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Different Sizes of Swiss Ball for Balance Training in Geriatric Population

Akanksha Malhotra[1], Neha Gupta[2]

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Abstract

Background: Swiss ball exercise is used as a rehabilitative tool to correct posture and to treat and prevent pain in neck and waist, because it can increase muscle strength, endurance, flexibility, and coordination and be used to improve perceptual balancing ability. In the present study, we aimed to investigate the effects of activities on different sizes of Swiss ball on balance in geriatric population.

Method: In this experimental study 30 elderly people in the age of 65–80 years participated. Subjects were equally divided in 2 groups. Group A having 15 subjects are given Swiss ball exercises on 55 cm Swiss ball for 4 weeks (4 days/week). Group B having 15 subjects are given exercises on 75 cm Swiss ball for 4 weeks (4 days/week). Berg Balance Scale (BBS) scores were noted both before and after the 4 weeks exercises session on Swiss ball. Pre-exercise evaluation was done. Then the post-exercise evaluation was done. Subjects were evaluated using BBS.

Result: Thirty patients in the age range 65–80 years participated in the study. Patients were given Swiss ball activities. Within the group the pre-intervention BBS was 36.2 ± 5.11 and the post-intervention was 41.4 ± 6.32 (*t*-value is 3.25, *p*-value is 0.05) for 55 cm diameter Swiss ball. There is significant difference with in the groups with respect to mean BBS scores. Within the group pre-intervention BBS was 37.6 ± 5.40 and post-intervention was 45.6 ± 4.27 (*t*-value is 1.94, *p*-value is 0.05) for 75 cm Swiss ball. There is no significant difference with in the groups with respect to mean BBS scores. Between the two groups the post intervention BBS was 41.4 ± 6.32 the Swiss ball of 55 cm and 45.6 ± 4.27 for Swiss ball of 75 cm (*t*-value is 0.041, *p*-value is 0.05). There is no significant difference in the BBS scores.

Conclusion: There was positive improvement in Berg balance score by Swiss ball training on 55 cm diameter of swiss ball. There was no positive improvement in Berg balance score by Swiss ball training on 75 cm diameter of swiss ball. There was no improvements seen when both the Swiss ball regimes are compared.

Keywords: Berg balance scale; Central nervous system; Swiss ball; Balance; Geriatric population.

Introduction

Balance is the ability to keep the center of gravity on the base of support for static and dynamic movement. It is a complicated process involving sense, movement and CNS and their integrated coordination (B Young-Do-Seo et al., 2012). Balance is considered a key component in many activities of daily living, from simple activities such as quiet standing, to more complex activities such as walking while talking or while changing directions (Ayelet Dunsky et al., 2017).[6] Balance is defined as the ability to maintain one's equilibrium when one's center of gravity shifts (dynamic balance), as in walking and running, and when one's gravity remains stationary (static balance), as during standing or sitting (Myoung-kwon Kim et al., 2016).[9]

Performing strength exercises on Swiss ball has been advocated on the belief that a labile surface

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will provide a greater challenge to the trunk musculature; increase the dynamic balance of the user. Stability is achieved through the co-activation of trunk muscles; therefore, endurance training has been postulated to be beneficial in training trunk muscles to provide stability (Bal BS, 2012).[1] Sensory information has an important influence on balance activity in older people, and integration of visual, vestibular and somatosensory information is necessary to generate appropriate balance responses (Narcis Gusi et al., 2012).[8]

Swiss ball exercises are used to strengthen the core abdominal muscles. Abdominal muscle endurance and strength are important for trunk stability, appropriate posture and body movements. The core is important because it provides proximal stability for distal mobility.

The Swiss ball can be used to promote balance in ADLs. Swiss ball exercises are widely used because they can improve strength, endurance, flexibility, coordination and balance (Wonjong Yu et al., 2017).[13] Swiss ball exercise is used as a rehabilitative tool to correct posture and to treat and prevent pain in neck and waist, because it can increase muscle strength, endurance, flexibility, and coordination and be used to improve perceptual balancing ability (Myoung-kwon Kim et al., 2016).[9]

Exercises conducted on uneven surfaces, such as swiss ball, can generate more activity then exercises on even surfaces and are effective for preventing musculoskeletal damage by improving dynamic balance (Myoung-kwon Kim et al., 2016).[9] Swiss ball activities requires more sense of balance and its positive effects are reinforcement of strength and endurance, increased joint flexibility, stability, coordination and sense of proprioception (Byoung-do-seo et al., 2012).[11] Most developed world countries have accepted the chronological age of 65 years as a definition of elderly or old age (Gaurai Gharote et al., 2016).[7]

Balance disorders generate a significant healthcare burden due to the rise in hospitalization morbidities, and mortalities in the elderly population. There are many factors that lead to balance disorders, including cardiovascular diseases, metabolic diseases, musculoskeletal disorders, neurological disorders, visual and hearing disturbance, fear of falling, surgical operations, and specific medications (Tahsin Baris Deger et al., 2019).[5]

All the aspects of health status., life style, life satisfaction, mental state or well-being. Together reflect the multidimensional nature of quality of life in an individual. Geriatric mental health problems with respect to the quality of life often remains neglected (Ankur Barua et al., 2007).[2]

Fall risk has been related to a number of factors such as history of falls, muscle weakness, gait deficit, balance deficit, use of assistive device, visual impairment, mobility impairment, fear of falling, cognitive impairment, depression, sedentary behavior, age, number of medications, nutritional deficits, urinary incontinence, arthritis, home hazards and footwears (Mona et al., 2018).[10] Maintaining balance without falling is essential for performing daily activities without injury. Impaired balance in elderly adults in general and in adults with intellectual disability (ID) in particular is problematic (Eli Carmeli et al., 2003).[3] The central nervous system and body proprioceptors work together to refine pattern of movement. Performing exercises on Swiss ball may increase proprioceptive demands and stress the muscles that are important (Garima et al., 2018).[4] The need for this study is that there are studies done on Swiss ball activities that has shown affect on balance in elderly population but there is no size comparison of swiss ball done on the population yet. This study is done to check which swiss ball gives better balance training to the population and is better adaptable to the population. Aim of the study is to observe the effect of size of Swiss ball on balance in geriatric population. Objective os the study is to compare the effect of Swiss ball activities of 55 cm diameter swiss ball and 75 cm diameter Swiss ball on balance in geriatric population as measured by Berg balance scale. Null hypothesis includes that there is no effect of sizes of Swiss ball on balance in elderly population. Alternate hypothesis includes that there is effect of sizes of Swiss ball on balance in elderly population.

Materials and Methods

The study design is experimental. The study population involved is geriatric population. The data was collected from Jain Neuro hospital, Karkarddoma. Thirty patients were selected on basis of onclusion and exclusion criteria. Selection criteria include inclusion criteria that include geriatric population, BBS score 30–45, age is 65–80 years, consent signed and are able to understand and execute the commands. Exclusion criteria includes physical activity dependent population (Fig. 1)

Independent variable is the Swiss ball exercises and dependent variable is BBS [reliability: Inter

rater reliability ICC = 0.87 (p <0.0001) construct validity = –0.53 (p <0.01)(Ching Yu Wang et al., 2006).[12]

Instruments required: Swiss ball (55 cm diameter and 75 cm diameter), stopwatch, balance berg scale (BBS), equipment required for testing are a stopwatch or watch with a second hand, and a ruler or other indicator of 2, 5 and 10 inches (5, 12 and 25 cm); chairs used during testing should be of reasonable heightn either a step or a stool (of average step height) may be used for item #12. Sampling involved is convenient sampling. Population is divided in 2 groups: group A involved the population that are given exercises on 55 cm diameter Swiss ball for 4 weeks (4 days/week) and group B involved the population that were given exercises on Swiss ball 75 cm diameter for 4 weeks (4 days/week).

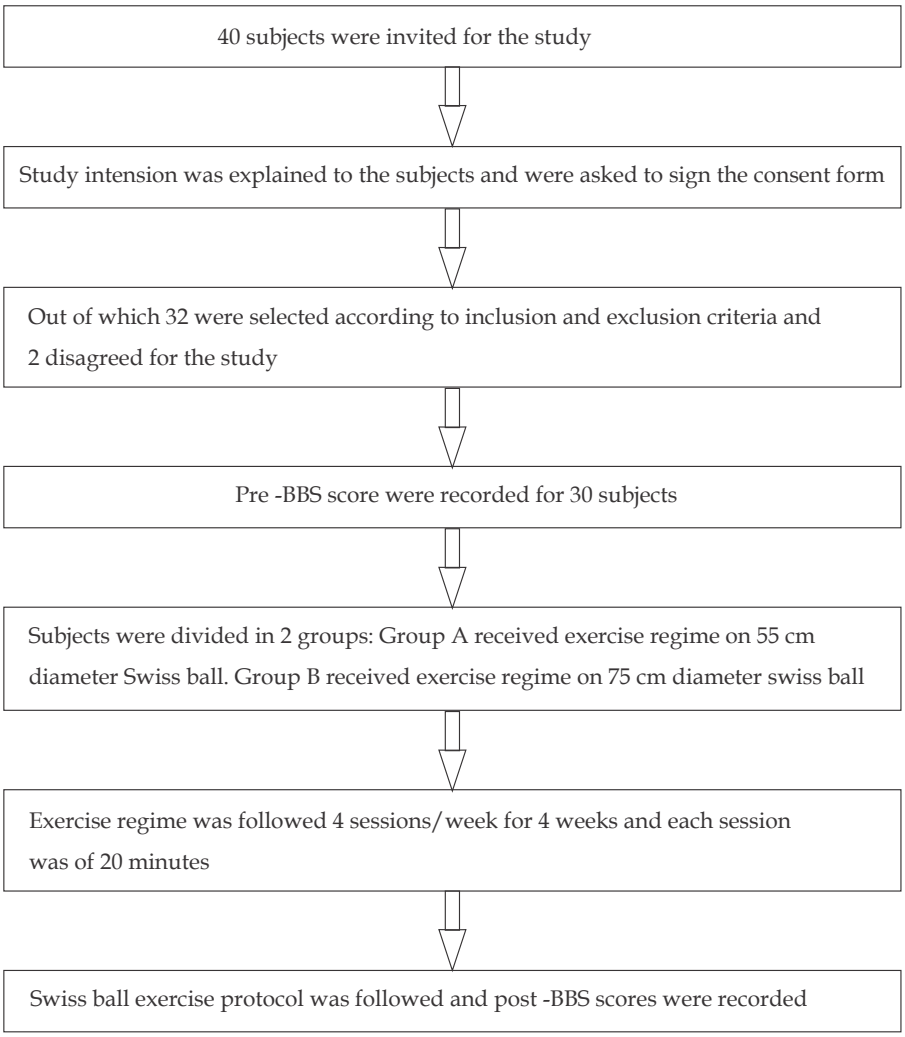


Fig. 1: Data flow diagram

Swiss Ball Training Protocols included

One set of trunk stabilization exercises composed of ten repetitions of four different routines. Ten sets were completed in each exercise session with a two-minute break between sets (1) A subject was asked to sit on a ball while lifting one or both arms (2) The subject sat on the ball with the feet (soles and heels) on the ground while bending the hip and knee joints at 90-degrees, and was then asked to maintain the trunk in an upright position for 20 seconds (3) The subject performed pelvic tilt (anterior/posterior, left/right) and rotation exercises (4) The subject placed the ball under his/hertrunk while in a four-point kneeling position and lifted the arms and legs in the following manner: Right arm with left leg and then left arm with right leg consecutively for five seconds (5) The subject in the prone position, the ball was placed beneath the feet and the hips were lifted for five seconds.

Results

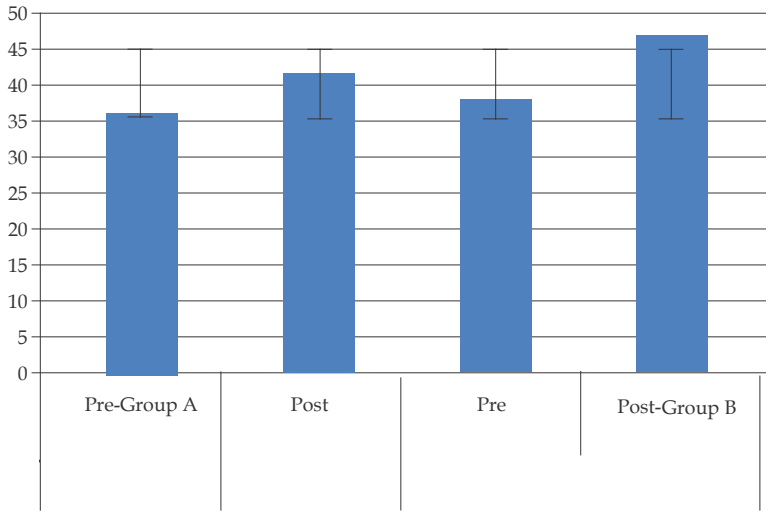
The data was entered and analyzed on MS Excel 2007 and then *t*-test was used to compare the difference of means between the group and within the group.

Used paired *t*-test with in the group because paired *t*-test is used to compare the means of two related groups to determine whether there is a statistically significant difference between these means.

Used unpaired *t*-test between the groups because unpaired *t*-test is used to compare the means of two unrelated groups to determine whether there is a statistically significant difference between the means of the two different groups.

The *p*-values for both paired and unpaired *t*-test is 0.05.

There were 30 patients (Age range: 65–80 years) who were enrolled on the basis that the odd ones are included in the Swiss ball prtocol on 55 cm diameter and even one are included in the Swiss ball protocol on 75 cm diameter. Patients were given swiss ball activities. Mean age 72.46 ± 6.70. Within the group BBS mean ± SD 36.2 ± 5.11 for pre and 41.4 ± 6.32 for post, *t*-value is 3.25, *p*-value is 0.05 for Swiss ball regime 55 cm. There is significant difference with in the groups with respect to mean BBS scores. The scores of BBS were significantly higher in post-exercise compared to the pre-exercise. Statistically there was a high significant difference between the pre-exercise and post-exercise of Swiss ball regime with 55 cm diameter. With in the group BBS mean ± SD 37.6 ± 5.40 for pre and 45.6 ± 4.27 for post, *t*-value is 1.94, *p*-value is 0.05 for Swiss ball regime 75 cm. There is no significant difference with in the groups with respect to mean BBS scores. The scores of BBS were significantly higher in post-exercise compared to the pre-exercise. Statistically there was a lower significant difference between the pre -exercise and post-exercise of Swiss ball protocol. Between the groups BBS mean ± SD 36.2 ± 5.11 for pre of Swiss ball of 55 cm and 37.6 ± 5.40 for pre of swiss ball regime of 75 cm, *t*-value is 0.47, *p*-value is 0.05. There is not a significant difference in the BBS score of the pre-conventional group compared to the pre swiss ball protocol group. Statistically pre swiss ball protocol regime is not highly significant as compared to pre-conventional therapy regime. Between the groups BBS mean ± SD 41.4 ± 6.32 for post of Swiss ball of 55 cm and 45.6 ± 4.27 for swiss ball protocol 75 cm, *t*-value is 0.041, *p*-value is 0.05. There is not a significant difference in the BBS score of the post conventional therapy regime group compared to the post Swiss ball protocol regime group. Statistically post Swiss ball protocol regime is not highly significant as compared to post Conventional therapy regime (Fig. 2).



p-value is 0.05

Fig. 2: Shows Comparison of BBS results of 2 sizes of Swiss ball Group A (55 cm Swiss ball) Group B (75 cm Swiss ball).

Discussion

In the current study there are improvements seen in balance when exercise regime was performed on 55 cm diameter Swiss ball. But there were no improvements seen in the balance when exercise regime was performed on 75 cm diameter and was no improvements e regimes were seen when both

the regimes were compared. These results obtained may be the results of the adaptability of the Swiss ball by the population.

There was a study that was conducted on the effect of 12 weeks of Swiss ball exercise protocol and this study gives the significant results on the elderly women on their physical fitness and balance ability. The study results showed the positive effects on the physical fitness and the balance ability of the older women.

There was another study that was done to see the effect of Swiss ball on static and dynamic balance. The results of the study were positive. there were improvements seen in the static and dynamic balance of the individual after performing the exercises on Swiss ball as to the persons who were not given exercises on Swiss ball. Swiss ball can be used to improve the static and dynamic balance of the individual and it can also enhance the concentration based performance for the individual.

One of the study showed that balance training decrease the fear of falling and improve the factors such as dynamic balance and the isometric strength in the individuals that are institutionalized older people. The results showed that the program was easy, affordable and effective as it improved the factors such as dynamic balance and isometric strength that were included as factors in the study that has to be seen effect on.

There was a study conducted that showed that taking balance training for older adults taken one step further resulted that is a description of the balance training this study shows that this balance training improved and strengthen the self efficacy in balance control that lead to the improved in the risk of fall, increasing the speed of walking, and also improved the physical function of the individual. The program was found motivating, valuable, fun and enjoyable for the individual that gives a result of high attendance for the study.

There was a study that shows the effect of core stability exercise that is done using the Swiss ball and how it effects the balance performance and quality of life of the elderly. The study concluded that use of exercise for the core stability gives much more effect than the floor exercises and improved balance in the elderly. The result of current study are related to the this study resulting in the improvements in the balance and the quality of life and administer a physical fitness program for the elderly can be taken into consideration and can be recommended to the individual. Considering the special conditions of the elderly both the types of the training.

Future scope of the study: There were no evaluation of activities of daily living that would show the improvements in the lifestyle of the population. The height criterion was not considered in the differentiation of the swiss ball sizes. There are certain limitations to the study that can be taken into considerations and further studies can be done that cope up with these limitations.

Limitations of the study: The small sample size that might have not given the actual results. There were no follow ups taken to study that is this treatment has the long-term effects on the patients activities. There were no evaluation of the activities of daily living that would show the improvements in the lifestyle of the population.

Conclusion

There was positive improvement in Berg balance score by Swiss ball training on 55 cm diameter of swiss ball.

There was no positive improvements in berg balance score by Swiss ball training on 75 cm diameter of Swiss ball. There was no improvements seen when both the Swiss ball regimes are compared.

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Original Article

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Effect of Positioning on Pulmonary Functions in Unilateral Pleural Effusion

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Abstract

Background: Pleural effusion is an abnormal accumulation of fluid in the intra-pleural space. The relative annual incidence of pleural effusion is estimated to be 320 per 100,000 people in industrialized countries. In pleural effusion positioning may be used to optimize gas-exchange. The therapeutic body positioning is a primary non-invasive physical-therapy intervention.

Methodology: The presence of pleural effusion was assessed by physical examination and chest X-ray. Pulmonary function testing (RMS HELIOS Spirometer) was conducted in sitting, right and left lateral decubitus positions. A forced expiratory maneuver was performed three times in each position after maintaining that position for 20 minutes and with rest as needed by the patient, between trials. It was made sure that subjects understood the instructions and performed the test with standard guideline (ATS Guidelines). The best values of forced vital capacity (FVC) and forced expiratory volume (FEV) were analyzed.

Results: No significant difference (p >0.10) was noted in FVC, FEV1 and FEV1/FVC values between the three positions. Although, mean values of FVC, FEV1 in sitting position (41.6 ± 12.20) was higher than mean value of FVC, FEV1 of lateral positions. In lateral decubitus position the mean FVC, FEV1 value of effusion lung upper most (37.8 ± 11.50) was slightly higher than effusion lung dependant (36.5 ± 12.8).

Conclusion: Position does not appear to have a significant effect on PFT in unilateral effusion patients.

Keywords: Pleural effusion, PFT (pulmonary function test), body position.

Introduction

Pleural effusion is an abnormal accumulation of fluid in the intra-pleural space.[1] The relative annual incidence of pleural effusion is estimated to be 320 per 100,000 people in industrialized countries.[2] Pleural fluid accumulation either displaces lung tissue or restricts the opening of adjacent alveolar sacs. It poses a unique threat to oxygen transport as a result of its direct physical effect on the lung, heart or both.[3] In pleural effusion positioning may be used to optimize gas-exchange.[4] Studies have shown that position will have effect on intra-pleural pressure and on ventilation.[5] The therapeutic body positioning is a primary non-invasive physical-therapy intervention.

Aim

This study was designed to investigate the effects of different body positioning on pulmonary function tests in unilateral pleural effusion patients.

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Objectives

To find out

1. The effect of different body position on pulmonary functions
2. The most beneficial body position
3. The least beneficial body position.

Materials and Methods

Study design: Experimental, crossover design

Sampling technique: non-probability sampling

Sample size: 25

Inclusion Criteria

- Subjects, irrespective of sex, of the age group 20–50 years with unilateral pleural effusion.
- Patients who are able to comprehend commands and willing to participate.

Exclusion Criteria

- Bilateral pleural effusion.
- Hemodynamically unstable patients
- Any neuromuscular conditions preventing from assuming the required positions and performing the test.

Procedure: After getting the written inform consent and according to inclusion and exclusion criteria the subjects were enrolled in the study. The presence of pleural effusion was assessed by physical examination (chest expansion, auscultation; etc.) and chest X-ray (level of fluid-size of effusion). Subjects were instructed to refrain from vigorous exercise and eating a heavy meal within 2 hours of the test and to wear comfortable, non-restrictive clothing.

Pulmonary function testing (RMS HELIOS Spirometer) was conducted in sitting, right and left lateral decubitus positions. A forced expiratory maneuver was performed three times in each position after maintaining that position for 20 minutes and with rest as needed by the patient, between trials.

It was made sure that subjects understood the instructions and performed the test with standard guideline (ATS Guidelines). The best values of forced vital capacity (FVC) and forced expiratory volume (FEV) were analyzed.

Fig. 1: Right lateral position.

Fig. 2: Sitting position.

Fig. 3: Left lateral position.

Outcome Measures

FVC, forced expiratory volume in 1 second (FEV1) and FEV1/FVC

Data Analysis

The outcome was cross matched with the expected values and with each three positional value. Parameters was expressed as mean values ± standard deviation. Analysis of variance was used to determine the effect of body position on Spirometric parameters.

Results

No significant difference ($p > 0.10$) was noted in FVC, FEV1 and FEV1/FVC values between the three positions. Although, mean values of FVC, FEV1 in sitting position (41.6 ± 12.20) was higher than mean value of FVC, FEV1 of lateral positions. In lateral decubitus position the mean FVC, FEV1

Table 1: Clinical data of 21 patients of pleural effusion (TB = Tuberculosis, CA = Carcinoma, S = Severe, Mod = Moderate, R = Right, L = Left) - (dropout -4)

Characteristics of patients	Mean ± SD	No. of patient
Sex M/F	16/5	21
Age (years)	33.3 ± 10.7	
Diagnosis, TB/CA	20/1	
Effusion side R/L	15/6	
Height	16.4 ± 7.3	
Weight	46.5 ± 6.07	
Effusion S/ Mod/ Mild	14/6/1	

Table 2: Sirometric data of 21 patients

Position	No. of Subjects	FVC Mean ± SD	FEV1 Mean ± SD	FEV1/FVC Mean ± SD	*p*-value
Sitting	21	41.6 ± 12.20	49.09 ± 19.7	113.24 ± 17.75	> 0.10
Effusion lung up	21	37.8 ± 11.50	43.86 ± 14.43	115.14 ± 6.68	
Effusion lung down	21	36.5 ± 12.8	42.95 ± 14.90	118.52 ± 8.18	

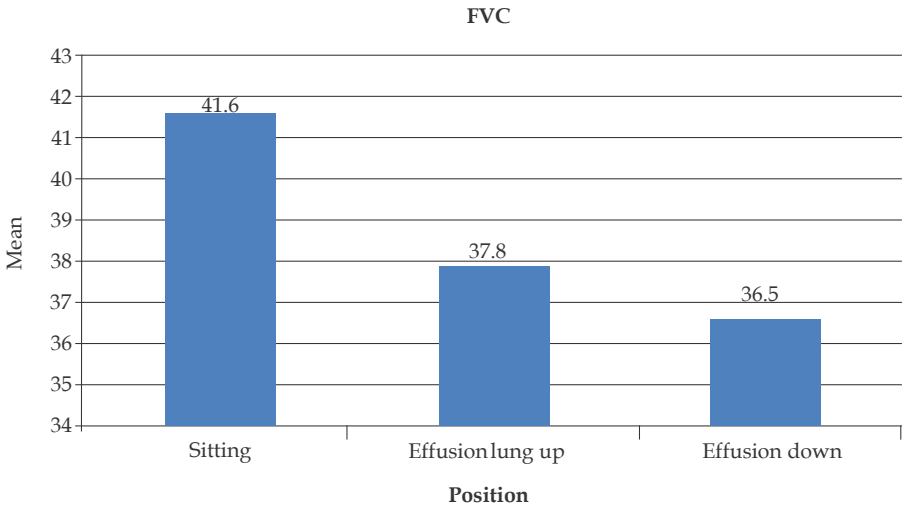

Fig. 4: FVC

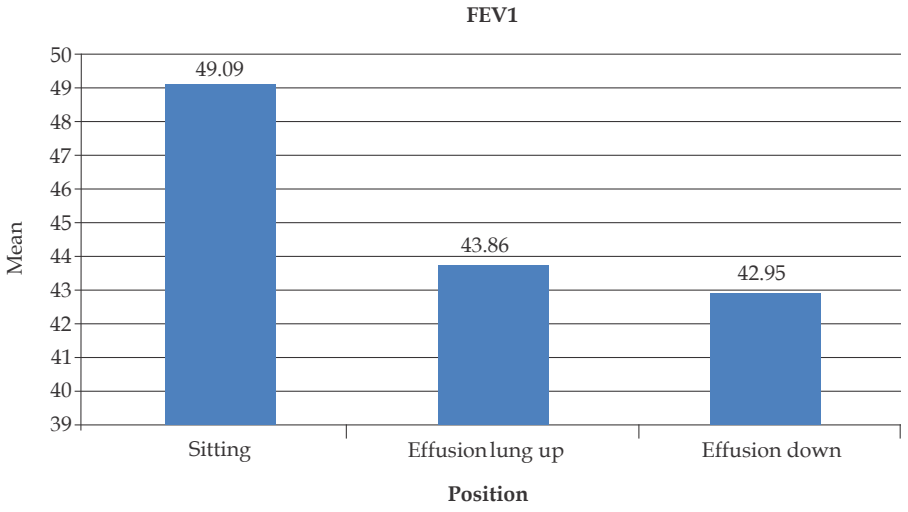

Fig. 5: FEV1

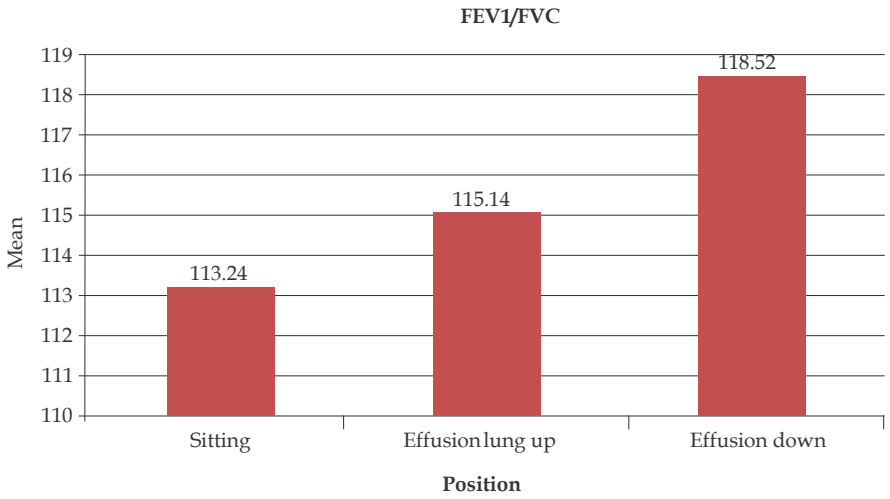

Fig. 6: FEV1/FVC

value of effusion lung upper most (37.8 ± 11.50) was slightly higher than effusion lung dependant (36.5 ± 12.8) (Figs. 4–6).

Discussion

The study was conducted to find out the effect of body position on pulmonary function test in unilateral pleural effusion patients. Therapeutic interventions were given to 21 subjects. Out of 21 patients 16 were male and 5 were female. The mean age was 33.3 ± 10.7.

In the study by spirometry FVC, FEV1, and FEV% readings were taken to find out restriction and it's severity. FVC was taken as outcome measure for the study to find out effect of position on PFT. The result showed no significant difference in FVC values of all three positioning. So, our results showed that the change in body position did not significantly affect FVC ventilation in the patients with various degree of pleural effusion.

Although, the present study showed that mean values of FVC in sitting position is higher than mean value of FVC of lateral positions. In lateral decubitus position the mean FVC value of effusion lung up is slightly higher than effusion lung down.

SR Neagley and CW Zwillich (1985) did study on "The effect of positional changes on oxygenation in patient with pleural effusion" in 10 asymetrical pleural effusion patients and measure arterial oxygen saturation (SaO_2) in sitting, supine, left and right lateral decubitus positions and concluded that there is no significant relationship between the size of the pleural effusion and the amount of arterial oxygen desaturation. They stated that there is a decrease in SaO_2 in normoxic patients when the side with large pleural effusion is dependent.[6]

However, Shi-Chuan Chang and, Guang-Ming Shiao (1989) did study on "Postural effect on gas exchange in patients with unilateral pleural effusion" by measuring arterial oxygen tension in 21 patients in right and left lateral decubitus positions have shown that PaO_2 values was higher when they were positioned in the lateral decubitus position with normal lung down. But when severe restriction present the reverse applied.[7]

They stated that, pleural fluid decrease lung volume, renders intra-pleural pressure lee negative, and, thus decreases ventilation to the lung on the side with effusion. It may also increases closing volume. This effect of pleural fluid on ventilation may lower the overall ventilation-perfusion ratios in the lung on the side with the effusion and cause hypoxemia. when the patients with the unilateral pleural effusion lie in the lateral decubitus position with the pleural effusion dependent, one may anticipate that worsening of ventilation-perfusion inequality will ensue because gravity increases the perfusion to the lung in which there is low ventilation-perfusion ratios. However, when the patients are positioned in the lateral decubitus postion with the normal lung down, blood is shifted away from this area to better ventilation lung with an improvement in oxygenation.

When effusion amount is large, pleural fluid may begin to move an impact on perfusion and decrease blood to the lung on the side with effusion. The mechanism responsible for this decrease in blood flow may be mechanical and/or due to hypoxia vasoconstriction resulting from local hypoxia in the lung on the affected side. This effect may be more

pronounced in the position when the side with the pleural fluid is dependent. This effect may shift both ventilation and perfusion to the contralateral normal lung. Accordingly, when the patients lie on the lung with effusion dependent, there is no further worsening of gas-exchange.

In contrast, when the patients lie on the lung without pleural effusion a compressive effect on the dependent normal lung exerted by contralateral side effusion may induce ventilation perfusion mismatch because gravity increases perfusion to this poorer ventilated lung.

These both above study show difference in their results. However, in the present study the difference in FVC is non-significant, a minute difference in FVC of two lateral decubitus shows better FVC with good lung down. However, we chose to monitor FVC rather than SaO_2 or PaO_2.

W.S. Druz et al. (1981) did study on "Activity of respiratory muscle in upright and recumbent humans" in nine subjects and have shown that the increase rib-cage motion characteristic of the upright posture owes to a combination of increased activation of rib-cage inspiratory muscles plus greater activation of the diaphragm that, together with a stiffened abdomen, act to move the rib cage more effectively.[8]

Position of the neck may alter the longitudinal tension on the trachea and thus tracheal stiffness which may affect expiratory flow rates. In our study we kept the head in neutral position so this can not be applied.

In present study, no statistically significant difference is found in FVC values of three positions, however minute changes present in mean values in effort dependent expiratory flow rates between sitting and side lying position which could be due to increase in the resistance of upper airway on assuming horizontal posture as the pharyngeal size decreased significantly with lying posture and decrease rib-cage motion in lying as explained above.

In current study based on X-ray chest, the patient were divided in three groups: mild, moderate, and severe. The restrictive lung function abnormality in spirometer is indicated by reduced FVC, FEV1 and increased FVC%. This changes increases with increasing severity of pleural effusion. According to this spirometric reading pleural effusion was categorized into mild, moderate and severe. In present study out of 21 subjects 18 were shows correlation between roenterographic and spirometric finding.

So, spirometric reading can be used to interpret the severity of effusion when chest x-ray not available.

M. Sonnenblick et al. (1983) studied on "Body positional effect on gas-exchange in unilateral pleural effusion" in eight patients and stated that larger positional difference were found in the patients with the smallest pleural effusion. However, In present study only one subject was with mild pleural effusion out of 21.[9]

PK Behrakis et al. (1983)[10] studied on "Lung mechanics in sitting and horizontal body positions" in 10 healthy young adult and measured lung compliance and found both static and dynamic lung compliance decreased in the supine position, while in the lateral position intermediate values were obtained. The reduction in lung compliance in the horizontal posture cab probably be attributed to

1. Increased pulmonary blood volume, which decreases the recoil of the lung at low volumes.
2. To small airway closure

In the presence of cardiac or pulmonary conditions, position related effect on cardio-pulmonary status may be accentuated in left and right side lying position.

The present study did not show statistically significant difference in FVC values of right and left lateral decubitus position in unilateral pleural effusion patients. These findings are at variance with result of previous workers who stated a favorable gas exchange could be obtained exclusively in the patients with unilateral lung disorder, when they were positioned in the lateral decubitus position with normal lung down.

The reason for these discrepancies may be explained by the following.

1. Rather than taking gas exchange we have taken only FVC in consideration by measuring FVC
2. During inspiration the hydrostatic pressure of a pleural effusion tends to fall because of the increase in thorax volume, thereby increasing the total pressure difference. This would lead to an apparent decrease of compliance which is more marked at intra-pleural regions, while mechanical resistance would increase. So, it is recommended to take inspiratory parameters rather than FVC.

Conclusion and Clinical Significance

Position does not appear to have a significat effect on PFT in unilateral effusion patients. Further study required with more sample size including the other cardiorespiratory parameters (ABG, SpO_2, HR, RR etc.) and by subjective measurements.

Any three positions can use interchangeably during rest and during physiotherapy treatment.

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Original Article

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Comparison of NDT Versus Conventional Physiotherapy to Improve Fine Motor Function in Hemiplegic Cerebral Palsy

Mohammed Aslam Ahmed

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Abstract

Twenty hemiplegic cerebral palsy subjects with mean age of 9.33 years included in the study. As per the inclusion criteria, subjects were included after the ethical committee approval. Informed consent obtained to conduct the study. Twenty hemiplegic cerebral palsy subjects were assessed for fine motor function using HELP. The children were divided into two groups based on random sampling. Group 1: NDT, *N* = 10. Group 2: conventional physiotherapy *N* = 10. Outcome data Assessments were performed at baseline and after 12 sessions. Within group analysis revealed that there is a significant improvement in balance (*p*-value <0.0001) and reduction of fear of fall (*p*-value < 0.0001) in subjects with Parkinson's disease after balance training. The correlation between the scores of Berg balance scale and fall efficacy scale are strongly negative (–0.921) before treatment and after treatment also there is a negative correlation (–0.699) but it is weak statistically.

Keywords: HELP; Hemiplegic cerebral palsy; Fine motor function.

Introduction

Cerebral palsy (CP) is described as a clinical entity that indicates a non-progressive disorder or brain damage in the early developmental period, often accompanied by sensory disorders, perception, cognition, communication, behavior, epilepsy and secondary musculoskeletal problems.[1] Cerebral palsy (CP) is the most common cause of neurological disability in children,[2] affecting approximately 1 in 1,300 live births.[3] At an early age, the most affected parts of upper extremity involvement are the wrist and hands. Abnormal hand postures such as thumb adduction and/or flexion with limited wrist extension are the primary manifestations of hand involvement.

Abnormal hand postures such as thumb adduction and/or flexion with limited wrist extension are the primary manifestations of hand involvement. Daily living activities and functional independence are affected by increased tonus of the upper limb, impaired posture and function.[4,5] The aim of the treatment for children with disabilities due to brain damage is to prepare and guide them towards their greatest possible independence and to prepare them for as normal adolescences and adult lives as can be achieved.[6] Spasticity is a widespread problem in cerebral palsy (CP) as it affects function and can lead to musculoskeletal complications.[7] It occurs as a result of pathologically increased muscle tone and hyperactive reflexes mediated by a loss of upper motor neuron inhibitory control.[8] Children with CP demonstrate poor hand function due to spasticity in the wrist and finger flexors.[9] Thus spasticity in the flexor muscles of the upper limbs poses a great deal of functional limitation in

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the hands. One common problem associated with poor hand function as a result of spasticity is the inability of the child to grasp objects and difficulty with fine motor tasks such as writing or cutting with hands.[8,9] Hand functioning, the ability of the hands to perform properly in various contexts, requires the integrity of the central nervous system and, therefore, may be disturbed by different brain disorders. Cerebral palsy (CP) is the most prevalent form of physical disability in children.[10] Occurring in 1 out of live births (http://www.cdc.gov/ncbddd/cp/index.html). Almost 50% of children with CP present an arm-hand dysfunction.[11,12] Children with unilateral spastic CP seldom use their paretic hand spontaneously in daily activities.[11,13] For these reasons, increasing attention in the last decade has focused on hand functioning in children with CP. The impact of CP on a child's hand functioning may be formalized through the theoretical framework of the International Classification of Functioning, Disability, and Health (ICF).[13] The aim of the treatment for children with disabilities due to brain damage is to prepare and guide them towards their greatest possible independence and to prepare them for as a normal adolescences and adult lives as can be achieved.[6] Kinesio taping (KT) is a relatively new therapeutic tool used in rehabilitation program of children with cerebral palsy, it has been used for a long time in sport or orthopedic fields, and has been approved as a supplemental intervention for other functional impairments.[6–9] It has been hypothesized that KT may favorably stimulate the coetaneous receptors of the peripheral sensorimotor system, since these receptors are associated with pain, proprioception and motor control.[3] Taping can influence the skin, lymphatic system, circulatory system, fascia, muscle and joint[12] and theoretically leads to enhancing proprioception,[3] diminishing pain and edema, reducing muscle spasms, and strengthening the muscles.[4,5] KT supports the joints by correcting the muscle function, restoring the proprioception, optimizing the postural alignment and stimulating the coetaneous receptors. It can reduce the pain and provide the proprioception feedback for reaching and maintaining the natural body posture as well.[6–9] KT significantly improves handgrip of children with CP. Imbalance between wrist flexor muscles (spastic) and wrist extensor muscles (weak) in children with CP leading to abnormal posture of hand that affects the ability to grasp.[9] Children with cerebral palsy (CP) show increased muscle stiffness and reduced muscle length, which may contribute to reduced function. Stretching is commonly used in the treatment and management of children with CP and is considered to be an important part of preventing or delaying the onset of contractures (National Institute for Health and Clinical Excellence, 2012).[7] Stretching exercises were developed to manage spasticity, including passive and active stretching, positioning, and isotonic and isokinetic stretching. The effect of stretching depends on tension applied to the soft tissue, duration, repetition in session, and daily frequency.[9]

Materials and Methods

Population

Population of the study constitutes 250 children of Latika Roy Foundation, Vasant Vihar, Dehradun.

Source of Subjects

Source of the study constitutes 20 children of Latika Roy Foundation, Vasant Vihar, Dehradun.

Sample

Twenty children with the diagnosis of Hemiplegic Cerebral Palsy with the age group of 2–18 years have been included in the study.

Place

This study has been performed in Latika Roy Foundation, Vasant Vihar, Dehradun.

Study Design

It is a comparative study.

Selection criteria

Inclusion criteria

1. Children with the diagnosis of Hemiplegic Cerebral Palsy.
2. Accessibility of the parents.
3. Age group 2–18 years.

Exclusion criteria

1. Children with other developmental disabilities.
2. Children over the age of 18 and less than 2 years.
3. Failure to reach the parent/caregiver who takes care of the child
4. Children with a history of trauma or injury in the past one month.
5. Botulinum toxin application to the upper

extremity in the previous 6 months

6. A surgery in the past 6 months for the upper extremity(upper limb surgery (i.e. tendon transfer/tendon lengthening)
7. Children with altered parameters for any reasons.
8. Fever
9. Uncooperative subjects

Variables

1. Hemiplegic cerebral palsy
2. Fine motor function
3. NDT (Neuro developmental therapy)
4. Conventional physiotherapy (Stretching and Kinesio Taping)
5. HELP (Hawaii early learning profile)

Protocol

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

↓

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

↓

Informed consent obtained from Latika Roy foundation to conduct the study

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Informed consent obtained from the parents of the subjects

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

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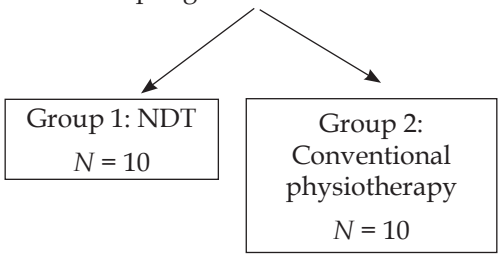
The children were divided into two groups based on random sampling



Procedure

Twenty subjects diagnosed with hemiplegic cerebral palsy aged between 2 and 18 years were included in the study. The study was conducted with children who are attending physiotherapy and rehabilitation programs in Latika Roy Foundation, Vasant Vihar Dehradun. The subjects were included in the study with the permission of their parents after obtaining informed consent following the necessary explanations and briefing. The subjects were divided into two groups on the basis of random sampling. Ten subjects were assigned as Group 1, and the management applied was NDT and the rest of the 10 subjects were assigned as Group 2 and the management applied was conventional physiotherapy. Pre-test and post-test valuesof the fine motor function for the upper extremity was evaluated using the Hawaii Early Learning profile (HELP), which has been tested for validity[10] and reliability[9] in subjects with neuromotor dysfunction. The treatment in both groups was applied by a physical therapist for 45-minute sessions 2 days/week for six weeks.[14] The strategies for subjects in Group 1 to improve fine motor function were NDT (Neuro developmental therapy) with strategies for the postural control and bilateral functional midline activities with focus on the hemiplegic hand (Fig. 1). The strategies for subjects in Group 2 to improve fine motor function were conventional physiotherapy and the methods used were passive stretching and taping for the hemiplegic hand. Passive stretching to tight muscles destructs the adhesions in muscles and sheath (Fig. 2). It must be decent gentle gradual stretch not overstretch at all, lasting 20 second then relaxation 20 second 3–5 times per session.[14] KT was applied from origin of extensors muscle to metacarpophalangeal (MCP) joint of fingers; and from origin of extensor and abductor policis longs to metacarpophalangeal MCP joint of thumb. Tension of tape in muscular zone was 30% and in joint area was 75%. KT was applied on dorsum aspect of wrist and forearm to support activation of extensor muscles of wrist and thumb.[12] Purpose of KT application in these manners was to improve the function of muscles and joint re-alignment (correction the wrist flexion and thumb in palm deformities). KT was used to correct the wrist flexion deformity in children with CP. When the tape is applied properly, the flexibility of KT does not restrict ROM of soft tissue but also supports weak muscles and provides joint mobility.[5]

Fig. 1: NDT [Picture showing the midline strategy].

Fig. 2: Core strengthening on physio ball.

Fig. 3: Conventional physiotherapy.

Discussion

All testing was completed at Latika Roy Foundation, Vasant Vihar, Dehradun. Twenty subjects with Hemiplegic cerebral palsy with the mean age of 9.33 were selected according to the selection criteria after the ethical committee approval. All the parents of the participants were informed and given verbal instructions for the testing procedure and informed consent form was obtained from the parent of each subject, prior to the participation in the study. The children were divided into two groups on the basis of random sampling. Ten children were assigned as Group 1, and the management applied was NDT and the rest of the ten children were assigned as Group 2 and the management applied was conventional physiotherapy (stretching and taping). Pre-test and post-test values of the fine motor function for the upper extremity was evaluated using the Hawaii Early Learning profile (HELP), which has been tested for validity[11] and reliability[12] in children with neuromotor dysfunction. Both the groups had improvement in the fine motor function post-treatment. The average improvement fine motor function tended to being higher in Group A (15.30 ± 8.769 versus 23.10 ± 9.803) than in Group B (12.30 ± 8.394 versus 13.80 ± 8.509). The results suggest that NDT is a more effective method to improve fine motor function in hemiplegic cerebral palsy as NDT uses proximal points of control to give the child an optimal amount of support or stability to promote isolated distal control (Bobath & Bobath, 1972). Through handling of the trunk, the therapist facilitates movement of the extremities. As the child's proximal control improves, less support and guidance are needed, and handling moves from proximal to distal aspects of the body (Scherzer & Tscharnuter, 1982).[15] The development of trunk stability and central axis control is a prerequisite to upper extremity functions and hand usage. Proximal stability is hypothesized to allow for the independent use of the arms and hands in manipulative and purposeful activity. That is, motor development is believed to progress from gross movements to fine movements and from proximal control to distal control (Tudor, 1981).[16] Observations of motor development in normal children suggest that children first gain control over the shoulder, waving the arm in gross, whole arm movements, and then learn to coordinate fine movements of the elbow, wrist, and fingers (Skinner, 1979).[17] The proximal-distal principle has been adopted by occupational and physical therapists as both a postulate of theories of normal motor development (Ayres, 1954/1974; Gilfoyle, et al., 1981)[18,19] and a principle of treatment (Ayres, 1954/1974; Bobath, 1971; Bobath & Bobath, 1972; Farber, 1982; Stockmeyer, 1967; Voss, 1972).[18,22-25,27] On the basis of the belief that the development or recovery of arm and hand function in persons with sustained central nervous system damage adheres to the proximal-distal principle of ontogeny, therapists often focus treatment on the development of proximal (axial) stability and control as necessary preparation for distal control or fine motor skill (Bobath 1964; Stockmeyer 1967; T Witchell 1951; Voss, lonta, & Myers 1985).[21,25,27,28] Therapists who design treatment programs based on the principles of neurodevelopmental treatment use proximal points of control to give the child an optimal amount of support or stability to promote isolated distal control (Bobath & Bobath, 1972).[23] Through handling of the trunk, the therapist facilitates movement of the extremities. As the child's proximal control improves, less support and guidance are needed, and handling moves from proximal to distal aspects of the body (Scherzer & Tscharnuter, 1982).[15]

Future Research

1. The severity of tone (MAS) in the upper limb can be considered.
2. The study can be performed taking a larger sample size.
3. Levels of MACS (Manual Ability Classification System) can be considered.
4. Other and different methods can be compared to improve the fine motor function in cerebral palsy.

5. The study can be performed in spastic quadriplegic and spastic diplegic cerebral palsy.
6. The study can be performed on either right or left hemiplegic cerebral palsy.

Relevance to Clinical Practice

Children with cerebral palsy (CP) are frequently referred for physical therapy, yet the effectiveness of treatment has not been well-documented. In the relatively few available studies, outcomes are divided between support and lack of support for treatment. The purpose of' this research was to compare the effectiveness of NDT and Conventional Physiotherapy to improve the fine motor function in Hemiplegic Cerebral Palsy and also to document and evaluate the effects of a physical therapy program on fine motor functions of children with hemiplegic Cerebral Palsy.

Conclusion

The result signifies that NDT is more effective than conventional physiotherapy to improve fine motor function in hemiplegic cerebral Palsy

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Ethical Clerence: It is abonafide work done by meand I have not taken any part of thesis from anywhere.

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Effect of Unilateral Mechanical Neck Pain on Cervical Flexion Strength and ROM Among University Students

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Abstract

Background: Mechanical neck pain is defined as pain experienced anywhere in the base of skull at ear level to the upper part of back or shoulder. It affects 2/3 of population, usually those employed in desk jobs with a sustained neck posture. The prevalence of neck pain has found to be increasing and is mainly found in female population. The contributing factors for neck pain are poor posture, strenuous activities related to sports or occupation. Mechanical neck pain has an impact on our daily living and cause limitations in activities and work capacity, and induces economic and medical burden on individuals and is a major health issue. There is need to identify the effect of mechanical neck pain on muscular strength and ROM.

Methods: Total 50 subjects (male and female) with unilateral mechanical neck pain (duration 3 or more months) with NDI Score ≥10 from age group 18–28 years were recruited in this study. A written consent was taken from all the subjects. General Assessment of the subjects was performed to meet the inclusion criteria. Prior to test subjects were informed about the procedure. To assess the cervical flexor strength, a modified sphygmomanometer was used. The ROM of cervical flexion, extension, lateral flexion and rotation was measured by using a universal goniometer.

Result: The result of this study was analyzed using the Pearson correlation coefficient. The study concludes that there is no significant effect of mechanical neck pain on cervical flexor strength but there is significant effect of mechanical neck pain on cervical flexion and lateral flexion range of motion.

Conclusion: Proper biomechanics help the students to work effectively and for longer duration without any neck pain. Any alteration in the biomechanics affecting ROM and strength will lead to pain and affect ADLs. So regular stretching of muscles and neck ROM exercises must be continued especially by students and working people in order to avoid any neck pain and to improve quality of life.

Keywords: Mechanical neck pain; Range of motion; Strength.

Introduction

Neck pain is defined as the pain experienced anywhere, in the base of skull, at ear level to the upper part of back or shoulder. The various symptoms associated with mechanical neck pain include general pain or aches that can be because of postural fatigue in the neck, shoulders or pain and discomfort in the soft tissues surrounding neck and shoulders.[1] It is the non specific or simple pain that is of mechanical or postural basis. It affects 2/3 of population at some or the other point in life especially in the middle age.[2] It usually affects people who are employed in desk jobs and people who develop a sustained neck posture.

The main contributing factors responsible for neck pain are poor posture, anxiety, depression, strenuous activities related to occupation or sports.[3] Mechanical neck pain has soft tissue origin

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such as cervical strain/sprain or myofascial pain. The causes of neck pain are mainly soft tissue injuries such as ligament sprain, muscle strain, degenerative disk diseases. Weakness of anterior cervical flexor muscles also contributes to persistent pain in patients complaining of chronic neck pain. Lack of inhibition of cervical extensors keep these muscles in spasm.[4] This predispose the patient to developing a forward head posture along with tightness of sternocleidomastoid muscles.[5]

In 1966, Krout and Anderson used manual muscle testing techniques to determine that patients who have chronic neck pain are weaker than healthy individuals; and patients responded to strengthening program.[6] Patients with neck pain complaints of muscle stiffness, increase tension which often leads to postural adaptations and pain.[2] The prevalence of mechanical neck pain is higher in Scandinavian countries than in European and Asian countries.[7] Prevalence of neck pain was 99.2% among 500 subjects in Uttar Pradesh, India.[8] In USA the prevalence of neck pain is 4.4% with 3.9% in men and 4.8% in women.[9]

The prevalence of neck pain has found to be increasing since 50 years and it is found to be more prevalent in females.[10] Limitation of mobility in neck has found to be very common in people with neck pain. Many manual therapy techniques are also being used for treatment of mechanical neck pain such as muscle energy technique, releasing the trigger points, spinal mobilization includes NAGS & SNAGS, cyriax.[11]

Many studies have been conducted that shows that there may be involvement of different muscles in mechanical neck pain such as upper, middle and lower trapezius, levator scapulae, serratus anterior. Studies have shown that people with neck pain have impaired strength, endurance of different muscles. Few researches say that trigger points in muscles like upper traps, SCM, levator scapulae lead to symptoms in patients of mechanical neck pain with upper traps mostly affected.[12,13] So neck strengthening exercises have found to be beneficial in decreasing pain, increasing the strength of cervical muscles, cervical range of motion and also decreasing the risk of any disability.[14]

To improve patients, quality of life as well as his functional status it is necessary to find out what all structures are responsible for producing disability and pain. Over the past few years, many studies have shown association b/w limited strength and endurance of cervical musculature and non-specific neck pain. There are many studies which say that lower trapezius strength is mainly affected in neck pain patients. Exercises such as stabilization exercises of neck are also being used to relieve pain, improve the functioning in nonspecific neck pain.[15] Many researchers have suggested that posture is related to health status. Poor posture leads to dysfunction and pain. People who have desk jobs or office workers spend a lot of time working on computer. The relationship between sitting posture and neck pain is still controversial even though some studies shows, significant difference in head neck posture in people with and without neck pain.[16]

Poor posture is not only common in middle age but also in young age which mean that neck pain is also common in young individuals especially in college going students. The excess of stress continuously put greater pressure on cervical region leading to neck pain. It has been seen that long duration work has tend to reduce endurance of the muscles and increase in fatigue around the neck or cervical region. With the increasing sedentary lifestyle especially reliance on the, computer tech at the work place, it is predicted that the overall prevalence will, continue to increase in future. Therefore effective management of neck pain is important not just for relieving the symptoms related to it but most importantly, to prevent the recurrent episode of neck pain and to prevent the suffering and loss of work productivity.[17] Shannon M. Peterson et al.[18] 2011, research stated that there is association of weakness of lower trapezius fibers and neck pain.

Mechanical neck pain has an impact on our daily living and cause limitations in activities and work capacity, and induces economic and medical burden on individuals and is a major health issue. Studies have shown that when imbalance between neck musculature occurs, the problem is generally prevalent. Hence there is need to identify the effect of mechanical neck pain on muscular strength and ROM. However the need of this study is to see the effect of unilateral mechanical neck pain on cervical flexion strength and ROM among university students.

Materials and Methods

Total 50 subjects (male and female) with unilateral mechanical neck pain (duration 3 or more months) with NDI Score ≥10 from age group 18–28 years were recruited in this study.[19] A written consent was taken from all the subjects. General Assessment of the subjects was performed to meet the inclusion criteria. Prior to test subjects were informed

about the procedure. To assess the cervical flexor strength, a modified sphygmomanometer was used (Fig. 1). With subject in hook lying position, the cuff of sphygmomanometer was inflated to 20 mm Hg and was placed between the upper cervical spine and surface of table. The patient was asked to flex the neck and hold it for 10 seconds. The normal response is achieving 26–30 mm Hg.

The ROM of cervical flexion, extension, lateral flexion and rotation was measured by using a universal goniometer (Fig. 2). For measuring cervical flexion and extension ROM (Fig. 3). Subject was asked to sit with thoracic and lumbar spine supported by the back of chair. Axis of goniometer was placed over external auditory meatus with the stable arm aligning perpendicular to ground and movable arm aligning along the tip of nose. Normal ROM for cervical flexion is 0–60 degrees and cervical extension is 0–75 degrees. To measure the cervical lateral flexion ROM, subject was asked to sit on a chair with back well supported. Axis of goniometer was placed over the spinous process of C7 vertebra with the stable arm aligning perpendicular to ground and movable arm along the dorsal midline of head taking occipital protuberance as reference. Normal ROM for lateral flexion is 0–45 degrees. For measuring cervical rotation ROM, subject was asked to sit on a chair with back well supported. Axis of goniometer was placed over center of cranial aspect of head with stable arm parallel to imaginary line between two acromion process & movable arm aligning along the tip of nose. Normal ROM for cervical rotation is 0–80 degree.

Correlation between Neck Disability Index (NDI) and cervical flexor strength and ROM was measured to assess their relationship.

Fig. 1: Modified sphygmomanometer.

Fig. 2: Universal goniometer.

Fig. 3: Measurement of cervical flexor strength.

Fig. 4: Measurement of range of motion.

Results

Table 1 shows Demographic data that contains gender ratio and affected side of patients.

Table 2 shows correlation between mechanical neck pain and cervical flexor strength, where p>0.05 which suggests the relation is non-significant.

Table 3 shows correlation between right side mechanical neck pain and cervical flexion ROM.

Table 4 shows the correlation between right side mechanical neck pain and lateral flexion ROM.

Table 1: Demographic data

Total no. of subjects	**50**
Gender (M:F)	6:44
Affected side (left/right)	21/29

Table 2: Correlation between neck disability index and cervical flexor strength

Affected side	**Neck disability index (Mean ± SD)**	**Cervical flexor strength (Mean ± SD)**	**Correlation (*r*-value)**
Right side	16.068 ± 5.535	54.565 ± 9.426	–0.022 (NS)
Left side	15.523 ± 4.621	51.080 ± 7.298	0.009 (NS)

*NS- Non-significant at p <0.05

Table 3 Correlation between neck disability index and cervical flexion ROM

Affected side	**Neck disability index (Mean ± SD)**	**Cervical flexion ROM (Mean ± SD)**	**Correlation (*r*-value)**
Right side	16.068 ± 5.531	34.379 ± 8.136	0.287 *
Left side	15.523 ± 4.621	51.080 ± 7.298	0.009 (NS)

*S- Significant

Table 4: Correlation between neck disability index and right lateral flexion ROM

Affected side	**Neck disability index (Mean ± SD)**	**Cervical flexion ROM (Mean ± Sd)**	**Correlation (*r*-value)**
Right side	16.068 ± 5.531	35.355 ± 6.092	–0.275 *
Left side	15.523 ± 4.621	53.933 ± 9.959	–0.158 (NS)

*S- significant

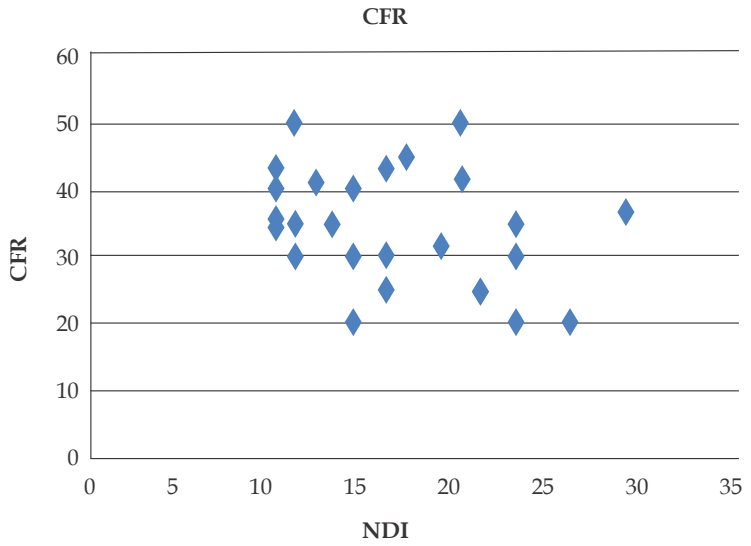

Fig. 5: Correlation between neck disability index and cervical flexion ROM (right side).

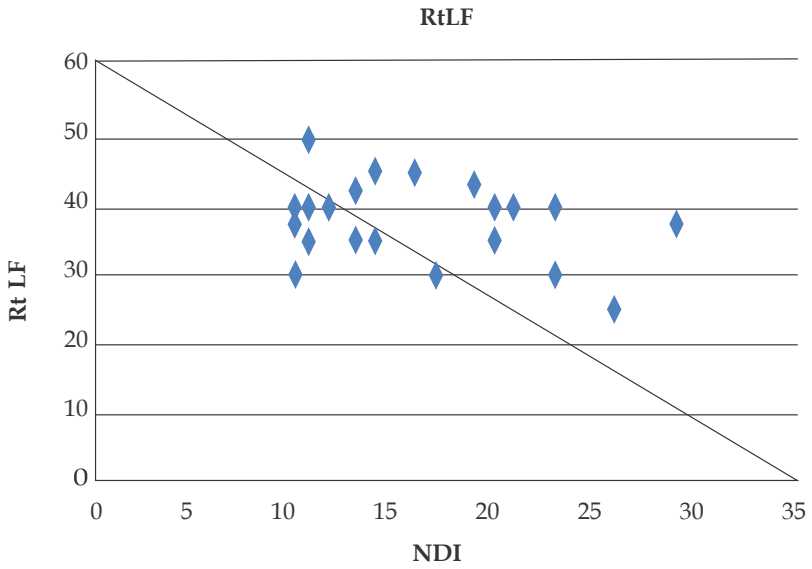

Fig. 6: Correlation between neck disability index and right lateral flexion ROM (right side).

Discussion

In this study, there is no significant correlation present in between cervical flexor strength and mechanical neck pain (Table 2 and Fig. 5). It is indicative of that mechanical neck pain alone cannot affect strength among college going students, some other factors should also be considered in conjunction. In one of the studies of Jin young kim et al. (2016),[20] it is stated that the forward head posture is considered one of the commonest findings in patients with chronic mechanical neck pain and results in serious alterations in joints between neck and the head but in this study. Forward head posture was not measured and if forward head posture was measured, we may get high correlation between cervical flexor muscle strength and mechanical neck pain.

This study shows significant correlation present between cervical flexion ROM and mechanical neck pain in right side affected students (Table 3). This is because college going students are mostly involved in writing and laptop work which require constant neck flexion leading to muscle fatigue and neck pain. But there is no correlation present between cervical flexion ROM and mechanical neck pain in left side affected students. This is because the number of left side affected students was less in number as compared to right side affected students; we may get correlation if the number of left side affected students were more in number or if the sample size was bigger.

In this study, there is significant correlation present between lateral flexion ROM and mechanical neck pain (Table 4 and Fig. 6). In one of the studies of Shannon M. Peterson et al. (2016),[21] they stated weakness of lower fibers of trapezius, middle fibers of trapezius &serratus anterior may be present in people with neck pain. So they recommended strengthening as well as endurance exercises for these muscles in neck pain with movement deficit. The study concluded that strength of lower trapezius on the affected side was lower in subjects with mechanical neck pain and lead to movement deficit. In this study significant correlation is present between lateral flexion ROM & neck pain in both right side and left side affected individuals which is indicative of lower strength of lower trapezius muscle on both sides.

There is no significant correlation between present between extension and rotation ROM with mechanical neck pain because in this study the extension and rotation ROM were not much affected as the other ROM. Moreover the sample size was also small; we may get correlation if the sample size was big.

Clinical implication of the study

This study may help in considerations that need to be taken for proper management of mechanical neck pain. As in this study subjects with neck pain found to have reduced flexion and lateral flexion ROM, hence for the proper management of patients with mechanical neck pain, there is a need to evaluate for the same and treat for restoration of ROM and strength of muscles.

Limitations of the study

1. The sample size was small.
2. The study was limited to 18–28 age group.
3. The study can be done on specific population only.

Scope of further study

1. Further studies must focus on other factors like strength of scapulothoracic muscles and measurement of forward posture in neck pain individuals because may be the findings then vary due to postural abnormalities and strength deficit. These factors may correlate to mechanical neck pain.
2. The study was done on young population. So future study can include the middle-aged individuals.
3. The sample size was also small, the future study should include a large sample size for better results.
4. The study can be correlated with shoulder joint too.

Conclusion

The study was conducted to check if there is association between mechanical neck pain and cervical flexor strength and to check association of mechanical neck pain with cervical ROM that is flexion, extension, lateral flexion and rotation. Proper biomechanics help the students to work effectively and for longer duration without any neck pain. Any alteration in the biomechanics that is ROM and strength will lead to pain and affect ADLs. The study suggested that there is negative correlation between mechanical neck pain and cervical flexor strength but there is significant correlation between mechanical neck pain and cervical flexion ROM. Also there is significant correlation between mechanical neck pain and lateral flexion ROM. So regular stretching of muscles and neck ROM exercises must be continued especially by students and working people in order to avoid any neck pain and to improve quality of life.

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Effectiveness of Modified Constraint-Induced Movement Therapy (mCIMT) in Stroke Patients Based on Severity

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Abstract

Introduction: WHO (1970 and still used) defined it as "A stroke is a clinical syndrome characterized by rapidly developing clinical symptoms or signs of focal, and at times global (applied to patients in deep coma and those with subarachnoid hemorrhage), loss of cerebral function, with symptoms lasting more than 24 hours or leading to death, with no apparent cause other than that of vascular origin". This definition includes stroke due to cerebral infarction, primary intracerebral hemorrhage (PICH), intraventricular hemorrhage, and most cases of subarachnoid hemorrhage (SAH); it excludes subdural hemorrhage, epidural hemorrhage, or intracerebral hemorrhage (ICH) or infarction caused by infection or tumor.[1–3]

Aim of the Study: mCIMT on upper extremity and hand functions among individuals with stroke based on the severity as assessed by the UEFM and ARAT.

Methods: The mCIMT was given as treatment intervention for stroke patients. The participants were asked to wear padded safety mitt on their less affected hand during treatment and at least 3 hours at home. All subjects were instructed to take the mitt off during certain activities mainly involving coordinated movements of both the hands simultaneously for example, when driving a car or riding a bike or reading a newspaper.

Discussion: The present study "Efficacy of modified constraint induced movement therapy in improving upper extremity and hand functions in stroke patients" has been started with aim to find out the effectiveness of mCIMT in different severity of stroke. Rinskinijl et al. 2013. Level 3a involves in-hand manipulation exercises, essential for regaining dexterity and bridging the gap between levels 2 and 3b, the latter involving activities of daily living. A database of exercises that can be used for both the dominant and non-dominant hands has been created for each aim at each level. Joachim Liepert et al., 2000. The mechanism of this massive cortical reorganization probably reflects either an increase in the excitability of neurons already involved in the innervation of more-affected hand movements or an increase in excitable neuronal tissue in the infarcted hemisphere, or both.

Conclusion: This study concluded that the patients from moderate to severe post-stroke disability improved better than the mild sever stroke patients so in this case the hypothesis can be rejected and it is accepted that CIMT can be used more beneficially in moderate and severe disability post stroke than the mild post-stroke disability.

Keywords: mCIMT; UEFM; Visual Analog Scale (VAS); Fugl-Meyer Assessment scale and Action research arm test (ARAT) scores.

Introduction

A cerebrovascular accident or brain attack is a sudden loss of brain function due to a disturbance in the blood supply to the brain. (Susan B O'sullivan, Thomas J Schmitz).

WHO (1970 and still used) defined it as "A stroke is a clinical syndrome characterized by rapidly developing clinical symptoms or signs of focal, and

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at times global (applied to patients in deep coma and those with subarachnoid hemorrhage), loss of cerebral function, with symptoms lasting more than 24 hours or leading to death, with no apparent cause other than that of vascular origin."

This definition includes stroke due to cerebral infarction, primary intracerebral hemorrhage (PICH), intraventricular hemorrhage, and most cases of subarachnoid hemorrhage (SAH); it excludes subdural hemorrhage, epidural hemorrhage, or intracerebral hemorrhage (ICH) or infarction caused by infection or tumor.[1–3]

Strokes can be classified into two major categories: ischemic and hemorrhagic. Ischemic strokes are caused by interruption of the blood supply, while hemorrhagic strokes result from the rupture of a blood vessel or an abnormal vascular structure. About 87% of strokes are ischemic, the rest are hemorrhagic.[1,2]

Epidemiology

Stroke is a global health problem. It is the second commonest cause of death and fourth leading cause of disability worldwide (Strong 2007).[4]

Stroke is one of the main health problems in the Western world (Roger et al., 2011).[5] Because about 80% of the survivors have an upper limb paresis immediately after stroke onset (Nakayama et al., 1994).[6] A wide range of interventions have been developed to improve upper limb function (Langhorne et al., 2009).[7]

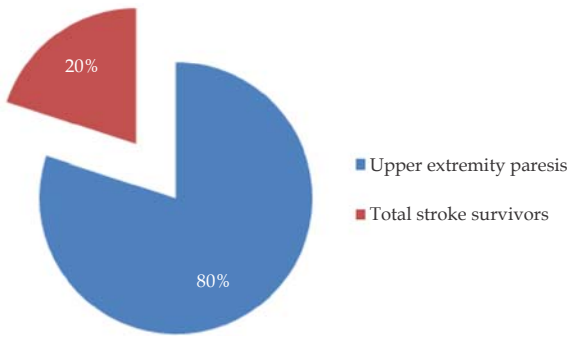

Fig. 1: Epidemiology

Stroke is a leading cause of functional impairment, with 20% of survivors requiring institutional care after 3 months and 15%–30% being permanently disabled (Steinwachs 2000).[8]

Stroke is a life-changing event that affects not only the person who may be disabled, but their family and caregivers. Utility analyzes show that a major stroke is viewed by more than half of those at risk as being worse than death (Dalal P 2004).[9]

Organized provisions of care in a stroke unit have been found to increase the number of patients who survive, return home, and regain functional independence in their everyday activities (Stroke Unit Trial lists Collaboration 1997).[10] However implementation of such organized care for stroke is limited and inadequate in low and middle income countries, especially in a country like India where resources for rehabilitation are scarce (Peter Langhorne 2012).[11]

Constraint-induced movement therapy is a form of rehabilitation therapy that improves upper extremity function in stroke and other Central nervous system damage victims by increasing the use of their affected upper limb.[15]

CIMT (constraint-induced movement therapy) by Taub, CIMT is a neurorehabilitation approach developed by behavioral neuroscientists Dr. Edward Taub and colleagues.

CIMT technique has following basic components:

The original CIMT treatment protocol is clearly described and includes three main elements (Morris et al., 2006).[16]

1. Repetitive, task-oriented training of the more impaired upper limb for 6 hours a day, on 10 consecutive week days;
2. A transfer package of adherence-enhancing behavioral methods designed to transfer the gains made in the clinical setting to the patient's real-world environment; and
3. Constraining the less impaired upper limb to promote the use of the more impaired upper limb during 90% of the waking hours

Modified CIMT (mCIMT): It was developed later, when use of CIMT clinically was not up to the mark or its application was laborious and time consuming. There were many different alternative modified forms of CIMT were made by defferent researchers.

There are limited evidence suggesting the influence of mCIMT in improvement of upper extremity and hand functions post-stroke based on the severity of lesion

This study will help in fulfilling this crucial question of rehabilitation so that more precise and less time-consuming treatment can be given.

This study can help the physical practitioners in such a way that it will give them a clear idea about in which specific severity of stroke the mCIMT would be most effective rather in which cases of stroke this should not be given.

Review of Literature

Langhorne P and Bernhardt J et al. (2009) concluded cerebrovascular accident (CVA) or brain attack is a sudden loss of brain function due to a disturbance in the blood supply to the brain.

The World Health Organization defined stroke (introduced in 1970 and still used) is "rapidly developing clinical signs of focal (or global) disturbance of cerebral function, lasting more than 24 hours or leading to death, with no apparent cause other than that of vascular origin."[7,12]

Yue X Shi et al. (2012). They concluded afairly strong evidence that modified CIMT could reduce the level of disability, improve the ability to use the paretic upper extremity, and enhance spontaneity during movement time, but evidence is still limited about the effectiveness of modified CIMT in kinematic analysis.[14]

Rinske Nijland et al. (2013) characterizing the protocol for early modified constraint-induced movement therapy in the EXPLICIT-stroke Trial explained that the purpose of the present paper is therefore to describe the essential elements of the mCIMT protocol as developed for the explaining plasticity after stroke (EXPLICIT-stroke) study.[13]

Marina Lucas and Pedrorebiero in 2013[7] concluded that the behavioral and neuro-imaging studies using mCIMT and CIMT promote cortical reorganization. Studies observed that many cortical areas like primary motor cortex, dorsal pre-motor cortex and supplementary motor area are activated by mCIMT and CIMT. However, there is no consensus about why some patients show a greater activation in the affected hemisphere, and why other patients experience a greater activation in the unaffected hemisphere. Consequently, the motor behavior in post-stroke patients is benefited from using mCIMT or CIMT; therefore, this therapy should be taken more into consideration by the professionals, due to its benefit.[15]

Joachim Liepert et al., 2000 concluded that this is the first demonstration in humans of a long-term alteration in brain function associated with a therapy-induced improvement in the rehabilitation of movement after neurological injury.[16]

Kristina Laaksonen 2012 concluded that MEG (magnetoencephalography) provides a suitable tool to study cortical neurophysiological alterations after stroke. We observed a variety of alterations which seem to be significantly related to clinical recovery. In the future, studies with more severe stroke patients and longer follow-up times as well as interventional studies may lead to an improvement of individually designed and well-targeted rehabilitation to maximize the recovery potential after stroke.[17]

VW Mark, E Taub and DM Morris 2006 concluded that in short we now understand that the mature brain is not physiologically stagnant either in health or non-progressive disease. Significant plastic brain reorganization can occur within hours of environmental or somatic changes that affect sensory input and such change may be adoptive or mal adoptive.[18]

Shama Praveen, 2018 et al. conducted study on mirror therapy and thermal stimulation on upper extremity motor functions in post-stroke hemiparetic subjects. Mirror therapy and thermal stimulation was found to be effective in improving functional independence in upper limb post sub-acute stroke. When mirror therapy and thermal stimulation is administered to patients suffering from sub-acute stroke over a period of 4 weeks, it results in an improvement in reaching forwards, grasping, manipulating objects and also improves other fine motor functions of the hand.[20]

Nishu Sharma, 2018 done study on intermittent pneumatic compression and mirror therapy improve hand functions after stroke. The study concluded that hand functions improved by intermittent pneumatic compression and mirror therapy in sub-acute stroke subjects and interventions should be emphasize to restore motor and sensory function.[21]

Sudha Dhami, 2019. mirror therapy and repetitive facilitation was found to be effective in improving functional independence in upper limb post sub-acute stroke. When mirror therapy and repetitive is administer third to patient suffering from sub-acute stroke over a period of 4 weeks, it results in an improvement in reaching forwards, grasping, manipulating objects and also improves others motor functions of the hand.[22]

Materials and Methods

A twelve patents were selected for this study on the basis of randomization selection criteria. The study was done at Neuro-Medicine Department, Arunabh NGO, Indore were diagnosed with Stroke/Cerebrovascular Accident (CVA) were chosen purposively selected as subjects for the study. Twelve stroke patients constituted the study group and were willing to take treatment for 3 -week sessions. The subjects/attendants had explained about the complete study procedure and information about the study had recorded in a consent form

dually signed by him. The study was approved by NGO Ethical Review Board (IRB). The study elements had analyzed for Fugl-Meyer Assessment scale and Action Research Arm Test (ARAT) scores in order to evaluate the importance of constraint induced movement (CIMT) technique and the significance of mean differences between pre-intervention and after intervention that further leaded the identification of the effectiveness of CIMT therapy among stroke patients.

Convenient sampling: Patients diagnosed with CVA from neuro medicine department was included in study based on inclusion criteria and exclusion criteria.

Inclusion criteria: First episode of stroke, stroke experienced more than 1 month and less than 6 months prior to study enrollment. Ability to actively extend up to 20 degrees at the wrist as assessed by manual goniometer, A score 24 or more on Mini Mental Status Examination (MMSE), Age 40 to 60 years, Modified Ashworth Spasticity (MAS) Scale 2 or less than 2 in affected upper extremity of 6 muscles (shoulder abductors, elbow flexors and extensors, wrist flexors and extensors, finger flexors and extensors and thumb flexors).

Exclusion criteria: Rigidity of the affected upper extremity, excessive pain in the more affected arm, as measured by a score of ≥4 on a 10 point visual analog scale (VAS), currently participating in any experimental rehabilitation or drug studies (mainly on muscle relaxants and on pain killers) and patients having sensory impairment of hand. Outcome measures- Upper extremity Fugl-Meyer (UEFM) and Action research arm test (ARAT) and Goniometer.

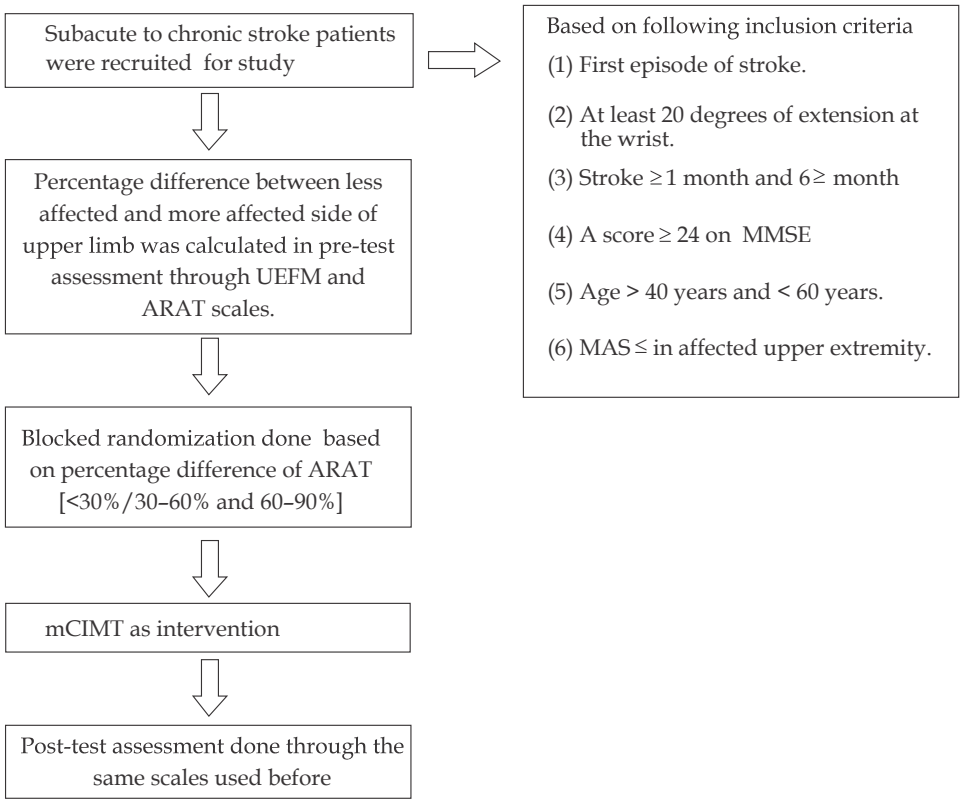

Fig. 2: Data flow diagram

Procedure

Patient's sensory integrity was assessed with touch of cotton ball, prick and hot and cold test tubes on dorsum of hand and forearm. Thereafter the ability of wrist to extend at least up to 20 degrees was assessed by goniometer. A steel half circle (180°) universal goniometer was used with fulcrum over lateral aspect of wrist over triquetrum, proximal arm over lateral to midline of ulna and distal arm lateral to mid line of 5th metacarpal bone.

There were two major assessments (pre-and post-interventions) were taken through two major outcome measures namely upper extremity Fugl-Mayer and action research arm test. In UEFM after checking up the deep tendon reflexes patients were asked to perform certain movements with more

affected arm and given scores out of 66 as sum of (0,1,2) corresponding to their no, partial or full movement abilities of arm.

In ARAT patients were given a series of objects in hand to assess hand abilities such as grasp, grip, pinch and gross movements. The patients were given 3 or 0 scores for each the correct or incorrect action performed during test. This test had four subtests having different totals with grand total of 57 and thus scores were given out of 57.

Patients were categorized into three mild, moderate and severe on both the scales. In UEFM the patients whose final score was between 0–27 considered as sever and score between 28–49 considered as moderate and score between 50–60 was considered as mild.

In ARAT the categorization was slightly different than Fugl-Mayer as here the percentage difference between more affected and less affected hand was taken to denote severity grading. The grand total of 57 was considered as 100% and thefinal percentage difference was calculated through subtracting the percentage of more affected arm from the less affected arm. Formula [percentage of less affected arm–percentage of more affected arm].

Now the patients were randomized through blocked randomization in three categories: 0–30% (as mild); 30–60% (as moderate) and 60–90% (as severe).

Thereafter mCIMT was given as treatment intervention for stroke patients. The participants were asked to wear padded safety mitt on their less affected hand during treatment and at least 3 hours at home. All subjects were instructed to take the mitt off during certain activities mainly involving coordinated movements of both the hands simultaneously for example, when driving a car or riding a bike or reading a newspaper.

Repetitive training and constraining

The mCIMT protocol applied in the EXPLICIT-stroke trial retains two of the three main elements of the original form of mCIMT, that is, the repetitive training and the constraining element, and is applied for 15 consecutive weekdays.

Repetitive training

Patients receive 1 hour of individual training on each working day during a 3-week period, starting 1 month after stroke. Depending on the patient's ability to sustain training, the hour can be divided into two 30-minute or four 15-minute sessions per working day.

In line with the original mCIMT protocol, repetitive training consists of 'shaping' and 'task practice'. (RinskeNijland et al., 2012) (Fig. 3).

Fig. 3: mCIMT protocol, repetitive training practice.

(a) *Shaping:* During each session, shaping principles play a dominant role. Shaping is defined as a training method in which a motor objective is approached in small steps by successive approximations (Morris et al., 2006). For instance, the task difficulty can be incrementally increased in accordance with a patient's capabilities, or the requirements for speed performance can be progressively augmented (Morris et al., 2006).

The main objective is to encourage the patient to use the more affected upper limb repeatedly to overcome (or prevent) learned non-use and to induce activity-dependent cortical reorganization (Morris et al., 2006).

Shaping is mainly applied at levels 1 and 2 of the treatment matrix.

(b) *Task practice:* Task practice is a less structured way of training than shaping. Task practice is defined as a training method in which functional tasks are practiced. It is implemented mainly at level 3 of the matrix, when a patient has successfully completed levels 1 and 2 and is able to integrate the improved control of the extensors in functional unilateral tasks (i.e. eating, cutting bread, cleaning a table, ironing or writing). (Rinske Nijland et al., 2012).

Constraining

In the EXPLICIT-stroke program, patients wear a padded safety mitt on the less affected hand during each training session, and for at least 3 hours per day, they were forced to use the more affected limb only. The mitt restricts the ability to use the less affected hand during most tasks, while still allowing protective extension in the elbow in case of imbalance. Patients receive homework at the end

of each training session, according to the treatment aims, to encourage them to exercise the more affected limb during the 3 hours when the mitt is worn outside therapy sessions. The homework is discussed and evaluated at the beginning of the next therapy session. (Rinske Nijland et al., 2012) (Fig. 4).

Fig. 4: Constraining training session of affected hand.

Patients are given homework, and patients also have to keep a diary, to encourage them to take the mitt practice seriously. The patients diary is filled in daily and checked by the therapist. The times dedicated to shaping and task practice during the training session, as well as the level and aim that the patient is working on, are documented by patient and therapist. In addition, the times when the mitt is put on and taken off have to be specified in the diary. The information recorded in the patient diary is useful as motivational feedback to the patient by demonstrating improvements.

The purpose of the orthotics and splints was to maintain the fingers/wrist in better alignment to enhance the use of the arm and hand in activities of daily living (ADL).

Environmental adaptations to facilitate use of the plegic hands included door knob turners, terry cloth bath mitts, adaptive drawer pulls, "pencil pushers" (built-up foam on pencils that were used to push buttons), Dycem wraps around utensils, scoop dishes and adaptive cups. The adaptive equipment and orthotics were updated throughout the entire intervention as needed.

Weight-bearing and stretching procedures were given for 1 hour at the beginning of each of the 2 daily sessions in order to reduce tone.

CI therapy was carried out in the second and third hours of the morning and afternoon sessions. Brief periods of conventional procedures such as stretching weight bearing were interpolated in the CI therapy activities to reduce hypertonicity and improve movement as needed. Shaping was used during training. It is a widely used behavioral training technique in which a desired motor or behavioral objective is approached in small steps, by successive approximations.

Shaping is commonly used in CI therapy and clinically it appeared to be particularly important with these patients. The training tasks were carried out in sets of ten trials.

CI Therapy for Plegic Hands 9 sec trials; rests were given between trials and there were longer rests between sets of 10 trials to prevent fatigue. Specific qualitative andquantitative feedback, coaching, modeling and encouragement were used throughout and especially immediately before and after trial performance. The shaping tasks were designed specifically to maximize the subjects' movements in areas that exhibited the most pronounced deficit and that appeared to have the greatest potential for improvement.

Statistical Technique

The raw data were entered into the computer database. The responses of frequencies were calculated and analyzed by using the raw data of 12 subjects. Prevalence of an outcome variable along with 95% confidence limits was calculated. Statistical software, SPSS version 17.0 was used for analysis.

A parametric test, unpaired *t*-test was used to identify the significance of difference between categories of upper extremities Fugl-Meyer and ARAT at pre- and post-intervention in stroke patients.

Paired *t*-test was used to identify the significance of difference in motor recovery in upper extremities score and percentage from ARAT between pre-intervention and post-intervention and handedness in left and right side of arm in stroke patients.

The Karl Pearson's coefficient of correlation had been used to identify the degree and direction of relationship of correlation of age and duration of stroke with upper extremities Fugl-Meyer score and percentage by Action research arm test at pre- and post-intervention stages. Correlation of upper extremities Fugl-Meyer score (hand) score at Pre- and post-intervention stages with Action research arm test score is also identified.

The probability value, $p > 0.05$ was considered as statistically insignificant but the probability value from $p < 0.05$ to $p < 0.1$ was considered as suggestively or poorly significant. The probability value from $p < 0.05$ to $p < 0.01$ was considered as statistically significant while from $p < 0.009$ to $p < 0.001$ was considered as statistically highly/

strongly significant. Following are the notations used to present the significance of observed probability value.

Results

A total of 12 cases of stroke treated as study elements that constituted study group (n = 12) were purposively selected as subjects for the present study. Out of 12 subjects, 9 (75.0%) were male while rest 3 (25.0%) were female. The age of all subjects were obtained in the ranges from 40 to 70 years. The spread of mean age in subjects with stroke were identified in the ranges of 56.00 ± 9.27 years. The following tables are showing the analyzed results with interpretations.

Table 1: The UEFM assessment at pre- and post-interventions

Upper extremity Fugl-meyer score	Pre-intervention		Post-intervention	
	N	%	*N*	%
0–27 (Severe)	11	91.7	3	25.0
28–49 (Moderate)	1	8.3	9	75.0
50–60 (Mild)	0	0.0	0	0.0
Total	12	100.0	12	100.0

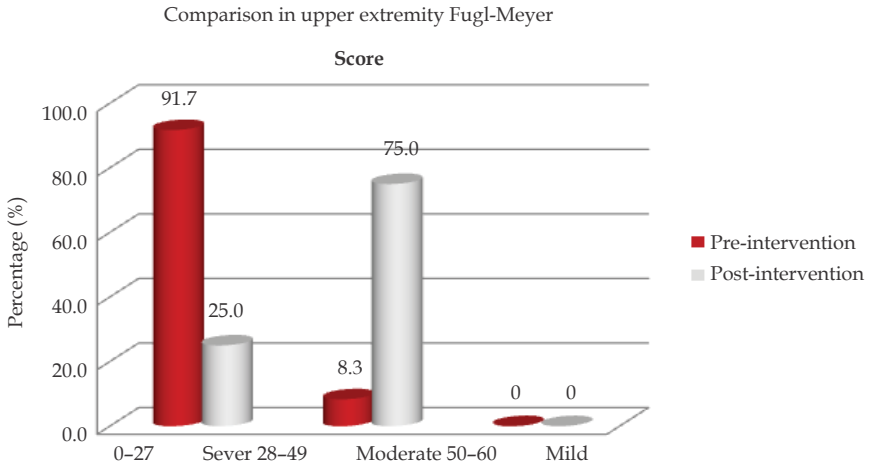

Fig. 5: Multiple bar diagram depicting the comparison in upper extremity Fugl-Meyer score between pre- and post-interventions among stroke patients.

Table 1 and Fig. 5 projected the stroke patients had improved functions after administration of CIMT therapy as the severity of stroke had reduced, easily seen by the increased score obtained after intervention. Major proportion of subjects 11 (91.7%) found with severe stroke while only 1 (8.3%) patient had moderate type severity of stroke at pre-intervention stage.

After administration of CIMT therapy most of the subjects found with reduction in severity of stroke as three-fourths 9 (75.0%) subjects detected with moderate type of stroke while rest one-fourth 9 (25.0%) were left in severe category of stroke.

Henceforth, it is inference that after intervention subjects had improved the functions of affected arm based on severity of stroke that impacted the effectiveness of CIMT therapy among stroke patients.

Table 2: The ARAT percentage at pre-intervention and post-intervention

Action research arm test score (%)	Pre-intervention		Post-intervention	
	N	%	*N*	%
0–30 (Mild)	2	16.7	4	33.3
30–60 (Moderate)	5	41.7	8	66.7
60–90 (Severe)	5	41.7	0	0.0
Total	12	100.0	12	100.0

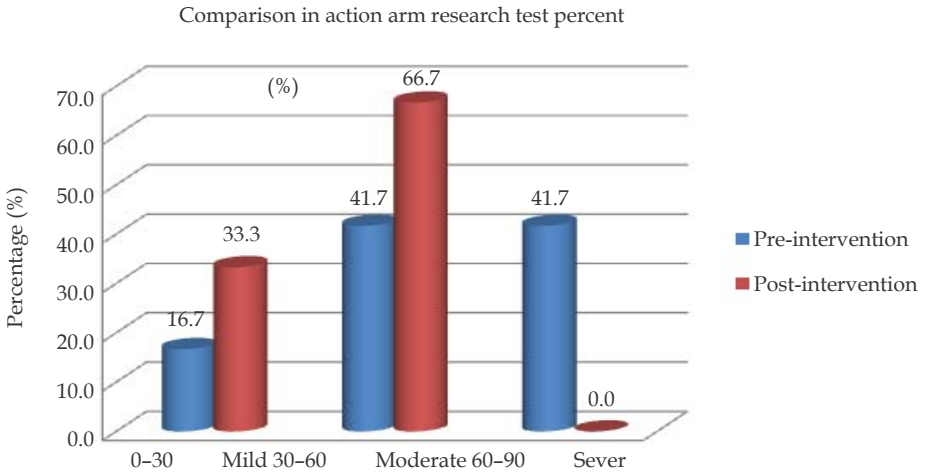

Fig. 6: Multiple bar diagram depicting the comparison in action research arm test (ARAT) percentage between pre and post interventions among stroke patients.

Table 2 and Fig. 6 focused on the percentage (%) of test allocated to stroke patients had improved functions after administration of CIMT therapy as the percentage (%) measured by ARAT was reduced after intervention.

Major proportion of subjects 5 (41.7%) diagnosed with moderate to severe dysfunction shown by percent recorded by Action Research Arm Test (ARAT) while only 2 (16.7%) patient had mild severity of stroke at pre-intervention stage. After administration of CIMT therapy most of the subjects found with decreased percentage recorded on ARAT showed reduction in severity of stroke as two-thirds 8 (66.7%) subjects detected with moderate type of severity while rest one-third 4 (33.3%) were measured in mild severity of stroke.

Henceforth, it is inference that after intervention subjects had improved the functions of affected arm based on severity of stroke that impacted the effectiveness of CIMT therapy among stroke patients.

Table 3: The comparison in mean difference between pre- and post-intervention in UEFM (score) and ARAT (percentage)

Handedness	Parameter/test	Side of lesion	Spread: Mean ± SD	MD	*t*-value	LOS
Right (n = 10)	Upper extremity Fugl-meyer (score)	Right	20.50 ± 4.01	9.90	11.67	$p < 0.001^{\#}$
		Left	30.40 ± 4.65			
	Action research arm test (%)	Right	54.00 ± 16.71	19.60	6.31	$p < 0.001^{\#}$
		Left	34.40 ± 16.81			
Left (n = 2)	Upper extremity Fugl-meyer (score)	Right	20.00 ± 4.24	6.00	6.00	$p > 0.05^{*}$
		Left	26.00 ± 2.83			
	Action research arm test (%)	Right	58.00 ± 29.70	15.50	1.48	$p > 0.05^{*}$
		Left	42.50 ± 14.85			

- #The mean difference is highly significant at the 0.001 level of significance. *The mean difference is not significant (insignificant) at the 0.05 level of significance. [Degrees of freedom are 9 and 1; MD-Mean Difference; LOS-Level of Significance]
- It was easily seen in the Table 3 that the stroke survivors with right handedness had improved functions after administration of CIMT therapy at right side of lesion had significantly different score and percentage as compared to left side handedness.

- The stroke survivors with left handedness hadn't improved functions at right side of lesion and insignificantly different score for upper extremities Fugl-Meyer (UEFM) and percentage for action research arm test (ARAT) when compared with the scores from UEFM and percentage from ARAT at left side of lesion. The stroke survivors with left handedness were only two and may be due to very small sample size the mean difference was not significant.
- The mean for upper extremity Fugl-Meyer of stroke survivors with right handedness at left side of lesion was 30.40 ± 4.65 points was much higher than right side of lesion was 20.50 ± 4.01 points and the mean difference of 9.90 points between right and left side of lesion was strongly significant (p <0.001) confirmed on statistical ground.
- The mean percentage difference of 19.60% among stroke survivors with right handedness between right and left side of lesion in right (54.00 ± 16.71) side was higher as compared to mean percentage for left (34.40 ± 16.81) side of lesion was strongly significant (p <0.001) confirmed statistically.
- The mean for upper extremity Fugl-Meyer of stroke survivors with left handedness at left side of lesion was 26.00 ± 2.83 points was higher than right side of lesion was 20.00 ± 4.24 points and the mean difference of 6.60 points between right and left side of lesion was statistically insignificant (p >0.05).
- The stroke survivors with left handedness found with mean difference of 15.50% between right and left side of lesion in action research arm test in right (58.00 ± 29.70) side of lesion was much higher as compared to mean percentage for left (42.50 ± 14.85) side of lesion was not statistically significant (p >0.05).
- Henceforth, it is statistically concreted that administration of CIMT therapy among stroke survivors with right handedness was beneficial in both the sides of lesion and reported with improved motor functions of affected arm based on severity of stroke that impacted the effectiveness of CIMT therapy among stroke patients.

Table 4: The comparison in mean differences in handedness and side of lesion between right and left side in UEFM and ARAT

Side of lesion	Parameter/test	Handedness	Spread Mean ± SD	MD	*t*-value	LOS
Right (n = 6)	Upper Extremity Fugl-Meyer (Score)	Right	20.33 ± 3.88	7.67	9.09	p < 0.001
		Left	28.00 ± 3.63			
	Action Research Arm Test (%)	Right	58.17 ± 21.19	17.50	5.97	p < 0.002#
		Left	40.67 ± 16.81			
Left (n = 6)	Upper Extremity Fugl-Meyer (Score)	Right	20.50 ± 4.18	10.83	9.29	p < 0.001#
		Left	31.33 ± 5.20			
	Action Research Arm Test (%)	Right	51.17 ± 14.36	20.34	3.85	p < 0.02*
		Left	30.83 ± 15.30			

- #The mean difference is highly significant at the 0.001 and 0.002 levels of significance. *The mean difference is significant at the 0.02 level of significance. [Degrees of freedom are 5; MD-Mean Difference; LOS-Level of Significance]
- Table 4 showed that the stroke patients with right and left side of lesions had improved functions after administration of CIMT therapy and significantly different score for upper extremity Fugl-Meyer (UEFM) and percentage for action research arm test (ARAT) between right and left side.
- The mean upper extremity Fugl-Meyer of stroke survivors with right side of lesion at left side handedness was 28.00 ± 3.63 points was much higher than right side handedness was 20.33 ± 3.88 points and the mean difference between right and left side handedness was strongly significant (p <0.001) confirmed on statistical ground.

- The mean percentage difference of 17.50% among stroke survivors with right side of lesion between right and left side handedness observed in action research arm test in right (58.17 ± 21.19) side handedness was much higher as compared to mean percentage for left (40.67 ± 16.81) side handedness was strongly significant (p <0.002) confirmed statistically.
- The mean for upper extremity Fugl-Meyer of stroke survivors with left side of lesion at left side handedness (31.33 ± 5.20) was higher than right side handedness (20.50 ± 4.18) and the mean difference of 10.83 points between right and left side handedness was strongly significant (p <0.001) concluded statistically.
- The stroke survivors with left side of lesion found with mean difference of 20.34% between right and left side handedness in action research arm test in right (51.17 ± 14.36) side handedness was much higher as compared to mean percentage for left (30.83 ± 15.30) side handedness was significant (p <0.02) confirmed statistically.
- Moreover, it is statistically concluded that administration of CIMT therapy among stroke survivors with right and left side of lesion was equally beneficial in both the sides of handedness and reported with improved motor functions regarding severity of stroke that impacted the effectiveness of CIMT therapy among stroke patients.

Discussion

The present study "Efficacy of modified constraint -induced movement therapy in improving upper extremity and hand functions in stroke patients" has been started with aim to find out the effectiveness of mCIMT in different severity of stroke.

Rinski Nijland et al. (2013) the therapy described in the mCIMT protocol is aimed at recovery in terms of neurological repair, by applying an impairment-focused intervention, while preventing the development of compensatory movement strategies. This approach is specified as the bottom-up approach in the EXPLICIT-stroke mCIMT protocol, referring to the hierarchical levels of the International Classification of Functioning, Disability and Health (ICF).[15]

Lepert J, Mitner et al. the foregoing evidence suggests that constraint induced therapy for chronic upper extremity paresis in adults after stroke would be associated with measurable neurophysiologic changes. Taub et al. were the first to demonstrate that CI therapy produces the large changes in brain organization and function, in laboratories he helped to set up changes that were correlative with the large changes in motor function that the therapy produced.[19]

Holloway M. 2003 et al. the functional changes in the brain that underlie the chronically maintained responses to training whether in healthy or in diseased adults are referred to by the term neuroplasticity (or neural plasticity or brain plasticity). It has generally been assumed that such changes involve physiological or microscopic structural alteration of neurons or neuronal circuits such as efficiency of synaptic connections or the growth of new synapses, without gross structural changes. However it would be incorrect to assume that such structural changes do not occur on macroscopic scale.[23]

The reason why mCIMT may also be used effectively in mild disability post-stroke cases.

Although the present study through its statistical analysis does not show much improvement in mild disability post-stroke cases which may be due to small sample size but on the basis of present study it can be assumed that if mCIMT showed improvement in moderate and severe cases then it may also show improvement in mild disability post-stroke as well. Future randomized control trials with more sample size (at least 30 patients) of mild disability post-stroke would be needed to get significant findings regarding effectiveness of mCIMT in mild post-stroke disability.

Limitations of present study are

1. The number of mild disability post-stroke cases was less.
2. The therapy sessions taken by patients before involving in CIMT therapy must be known.
3. Less overall duration of study.
4. Less sample size.
5. Limited parameters were taken.
6. No long-term follow up was taken after 3 weeks.
7. Measurements were taken manually which may produce human errors.

Future recommendations are

1. Increase overall duration of study at least 1 year.
2. Increase sample size at least 30 patients in

each category (mild, moderate and severe disability post-stroke)

3. Increase number of parameters, which can be: can add motor activity log or wolf motor scales and any functional scale for upper limb.
4. Follow ups should be taken to assess long-term effects.
5. Measurements can also incorporate any automatic mechanical device if possible to avoid human errors.

Conclusion

This study concluded that the patients from moderate to severe post-stroke disability improved better than the mild sever stroke patients so in this case the hypothesis can be rejected and it is accepted that CIMT can be used more beneficially in moderate and severe disability post-stroke than the mild post-stroke disability.

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[3] Fleischer W, Reimer K. Povidone-iodine antisepsis. State of the art. Dermatology 1997; 195 Suppl 2: 3–9.

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[9] National Statistics Online—Trends in suicide by method in England and Wales, 1979–2001. www.statistics.gov.uk/downloads/theme_health/HSQ 20.pdf (accessed Jan 24, 2005): 7–18. Only verified references against the original documents should be cited. Authors are responsible for the accuracy and completeness of their references and for correct text citation. The number of reference should be kept limited to 20 in case of major communications and 10 for short communications.

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