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Effect Of Suboccipital Muscle Inhibition Technique Versus Static Stretching Technique On Ankle Rom & Balance In Spastic Diplegic Cerebral Palsy Patients With Calf Tightness - A Comparative Study

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ABSTRACT

BACKGROUND: Spastic CP is the most prevalent diagnosis among children with CP. Lower limb muscles often afflicted in children with cerebral palsy include gastro-soleus. So, Children with spastic diplegic CP exhibited more stiffness at the ankles than the knees affecting ankle dorsiflexion and balance. This study was carried out to investigate the effects of SMIT Vs SS technique in spastic diplegic CP with calf tightness.

AIM: To compare the effectiveness of suboccipital muscle inhibition technique versus static stretching technique on ankle ROM and balance in spastic diplegic cerebral palsy patients with calf tightness.

METHODOLOGY: Subjects were divided by using convenient sampling. 48 subjects were selected by Inclusion criteria. Subjects were evaluated for ankle DF-ROM, MAS & PBS. In this study, 48 subjects were assigned, 24 subjects were in group A who received SMIT in six sessions for 2 weeks. Group B consisted of 24 subjects who received static stretching technique in six sessions for 2 weeks.

RESULT: The results indicated that while both techniques had some impact, SMIT demonstrated significant improvements in the Modified Ashworth Scale (MAS) and Pediatric Balance Scale (PBS) scores, suggesting its efficacy in enhancing motor function in this population.

CONCLUSION : The findings of this study support the effectiveness of SMIT in improving spasticity and balance in spastic diplegic CP patients with calf tightness. While static stretching also

offers benefits, SMIT appears to be the more effective intervention

CLINICAL IMPLICATION : Given the promising results of SMIT, it may be beneficial for clinicians to incorporate this technique into rehabilitation programs for spastic diplegic CP patients, particularly those with calf tightness.

KEYWORDS: Suboccipital Muscle Inhibition, Cerebral Palsy, Static Stretching, Spasticity, Balance, Ankle Range Of Motion

INTRODUCTION

The term “Cerebral Palsy/CP" refers to a group of persistent movement and postural problems that limits activity which are caused by non-progressive disturbances in the growing fetal or immature brain. The overall prevalence of CP ranges from 1.5 to 3 per 1,000 live births [1] Based on the primary motor disorder, there are three major subtypes of CP: spastic, dyskinetic, and ataxic. Spastic CP is the most common disorder among children with CP.[2].

When a muscle stretches, the neuromuscular system may automatically adjust muscle tone. This variation of the stretch response is important for maintaining balance and controlling motion. Spasticity is characterized by an enhanced stretch reflex, which increases with movement velocity. Excessive and improper muscular activation can lead to hypertonia. Spasticity is a common disability after an upper motor neuron (UMN) damage, such as cerebral palsy (CP). Spasticity is the most prevalent motor disability in cerebral palsy (CP) [2]

Spastic CP is the most prevalent diagnosis among children with CP. Spasticity can affect the entire body, but is often more severe in the lower limbs of children with bilateral involvement and the upper limbs of those with unilateral involvement. Lower limb muscles often afflicted in children with cerebral palsy include gastro-soleus, hamstrings, rectus femoris, adductors, and psoas.[2]
Children with spastic diplegic CP exhibited more stiffness at the ankles than the knees.[3]

Spasticity can limit voluntary control and increase energy expenditure during movement. Additionally, it hinders muscle lengthening during growth, potentially contributing to secondary muscle and soft tissue contractures and skeletal deformity. Muscle contractures and skeletal deformations can cause deformed lever arms, leading to aberrant joint moments during walking.[2]

Children with CP have limited ankle ROM, which is associated with increased tissue stiffness, increased reflexive torque of the gastrocnemius and soleus, and ankle joint spasticity and weakness. A limitation in ankle ROM during gait and balance performance has been identified in children with CP. Ankle ROM improvement, on the other hand, may aid in gait and balance performance [3].

Children with cerebral palsy frequently exhibit unstable postures, such as bending and uneven trunks, and struggle with balance while sitting. Children with cerebral palsy also have limited trunk, pelvic, and lower extremity motions. As a result, they stand and walk unprepared, elevating their upper limbs or overextending their upper bodies to make up for their decreased antigravity activity.[17]

The CP group had lower gait efficiency, as seen by their increased stride duration and step width, but decreased walking speed and stride length due to poor balance control caused by neuromusculoskeletal diseases.[18]

Many treatment interventions, such as whole-body vibration, anticipatory postural adjustments, dynamic ankle-foot orthoses, botulinum toxin injection, and extracorporeal shock wave therapy, have been used to help children with cerebral palsy with their spasticity and balance.[19]

Children with cerebral palsy might benefit from modified core stabilization and strengthening exercises that support their fine and gross motor skills. These workouts can also enhance stability, gait, balance, postural control, and decreased muscular tone [20]. Functional electrical stimulation is also a beneficial intervention to improve balance and gait.[21]

For the evaluation of spasticity, Modified Ashworth Scale (MAS) is used [5]. As the calf tightness leads to reduced ROM for dorsiflexion thus passive dorsiflexion ROM test is used as an evaluative measure [6] and the balance is evaluated by using pediatric balance scale [15].

The superficial back line connects the plantar fascia, gastrocnemius, soleus, hamstrings,

sacrotuberous ligament, erector spinae, suboccipital muscle, and epicranial fascia, whereas the suboccipital muscle connects the fascia of the lower limb [8]. The SMI technique is a way of producing fascial relaxation by using various techniques to the patient's suboccipital area while the patient is lying down [4].

Calf and hamstring flexibility increase as a result of the presence of a Myodural Bridge connecting the rectus capitis posterior minor muscles to the duramater that produce inhibition of lower limb muscles in general [4].

In subjects with spastic CP, static stretching (SS) is an important part of physical treatment. It is a simple and non-invasive therapy for increasing muscular belly elongation and length, decreasing muscle stiffness, maintaining or increasing joint range of motion (ROM), and delaying the onset of contractures. In general, frequent elongation of the muscular belly during stretching appears to be required to elicit such alterations [9].

There are various studies showing effectiveness of SMIT & static stretching technique individually.

So, the purpose of this study is to compare the effect of suboccipital muscle inhibition technique with static stretching in spastic diplegic cerebral palsy patients with calf tightness.

OBJECTIVES

- To study the effect of suboccipital inhibition technique on ankle ROM using goniometry in spastic diplegic cerebral palsy patients with calf tightness.
- To study the effect of static stretching exercise on ankle ROM using goniometry in spastic diplegic cerebral palsy patients with calf tightness.
- To study the effect of suboccipital inhibition technique on balance using paediatric balance scale in spastic diplegic cerebral palsy patients with calf tightness.
- To study the effect of static stretching technique on balance using paediatric balance scale in spastic diplegic cerebral palsy patients with calf tightness.

HYPOTHESIS

- **NULL HYPOTHESIS:**

- There will be no significant difference between suboccipital muscle inhibition technique versus static stretching technique on ankle ROM in spastic diplegic CP patients with calf tightness.

- There will be no significant difference between suboccipital muscle inhibition technique versus static stretching technique on balance in spastic diplegic CP patients with calf tightness.

- **ALTERNATE HYPOTHESIS:**

- Suboccipital muscle inhibition technique will be more effective than static stretching technique on ankle ROM in spastic diplegic CP patients with calf tightness.

- Static stretching technique will be more effective than suboccipital muscle inhibition technique on ankle ROM in spastic diplegic CP patients with calf tightness.

- Suboccipital muscle inhibition technique will be more effective than static stretching technique on balance in spastic diplegic CP patients with calf tightness.

- Static stretching technique will be more effective than suboccipital muscle inhibition technique on balance in spastic diplegic CP patients with calf tightness.

- There will be significant difference between effect of suboccipital muscle inhibition technique versus static stretching technique on ankle ROM and balance in spastic diplegic CP patients with calf tightness.

REVIEW OF LITERATURE

1. **Azam AM et al (2017)** conducted study on efficacy of suboccipital muscles decompression techniques in restoring functional walking capacity in hemiplegic cerebral palsy children. 30 hemiplegic cerebral palsy children were randomly assigned into two groups; group A were given SMIT plus traditional physiotherapy program and group B were given traditional physiotherapy program only. They concluded that SMIT can be used to restore functional walking capacity in hemiplegic cerebral palsy children by distribute the inhibition effect to tight muscles in lower limbs via muscle-fascial chains.

2. **Han-sol kang and Hyung-wook kwon et al (2021)** conducted study on effects of the SMIT on the AROM of ankle joint, lunge angle and balance in healthy adults, according to the duration of its application. A total of 80 participants were randomly allocated to the 4 min SMIT group and 8 min SMIT group, 4 min sham SMIT group and 8 min SSMIT group. AROM of dorsiflexion and LA were assessed, and a single leg balance test was performed before and after the intervention. The results suggests that the SMIT, at durations of both 4 min and 8 min, could be effective tools for improving AROM, LA and balance.

3. **Annika kruse et al (2022)** conducted study on Acute Effects of Static and Proprioceptive Neuromuscular Facilitation Stretching of the Plantar Flexors on Ankle Range of Motion and Muscle-Tendon Behavior in Children with Spastic Cerebral Palsy. Two groups were formed; static stretching was given for one group with 30 sec hold in maxDF and In another group, PNF stretching was given with an isometric contraction of 5-6 sec followed by stretching of 25 sec.10 stretches were applied in total. They concluded that there is increase in MTU lengthening after static stretching and decrease in MTU lengthening after PNF stretching.

4. **Shrikrishna Shinde and Neha Warkhede et al (2021)** conducted study to compare the effectiveness of static stretching and Suboccipital muscle inhibition technique on hamstring muscle flexibility in college students. 30 young adults were recruited from medical college and evaluated for hamstring tightness using finger to floor test and popliteal angle. Then 15 subjects were given static stretch for 30 seconds followed by 15 sec relaxation, 5 times in each session 3 times a week for 2 weeks. Another 15 subjects

were given SMIT for 5 min each session, 3times a week for 2 weeks. And they concluded that both techniques are effective in improving hamstring muscle flexibility.

5. **Anil Chauhan and manvi singh et al (2019)** conducted study to determine the pooled-prevalence of cerebral palsy in Indian children. The present study is a singular systematic review on the prevalence of cerebral palsy in India. The prevalence of cerebral palsy in India is similar to global estimates. The authors attempted to gather data from the unpublished literature regarding the prevalence of cerebral palsy in addition to searching the published literature from several databases (PubMed, Ovid SP, and EMBASE). They looked through cohort, cross-sectional, prospective, and retrospective studies of kids in India who had cerebral palsy. A quality assessment was carried out once data extraction from the included studies were completed. STATA MP12 was used to analyze the data. Eight articles that met the criteria were considered for quantitative analysis out of the 862 publications that were searched. Per 1000 children surveyed, the overall pooled prevalence of cerebral palsy was 2.95 (95% CI 2.03-3.88). The subgroup analysis revealed that the pooled prevalence for the study population was 1.83 (95% CI 0.41-3.25), 2.29 (95% CI 1.43-3.16), and 4.37 (95% CI 2.24-6.51) for the rural, urban, and mixed rural-urban study populations, respectively.

   The present study also highlights a paucity of high-quality, population-based prevalence studies on cerebral palsy in India. It is concluded that the overall pooled prevalence of cerebral palsy per 1000 children surveyed is 2.95.

6. **Pong Sub Youn and Shin Jun Park et al (2020)** This study aimed to examine the impact of ankle joint mobilization on ankle range of motion, gait, and standing balance in children with cerebral palsy (CP). They divided 32 children with cerebral palsy into two categories ankle joints mobilization (n = 16) and sham joint mobilization (n = 16) groups. After six weeks of ankle joint mobilization, passive ROM in ankle dorsiflexion in sitting and supine positions, center of pressure (COP) displacements (sway length, area) with eyes open (EO) and closed (EC), and gait function tests (TUG and 10-m walk test) were measured. The dorsiflexion ROM, TUG, and 10-m walk test significantly increased in the mobilization group compared to the control group. Ankle joint mobilization can be regarded as a promising method to increase dorsiflexion and improve gait in CP-suffering children.

7. **Do Hyun Kima and Duk-Hyun Anb et al (2017)** conducted study on Validity and reliability of ankle dorsiflexion measures in children with cerebral palsy and they concluded that reliability of ankle dorsiflexion ROM using a universal goniometer, the intraclass correlation coefficient (ICC) varied from 0.75 to 0.96 and the overall ICC score was 0.91 ($p < 0.001$).

8. **BC Craven and A R Morris (2010)** conducted study on the reliability of the Modified Ashworth Scale for measurement of spasticity among patients with SCI. For the hip abductors and adductors, knee flexors and extensors, and ankle plantar and dorsiflexors, MAS scores of twenty participants with chronic SCI were noted. Using standardized test locations and a one-cycle per second metronome, two blinded raters (A and B) evaluated MAS scores once a week for five weeks at the same time of day. Ratings were taken on the second cycle. Using Cohen's Kappa, the repeatability of the MAS score [intra-rater, inter-rater] was determined. To assess inter-session reliability, intraclass correlation coefficients were computed; Kappa values >or=0.81 and ICC values >or=0.75 were preferred. The level of intra-rater reliability varied throughout raters and ranged from fair to nearly excellent (0.2<kappa<icc<0.75)
and concluded that it has the ICC values > 0.75.

9. **Jin- Gang Her and Ji-Hea Woo et al (2012)** The purpose of this study was to determine the absolute reliability and relative reliability of the Pediatric Balance Scale (PBS) for children with Cerebral Palsy (CP). This study set out to ascertain the Pediatric Balance Scale (PBS)'s absolute and relative reliability for children with cerebral palsy (CP). 36 CP children were chosen to test the inter- and intra-rater dependability. 27 CP children were enlisted to test the test-retest reliability. 36 video recordings of children with cerebral palsy were scored by seven pediatric physical therapists in order to assess inter-rater reliability. After a two-week break, each video recording was rescored by two therapists to assess intra-rater reliability. One rater scored each of the 27 video segments twice, separated by two weeks, in order to assess the test-retest reliability. Using the intraclass correlation coefficient (ICC), relative dependability was determined. Using the smallest real difference (SRD) and the standard error of measurement, absolute dependability was evaluated. Excellent absolute reliability as well as relative reliability of the PBS was obtained, so the PBS is reliable for examining the functional balance of children with cerebral palsy and has good reliability with ICC 0.998.

10. **Gunnar Hagglund And Philippe Wagner et al (2011)** conducted study on Spasticity of the gastrosoleus muscle is related to the development of reduced passive dorsiflexion of the ankle in children with cerebral palsy. Analysis was done on all measures taken from January 1995 to June 2008 in the population of

children with CP who were between the ages of 0 and 18. 2,796 exams from 355 kids served as the study's foundation. Muscle tone's impact on range of motion was calculated statistically using a random impacts model. As a result A reduction in the ankle joint's range of dorsiflexion the whole material by an average of 19 (95% CI: 14–24) degrees throughout 18 years of existence at the beginning. Between the child's level of spasticity and the ROM, there was a statistically significant correlation during the year before ROM measurements were made.

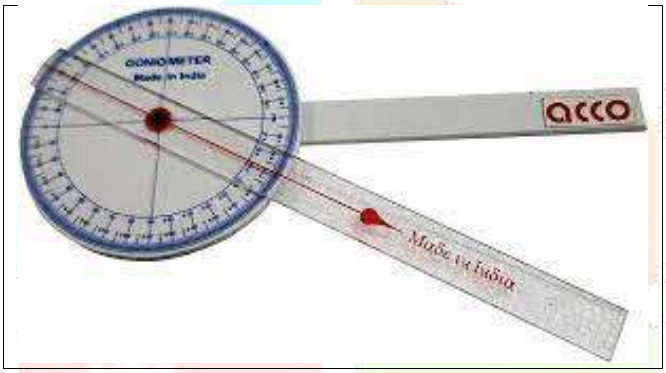
METHODOLOGY

- **Study type**: A Comparative study
- **Type of sampling**: Convenient sampling
- **Study design**: Pre and post experimental study
- **Sample size**: 48
- **Study duration**: 6 months
- **Study setting:** Miraj-Sangli City

MATERIALS

- Data collection sheet
- Consent form
- Universal goniometer
- Mat

FIGURE NO. 1



UNIVERSAL GONIOMETER

FIGURE NO. 2

MAT

INCLUSION AND EXCLUSION CRITERIA

INCLUSION CRITERIA:

- Age group: 2 to 13 yrs
- Both the genders
- Spastic diplegic type of CP patients
- Parent of subjects giving their consent
- Able to accept and follow verbal instructions
- Spasticity: ≥ grade 1 on MAS
- Ankle dorsiflexion range: < 15

EXCLUSION CRITERIA:

- Botulinium toxin injection in the past 6 months.
- Having any congenital deformities of lower limb.
- Having seizures.
- Having systemic or localized infections.
- Having healing fractures.
- Having surgical incisions and open wounds on lower limb.

OUTCOME MEASURES

- **Passive Ankle Dorsiflexion ROM:**
  (Reliability: 0.98)
- Positioning of the patient: Supine position with knee in extension.
- Procedure: The goniometer axis is located on the lateral malleolus and the stationary arm is located parallel to the fibular head. The movement arm was then the lateral aspect of the fifth metatarsal bone. The examiner fixed the tibial bone and pushed the foot of the participant toward the dorsiflexion. The dorsiflexion ROM was measured where the end-feel was felt.

FIGURE NO. 3

PASSIVE ADF ROM BY GONIOMETRY

- **Pediatric Balance Scale:**
  (Reliability :0.99)

A

PEDIATRIC BALANCE SCALE

Name: _____ Date: _____

Location: _____ Examiner: _____

Item Description	Score 0 - 4	Seconds optional
1. Sitting to standing	_____	
2. Standing to sitting	_____	
3. Transfers	_____	
4. Standing unsupported	_____	_____
5. Sitting unsupported	_____	_____
6. Standing with eyes closed	_____	_____
7. Standing with feet together	_____	_____
8. Standing with one foot in front	_____	_____
9. Standing on one foot	_____	_____
10. Turning 360 degrees	_____	_____
11. Turning to look behind	_____	
12. Retrieving object from floor	_____	
13. Placing alternate foot on stool	_____	_____
14. Reaching forward with outstretched arm	_____	
Total Test Score	_____	

General Instructions

1. Demonstrate each task and give instructions as written. A child may receive a practice trial on each item. If the child is unable to complete the task based on their ability to understand the directions, a second practice trial may be given. Verbal and visual directions may be clarified through the use of physical prompts.

2. Each item should be scored utilizing the 0 to 4 scale. Multiple trials are allowed on many of the items. The child's performance should be scored based upon the lowest criteria, which describes the child's best performance. If on the first trial a child receives the maximal score of 4, additional trials need not be administered. Several items require the child to maintain a given position for a specific time. Progressively, more points are deducted if the time or distance requirements are not met; if the subject's performance warrants supervision; or if the subject touches an external support or receives assistance from the examiner. Subjects should understand that they must maintain their balance while attempting the tasks. The choice, of which leg stand on or how far to reach, is left to the subject. Poor judgement will adversely influence the performance and the scoring. In addition to scoring items 4, 5, 6, 7, 8, 9, 10, and 13, the examiner may choose to record the exact time in seconds.

Figure. No caption available.

- **Modified Ashworth scale:**

  (Reliability: 0.75)

Score	Description
0	No increase in muscle tone
1	Slight increase in muscle tone, manifested by a catch and release or by minimal resistance at the end of the range of motion when the affected part(s) is moved in flexion or extension
1+	Slight increase in muscle tone, manifested by a catch and release or by minimal resistance throughout the remainder (less than half) of the range of motion
2	More marked increase in muscle tone through most of the range of motion, but affected part(s) easily flexed
3	Considerable increase in tone, passive movement difficult
4	Affected part(s) rigid in flexion or extension

Source: Reprinted from Bohannon RW, Smith MB. Interrater reliability of a modified Ashworth scale of muscle spasticity. Phys Ther, Feb 1987, 67,

PROCEDURE

ETHICAL COMMITTEE CLEARANCE

SCREENING ACCORDING TO INCLUSION EXCLUSION CRITERIA

THE WHOLE PROCEDURE OF THE STUDY WILL BE EXPLAINED TO PARENTS/ GUARDIAN OF ALL SUBJECTS

WRITTEN CONSENT FORM WILL BE TAKEN FROM THE PARENTS/GUARDIANS OF ALL THE SUBJECTS

PRIOR AND AFTER THE TREATMENT, BOTH THE OUTCOME MEASURES GONIOMETRY AND PEDIATRIC BALANCE SCALE WILL BE MEASURED

SUBJECTS DIVIDED INTO TWO GROUPS AND INTERVENTION TO BE GIVEN FOR 3 TIMES PER WEEK FOR 2 CONSECUTIVE WEEKS

GROUP A
Suboccipital muscle inhibition
Single session of 5 min
3 session/week
2 consecutive weeks

GROUP B
Static stretching technique
30 sec hold & 15 sec rest
5 times/session,3session/week
2 consecutive weeks

PRE AND POST INTERVENTIONAL STATISTICAL ANALYSIS WAS DONE

RESULT

PROTOCOL

- **SUBOCCIPITAL MUSCLE INHIBITION TECHNIQUE:**

- The therapist sits at the end of the table with patient supine with eyes closed.
- Therapist finger placed under the subject's head, pads of the therapist finger on the projection of the posterior arch of atlas which might be palpated between external occipital protuberance and spinous process.
- Then there should be the 90-degree flexion of metacarpophalangeal joint The upward pressure toward the subject's nose is applied.
- The technique is applied for 5 minutes, single session given for 3 times per week for 2 weeks.

FIGURE NO. 4

APPLYING SMIT ON SUBJECT

- **STATIC STRETCHING TECHNIQUE**

- During the SS training, the ankle joint was moved into maxDF with the knee in full extension until the point of discomfort (but no pain) was reached or joint resistance prevented any further movement. The ankle joint was then held in this maximal position for 30 s followed by a rest period of 15 s.
- Afterwards, the procedure was repeated with the knee in flexed position (~90◦) to mainly stretch the soleus muscle.
- The technique is applied for 5 times/session , 3 session/week for 2 consecutive weeks.

FIGURE NO. 5

APPLYING SS TECHNIQUE WITH KNEE EXTENDED

FIGURE NO. 6

APPLYING SS TECHNIQUE WITH KNEE FLEXED

STATISTICAL ANALYSIS

The normality testing of data was done by Shapiro-wilk test.

The comparison of pre and post intervention within group on MAS , PBS & ankle DF ROM done using Wilcoxon test.

The comparison between groups was done by using mann whitney test.

RESULTS

Normality test using Shapiro-Wilk

TABLE NO. 1

Variable	Time Frame	Group A		Group B	
		z-value	p-value	z-value	p-value
MAS Right	Pre	0.793	0.001	0.779	0.001
	Post	0.542	0.001	0.715	0.001
MAS Left	Pre	0.726	0.001	0.780	0.001
	Post	0.580	0.001	0.742	0.001
PBS	Pre	0.922	0.065	0.961	0.462
	Post	0.951	0.286	0.939	0.157
ADF Right	Pre	0.969	0.631	0.915	0.046
	Post	0.934	0.122	0.889	0.012
ADF Left	Pre	0.920	0.057	0.885	0.011
	Post	0.939	0.155	0.918	0.052

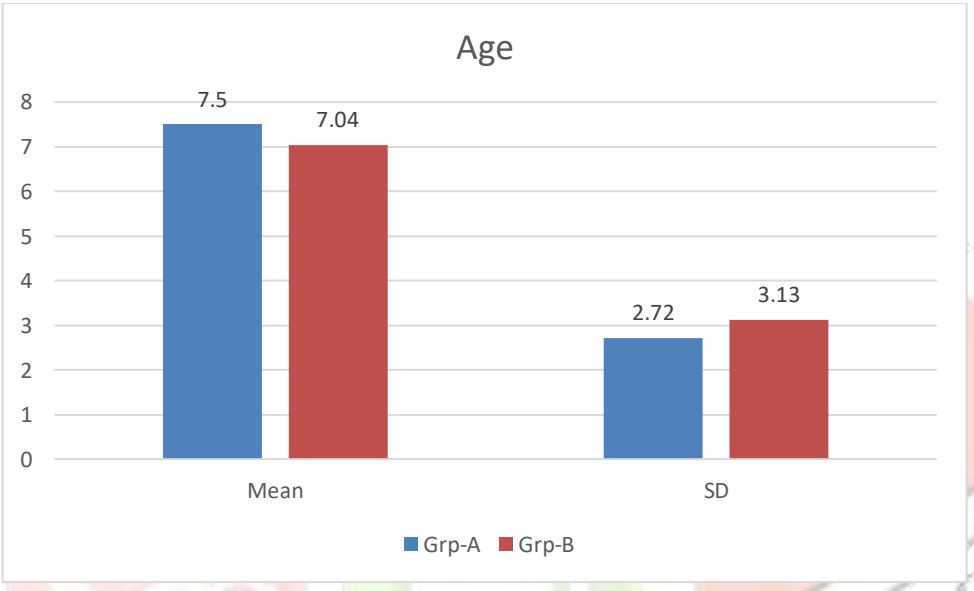
Statistical analysis were performed by using SPSS 23, and as the sample size is less than 2000 so Shapiro-Wilk test used to identify the normality and found data do not follows normal distribution by ($P < 0.05$). Data set is not normally distributed as all the variables have not indicated p-value greater than 0.05 in the observation. The researcher shall use non-parametric test for data analysis purpose in the following sections. As the collected data is not normally distributed, to find out the effect within the group, paired sample Wilcoxon test is used. Between groups analysis is done using Mann Whitney Test. $P < 0.05$ considered as statistically significant in the study (CI 95%).

Between group analysis using Mann Whitney Test

TABLE NO. 2

Variable	Group	Mean	SD	z-value	p-value
Age	Grp-A	7.50	2.72	0.601	0.548
	Grp-B	7.04	3.13		

GRAPH NO. 1



Within group Pre and post test

Comparison of pre-test and post-test scores of MAS Right in two Groups by paired sample Wilcoxon test

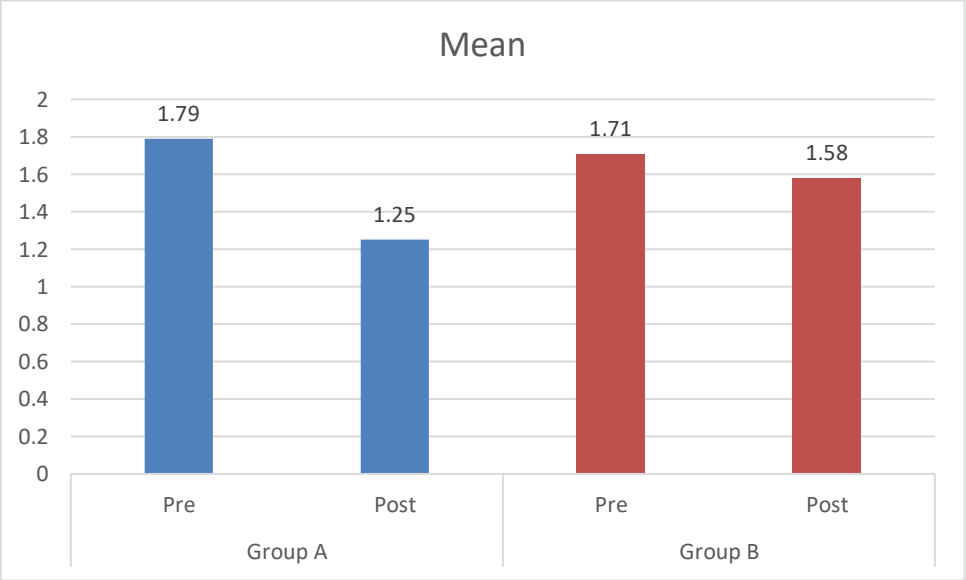
TABLE NO. 3

Groups	Times	Mean	SD	Mean Diff.	SD Diff.	Effect size	z-value	p-value
Group A	Pre	1.79	0.78	0.54	0.66	0.82	3.127	0.001*
	Post	1.25	0.44					
Group B	Pre	1.71	0.75	0.13	0.34	0.37	1.732	0.083
	Post	1.58	0.78					

The mean value in group-A indicated changes post treatment and lower values are recorded for post treatment outcome and also the standard deviation shows the consistency with post treatment value which is less to pre value. The effect size or Cohen's D indicates 0.82 value which is assumed to be high in effect size as per the standard parameters of reference. Based on the results of the test analysis at 5% significance level, there is a significant statistical reliable difference between the pre & post treatment values with p-value is less than the 5% significance level (i.e. 0.001 < 0.05) in the study and therefore it justifies the improvements in health outcome post intervention.

The mean value in group-B indicated changes post treatment and lower values are recorded for post treatment outcome and also the standard deviation shows the limited consistency with post treatment value which is more than pre value. The effect size or Cohen's D indicates 0.37 value which is assumed to be low in effect size as per the standard parameters of reference. Based on the results of the test analysis at 5% significance level, there is a non-significant statistical reliable difference between the pre & post treatment values with p-value is more than the 5% significance level (i.e. 0.083 > 0.05) in the study and therefore it justifies the partial improvements in health outcome post intervention

GRAPH NO.2



Within group Pre and post test

Comparison of pre-test and post-test scores of MAS Left in two Groups by paired sample Wilcoxon test

TABLE NO. 4

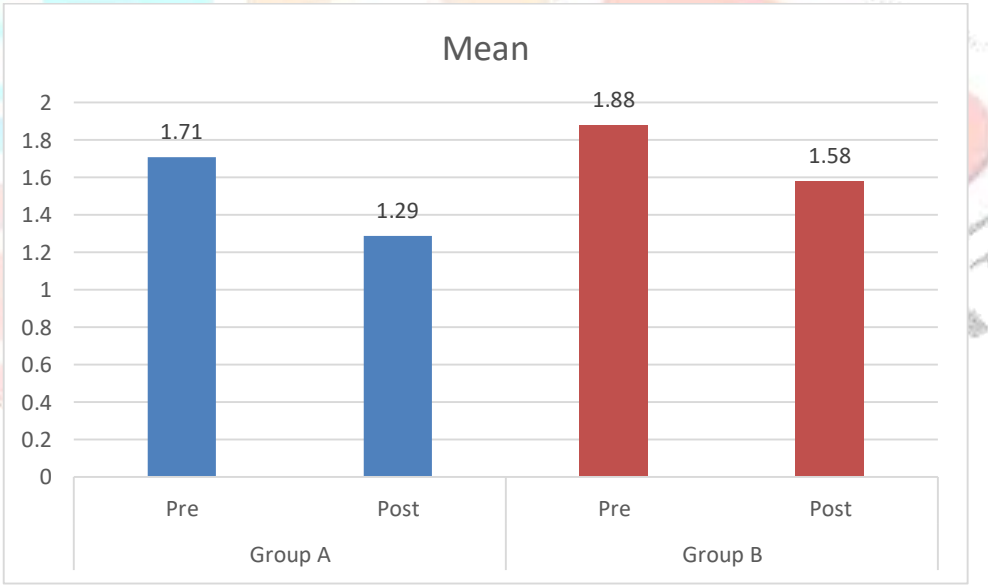
Groups	Times	Mean	SD	Mean Diff.	SD Diff.	Effect size	z-value	p-value
Group A	Pre	1.71	0.86	0.42	0.50	0.83	3.162	0.001*
	Post	1.29	0.55					
Group B	Pre	1.88	0.85	0.29	0.46	0.63	2.646	0.008
	Post	1.58	0.72					

The mean value in group-A indicated changes post treatment and lower values are recorded for post treatment outcome and also the standard deviation shows the consistency with post treatment value which is less to pre value. The effect size or Cohen's D indicates 0.83 value which is assumed to be high in effect size as per the standard parameters of reference. Based on the results of the test analysis at 5% significance level, there is a significant statistical reliable difference between the pre & post treatment values with p-value is less than the 5% significance

level (i.e. 0.001 < 0.05) in the study and therefore it justifies the improvements in health outcome post intervention.

The mean value in group-B indicated changes post treatment and lower values are recorded for post treatment outcome and also the standard deviation shows the consistency with post treatment value which is equal to pre value. The effect size or Cohen's D indicates 0.63 value which is assumed to be medium in effect size as per the standard parameters of reference. Based on the results of the test analysis at 5% significance level, there is a significant statistical reliable difference between the pre & post treatment values with p-value is less than the 5% significance level (i.e. 0.008 < 0.05) in the study and therefore it justifies the improvements in health outcome post intervention

GRAPH NO. 3



Within group Pre and post test

Comparison of pre-test and post-test scores of PBS in two Groups by paired sample Wilcoxon test

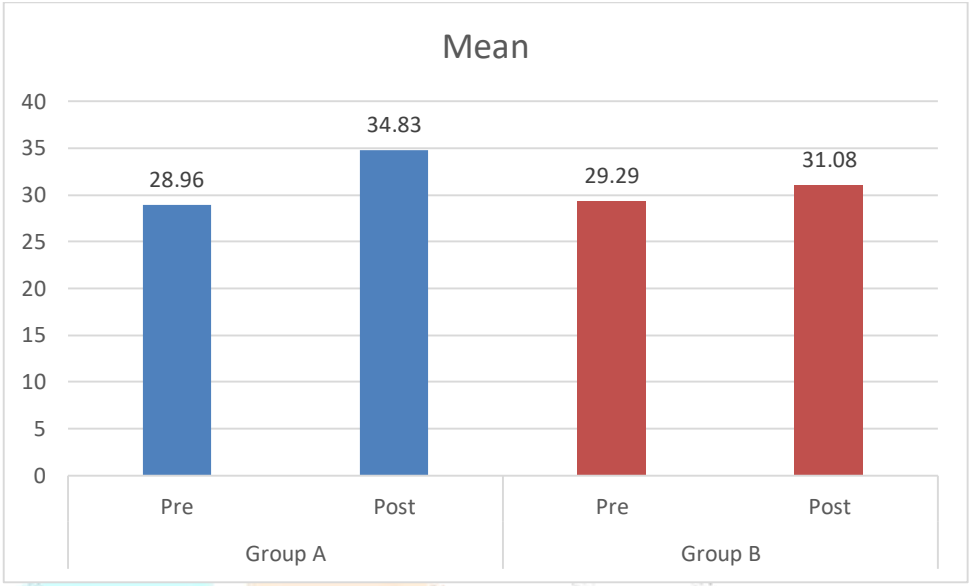
TABLE NO. 5

Groups	Times	Mean	SD	Mean Diff.	SD Diff.	Effect size	z-value	p-value
Group A	Pre	28.96	8.69	5.88	1.85	3.18	4.299	0.001*
	Post	34.83	8.92					
Group B	Pre	29.29	7.01	1.79	1.14	1.57	4.061	0.001*
	Post	31.08	6.85					

The mean value in group-A indicated changes post treatment and higher values are recorded for post treatment outcome and also the standard deviation shows the limited consistency with post treatment value which is more to pre value. The effect size or Cohen's D indicates 3.18 value which is assumed to be very high in effect size as per the standard parameters of reference. Based on the results of the test analysis at 5% significance level, there is a significant statistical reliable difference between the pre & post treatment values with p-value is less than the 5% significance level (i.e. 0.001 < 0.05) in the study and therefore it justifies the improvements in health outcome post intervention.

The mean value in group-B indicated changes post treatment and higher values are recorded for post treatment outcome and also the standard deviation shows the consistency with post treatment value which is less to pre value. The effect size or Cohen's D indicates 1.57 value which is assumed to be very high in effect size as per the standard parameters of reference. Based on the results of the test analysis at 5% significance level, there is a significant statistical reliable difference between the pre & post treatment values with p-value is less than the 5% significance level (i.e. 0.001 < 0.05) in the study and therefore it justifies the improvements in health outcome post intervention

GRAPH NO. 4


Mean
40
35
30
25
20
15
10
5
0
28.96
34.83
29.29
31.08
Pre
Post
Pre
Post
Group A
Group B

Within group Pre and post test

Comparison of pre-test and post-test scores of ADF Right in two Groups by paired sample Wilcoxon test

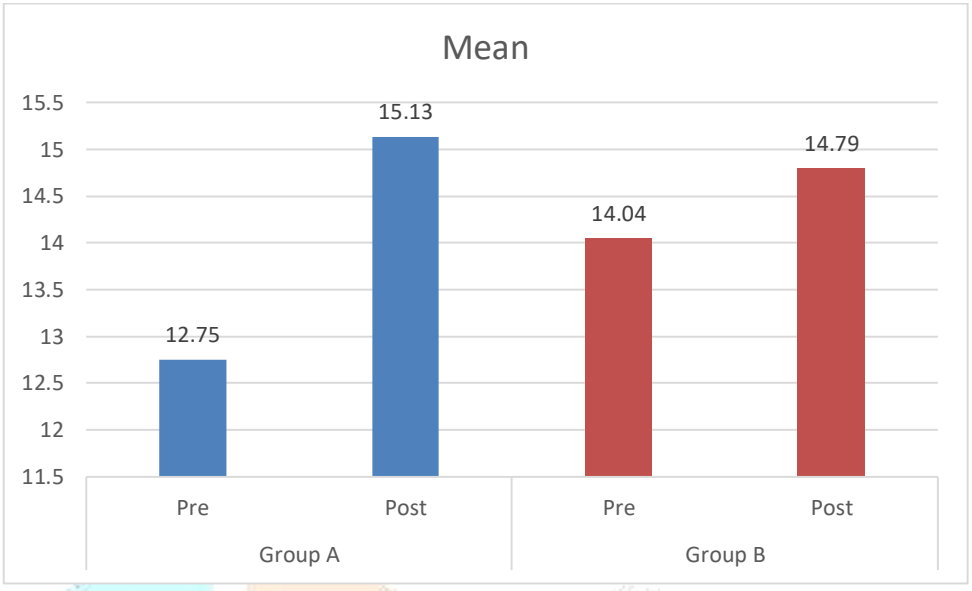
TABLE NO. 6

Groups	Times	Mean	SD	Mean Diff.	SD Diff.	Effect size	z-value	p-value
Group A	Pre	12.75	3.14	2.38	0.82	2.88	4.355	0.001*
	Post	15.13	2.71					
Group B	Pre	14.04	2.94	0.75	0.53	1.41	4.025	0.001*
	Post	14.79	2.77					

The mean value in group-A indicated changes post treatment and higher values are recorded for post treatment outcome and also the standard deviation shows the consistency with post treatment value which is less to pre value. The effect size or Cohen's D indicates 2.88 value which is assumed to be very high in effect size as per the standard parameters of reference. Based on the results of the test analysis at 5% significance level, there is a significant statistical reliable difference between the pre & post treatment values with p-value is less than the 5% significance level (i.e. 0.001 < 0.05) in the study and therefore it justifies the improvements in health outcome post intervention.

The mean value in group-B indicated changes post treatment and lower values are recorded for post treatment outcome and also the standard deviation shows the consistency with post treatment value which is less to pre value. The effect size or Cohen's D indicates 1.41 value which is assumed to be very high in effect size as per the standard parameters of reference. Based on the results of the test analysis at 5% significance level, there is a significant statistical reliable difference between the pre & post treatment values with p-value is less than the 5% significance level (i.e. 0.001 < 0.05) in the study and therefore it justifies the improvements in health outcome post intervention

GRAPH NO. 5


Mean
15.5
15
14.5
14
13.5
13
12.5
12
11.5
12.75
15.13
14.04
14.79
Pre
Post
Pre
Post
Group A
Group B

Within group Pre and post test

Comparison of pre-test and post-test scores of ADF Left in two Groups by paired sample Wilcoxon test

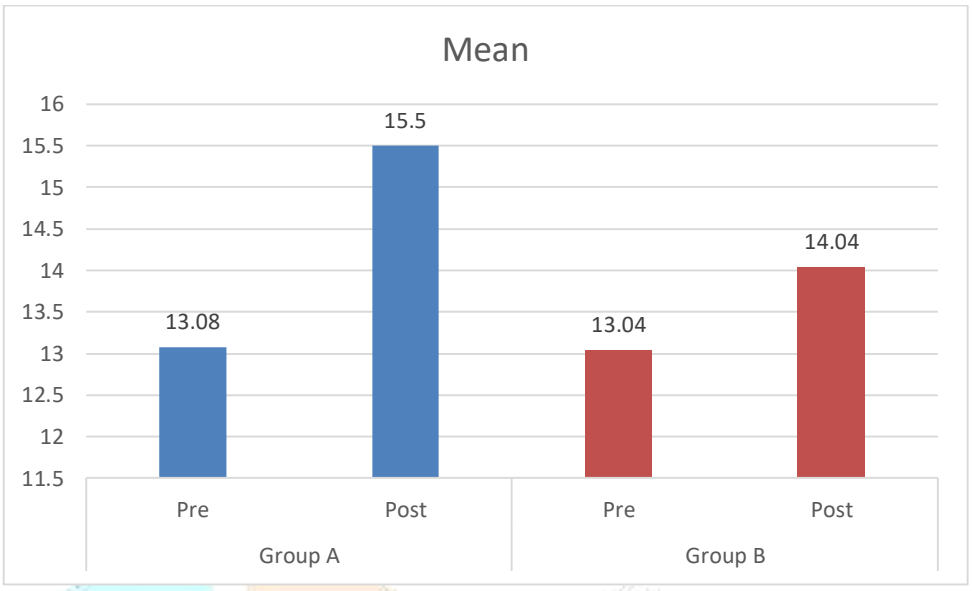
TABLE NO. 7

Groups	Times	Mean	SD	Mean Diff.	SD Diff.	Effect size	z-value	p-value
Group A	Pre	13.08	3.45	2.42	1.10	2.20	4.275	0.001*
	Post	15.50	2.96					
Group B	Pre	13.04	3.20	1.00	0.78	1.28	3.900	0.001*
	Post	14.04	2.88					

The mean value in group-A indicated changes post treatment and higher values are recorded for post treatment outcome and also the standard deviation shows the consistency with post treatment value which is less to pre value. The effect size or Cohen's D indicates 2.20 value which is assumed to be very high in effect size as per the standard parameters of reference. Based on the results of the test analysis at 5% significance level, there is a significant statistical reliable difference between the pre & post treatment values with p-value is less than the 5% significance level (i.e. 0.001 < 0.05) in the study and therefore it justifies the improvements in health outcome post intervention.

The mean value in group-B indicated changes post treatment and lower values are recorded for post treatment outcome and also the standard deviation shows the consistency with post treatment value which is less to pre value. The effect size or Cohen's D indicates 1.28 value which is assumed to be very high in effect size as per the standard parameters of reference. Based on the results of the test analysis at 5% significance level, there is a significant statistical reliable difference between the pre & post treatment values with p-value is less than the 5% significance level (i.e. 0.001 < 0.05) in the study and therefore it justifies the improvements in health outcome post intervention

GRAPH NO. 6


Mean
16
15.5
15
14.5
14
13.5
13
12.5
12
11.5
13.08
15.5
13.04
14.04
Pre
Post
Pre
Post
Group A
Group B

Between groups analysis using Mann Whitney independent samples test

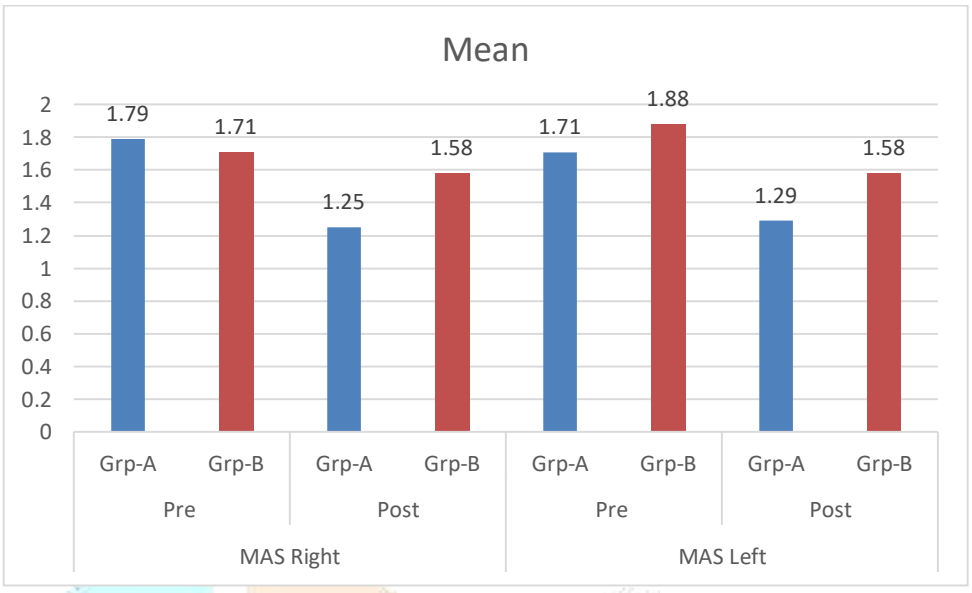
TABLE NO.8

Group	Time Frame	Group	Mean	SD	z-value	p-value
MAS Right	Pre	Grp-A	1.79	0.78	0.367	0.713
		Grp-B	1.71	0.75		
	Post	Grp-A	1.25	0.44	1.492	0.136
		Grp-B	1.58	0.78		
MAS Left	Pre	Grp-A	1.71	0.86	0.725	0.469
		Grp-B	1.88	0.85		
	Post	Grp-A	1.29	0.55	1.553	0.120
		Grp-B	1.58	0.72		

From the above table it is observed that between groups analysis is non-significant for MAS Right pre time frame at 5% level significance as the p-value is more than 5%. It shows non-significant differences between the groups. From the above table it is observed that between groups analysis is non-significant for MAS Right post time frame at 5% level significance as the p-value is more than 5%. It shows non-significant differences between the groups

From the above table it is observed that between groups analysis is non-significant for MAS Left pre time frame at 5% level significance as the p-value is more than 5%. It shows non-significant differences between the groups. From the above table it is observed that between groups analysis is non-significant for MAS Left post time frame at 5% level significance as the p-value is more than 5%. It shows non-significant differences between the groups

GRAPH NO.7


Mean
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
1.79
1.71
1.25
1.58
1.71
1.88
1.29
1.58
Grp-A
Grp-B
Grp-A
Grp-B
Grp-A
Grp-B
Grp-A
Grp-B
Pre
Post
Pre
Post
MAS Right
MAS Left

Between groups analysis using Mann Whitney independent samples test

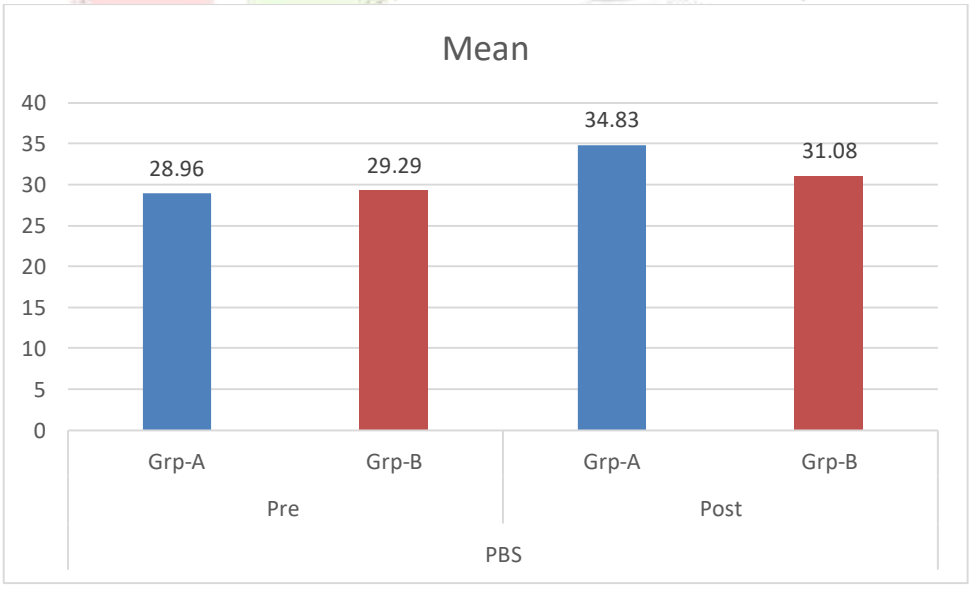
TABLE NO. 9

Group	Time Frame	Group	Mean	SD	z-value	p-value
PBS	Pre	Grp-A	28.96	8.69	0.021	0.984
		Grp-B	29.29	7.01		
	Post	Grp-A	34.83	8.92	1.497	0.134
		Grp-B	31.08	6.85		

From the above table it is observed that between groups analysis is non-significant for PBS pre time frame at 5% level significance as the p-value is more than 5%. It shows non-significant differences between the groups.

From the above table it is observed that between groups analysis is non-significant for PBS post time frame at 5% level significance as the p-value is more than 5%. It shows non-significant differences between the groups

GRAPH NO.8



Between groups analysis using Mann Whitney independent samples test

TABLE NO. 10

Group	Time Frame	Group	Mean	SD	z-value	p-value
ADF Right	Pre	Grp-A	12.75	3.14	1.474	0.140
		Grp-B	14.04	2.94		
	Post	Grp-A	15.13	2.71	0.437	0.662
		Grp-B	14.79	2.77		
ADF Left	Pre	Grp-A	13.08	3.45	0.041	0.967
		Grp-B	13.04	3.20		
	Post	Grp-A	15.50	2.96	1.703	0.089
		Grp-B	14.04	2.88		

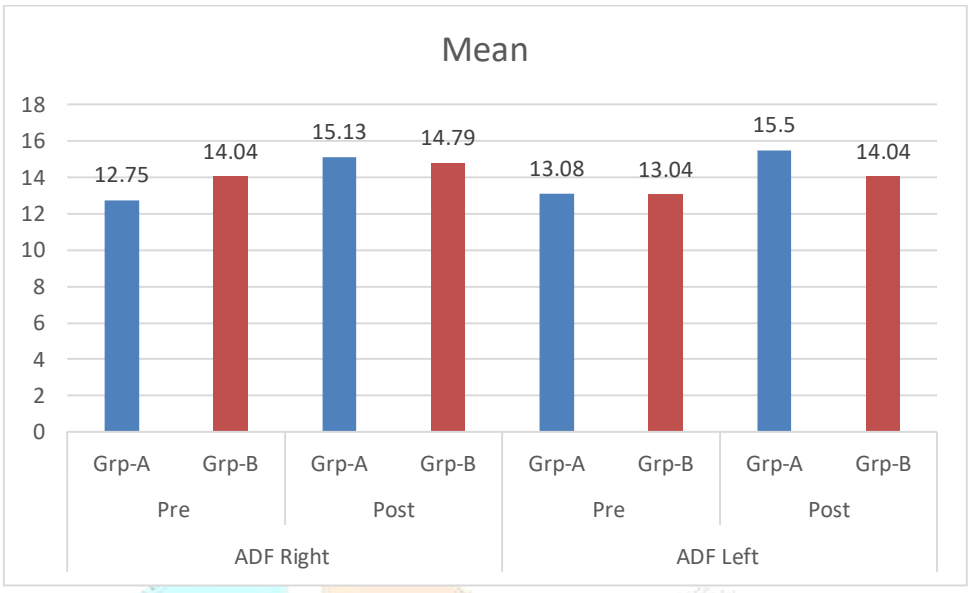
From the above table it is observed that between groups analysis is non-significant for ADF Right pre time frame at 5% level significance as the p-value is more than 5%. It shows non-significant differences between the groups.

From the above table it is observed that between groups analysis is non-significant for ADF Right post time frame at 5% level significance as the p-value is more than 5%. It shows non-significant differences between the groups

From the above table it is observed that between groups analysis is non-significant for ADF Left pre time frame at 5% level significance as the p-value is more than 5%. It shows non-significant differences between the groups.

From the above table it is observed that between groups analysis is non-significant for ADF Left post time frame at 5% level significance as the p-value is more than 5%. It shows non-significant differences between the groups

GRAPH NO. 9


Mean
18
16
14
12
10
8
6
4
2
0
12.75
14.04
15.13
14.79
13.08
13.04
15.5
14.04
Grp-A
Grp-B
Grp-A
Grp-B
Grp-A
Grp-B
Grp-A
Grp-B
Pre
Post
Pre
Post
ADF Right
ADF Left

DISCUSSION

This study aimed to investigate the effects of the Suboccipital Muscle Inhibition Technique (SMIT) versus static stretching (SS) on ankle dorsiflexion range of motion (DF-ROM) and balance in spastic diplegic cerebral palsy (CP) patients with calf tightness.

In this study, 48 subjects were assigned, 24 subjects were in group A who received SMIT in six sessions for 2 weeks. Group B consisted of 24 subjects who received static stretching technique in six sessions for 2 weeks. The outcome measures were modified Ashworth scale for spasticity, paediatric balance scale and ankle dorsiflexion which was measured using goniometer. Outcome measure were assessed pre-treatment, immediately after 1st session, after 1 week and after 2 weeks post treatment sessions.[4]

The results indicated that while both techniques had some impact, SMIT demonstrated significant improvements in the Modified Ashworth Scale (MAS) and Pediatric Balance Scale (PBS) scores, suggesting its efficacy in enhancing motor function in this population.

Within-Group Comparisons shows that, Group A, which received SMIT, exhibited marked improvements in both spasticity and balance. The significant decrease in the MAS Right score from a mean of 1.79 to 1.25, coupled with a large Cohen's D effect size of 0.82, underscores the effectiveness of the SMIT approach in reducing spasticity and improving motor function. This finding is consistent with existing literature that highlights the importance of myofascial techniques in addressing muscle tightness and enhancing functional outcomes in individuals with CP.

In contrast, Group B, which underwent static stretching, showed improvements in MAS and PBS scores; however, these changes were not statistically significant ($p > 0.05$). The small effect size of 0.37 suggests that while static stretching may have some benefits, its impact is considerably less than that of SMIT. This disparity may be attributed to the mechanism of action inherent in the SMIT technique, which facilitates deeper fascial release and neuromuscular inhibition through connections with the suboccipital area and the Myodural Bridge.

Between-group comparisons revealed no significant differences in MAS and ankle dorsiflexion (ADF) scores at pre- and post-intervention stages. Although this finding suggests that both interventions may lead to similar outcomes in certain parameters, it emphasizes the necessity of exploring the underlying mechanisms and longer-term effects of these treatments. The lack of significant differences may also reflect the need for larger sample sizes or longer intervention durations to capture potential disparities more effectively.

The findings align with those of **Ahmed M. Azam et al**., who noted the efficacy of specific muscle decompression techniques in enhancing functional walking capacity in hemiplegic CP children. The interconnectedness of the superficial back line and the influence of fascial connections on lower limb function highlight the importance of considering myofascial relationships in treatment approache [8]. The results from **Han-Sol Kang et al.** further support the notion that SMIT can enhance ankle joint active range of motion and balance in healthy adults, suggesting that similar mechanisms may be at play in the CP population.[10]

A previous study **(Lynn Bar-On et al)**, spasticity and its contribution to hypertonia in CP, says that Deregulation of the motor pathways that extend from the cerebral cortex and brain stem to the spinal cord—primarily the corticospinal, reticulospinal, and vestibulospinal tracts—causes loss of normal control. Lesions affecting the corticospinal pathway in the medullary pyramids or spinal cord do not show signs of spasticity. Rather, it is believed that injury to tracts that have interactions with the corticospinal tract is a factor in spasticity. For instance, injury to the reticulospinal tract reduces its inhibitory effect, which raises muscular tone. It is believed that a flexed posture results from a drop in extensor tone, which is caused by a reduction in motor neuron firing caused by a loss of vestibulospinal tract excitation by the brain. Additional descending pathways that may influence the control of stretch reflexes include the coerulospinal and rubrospinal tracts. It is also believed that spasticity is a result of additional spinal network adaptations brought on by the initial damage. The

two primary inhibitory spinal processes that are hypothesized to be responsible for spasticity are homosynaptic depression and reciprocal inhibition.[2]

The Sub-Occipital Muscle Inhibition (SMI) technique presents a valuable intervention for pediatric patients, particularly those with cerebral palsy (CP) who experience significantly tight muscles. Its application is particularly beneficial in several clinical scenarios, such as The SMI technique offers a gentle alternative that can help inhibit overactive muscles without inducing pain, thereby enhancing patient comfort and compliance. In cases where passive stretching is contraindicated—such as the presence of intramedullary nails, plates, screws, or when a patient is in a plaster cast—SMI provides a non-invasive option. This technique allows therapists to target tight muscle groups without exacerbating any existing conditions or causing harm to underlying structures. Forced passive stretching can lead to muscle strain, particularly in children with significant muscle tightness or spasticity. The SMI technique mitigates this risk by promoting fascial relaxation and muscle inhibition through the sub-occipital area, reducing the need for aggressive passive maneuvers. After surgical interventions, such as muscle release procedures, passive stretching of tight muscles may not be advisable due to the risk of re-injury or strain. Implementing the SMI technique during the rehabilitation phase can facilitate recovery by allowing for muscle relaxation and improved neuromuscular function without the risks associated with passive stretching.[8]

The SMI technique is an effective, safe, and adaptable intervention for pediatric

patients with tight muscles, particularly in those with CP. Its ability to provide muscle inhibition and relaxation without pain or risk of injury makes it a crucial component in the management and rehabilitation of this population.

CONCLUSION

In conclusion, the findings of this study support the effectiveness of SMIT in improving

spasticity and balance in spastic diplegic CP patients with calf tightness. While static stretching also offers benefits, SMIT appears to be the more effective intervention.

The SMI technique's ability to effectively inhibit overactive muscles without inducing pain positions it as a vital intervention for pediatric patients, especially those with spastic diplegia. Given the limitations of traditional passive stretching, particularly in cases with surgical implants or during recovery phases, the SMI technique emerges as a safe and effective alternative. Its incorporation into rehabilitation protocols could enhance functional outcomes for children with tight muscles, warranting further exploration of its long-term benefits and broader applications.

CLINICAL IMPLICATION

Given the promising results of SMIT, it may be beneficial for clinicians to incorporate this technique into rehabilitation programs for spastic diplegic CP patients, particularly those with calf tightness. The substantial improvement in motor function observed in Group A highlights the need for tailored interventions that address the unique biomechanical challenges faced by this population. Future studies should focus on optimizing treatment protocols, including variations in duration and frequency of SMIT application, to maximize outcomes.

LIMITATIONS AND SUGGESTIONS

- **Limitations :**

-Several limitations should be acknowledged:

1. The sample size was relatively small, which may limit the generalizability of the findings.
2. The lack of long-term follow-up data makes it difficult to assess the sustainability of the observed improvements.

- **Suggestions :**

Future research should investigate the long-term effects of SMIT and its comparative efficacy across different age groups and severities of CP. Additionally, exploring the mechanisms underlying the observed benefits could provide further clarity and enhance clinical application.

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