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Review Article

Effectiveness of neurodevelopmental therapy versus conventional physiotherapy in improving fine motor function among hemiplegic cerebral palsy children: a randomized controlled trial

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ABSTRACT

Cerebral palsy (CP) is a non-progressive neurological disorder that affects posture and motor control, with hemiplegia being one of its most common forms. Fine motor dysfunction is a frequent feature of hemiplegic CP and often limits participation in daily activities. Neuro-Developmental Therapy (NDT) and conventional physiotherapy are commonly used intervention strategies to improve motor performance in this population. This randomized controlled trial was conducted on 30 children aged 2 to 18 years diagnosed with hemiplegic cerebral palsy, who were randomly assigned to either an NDT group or a conventional physiotherapy group. Both groups received their respective interventions for six weeks. Fine motor function was assessed at baseline and post-intervention using the Hawaii Early Learning Profile (HELP). Results showed that both groups demonstrated statistically significant improvements in fine motor function following the intervention period; however, greater improvement was observed in the NDT group compared to the conventional physiotherapy group. These findings suggest that Neuro-Developmental Therapy may be more effective than conventional physiotherapy in enhancing fine motor skills in children with hemiplegic cerebral palsy. Further research with larger sample sizes is recommended to confirm these results and strengthen the evidence base.

Keywords: Cerebral palsy, Hemiplegia, Fine motor function, Neuro-Developmental Therapy, Conventional physiotherapy.

INTRODUCTION

Cerebral palsy (CP) is a non-progressive neurological disorder resulting from early brain damage, leading to impaired movement and posture and often accompanied by sensory and cognitive deficits [1]. Affecting approximately 1 in 1,300 live births, CP represents the most common neurological disability in childhood, with a substantial global disease burden. Early manifestations of CP frequently include spasticity, particularly involving the wrist and fingers, resulting in hand dysfunctions such as thumb adduction and limited wrist extension [2,3]. These impairments significantly compromise activities of daily living and reduce functional independence [4]. Spasticity, characterised by increased muscle tone and exaggerated stretch reflexes due to upper motor neuron lesions, further exacerbates motor limitations in children with CP [5]. As a result, many children experience difficulty performing fundamental tasks such as grasping, releasing objects, and executing fine motor skills. These challenges are particularly evident in unilateral spastic CP, where the affected upper limb is often underused in daily activities.

The International Classification of Functioning, Disability, and Health (ICF) provide a comprehensive framework for understanding the multidimensional impact of CP on body structures, functions, activities, and participation [6]. Efficient hand function depends on the integrity of the central nervous system, and any neurological disruption can restrict functional abilities required for daily self-care tasks such as eating, grooming, and dressing [7]. Conventional physiotherapy interventions primarily aim to normalise movement patterns, reduce spasticity, and improve functional performance. Neuro-Developmental Therapy (NDT), developed by Bertha and Karel Bobath, adopts a holistic approach emphasising quality of movement and postural control rather than isolated muscle strengthening [8]. The NDT philosophy underscores the importance of sensory-motor experiences in facilitating motor learning and improving functional outcomes. Since abnormal movement patterns may contribute to secondary musculoskeletal and functional impairments, NDT interventions also address associated perceptual and cognitive components of motor control [8].

In recent years, adjunctive therapeutic approaches such as Kinesio taping (KT) have gained attention in pediatric rehabilitation. KT involves the application of elastic, latex-free cotton tape designed to support weakened muscles and enhance movement without restricting joint mobility. Evidence suggests that KT may contribute to improved proprioceptive input and functional performance when integrated with physiotherapy programs. Systematic reviews have highlighted the growing interest in multimodal rehabilitation approaches for children with CP, emphasising the need for evidence-based interventions to optimise motor outcomes. Collectively, these findings reinforce the importance of comprehensive, individualised rehabilitation strategies aimed at maximising functional independence and improving quality of life for children with cerebral palsy.

METHODOLOGY

Population

The study population comprised 250 children diagnosed with Hemiplegic Cerebral Palsy (HCP) who were attending various rehabilitation centers in Dehradun. This population represented a broad spectrum of demographic and clinical backgrounds, reflecting the diverse manifestations of HCP and its impact on motor function.

Source of subjects

A total of 30 children were selected from among those undergoing therapy at the participating rehabilitation centres in Dehradun. Selection was based on the diagnosis of hemiplegic cerebral palsy and fulfilment of the inclusion and exclusion criteria established for the study.

Sample

The sample consisted of 30 children with hemiplegic cerebral palsy, aged between 2 and 18 years. This age range was chosen to ensure cognitive and behavioural readiness for participation and to coincide with critical stages of fine motor development.

Study setting

The study was conducted across multiple rehabilitation centres in Dehradun, Uttarakhand, to capture the variability in therapeutic environments and enhance the external validity of the results.

Study design

A comparative experimental design was employed to evaluate and compare the effects of Neuro-Developmental Therapy (NDT) and Conventional Physiotherapy on fine motor function in children with hemiplegic cerebral palsy. This design allowed for a direct comparison between the two intervention approaches.

Selection criteria

Inclusion criteria

Children diagnosed with Hemiplegic Cerebral Palsy.

Age between 2 and 18 years.

Availability and willingness of parents or primary caregivers to participate in the study and provide consent.

Exclusion criteria

Children diagnosed with other developmental disorders not related to hemiplegic CP.

Children younger than 2 years or older than 18 years.

Inability to contact or communicate with the parent or primary caregiver.

History of trauma or injury within the last month.

Receipt of Botulinum toxin injection in the upper extremity within the past six months.

History of upper extremity surgery (e.g., tendon transfer or lengthening) within the past six months.

Presence of fever, illness, or uncooperative behavior during assessment or intervention.

Variables

The key study variables included:

Diagnosis of Hemiplegic Cerebral Palsy.

Fine motor function assessed using the Hawaii Early Learning Profile (HELP).

Effectiveness of Neuro-Developmental Therapy (NDT).

Effectiveness of Conventional Physiotherapy techniques, including stretching and Kinesio Taping (KT).

Protocol

30 hemiplegic cerebral palsy subjects with mean age of 9.33 years included in the study

↓

As per the inclusion criteria, subjects were included after the ethical committee approval

↓

Informed consent given to conduct the study

↓

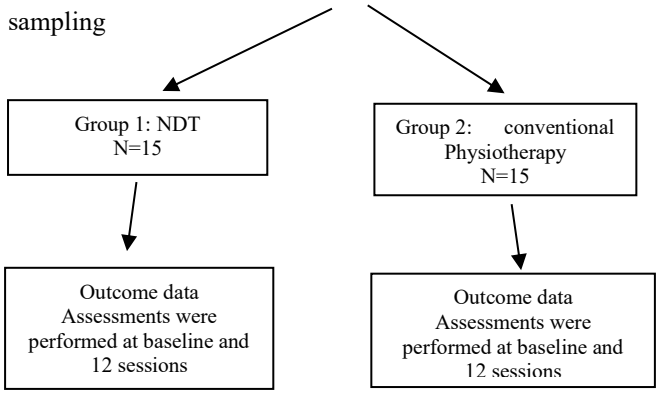
Informed consent obtained from the parents of the subjects

↓

20 hemiplegic cerebral palsy subjects were assessed for fine motor function using HELP

↓

The children were divided into two groups based on random sampling



Procedure

After obtaining informed consent from parents or guardians, 30 children meeting the eligibility criteria were enrolled and randomly allocated into two equal groups (n = 15 per group) using simple random sampling methods.

Group 1: Neuro-Developmental Therapy (NDT) Group 2: Conventional Physiotherapy

Pre-test and post-test assessments of fine motor function were performed using the Hawaii Early Learning Profile (HELP), a validated and reliable tool for evaluating neuromotor function in children. Each child received a 45-minute therapy session twice weekly for six consecutive weeks, supervised by a qualified physical therapist.

Intervention protocols

Neuro-Developmental therapy (NDT)

Participants in Group 1 received NDT sessions focusing on improving fine motor function through facilitation of postural control, bilateral midline activities, and active use of the affected upper limb. The techniques emphasized promoting normal movement patterns, enhancing neuromuscular coordination, and reducing compensatory strategies.

Conventional physiotherapy

Participants in Group 2 received traditional physiotherapy, including passive stretching and Kinesio Taping (KT) of the affected upper limb.

Passive stretching

Involved gentle, progressive elongation of tight muscles for 20 seconds followed by a 20-second relaxation period, repeated for 3–5 cycles per session. The goal was to relieve muscle tightness and improve joint mobility.

Kinesio taping

KT was applied from the origin of the extensor muscles to the metacarpophalangeal (MCP) joints of the fingers, and from the extensor and abductor pollicis longus origins to the MCP joint of the thumb. Tension was applied at 30% over muscular zones and 75% over joint areas, targeting the dorsum of the wrist and forearm to facilitate activation of wrist and thumb extensors. The taping aimed to improve alignment, reduce wrist flexion deformity, and promote functional hand use.

RESULT

Subject Information

Table 1- 4 shows the demographic and clinical characteristics of the 20 subjects who participated in the study. There were 10 (50%) male subjects and 10 (50%) female subjects.

Right hand dominance reported in 11 subjects (55%), while 9 subjects (45 %) were left hand dominance. There was no significant difference between both groups in terms of age ($p=0.7059$) mean age of Group A is 9.74 and mean age of Group B is 8.92.

Changes in fine motor function

Mean test scores and standard deviations for both groups are shown in the table 5 and 6 (Paired T test).

The mean and standard deviation values of fine motor function in Group A for baseline assessment is 15.30± 8.769 and final assessment is 23.10± 9.803 with a significant value of ($p<0.001$).

The mean and standard deviation values of fine motor function in Group B for baseline assessment are 12.30±8.394 and for the final assessment are 13.80±8.509, with a significant value of ($p<0.001$).

Table 7 shows the mean test scores and standard deviations for both groups for the Unpaired T test. The mean difference between baseline and final assessments is 3 and 9.30, respectively.

The P value for baseline assessment is not significant with a value of ($p>0.4447$), and it is significant in the final assessment with a value of ($p<0.0360$).

Both groups had improvement in the fine motor function post-treatment. The average improvement in fine motor function tended to be higher in Group A (15.30 ± 8.769 versus 23.10 ± 9.803) than in Group B (12.30 ± 8.394 versus 13.80 ± 8.509).

Table 1: summary sheets of group A and group B

Group a				.	
NDT				Fine motor function	
Name	Gender	Side	Age	Baseline	Final
A-1	M	Left	12.5	13	19
A-2	M	Right	12.1	7	14
A-3	M	Right	11.1	14	21
A-4	M	Left	9.8	13	18
A-5	F	Left	5.1	11	17
A-6	M	Left	17.6	32	42
A-7	F	Right	2.3	12	23
A-8	M	Right	6.9	6	12
A-9	F	Left	4.7	30	37
A-10	F	Right	15.3	15	28
Group b				.	
Conventional physiotherapy				Fine motor function	
Name	Gender	Side	Age	Baseline	Final
B-1	M	Left	8.7	19	20
B-2	M	Right	5.8	3	5
B-3	M	Left	14.4	16	18
B-4	M	Left	7.9	8	9
B-5	F	Right	3.11	12	13
B-6	F	Right	8.2	8	10
B-7	F	Left	9.5	5	6
B-8	M	Right	2.2	10	11
B-9	M	Right	16.3	10	12
B-10	M	Right	13.1	32	34

Table 2: Gender distribution

Group	Group A	Group B
Male (%)	60.0	70.0
Female (%)	40.0	30.0
Male(f)	6	7
Female(f)	4	3

Figure 1: Gender distribution

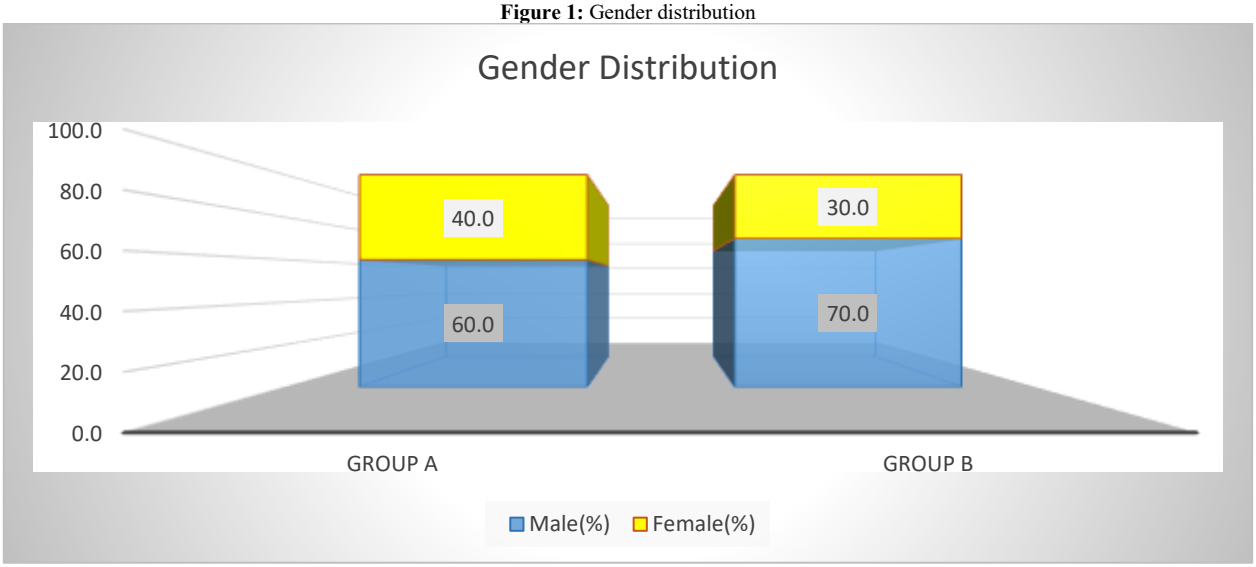


Table 3: Sides involved

Group	Group A	Group B
Left(%)	50.0	40.0
Right(%)	50.0	60.0
Left(f)	5	4
Right(f)	5	6

Figure 2: Sides involved

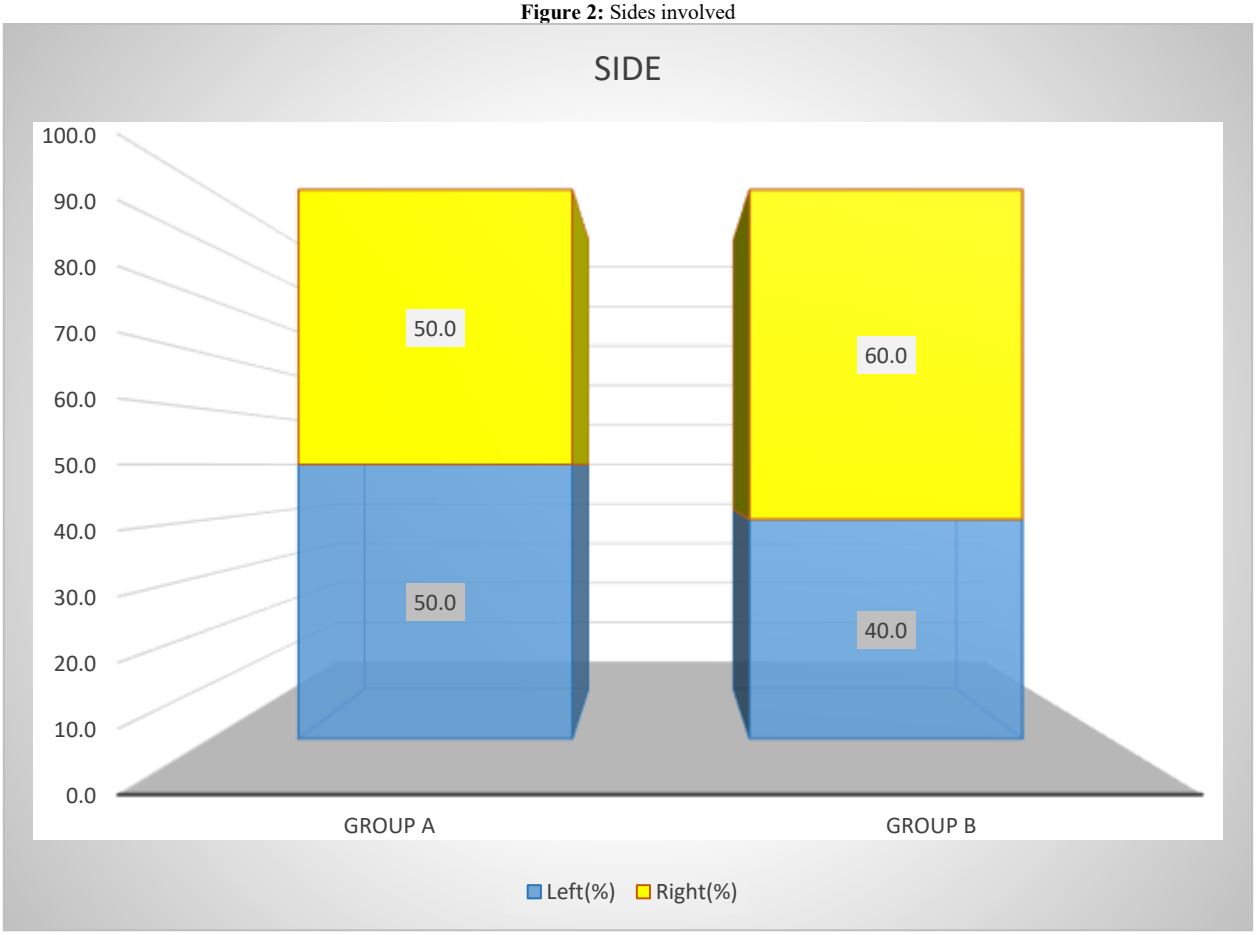


Table 4: Comparison of age

Unpaired T Test	Age	
	Group A	Group B
Mean	9.74	8.92
S.D.	4.923	4.626
Number	10	10
Mean Difference	0.82	
Unpaired T Test	0.383	
P value	0.7059	
Table Value at 0.05 DF 28	2.10	
Result	Not-Significant	

Figure 3: comparison of age

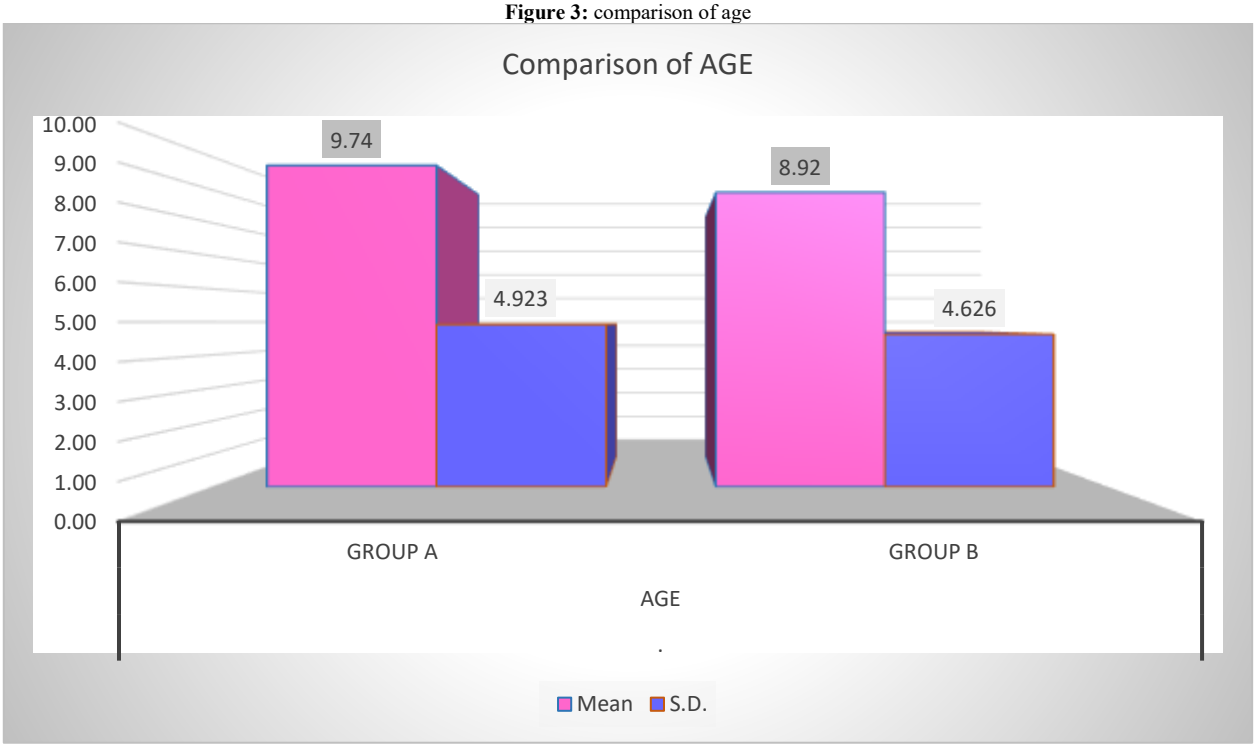


Table 5: Paired t-test: group a

Paired t test	Group a	
	Fine motor function	
Table no 5	Baseline	Final
Mean	15.30	23.10
S.d.	8.769	9.803
Number	10	10
Mean difference	-7.80	
Paired t test	9.428	
P value	<0.001	
Table value at 0.05	2.26	
Result	Significant	

Figure 4: Paired t-test: group A

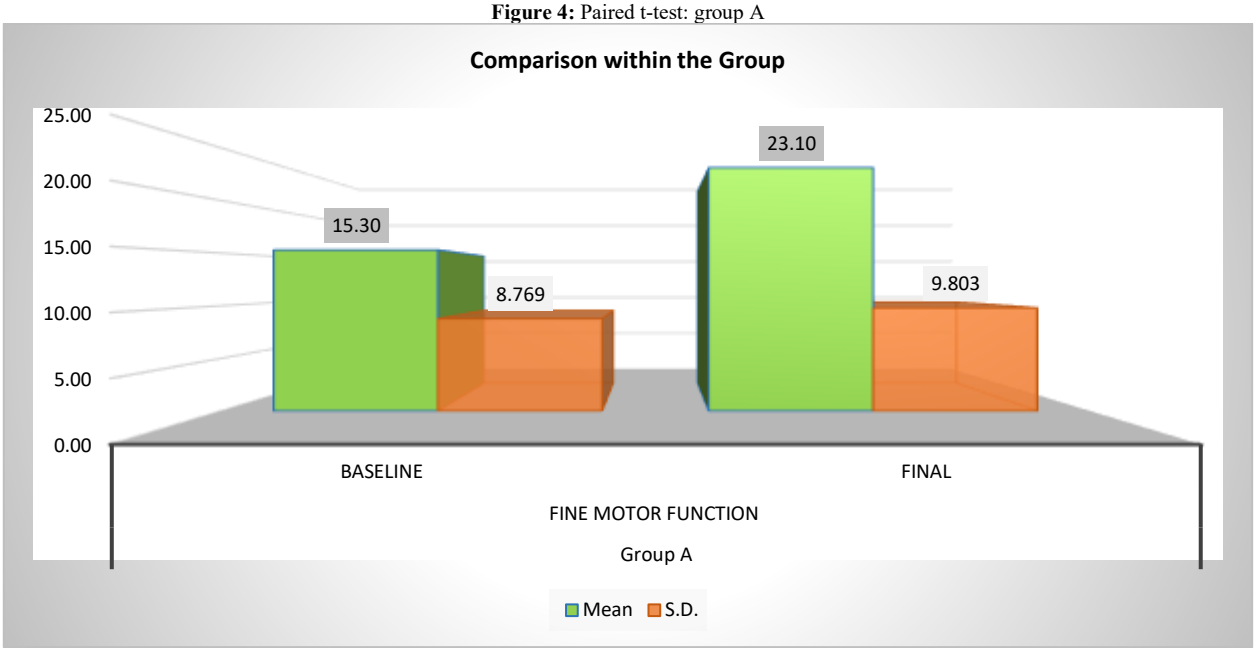


Table 6: Paired t-test: Group B

Paired T Test	Group B	
	Fine motor function	
Table No 6	BASELINE	FINAL
Mean	12.30	13.80
S.D.	8.394	8.509
Number	10	10
Mean Difference	-1.50	
Paired T Test	9.000	
P value	<0.001	
Table Value at 0.05	2.26	
Result	Significant	

Figure 5: Paired t-test: Group B

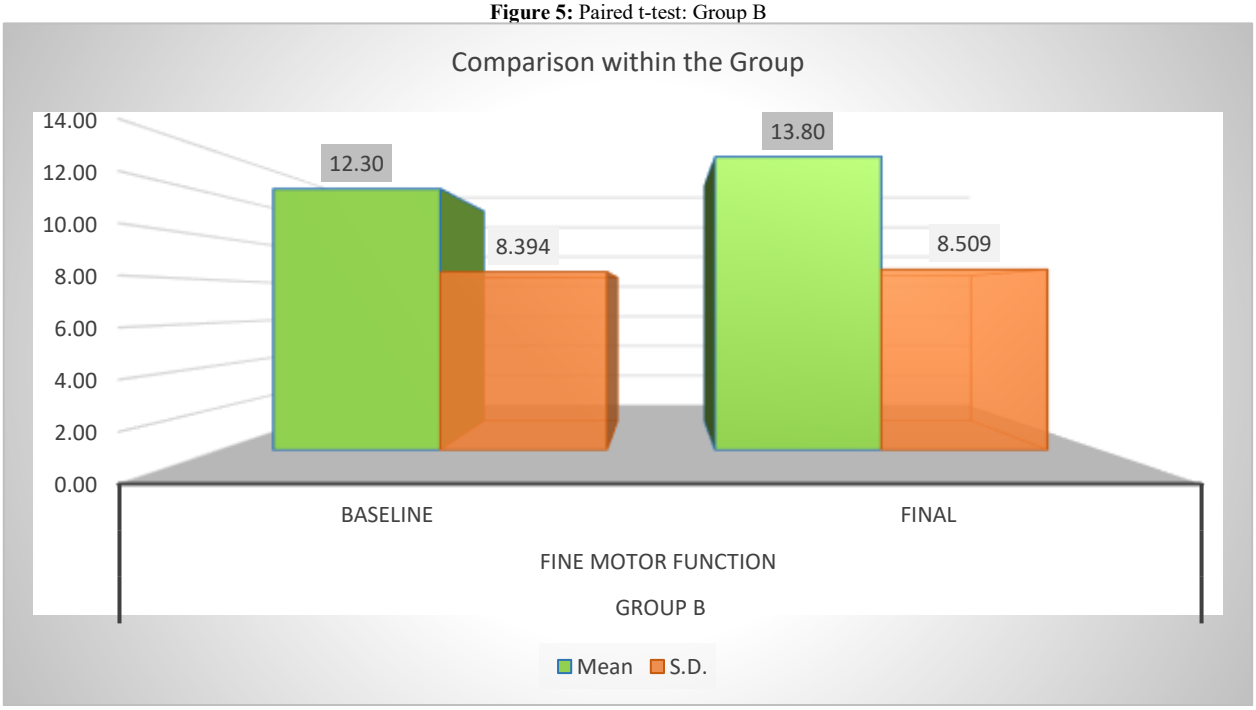
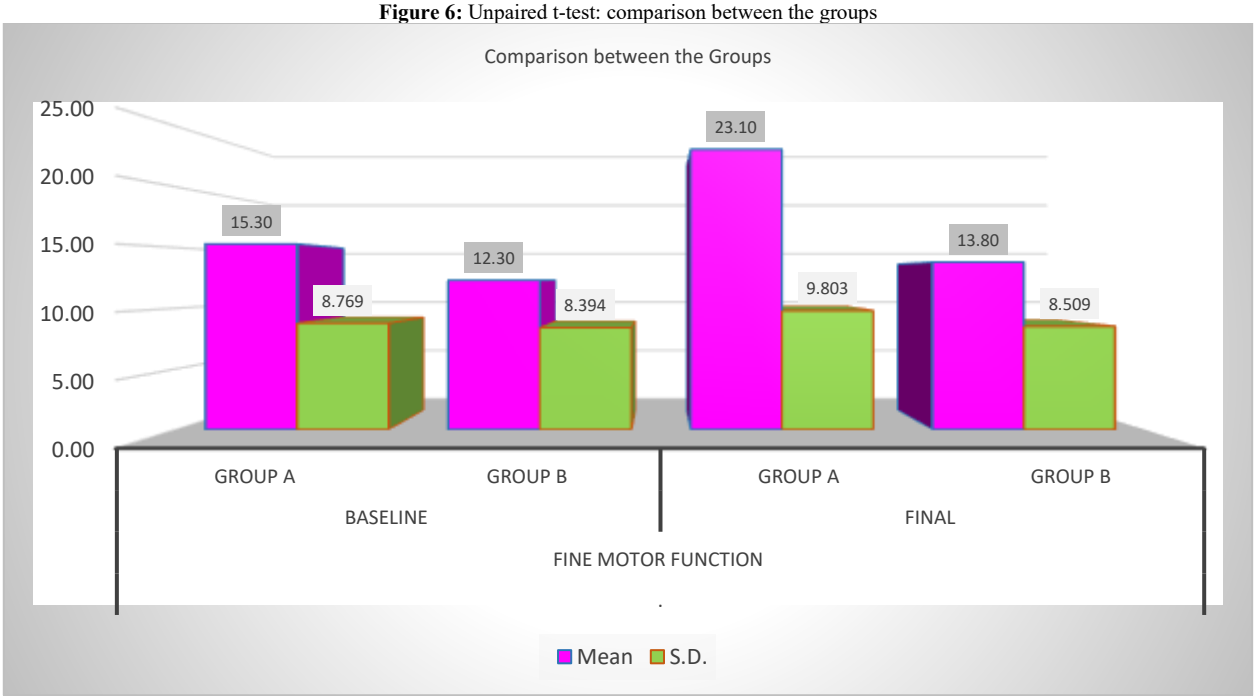


Table 7: Unpaired t-test: comparison between the groups

Unpaired T Test	Fine motor function			
	Baseline		Final	
	Group A	Group B	Group A	Group B
Mean	15.30	12.30	23.10	13.80
S.D.	8.769	8.394	9.803	8.509
Number	10	10	10	10
Mean Difference	3.00		9.30	
Unpaired T Test	0.782		2.266	
P value	0.4447		0.0360	
Table Value at 0.05 DF	2.10		2.10	
Result	Not-Significant		Significant	

Figure 6: Unpaired t-test: comparison between the groups



DISCUSSION

The present randomized controlled trial evaluated the effectiveness of Neuro-Developmental Therapy (NDT) compared with conventional physiotherapy in improving fine motor function among children with hemiplegic cerebral palsy. Both intervention groups demonstrated improvements in fine motor performance following six weeks of therapy, indicating that structured physiotherapy interventions are beneficial for children with hemiplegic CP. However, the magnitude of improvement was notably greater in the NDT group, suggesting superior efficacy of this approach.

The greater improvement observed in the NDT group may be attributed to its emphasis on postural control, trunk stability, and proximal alignment, which are essential prerequisites for effective distal limb function. NDT interventions facilitate coordinated activation of the trunk and shoulder girdle, providing a stable base for refined hand and finger movements. This proximal-to-distal facilitation aligns with established principles of motor development and motor learning, which emphasise the role of postural stability in skilled motor performance.

In contrast, conventional physiotherapy, although beneficial through techniques such as stretching and Kinesio taping, primarily addresses local muscle flexibility and tone rather than integrated postural control. While these methods may temporarily improve range of motion and reduce spasticity, they may be less effective in promoting long-term improvements in coordinated fine motor tasks. The relatively smaller gains observed in the conventional therapy group support this interpretation.

The findings of the present study are consistent with previous literature highlighting the importance of trunk control and postural adjustments in facilitating upper limb function. Improved postural stability enables children to perform anticipatory postural adjustments, thereby enhancing reach, grasp, and object manipulation. Overall, the results underscore the clinical relevance of incorporating neurodevelopmental principles into rehabilitation programs to optimize fine motor outcomes and functional independence in children with hemiplegic cerebral palsy [9].

CONCLUSION

The findings of this study indicate that Neuro-Developmental Therapy (NDT) is more effective than

conventional physiotherapy in enhancing fine motor function in children with Hemiplegic Cerebral Palsy (HCP). By emphasizing proximal stability and postural control, NDT facilitates improved coordination and functional use of the affected upper limb, thereby promoting more efficient hand function. These results support the integration of NDT into rehabilitation programs for children with HCP and highlight the importance of targeting proximal motor control to optimize distal fine motor outcomes.

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Conflict of Interest: The authors declare that there is no conflict of interest related to this study.

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Ethical approval: The study was approved by the Institutional Ethics Committee, and all procedures were conducted in accordance with ethical guidelines for research involving human participants.

REFERENCES

1. Himmelmann K, 2013. Epidemiology of cerebral palsy. Handbook of Clinical Neurology. 111, Pages 163–169. Doi: 10.1016/B978-0-444-52891-9.00015-4.

2. Basu AP, Pearse J, Kelly S, et al, 2014. Early intervention to improve hand function in hemiplegic cerebral palsy. Front Neurol. 5, Pages 281. Doi: 10.3389/fneur.2014.00281.

3. Arner M, Eliasson AC, Nicklasson S, et al, 2008. Hand function in cerebral palsy: Report of 367 children in a population-based longitudinal health care program. J Hand Surg Am. 33, Pages 1337–1347. Doi: 10.1016/j.jhsa.2008.02.032.

4. Flett PJ, 2003. Rehabilitation of spasticity and related problems in childhood cerebral palsy. J Paediatr Child Health. 39(1), Pages 6–14. Doi: 10.1046/j.1440-1754.2003.00082.x.

5. Bobath B, Bobath K, 1984. The neuro-developmental treatment. In: Management of the Motor Disorders of Children with Cerebral Palsy. Oxford: Spastics International Medical Publications. Pages 6–18.

6. Kong K, 1991. Bobath and NDT philosophy and their implications in therapy. Physiotherapy. 77(6), Pages 268–270.

7. Novak I, McIntyre S, Morgan C, et al, 2013. A systematic review of interventions for children with cerebral palsy: State of the evidence. Dev Med Child Neurol. 55(10), Pages 885–910. Doi: 10.1111/dmcn.12246.

8. Morris D, Jones D, Ryan H, et al, 2013. The clinical effects of Kinesio® Tex taping: A systematic review. Physiother Theory Pract. 29(4), Pages 259–270. Doi: 10.3109/09593985.2012.731675.

9. Rasti Z, Shamsoddini A, Dalvand H, et al, 2017. Effect of Kinesio taping on handgrip and active range of motion of hand in children with cerebral palsy. Iran J Child Neurol. 11(4), Pages 43–51.