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Effective of Core Muscles Exercises and Proprioceptive Exercises on Balance and Functional Mobility in Children with Cerebral Palsy- A Comparative Study

[1]Dr. Samiya Shaikh; [2]Dr. Abhijit Satralkar; [3]Dr. Sucheta Golhar
Pes Modern College of Physiotherapy, Shivajinagar Pune-05

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ABSTRACT

- ***Background and Objectives:***

Cerebral palsy, a term comprises a physical disability in development, which does not spread by contact, mainly in various parts of body and its movements. Children with cerebral palsy have poor gait and reaching movement because of walking difficulty and poor balance control. Core exercises, that it has positive influence on balance and functional mobility. Proprioception exercises have proven to be effective in improving dynamic balance. Many studies have been carried to show the individual effect of proprioceptive exercises and core muscle exercises to improve balance and functional mobility of cerebral palsy children. But there is no evidence showing comparison between core exercises and proprioceptive exercises in children with cerebral palsy. Hence this study aims to see the effects of both treatment and prove which one is better by comparing proprioceptive and core stability exercises.

- ***Methods: -***

A total 60 participants were included in the study out of which 54 completed the study. The participants were divided into two groups. 28 participants were given core stability exercises along with conventional exercises and 26 participants were given proprioceptive training along with conventional exercises. The intervention was given for 8 weeks. Outcomes were taken at the baseline and at the end of 8 weeks.

- ***Results: -***

In this study total 54 subjects, both male (42%) and female (58%) with mean age 8.06±0.80 (Group A) and8.52±1.26 (Group B) were selected using simple random sampling and were allocated into two groups 28 subjects in Group A and 26 subjects in Group B using envelope method. The participants in Group A subjects received core stability exercises along with conventional exercises and Group B received proprioceptive training along with conventional exercises.

- ***Between Groups Comparison***

When the comparison of TUG scores between group A and group B was done unpaired t test, there was no significant difference with p value (>0.05).

Thus Group A (core stability exercises) and group B (proprioceptive training) were equally effective in improving functional mobility in children with cerebral palsy at the end of eight weeks intervention which supports the null hypothesis

When the comparison of BOT scores between Group A and Group B was done using unpaired t test, there was no significant difference with p value (>0.05).

Thus, Group A (core stability exercises) and Group B (proprioceptive training) were equally effective in improving balance in children with cerebral palsy at the end of eight weeks intervention which supports the null hypothesis.

- ***Conclusion: -***

The study concluded that both core exercises and proprioceptive exercises were equally effective in improving functional mobility and balance in children with cerebral palsy at end of 8 weeks' intervention.

In the end, the study revealed no significant differences between the two groups, as both core exercises and proprioceptive exercises resulted in similar improvements in balance and functional mobility in children with cerebral palsy. Core muscle strength is closely linked to lower limb muscle endurance, and strengthening the core can enhance stability in lower limb movements, ensuring smooth and stable motion. On the other hand, proprioceptive training enhances knee stability through various sensory inputs, including muscle spindles, Golgi tendon organs, and joint afferents, all of which contribute to joint position sensing. In conclusion, both core stability exercises and proprioceptive training were found to be effective in improving balance and functional mobility over an 8-week intervention period, underscoring their potential to enhance these aspects of physical function.

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SUMMARY

- *Background and Objectives: -*

Cerebral palsy is a condition , comprises a physical disability in development, which does not spread by contact, mainly in various areas of body and its movement. Children with cerebral palsy have poor gait and reaching movement because of walking difficulty and poor balance control. Core stability exercises have been proven that it has positive influence on balance and functional mobility. The proprioception exercises improved objectives measurements of functional status. The decline in dynamic position sense is associated with decrease in the balance of CP children and this decline in proprioception can be prevented or improved by proprioceptive training. Many studies have been carried out to show the individual effect of proprioceptive training and core stability exercises to improve balance and functional mobility of cerebral palsy children. But there is no evidence showing comparison between core stability and proprioceptive training in children with cerebral palsy.

Hence this study aims to analyze the effectiveness of both treatment and prove the better effectiveness by comparing proprioceptive and core stability exercises.

- *Methods: -*

A total 60 participants were included in the study out of which 54 completed the study. The participants were divided into two groups. 28 participants were given core stability exercises along with conventional exercises and 26 participants were given proprioceptive training along with conventional exercises. The intervention was given for 8 weeks. Outcomes were taken at the baseline and at the end of 8 weeks.

- *Results: -*

In this study total 54 subjects, both male (42%) and female (58%) with mean age 8.06±0.80 (Group A) and8.52±1.26 (Group B) were selected using simple random sampling and were allocated into two groups 28 subjects in Group A and 26 subjects in Group B using envelope method. The participants in Group A subjects received core stability exercises along with conventional exercises and Group B received proprioceptive training along with conventional exercises.

- *Within Group Comparison*

There was a significant difference seen in the pre (8.06±0.8) and post (7.43±0.75) intervention TUG values within Group A with $p<0.05$. Also there was significant difference seen in pre (8.52±1.26) and post (7.91±1.01) intervention TUG values within Group B with $p<0.05$. Thus, within group comparison of both the groups using paired t test observed that both the treatments were effective in improving functional mobility at the end of 8 weeks in children with cerebral palsy. There was a significant difference seen in the pre (16.64+4.59) and post (17.54+5.28) mean BOT values in Group A with $p<0.05$. Also there was a significant difference seen in the pre (17.54±5.28) post (22.85±4.89) mean BOT values in group 2 with $p<0.05$. Thus, within group comparison of both the groups using paired t test observed that both the treatments were effective in improving balance at the end of 8 weeks in children with cerebral palsy.

- *Between Groups Comparison*

When the comparison of TUG scores between group A and group B was done unpaired t test, there was no significant difference with p value (>0.05).

Thus Group A (core stability exercises) and group B(proprioceptive training) were equally effective in improving functional mobility in children with cerebral palsy at the end of eight weeks intervention which supports the null hypothesis

When the comparison of BOT scores between Group A and Group B was done using unpaired t test, there was no significant difference with p value (>0.05).

Thus, Group A (core stability exercises) and Group B (proprioceptive training) were equally effective in improving balance in children with cerebral palsy at the end of eight weeks intervention which supports the null hypothesis.

- *Conclusion: -*

The Study concluded that both core stability exercises and proprioceptive training were equally effective in improving functional mobility and balance in children with cerebral palsy at end of 8 weeks' intervention.

In the end, the study revealed no significant differences between the two groups, as both core exercises and proprioceptive exercises resulted in similar improvements in balance and functional mobility in children with cerebral palsy. Core muscle strength is closely linked to lower limb muscle endurance, and strengthening the core can enhance stability in lower limb movements, ensuring smooth and stable motion. On the other hand, proprioceptive training enhances knee stability through various sensory inputs, including muscle spindles, Golgi tendon organs, and joint afferents, all of which contribute to joint position sensing. In conclusion, both core stability exercises and proprioceptive training were found to be effective in improving balance and functional mobility over an 8-week intervention period, underscoring their potential to enhance these aspects of

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physical function.

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CHAPTER ONE
INTRODUCTION

Cerebral palsy is term which comprises a physical disability in development, which does not spread by contact, chiefly in various areas of body movement [1] Cerebral palsy (CP) is characterized by gait abnormalities because of weak muscles, increased tone, and abnormal movement, that is the most common cause of impairment in children. [2]

The impairments can lead to difficulty in walking independently, compromising steps on uneven surface and running, and other activities of daily living. (3)

Children with CP have difficulties in activities, which severely affect the children's quality of life. Children with cerebral palsy have poor gait and reaching movement because of walking difficulty and poor balance control. [3] Balance is most important fundamental components of movement. [3] The children with cerebral palsy have poor static and dynamic balance than healthy children. The balance control ability of child with cerebral palsy is affected especially in standing and sitting position. [3]

Core muscle stability is important for appropriate balance within the space. "Core" is the group of trunk muscles that surround the spine and abdomen. Abdominal, glutei, hip girdle, par spinal and other muscles work together to provide spinal stability. The active system consists of the muscles and tendons surrounding the spinal column.

The various force and motion which are located in the ligaments, tendons, muscles, and neural control centers. All three systems interact with each other to provide sufficient stability to the spine to face challenges from spinal posture and static and dynamic loads. [4]

Children with cerebral palsy (CP) have limitations with postural control and anticipatory postural adjustments. Their capacity to sit independently is delayed which interfere with daily life activities. [5]

Balance is an important component of core stability.[6]

Core training (CST) is popular training in sports and now it's widely being applied to rehabilitation.[8] CST also has been confirmed that has a positive effect on dynamic sitting and standing balance, trunk control, and gait.[10] Adding CST to the rehabilitation program can significantly improve the endurance time of trunk muscles and gait in children with hemiplegic CP. Since children with CP commonly have a weak muscles in the trunk, CST will be a feasible intervention to manage the pain of patients and improve the quality of life [10].

Proprioception was defined as the sense of joint and body movements in space. Proprioception is a sense produced by the sensory receptors that are sensitive to pressure in the tissues that surround them. Also improvements in functional balance due to proprioceptive training may be attributed to the improvement of mechanoreceptor activation. They are also present in the bones of the legs, arms or other parts of the body and these receptors response to stretches of the muscle surrounding them and send impulse through the sensory nerve fibers to the brain.[11])

As the improvement in balance assists in improving functional mobility in cerebral palsy children, this study aims to find effectiveness and which treatment are better core stability exercises or proprioceptive training.

- *Need of Study*

The position and motion sense of the muscles, joints and touch receptors of the extremities and trunk (i.e. Proprioceptive system) sends signals regarding body positions particularly in relation to the supporting surfaces. Proprioception is a sensory perception notified by the sensory receptors that are sensitive to pressure in the tissues. These receptors respond to stretches of the muscles surrounding these regions, sending impulses through the sensory Nerve fibers to the higher centers of the brain (i.e. cerebellum and brainstem).

Core stability improves the connections between the abdominal, spinal, shoulder and pelvic girdle musculature by stabilizing the trunk and providing support for extremity activities. The muscles in core help in anchoring the center of gravity, which gives the ability to balance while sitting, standing, or running, core muscles play an integral role in keeping the body balanced. So when given core exercise training is given to cerebral palsy children their muscles get activated, strengthened and gain endurance, as well as they gain more of neural control over their core musculature giving them the ability to hold the upright position of the trunk.

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Both the interventions are working according to different mechanism such as proprioceptive training group using mostly the neural components (i.e. proprioceptors)[1]as the mainstay for the protocol whereas the core training group uses the neural and the muscular component[39],[40] as well, when training the core muscles there is a difference between the physiological basis of the mechanisms acting over the training essence of the protocols.

These two protocols are two different reasonable entities using their own mechanisms and are therefore comparable in terms of effectiveness to enquire which better training in Cerebral Palsy children is.

Hence in this study, we aimed to compare the effects of both the protocols.

- *Aim*

To compare the effects of core muscle exercises and proprioceptive exercises on balance and functional mobility in children with cerebral palsy at the end of 8 weeks.

- *Objectives*

- *Primary Objective:*

To compare the effects of core muscle exercises and proprioceptive exercises on balance and functional mobility in children with cerebral palsy using BOT 2 balance subset and TUG (timed up and go test) at the end of 8 weeks.

- *Secondary Objective 1:*

To find the effects of core muscle exercises on balance and functional mobility in children with cerebral palsy using BOT 2 balance subset and TUG(timed up and go test) at the end of 8 weeks.

- *Secondary Objective 2:*

To find the effectiveness of proprioceptive exercises on balance and functional mobility in children with cerebral palsy BOT 2 balance subset and TUG(timed up and go test) at the end of 8 weeks

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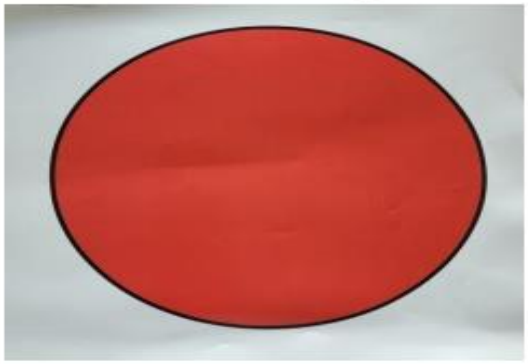
CHAPTER TWO
MATERIAL AND METHODOLOGY

➢ *Materials:*

BOT 2 TOOL Beam balance

BOT target

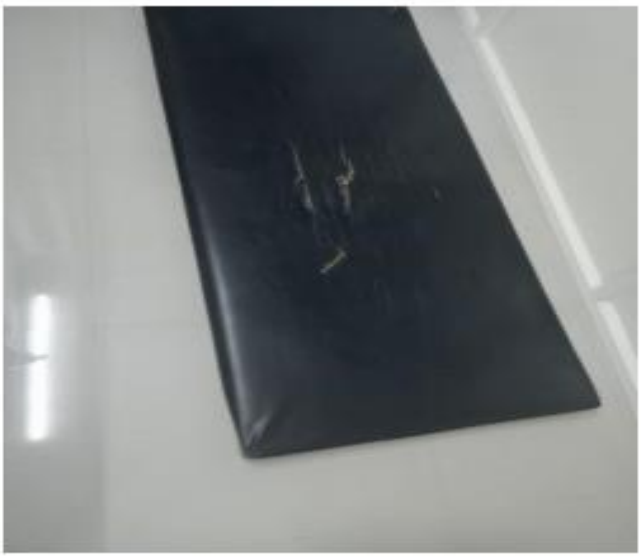


Balance subset

Scoresheet

Swiss ball

Mat



Weight cuff

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- Paper
- Pen
- Chair
- Assent form (Annexure 1)
- Consent form(Annexure 2)
- Data collection sheet (Annexure 3)

➢ *Methodology*

- Study design: comparative study
- Study setting: hospitals in and around the city
- Sampling technique: convenient sampling
- Allocation method: envelope method
- Study population: children with cerebral palsy
- Study duration: 18 months
- Intervention duration: 8 weeks

➢ *Inclusion Criteria*

- Cerebral palsy children with age group of 8-16years[(1)]
- Cerebral palsy children who can and understand and follow the instructions.[(1)]
- Both males and females[(1)]
- Cerebral palsy children with GMFC SCALE LEVEL I[(1)]
- spastic cerebral palsy diagnosed by pediatrician[(1)].

➢ *Exclusion Criteria*

- Auditory impairments
- Visual impairments
- Uncontrolled convulsions

➢ *Withdrawal Criteria*

- Patient who are not willing to continue with the treatment protocol.
- Patient who are not able to cop up with the treatment protocol.

➢ *Outcome Measures*

- BOT- 2 Tool Balance subset ICC=0.99[(34)] **BOT- 2 Tool Balance** subset **ICC=0.99**(34)
- **TUG timed up and go** for functional mobility **ICC 0.80-0.99**[(33)] **validity** (p = . 256), 95% CI = [0.47, 0.69].[(50)]

➢ *Operational Definition*

- Cerebral palsy:

Spastic Cerebral palsy is a group of disorders, which are irreversible, non- progressive of movement and posture, causing activity limitation with age group 8 to 16years and GMFCS LEVEL I who can understand and follow the instructions.

- *Functional Mobility:*

It is a person's capability to move around independently in environment for functional and daily activities and can complete the timed up and go test to assess the speed of functional walk.

- *Balance:*

Ability to maintain the static or dynamic posture without any support.

➢ *Procedure*

- Ethical clearance was being obtained from the institutional ethical committee.
- Informed consent was taken from the participants.
- Participants that satisfy the inclusion criteria were included in the study.

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- Then they were allocated to the groups using envelope method. Group A was given core stability exercises along with conventional exercises and Group B was given proprioceptive training along with conventional exercises.
- The detailed procedure of the study was explained to the participants.
- Outcome measures were taken at the beginning of the study and at the end of eight weeks.

➢ *Intervention*

Core stability Exercises (GROUP A)

Abdomin draw-in with both knee to chest Instructions given "take your stomach in and now take your both knees towards chest"	10 Times 
Trunk rotation sitting on physioball Instructions: "Reach your left hand to my right hand" Repeat on other side.	10 times 
Lying in supine position on a mat and upper and lower limbs upwards Instructions: "take your hands and leg up towards the ceiling".	10 Times 

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Single leg bridging Instructions: “take your right leg up and now lift your waist up” Repeat on other leg	10 Times 
Quadrupled position – raising the right upper limb and left lower limb Instructions: take horse position and now take right hand and left leg out.	5 Times 

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Proprioceptive Training (Group B)

Exercises	Repetitions
Stair climbing up and down Instructions: climb the stairs without taking support	5 times each  
Standing with feet shoulder width apart and arms extended out slightly forward lower that the shoulder, then lifting both heels off the floor. Instructions: "take your hands up and now lift up your heels and stand on toes."	5 minutes 

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One leg standing with one foot raised in front (with or without support) Instructions : "lift your right leg up in front" "Lift your right leg up in front"	5 minutes 
Walking heel to toes Instructions: "walk touching your right heel to left toes and now walk touching your left heel to left toes."	15 times 
Rising from chair without arms support Instructions: "sit on the chair, don't use your hands Now get up without using your hands."	4 times 

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➢ *Conventional Treatment*

All the children in both groups received the physical therapy exercises (1 hour, three sessions/week) for eight successive weeks. Each exercise was repeated 3 times with a rest period.

Mats, wedges, rolls, physioballs, steppers and balance beam were used for conducting the physical therapy program. The treatment included the following exercises:

- Stretching exercises in the affected muscle group.
- Strengthening exercises in the affected muscle group
- Hopping in different directions.
- Single leg standing.
- walk overcoming obstacles (forward, backward and sideward).
- Walking between steppers, and on different surfaces (foam or mat).
- Jumping in place.
- Stepping up and down a step.


Fig 1 Streching for TFL


Fig 2 Streching for TA


Fig 3 Streching for Hamstring


Fig 4 Streching for Biceps


Fig 5 Streching for Supinator


Fig 6 Streching for Triceps

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Fig 7 Walking on Mat

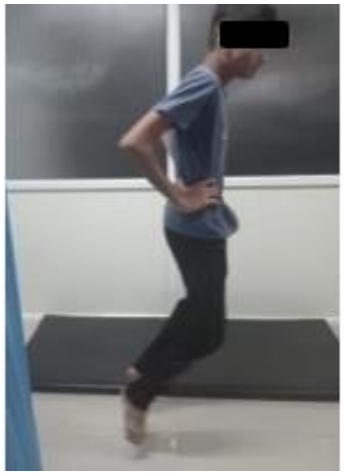
Fig 8 Hopping Forward


Fig 9 Stepping up on a Step


Fig 6 Stepping Down

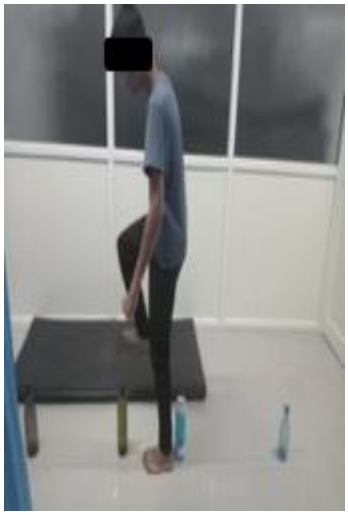
Fig 10 Obstacle Walking Forward


Fig 11 Obstacle Walking Sidewards


Fig 12 Adductors Strengthening


Fig 13 Hip Flexors Strengthening


Fig 14 Single Leg Standing

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- *Data Analysis and Interpretation*

Descriptive and inferential statistical analyses were carried out in the present study.

Results on continuous measurements were presented on Mean ±SD and results on categorical measurement were presented in number (%).

Level of significance was fixed at p=0.05 and confidence interval was set to 95% and any value less than or equal to 0.05 was considered to be statistically significant.

Paired t test was used to find the significance of the study parameters on continuous scale within and between two groups.

The Statistical software IBM SPS statistics 20.0 was used for the analysis of the data and Microsoft word and Excel were used to generated graphs and tables.

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CHAPTER THREE
RESULTS AND TABLES

- *Gender Distribution in Group A and Group B*

Table 1 Gender Distribution Table

	GROUP A	GROUP B
FEMALE	17(60.71%)	14(53.85%)
MALE	11(39.29%)	12(46.15%)
TOTAL	28(100)	26(100)

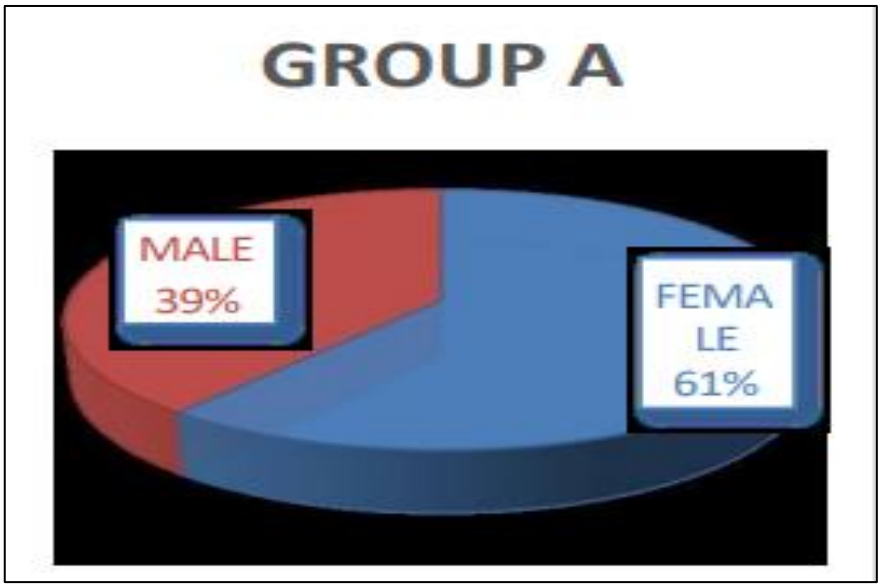

Fig 15.1 Pie Chart 1 Group A Gender Distribution

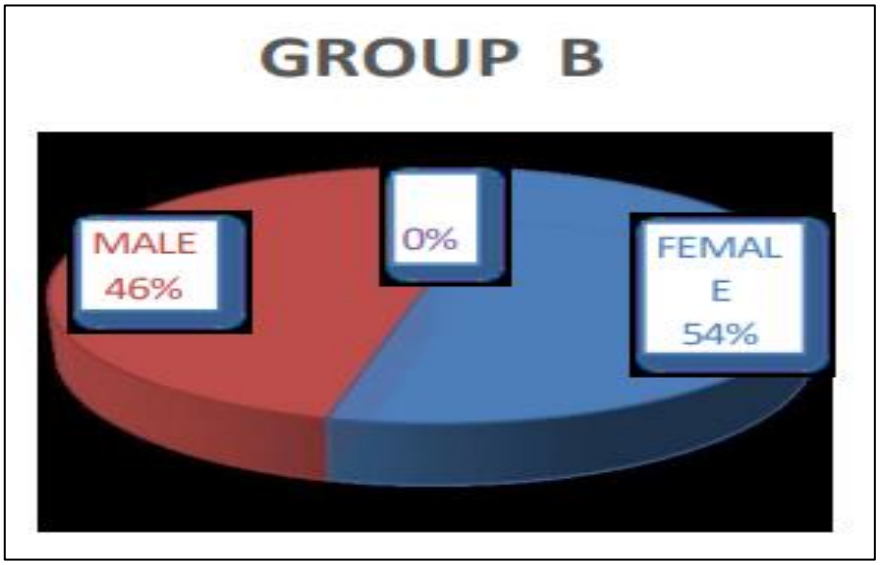

Fig 15.2 Pie Chart 2 Group B Gender Distribution

- *Comparison of baseline values between groups*

Age distribution in Group A and Group B

Table 2 Age Distribution Group A and Group B

	Group A	**Group B**
Mean (SD)	8.06±0.80	8.52±1.26
Median (IQR)	7.90(7.32-8.72)	8.52(7.63-9.26)

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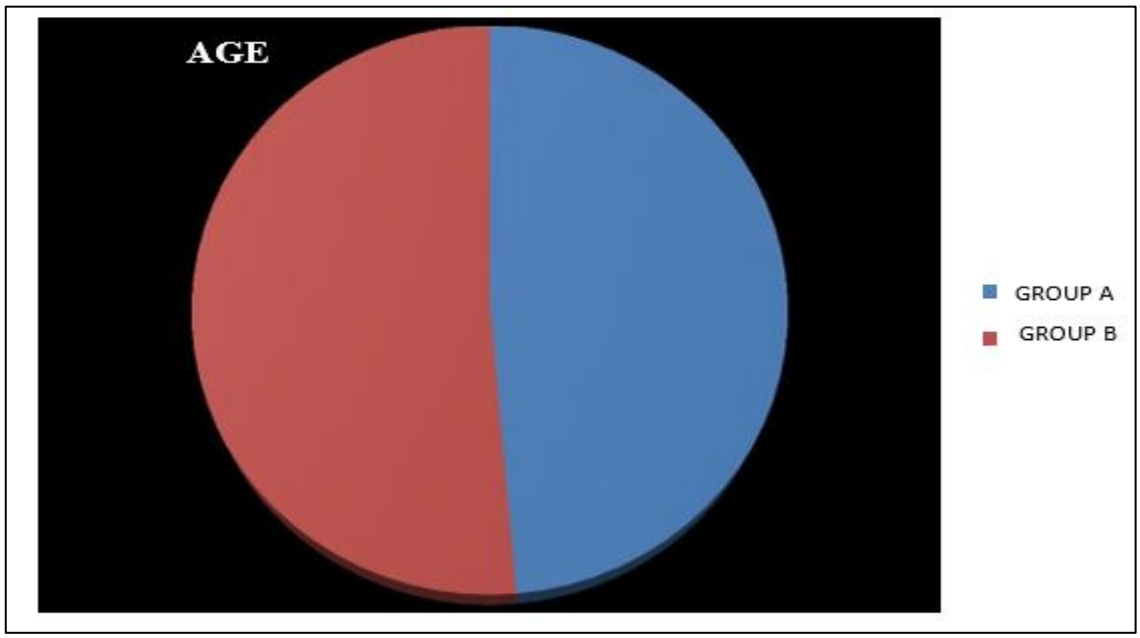


Fig 16 Pie Chart Age Distribution Group A and Group B

➢ *Baseline Measurements for Outcome Measures.*

Table 3 Baseline Measurements for Outcome Measures

	Group A	**Group B**
TUG	8.06(0.80)	8.52(1.26)
BOT 2 (balance subset)	16.64(4.59)	17.54(5.28)

- *Interpretation: -*

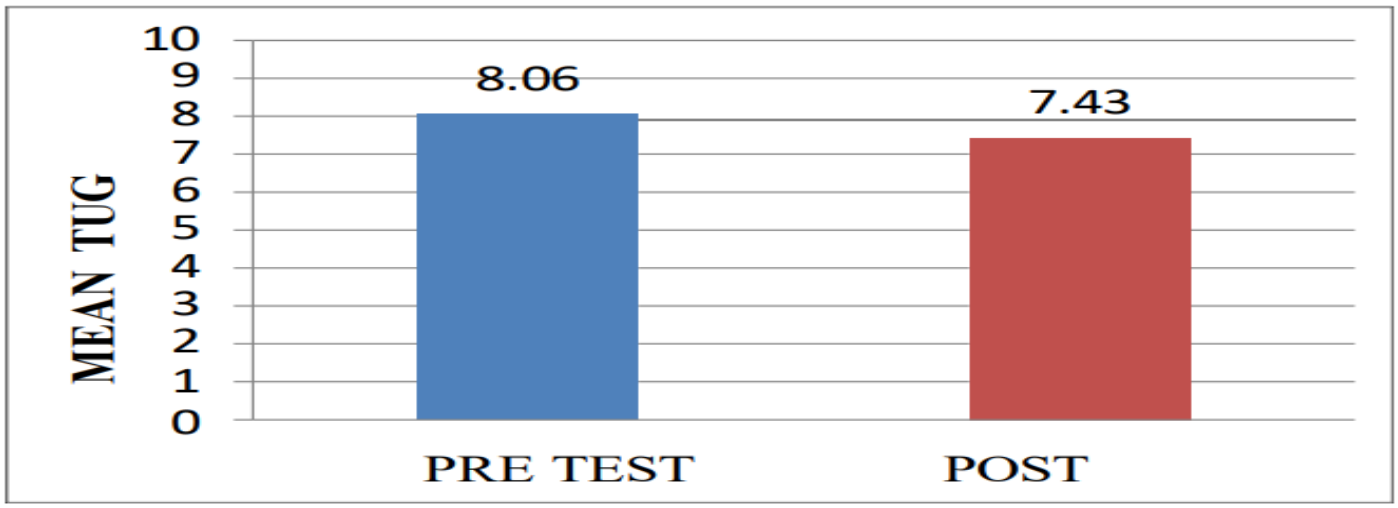
✓ TUG pre values were not normally distributed.
✓ There was no statistically significant (P>0.05) difference between the TUG values showing groups were similar at baseline.

BOT 2(balance) pre values were not normally distributed. Though the Group B values were slightly higher there was no statistically significant (P>0.05) difference between BOT values showing the groups were similar at baseline.

➢ *Within Group Analysis Tug Group A*

Table 4 TUG Values Pre and Post for Group A

TUG	**Pre test**	**Post test**	**t value**	**p value**
SCORE	8.06(0.80)	7.43(0.75)	6.4	<0.05



Graph 1 TUG Values pre and Post Test for Group A

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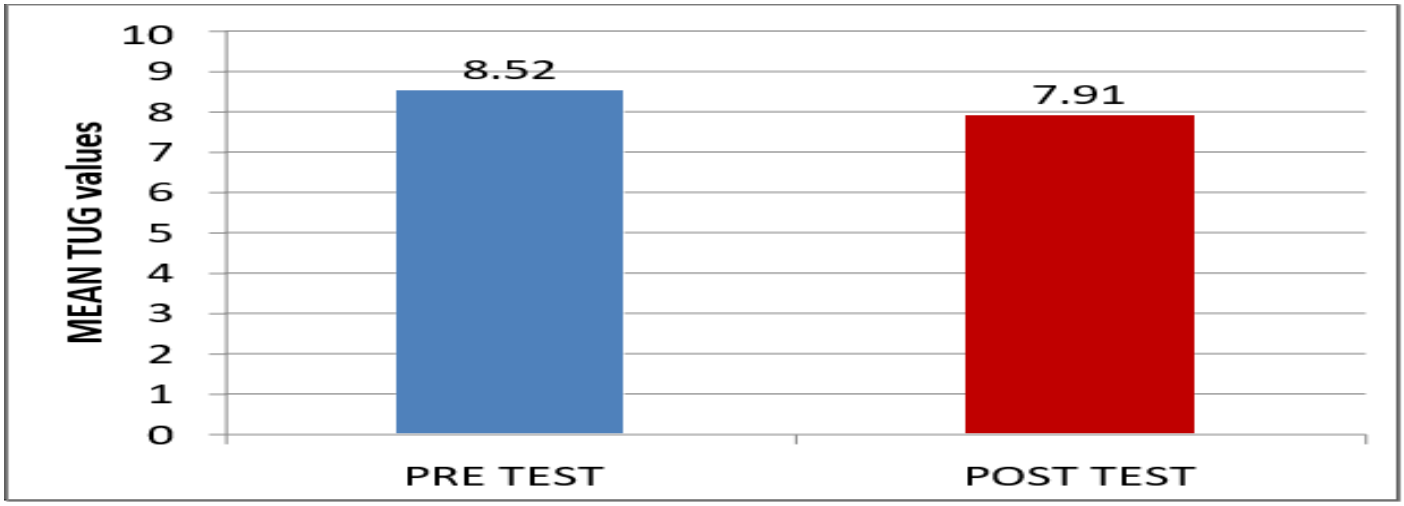
- *Interpretation:*

✓ Within group comparison pre and post values Group A TUG values.
✓ There was statistically significant ($p<0.05$) decrease in TUG post values as compared to baseline values in Group A.

➢ *Within Group Comparison Pre and Post Values Group B Tug*

Table 5 TUG Values Pre and Post Group B

	Pre test	Post test	t value	p value
TUG VALUES	8.52(1.26)	7.91(1.01)	6.34	<0.05



Graph 2 TUG Values Pre and Post Group B

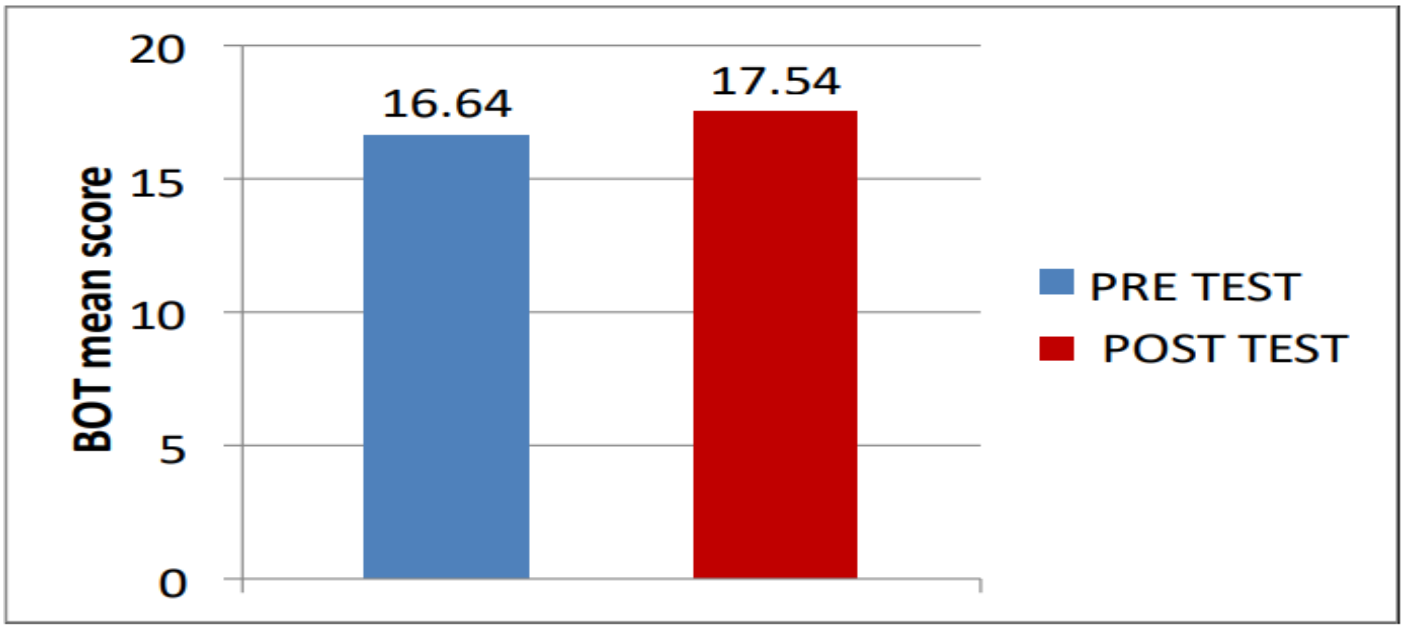
- *Interpretation:*

✓ There was statistically significant ($p<0.05$) decrease in TUG post values as compared to baseline values in Group B.

➢ *Within Group Comparison Bot Pre Post Values GroupA*

Table 6 Within Group Comparison Bot Pre Post Values Group A

	Pre	Post	t value	p value
BOT balance subset	16.64(4.59)	17.54(5.28)	8.55	<0.05



Graph 3 Within Group Comparison Bot Pre Post Values Group B

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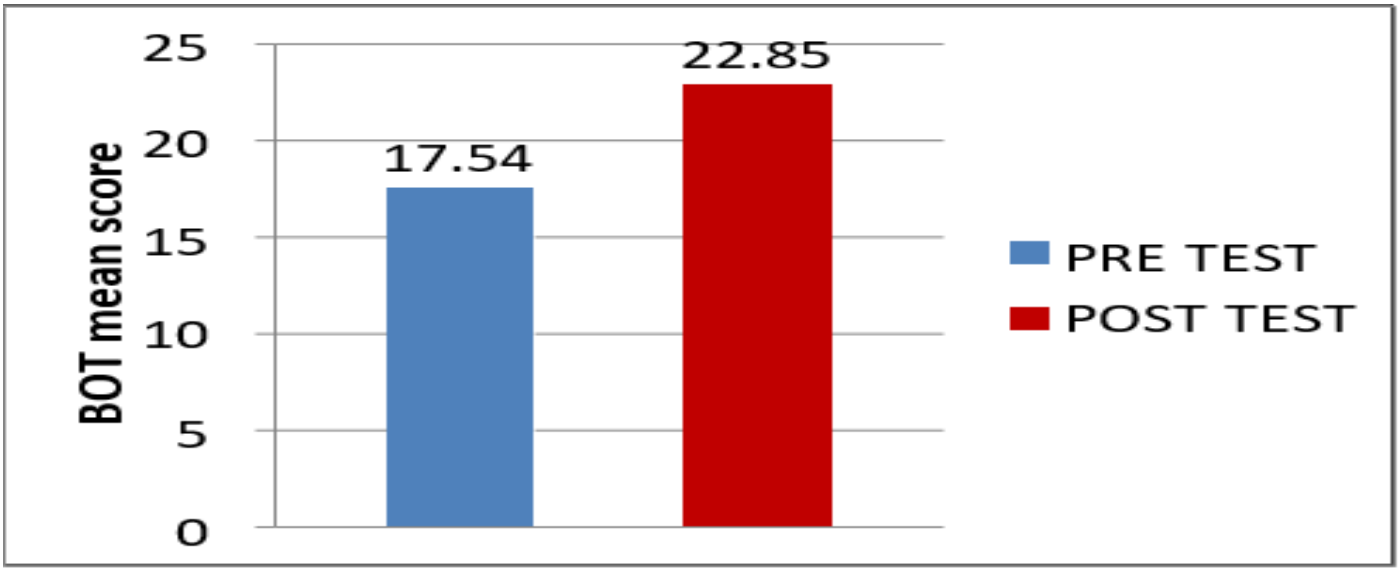
- *Interpretation:*

✓ There was statistically significant increase in BOT post values as compared to baseline values in Group A.

➢ *Within Group Comparison BOT 2 Balance Pre Post Group B*

Table 7 BOT 2 Balance Pre Test and Post Test mean Score Group B

	Pre test	Post test	t value	p value
BOT 2 (balance subset)	17.54(5.28)	22.85(4.89)	9.537	<0.05



Graph 4 BOT 2 Balance Pre Test and Post Test mean Score Group B

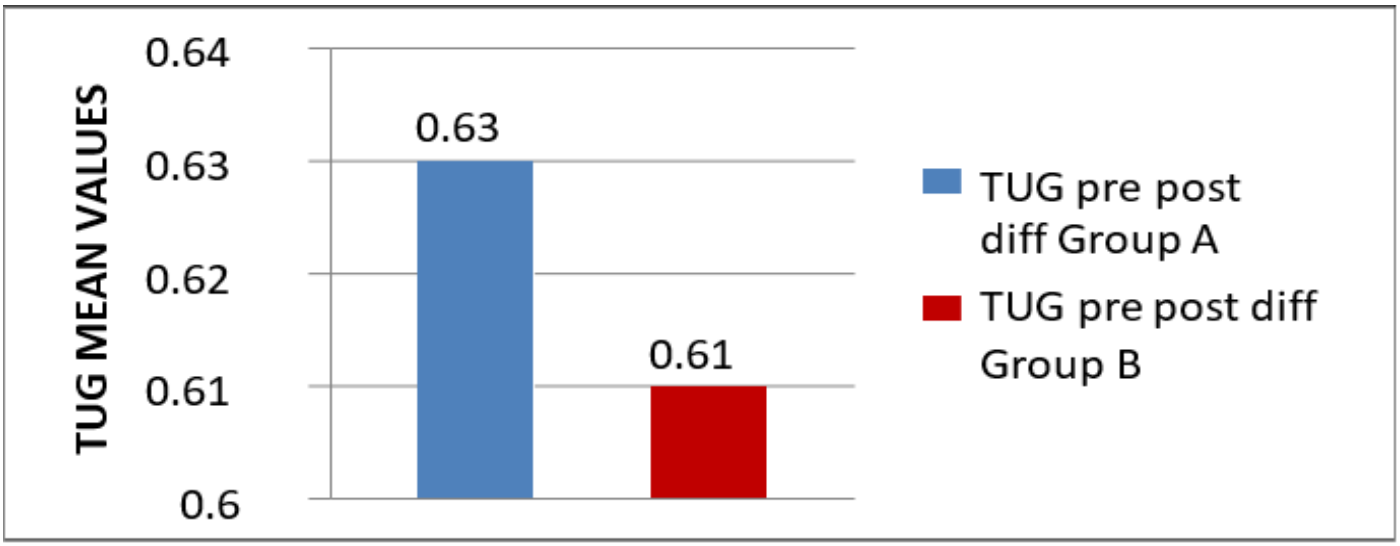
- *Interpretation:*

✓ Pre post differences in Group B were not normally distributed. There was statistically significant increase in BOT post values as compared to baseline values in Group B also.

➢ *Between Group Analysis*

Table 8 TUG Pre Post Diff Mean between Group A and B

	Pre post diff group A	Pre post diff group B	P value
Tug values mean	0.63	0.61	P>0.05



Graph 5 TUG Pre Post Diff mean between Group A and B

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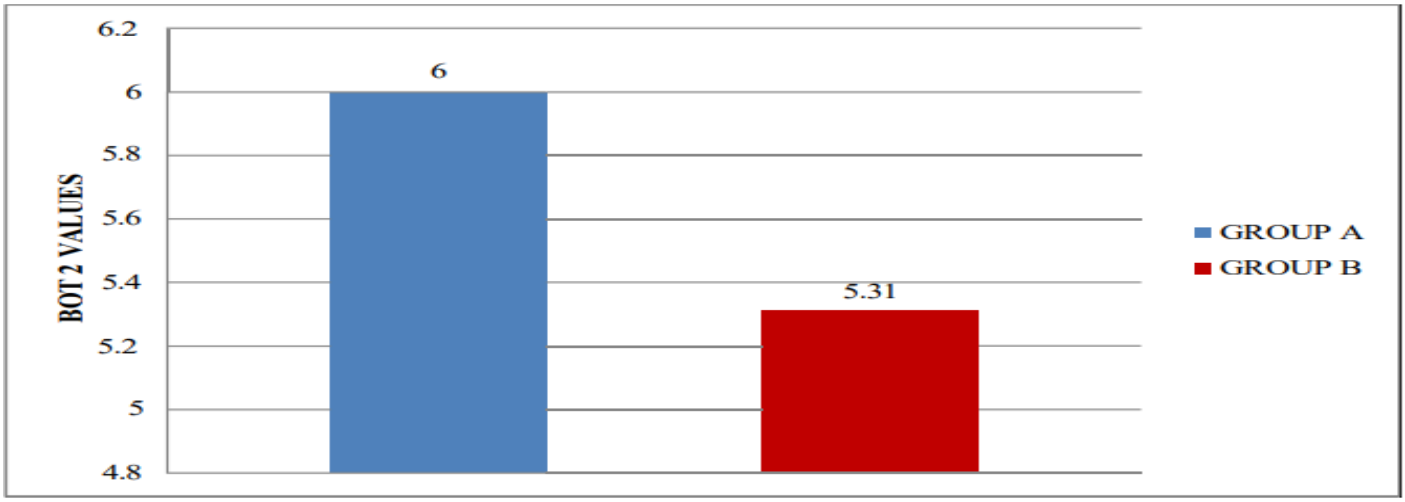
- *Interpretation:*

✓ Comparison of pre post diff between the groups TUG
✓ Though the group 1 value had more improvement, there was no statistically significant difference between the two groups.

➢ *Between Group Comparison BOT 2 Pre Post Difference*

Table 9 between Group Pre and Post mean Diff Group A and B

	Pre post mean Diff Group A	Pre post mean Diff Group B	Z value	P value
Bot 2 values	6±3.71	5.31±2.84	0.908	>0.05



Graph 6 between Group Pre and Post mean Diff Group A and B

- *Interpretation :*

✓ Though the Group A had more improvement there was no statistically significant difference between the two groups.

➢ *Results*

In this study total 54 subjects, both male(42%) and female(58%) with mean age 8.06±0.80 (Group A) and 8.52±1.26 (Group B) were selected using simple random sampling and were allocated into two groups 28 subjects in Group A and 26 subjects in Group B using envelope method.

The participants in Group A subjects received core stability exercises along with conventional exercises and Group B received proprioceptive training along with conventional exercises.

➢ *Within group comparison*

There was a significant difference seen in the pre (8.06±0.8) and post (7.43±0.75) intervention TUG values within Group A with $p<0.05$.

Also there was significant difference seen in pre (8.52±1.26) and post (7.91±1.01) intervention TUG values within Group B with $p<0.05$.

Thus, within group comparison of both the groups using paired t test observed that both the treatments were effective in improving functional mobility at the end of 8 weeks in children with cerebral palsy.

There was a significant difference seen in the pre (16.64+4.59) and post (17.54+5.28) mean BOT values in Group A with $p<0.05$.

Also there was a significant difference seen in the pre (17.54±5.28) post (22.85±4.89) mean BOT values in group 2 with $p<0.05$.

Thus, within group comparison of both the groups using paired t test observed that both the treatments were effective in improving balance at the end of 8 weeks in children with cerebral palsy.

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- *Between groups comparison*

When the comparison of TUG scores between group A and group B was done unpaired t test, there was no significant difference with p value (>0.05). Thus Group A (core stability exercises) and group B (proprioceptive training) were equally effective in improving functional mobility in children with cerebral palsy at the end of eight weeks' intervention which supports the null hypothesis

When the comparison of BOT scores between Group A and Group B was done using unpaired t test, there was no significant difference with p value (>0.05).

Thus, Group A (core stability exercises) and Group B (proprioceptive training) were equally effective in improving balance in children with cerebral palsy at the end of eight weeks' intervention which supports the null hypothesis.

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CHAPTER FOUR
DISCUSSION

The primary objective of this study was to compare the impact of two different interventions, namely core muscle exercises and proprioceptive exercises, on balance and functional mobility in children diagnosed with cerebral palsy. The study aimed to determine the relative effectiveness of these interventions over an 8-week duration.

A total of 54 participants were enrolled in the study, with 28 individuals in Group A receiving core muscle exercises in combination with conventional training, and 26 participants in Group B undergoing proprioceptive training alongside conventional training. Balance was assessed using the balance subset of the Bruininks-Oseretsky Test, Second Edition (BOT-2), while functional mobility was evaluated using the Timed Up and Go Test (TUG).

It is evident that cerebral palsy is associated with decline in proprioceptors. [(1)] Proprioception is a sensory perception notified by the sensory receptors that are sensitive to pressure in the tissues. These receptors respond to stretches of the muscles surrounding these regions, sending impulses through the sensory nerve fibers to the higher centers of the brain (i.e. cerebellum and brainstem). This decline in proprioceptors results in decreased postural control and balance which hampers their activities of daily living.[(1)]

In cerebral palsy children there are weak core muscles also results in impaired postural control and balance. Core stability improves the connections between the abdominal, spinal, shoulder and pelvic girdle musculature by stabilizing the trunk and providing support for extremity activities. The muscles in core help in anchoring the center of gravity, which gives the ability to balance while sitting, standing, or running, core muscles play an integral role in keeping the body balanced.[(39)(40)]

Similarly, improvements in functional mobility and balance as a result of proprioceptive training can be linked to heightened mechanoreceptor activation. This training can enhance joint and kinesthetic sensation, reducing the risk of falls. Notably, a decline in dynamic position sense is linked to decreased proprioceptor efficiency in children with cerebral palsy, negatively affecting functional mobility. Proprioceptive training can counteract this decline by improving proprioception, addressing sensorimotor components, and processes involved in balance. These components include the proprioceptive and vestibular systems, body schema, and base of support, body symmetry, and trunk sway. Several studies have demonstrated that proprioceptive training in older adults can enhance inter- and intramuscular coordination, leading to improved dynamic balance.

In the end, the study revealed no significant differences between the two groups, as both core exercises and proprioceptive exercises resulted in similar improvements in balance and functional mobility in children with cerebral palsy. Core muscle strength is closely linked to lower limb muscle endurance, and strengthening the core can enhance stability in lower limb movements, ensuring smooth and stable motion. On the other hand, proprioceptive training enhances knee stability through various sensory inputs, including muscle spindles, Golgi tendon organs, and joint afferents, all of which contribute to joint position sensing. In conclusion, both core stability exercises and proprioceptive training were found to be effective in improving balance and functional mobility over an 8-week intervention period, underscoring their potential to enhance these aspects of physical function.

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CHAPTER FIVE
CONCLUSION

The study concluded that both core exercises and proprioceptive training were equally effective in improving functional mobility and balance in children with cerebral palsy at end of 8 weeks' intervention.

In the end, the study revealed no differences in the effectiveness between the two groups, as both core exercises and proprioceptive exercises resulted in similar improvements in balance and functional mobility in children with

Cerebral palsy. Core muscle strength is closely linked to lower limb muscle endurance, and strengthening the core can enhance stability in lower limb movements, ensuring smooth and stable motion. On the other hand, proprioceptive training enhances knee stability through various sensory inputs, including muscle spindles, Golgi tendon organs, and joint afferents, all of which contribute to joint position sensing. In conclusion, both core stability exercises and proprioceptive training were found to be effective in improving balance and functional mobility over an 8-week intervention period, underscoring their potential to enhance these aspects of physical function.

- *Clinical Implications*

  Both the protocols that is core stability and proprioceptive training can be implemented in clinical practice in physiotherapy clinics in this population.

- *Limitations*

  Long term effect and follow could not be assessed.

- *Future Scope of Study*

  Combined effect of core stability and proprioceptive training can be studied.

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REFERENCES

[1]. Kuki Bardoloi Effectiveness of proprioceptive training over strength training in improving the balance of cerebral palsy children with impaired balance. (Scientific Research Journal of India-SRJI Vol-1 No -1 year 2012).
[2]. Cerebral palsy. National Center on Birth Defects and Developmental Disabilities, October 3,2002
[3]. Bax M, Goldstein M, Rosenbaum P, Leviton A, Paneth N, Dan B et al. Proposed definition and classification of cerebral palsy. Dev Med Child Neurol 2005; 47: 571-6.
[4]. Panjabi CW. (2013): The reliability of an instrumented device for measuring components of star excursion balance test, North American Journal of sports physical therapy, volume, number 2, page 92.
[5]. Hartbourne, R., Willett, S., Kyvelidou, A., Deffeyes, J., and Stergiou, N., (2010): A comparison of Interventions for Children with Cerebral Palsy to Improve Sitting Postural Control: A Clinical Trial, Physical Therapy; 90(12), 1881-1889.
[6]. Borghuis J, Hof, L.A., Koen, A.P.M. Lemmink (2008): The importance of sensory-motor control in providing core stability. Sports Medicine. ; 38(11):23.
[7]. Yi SH, Hwang JH, Kim SJ, Kwon JY. Validity of pediatric balance scales in children with spastic cerebral palsy. Neuropediatrics 2012 Dec;43(06):307-13
[8]. Ali MSM, Elazem F, Anwar GM. Effect of core stabilizing program on balance in spastic diplegic cerebral palsy children. Int J PharmTech Res 2016;9(5):129-36.
[9]. Chung EJ, Kim JH, Lee BH. The effects of core stabilization exercise on dynamic balance and gait function in stroke patients. J Phys Ther Sci 2013;25(7):803-6.
[10]. Ahmed MA, Abd El Azeim FH, Abd El Raouf ER. The problem solving strategy of poor core stability in children with cerebral palsy: a clinical trial. J Pediatr Neonatal Care. 2014;1(6):1-6.
[11]. Farid R, Norasteh AA, Hatamian, H. The effect of core stability exercise program on the balance of patients with multiple sclerosis. Caspian J Neurol Sci 2016;2(4):9-17.
[12]. El Shemy SA. Trunk endurance and gait changes after core stability training in children with hemiplegic cerebral palsy: A randomized controlled trial J Back Musculoskelet Rehabil 2018;31(6):1159-67.
[13]. Elshafey MA, Abdrabo MS, Elnaggar RK. Effects of a core stability exercise program on balance and coordination in children with cerebellar ataxic cerebral palsy. Journal of musculoskeletal & neuronal interactions. 2022 Mar 1;22(2):172-8
[14]. Samah Attia El Shemy Trunk endurance and gait changes after core stability training in children with hemiplegic cerebral palsy: A randomized controlled trial
[15]. Abd-Elfattah HM, Aly SM. Effect of core stability exercises on hand functions in children with hemiplegic cerebral palsy. Annals of Rehabilitation Medicine. 2021 Feb 9;45(1):71- 8.
[16]. Pantibatla S, Kumar V, Narayan A. Relationship between trunk control and balance in children with spastic cerebral palsy: a cross sectional study. Journal of clinical and diagnostic research: JCDR. 2017 Sep;11(9):YC05.
[17]. Vestibular Disorders Association. Official Website. Retriebed on 10/6/2011
[18]. Edward R.Laskowski, MD; Karen newcomer-Aney, MD; Jaysmith, MD.Refining rehabilitation with proprioceptive training: expecting return to play; The physician and sports medicine; 1997 Oct;Vol.25, No. 10
[19]. Ogoke CC. Clinical classification of cerebral palsy. Cerebral Palsy-Clinical and Therapeutic Aspects. 2018 Nov 5.
[20]. Krigger KW. Cerebral palsy: an overview. Am Fam Physician. 2020 Jan 1;73(1):91-100. PMID: 16417071.
[21]. Haruyama K, Kawakami M, Otsuka T. Effect of Core Stability Training on Trunk Function, Standing Balance, and Mobility in Stroke Patients. Neurorehabil Neural Repair. 2017 Mar;31(3):240-249. doi: 10.1177/1545968316675431. Epub 2016 Nov 9. PMID:
[22]. 27821673.
[23]. Shumway-Cook A, Hutchinson S, Kartin D, Price R, Woollacott M. Effect of balance training on recovery of stability in children with cerebral palsy. Dev Med Child Neurol. 2003 Sep;45(9):591-602. doi: 10.1017/s0012162203001099. PMID: 12948326.
[24]. Seson A. Traditional core stabilization therapy versus intensive therapy for toddlers with cerebral palsy (Doctoral dissertation, Azusa Pacific University).
[25]. Wingert JR, Burton H, Sinclair RJ, Brunstrom JE, Damiano DL. Joint-position sense and kinesthesia in cerebral palsy. Archives of physical medicine and rehabilitation. 2009 Mar 1;90(3):447-53.
[26]. Damiano DL, Wingert JR, Stanley CJ, Curatalo L. Contribution of hip joint proprioception to static and dynamic balance in cerebral palsy: a case control study. Journal of neuro engineering and rehabilitation. 2013 Dec;10(1):1-0.
[27]. Aman JE, Elangovan N, Yeh IL, Konczak J. The effectiveness of proprioceptive training for improving motor function: a systematic review. Frontiers in human neuroscience. 2015 Jan 28;8:1075.
[28]. Laskowski ER, Newcomer-Aney K, Smith J. Proprioception. Physical medicine and rehabilitation clinics of North America. 2000 May 1;11(2):323-40.
[29]. Ali AS, Darwish MH, Shalaby NM, Abbas RL, Soubhy HZ. Efficacy of core stability versus task oriented trainings on balance in ataxic persons with multiple sclerosis. A single blinded randomized controlled trial. Multiple Sclerosis and Related Disorders. 2021 May 1;50:102866.
[30]. Naderi Z, Jalali K. The effect of eight weeks of core stability and Pilates trainings on ankle proprioception, postural control, walking performance, self-efficacy and fear of falling in elderly women. Report of Health Care. 2018 Sep 1;4(3):1-3.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24JUN779

[31]. Yoo SD, Jeong YS, Kim DH, Lee M, Noh SG, Shin YW, Kim SH, Kim HS. The Efficacy of Core Strengthening on the Trunk Balance in Patients with Subacute Stroke. Journal of the Korean Academy of Rehabilitation Medicine. 2010 Dec 1;34(6):677-82.
[32]. Rangari SS, Qureshi I, Samal SN. Efficacy of Core Strengthening Exercises on Swissball Versus Mat Exercises for Improving Trunk Balance in Hemiplegic Patients Following Stroke. Indian Journal of Public Health Research & Development. 2020 Apr 1;11(4).
[33]. Samal SN, Samal SS, Chaudhary NI, Chaudhary S, Gawande V. Efficacy Of Core Strengthening Exercises On Swissball Versus Conventional Exercises For Improving Trunk Balance In Hemiplegic Patients Following Stroke. International Journal of Research in Pharmaceutical Sciences. 2021 Feb 27;12(1):889-93.
[34]. Carey H, Martin K, Combs-Miller S, Heathcock JC. Reliability and Responsiveness of the Timed Up and Go Test in Children With Cerebral Palsy. Pediatr Phys Ther. 2016 winter;28(4):401-8. doi: 10.1097/PEP.0000000000000301. PMID: 27661230.
[35]. Kim SG, Kim DH. Reliability, minimum detectable change, and minimum clinically important difference of the balance subtest of the Bruininks-Oseretsky test of motor proficiency-second edition in children with cerebral palsy. J Pediatr Rehabil Med. 2022;15(1):175-180. doi: 10.3233/PRM-190639. PMID: 35253658.
[36]. Hu H, Meijer OG, Hodges PW, Bruijn SM, Strijers RL, Nanayakkara PW, van Royen BJ, Wu WH, Xia C, van Dieën JH. Control of the lateral abdominal muscles during walking. Hum Mov Sci. 2012 Aug;31(4):880-96. doi: 10.1016/j.humov.2011.09.002. Epub 2011 Nov 26. PMID: 22119422.
[37]. White SG, McNair PJ. Abdominal and erector spinae muscle activity during gait: the use of cluster analysis to identify patterns of activity. Clin Biomech (Bristol, Avon). 2002 Mar;17(3):177-84. doi: 10.1016/s0268-0033(02)00007-4. PMID: 11937255.
[38]. Chung EJ, Kim JH, Lee BH. The effects of core stabilization exercise on dynamic balance and gait function in stroke patients. J Phys Ther Sci. 2013 Jul;25(7):803-6. doi: 10.1589/jpts.25.803. Epub 2013 Aug 20. PMID: 24259857; PMCID: PMC3820398.
[39]. Saeys W, Vereeck L, Truijen S, Lafosse C, Wuyts FP, Heyning PV. Randomized controlled trial of truncal exercises early after stroke to improve balance and mobility. Neurorehabil Neural Repair. 2012 Mar-Apr;26(3):231-8. doi: 10.1177/1545968311416822. Epub 2011 Aug 15. PMID: 21844283.
[40]. Kisner C, Colby LA, Borstad J. Therapeutic exercise: foundations and techniques. Fa Davis; 2017 Oct 18.
[41]. Mohebi Rad Z, Norasteh AA. The Effect of a Six-Week Core Stability Exercises on Balance, Strength, and Endurance in Female Students With Trunk Defects. Physical Treatments. 2020; 10(4):231-238. http://dx.doi.org/10.32598/ptj.10.4. 460.1
[42]. Özal C, Aksoy S, Kerem Günel M. Postural Control Alterations in Children with Mild Forms of Spastic Cerebral Palsy. Pediatric Health, Medicine and Therapeutics. 2022 Jan 1:367-76.
[43]. Winter L, Huang Q, Sertic JV, Konczak J. The Effectiveness of Proprioceptive Training for Improving Motor Performance and Motor Dysfunction: A Systematic Review. Frontiers in Rehabilitation Sciences. 2022 Apr 8;3:830166.
[44]. Panibatla S, Kumar V, Narayan A. Relationship between trunk control and balance in children with spastic cerebral palsy: a cross-sectional study. Journal of clinical and diagnostic research: JCDR. 2017 Sep;11(9):YC05.
[45]. Huang C, Chen Y, Chen G, Xie Y, Mo J, Li K, Huang R, Pan G, Cai Y, Zhou L. Efficacy and safety of core stability training on gait of children with cerebral palsy: a protocol for a systematic review and meta-analysis. Medicine. 2020 Jan;99(2).
[46]. El-Basatiny HM, Abdel-Aziem AA. Effect of trunk exercises on trunk control, balance and mobility function in children with hemiparetic cerebral palsy. International Journal of Therapies and Rehabilitation Research. 2015;4(5):236.
[47]. Akbas AN, Gunel MK. Effects of trunk training on trunk, upper and lower limb motor functions in children with spastic cerebral palsy: a stratified randomized controlled trial. Konuralp Medical Journal. 2019 Jun 28;11(2):253-9.
[48]. Monica S, Nayak A, Joshua AM, Mithra P, Amaravadi SK, Misri Z, Unnikrishnan B. Relationship between trunk position sense and trunk control in children with spastic cerebral palsy: a cross- sectional study. Rehabilitation Research and Practice. 2021 Aug 19;2021.
[49]. Akkaya KU, Elbasan B. An investigation of the effect of the lower extremity sensation on gait in children with cerebral palsy. Gait & Posture. 2021 Mar 1;85:25-30.
[50]. Selves C, Renders A, Detrembleur C, Lejeune T, Stoquart G, Gilliaux M. Reliability and Concurrent Validity of the BruininksOseretsky Test in Children with Cerebral Palsy. Biomedical journal of scientific and technical research. 2019;18(5):13961.
[51]. Gan SM, Tung LC, Tang YH, Wang CH. Psychometric properties of functional balance assessment in children with cerebral palsy. Neurorehabilitation and neural repair. 2008 Nov;22(6):745-53.
[52]. Bruininks RH, Bruininks BD. Bruininks-Oseretsky test of motor proficiency.
[53]. Selves C, Renders A, Detrembleur C, Lejeune T, Stoquart G, Gilliaux M. Reliability and Concurrent Validity of the BruininksOseretsky Test in Children with Cerebral Palsy. Biomedical journal of scientific and technical research. 2019;18(5):13961.
[54]. Woollacott MH, Shumway-Cook A. Postural dysfunction during standing and walking in children with cerebral palsy: what are the underlying problems and what new therapies might improve balance?. Neural plasticity. 2005 Jan 1;12(2-3):211-9.
[55]. Smith J, DiVito M, Fergus A. Reliability and discriminant validity of the quantitative timed up and go in typically developing children and children with cerebral palsy GMFCS levels I-II. Journal of Pediatric Rehabilitation Medicine. 2023 Jan 1;16(1):25- 35.

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ANNEXURE

ASSENT FORM

I_____, exercising my free power of choice, hereby give my consent for participation in the research study entitled: **"Effectiveness of core stability exercises and proprioceptive training on balance and functional mobility in children with cerebral palsy- a comparative study "**. I have been informed, to my satisfaction, by the Principle Investigator of the study about the purpose of the study and the nature of the procedure to be done. I am aware that my parents/guardians do not have to bear the expenses of the treatment if I suffer from any study related injury, which has causal relationship with the said study drug/investigation/procedure.

I am also aware of my right to opt out of the research study, at any time during the course of the trial, without having to give reasons for doing so and my withdrawal from the study will not impact the treatment and I shall continue to receive it.

Name and Signature of the study participant Date:

Name and Signature of the parent/legally acceptable guardian of study participant

Date:

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Patient Informed Consent Form

Name of Participant :-

Age :-

Address :-

Contact no :-

Name of Principal Investigator :-

Title of the study: **Effectiveness of core stability exercises and proprioceptive training on balance and functional mobility in children with cerebral palsy- a comparative study".**

I, ---------- have read the information or the information has been read to me. The nature of study, possible risk and benefits to me, precautions to be taken by me, my rights and responsibilities related to this study are explained to me by the investigator to my satisfaction. I have understood that the information/data obtained from this study may be used for scientific purpose (Publication/presentation in scientific meetings) by the investigators, without revealing my identity. I have no objection for this.

I have understood that I can withdraw from this study at any point of time without giving any reason and this will not affect my future treatment in this hospital. I have understood whom to contact in case of any adverse effect/doubt.

I am also aware that the investigator can terminate my participation in this study at any time due to any reason, without taking my consent

I hereby give my consent to participate in the study titled "**Effectiveness of core stability exercises and proprioceptive training on balance and functional mobility in children with cerebral palsy- a comparative study".**

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DATA COLLECTION SHEET

Name of Patient :-
Age :-
Gender :-
Date of Examination :- GMFCS LEVEL

	PRE INTERVENTION	POST INTERVENTION
BOT 2 SCORE		

	PRE INTERVENTION	POST INTERVENTION
TIMED UP AND GO TEST		

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GANTT CHART

	Jun-July 2022	Jul-Aug 2022	Sept 2022	Sep 2022	Oct-Mar 2023	Apr-Jun 2023	July 2023
Preparation of synopsis							
Final copy							
IEC Approval							
Synopsis submission							
Data collection							
Data Analysis							
Dissertation Submission							

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MASTER CHART

GROUP –A (Core stability)

		TUG Scores		BOT 2 Scores	
Sr no.	**Age/Gender**	**Pre Score**	**Post Score**	**Pre Score**	**Post Score**
1	10/M	9	7.6	14	16
2	11/M	9.06	8.6	11	19
3	12/F	8.6	7	12	21
4	8/F	8.73	8.4	11	20
5	9/F	9.46	7.86	10	19
6	8.5/F	6.7	7	12	21
7	9/F	7.03	6.23	21	31
8	10/F	7.73	6.63	15	23
9	12/F	8.33	8.06	15	24
10	12/F	7.46	7.066	12	27
11	12/F	7.5	6.83	14	17
12	12/F	8.7	8.13	12	21
13	12/F	9.16	7.73	11	18
14	10/F	8.06	7.46	13	20
15	11/F	7.63	7.23	22	19
16	12/M	7.73	7.66	19	26
17	12/M	8.36	7.43	28	34
18	12/F	7.06	7.13	17	26
19	10/F	7.06	6.56	18	23
20	12/F	6.9	6.16	18	24
21	10/F	7.43	7	17	18
22	9/M	7.2	7.06	20	24
23	10/M	7.73	7.23	24	24
24	11/M	7.03	6.5	20	25
25	12/M	8.66	7.5	20	24
26	10/M	9.36	8.03	19	23
27	11/M	8.56	8.66	20	22
28	12/M	9.33	9.16	21	25

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GROUP -B (Proprioceptive Training)

		TUG Scores		BOT 2 Scores	
Sr no.	**Age/Gender**	**Pre Score**	**Post Score**	**Pre Score**	**Post Score**
1	10/F	9.3	7.6	21	23
2	8/f	8.5	7.96	24	29
3	13/M	7.73	7.43	25	28
4	12/m	7.63	7.53	21	31
5	12/M	9.1	7.8	19	26
6	10/m	9.8	9.16	10	19
7	12/M	7.83	7.23	22	29
8	13/M	9.16	8	12	21
9	12/m	9.5	9.06	14	17
10	12/m	11.06	9.93	13	20
11	8/f	12.06	10.63	10	16
12	9/f	8.5	7.96	20	23
13	9/M	9.33	9.16	23	26
14	10/M	7.03	6.66	11	19
15	11/F	8.5	7.96	24	27
16	10/M	7.06	7	17	19
17	9/M	8.7	8.13	15	22
18	8/M	7.06	7	27	30
19	8/F	8.33	8.06	17	26
20	9/F	6.7	7	12	21
21	8/F	7.73	6.63	18	24
22	8/F	7.8	7	12	19
23	8/F	7.46	7.13	12	13
24	10/F	7.4	7	18	20
25	11/F	9.2	8.06	18	24
26	10/F	9	8.56	18	19