performance levels within a range of 50 to 75. Happiness and satisfaction levels were notably high, with a mean score of 79.2 ± 9.8, reflecting contentment and fulfillment among participants, with scores ranging from 65 to 90.

### DISCUSSION

Neurogenic clubfoot poses significant challenges in pediatric orthopedics, often requiring comprehensive management strategies to address its complex etiology and sequelae. Our study aimed to evaluate the long-term functional outcomes and quality of life (QoL) in children with neurogenic clubfoot over a one-year period. The findings focus light on various aspects of functional impairment and highlight the importance of multidisciplinary approaches in optimizing patient care [7].

The baseline characteristics of the study cohort revealed a relatively homogeneous distribution in terms of age, gender, laterality, and previous treatment history. The mean age of participants was 5.8 years, reflecting the typical age range for diagnosis and intervention in neurogenic clubfoot cases. The near-equal distribution of gender and laterality further ensured a balanced representation of the condition across different demographic groups. Additionally, the prevalence of previous treatment in 45% of participants underscores the chronic and recurrent nature of neurogenic clubfoot, necessitating ongoing management and follow-up [8].

Clinical assessments at baseline provided valuable insights into the initial severity and presentation of neurogenic clubfoot in the study population. Foot alignment, assessed using the Ponseti Score, indicated moderate impairment with a mean score of 4.2 out of 6. This suggests a significant deviation from normal foot anatomy, highlighting the complexity of deformity correction in neurogenic clubfoot. Similarly, assessments of range of motion, muscle strength, and neurological status revealed varying degrees of functional impairment, underscoring the multifaceted nature of the condition. These baseline findings serve as reference points for evaluating the efficacy of interventions and tracking changes in functional outcomes over time [9].

The functional outcomes assessed at baseline and follow-up intervals provided valuable insights into the impact of neurogenic clubfoot on various domains of daily living. At baseline, children exhibited limitations in mobility, self-care, and social function, as evidenced by lower scores on the Gillette Functional Assessment Questionnaire (FAQ). Pain and discomfort were also reported, reflecting the physical and psychosocial burden associated with neurogenic clubfoot. These findings underscore the importance of early intervention and comprehensive rehabilitation to mitigate functional impairment and enhance overall QoL.

Over the one-year follow-up period, improvements were observed in several domains of functional outcomes, albeit with varying trajectories. At the 6-month follow-up, significant enhancements were noted in global function, upper extremity function, and basic mobility, as indicated by higher scores on the Pediatric Outcomes Data Collection Instrument (PODCI). These improvements may be attributed to the effects of interventions such as bracing, physical therapy, and surgical correction, aimed at addressing musculoskeletal deformities and optimizing motor function. However, the extent of improvement varied across domains, with sports and physical function showing relatively slower progress, possibly reflecting persistent motor deficits and residual functional limitations [10].

By the 12-month follow-up, further enhancements were observed in all domains of functional outcomes, albeit at a slower rate compared to earlier intervals. Global function, upper extremity function, and basic mobility continued to improve, albeit at a more gradual pace, indicating ongoing gains in functional independence and motor skills. Sports and physical function also showed incremental improvements, suggesting enhanced participation in recreational activities and physical exercise. Importantly, happiness and satisfaction scores demonstrated notable increases, reflecting subjective perceptions of well-being and QoL improvement among children with neurogenic clubfoot [11].

The observed improvements in functional outcomes underscore the efficacy of multidisciplinary management approaches in addressing the complex needs of children with neurogenic clubfoot. Early diagnosis, timely interventions, and coordinated care involving orthopedic surgeons, neurologists, physical therapists, and other allied health professionals play a crucial role in optimizing outcomes and promoting long-term functional independence. Moreover, ongoing monitoring and tailored interventions tailored to individual needs are essential for sustaining gains and minimizing the risk of recurrence or complications [12].

Limitations of this study include its relatively small sample size and short-term follow-up duration, which may limit the generalizability of findings and the ability to assess long-term outcomes accurately. Future studies with larger cohorts and longer follow-up periods are warranted to validate these findings and explore additional factors influencing functional outcomes and QoL in children with neurogenic clubfoot. Moreover, the inclusion of objective measures such as gait analysis and electromyography could provide further insights into motor function and biomechanical changes associated with neurogenic clubfoot.

## CONCLUSION

In conclusion, our study provides valuable insights into the long-term functional outcomes and QoL in children with neurogenic clubfoot. Despite the challenges posed by this complex condition, multidisciplinary interventions can lead to significant improvements in functional independence and overall well-being.

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