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Relationship of Aerobic Capacity and Rating of Perceived Exertion Among Male and Female Collegiate Athletes

Neeraj Kumar[1], Kirti Matta[2]

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Abstract

Context: Fitness is a very important part of our life and for fitness aerobic exercises are very common such as walking, dancing, cycling, and swimming. The aerobic capacity is also considered as cardiorespiratory endurance or VO2 max *Aims:* The relationship of anaerobic exercise with rate of perceived exertion has been previously documented in athletes, but there was a paucity of researches on the relationship of aerobic capacity with RPE among collegiate athletes in India. Therefore the purpose of this study was to find the relationship between aerobic capacity and rating of perceived exertion among male and female collegiate athletes. Furthermore, the present research work had also compared the rating of perceived exertion between males and females collegiate athletes *Settings and design:* A total of 100 participants with 50 male and 50 female between the age group of 18 and 25 with no history of recent injury or any disease and substance abuse, who volunteered to participate were selected for this study. *Methods and material:* The VO_2 max of all participants was measured by Rockport 1 mile walk test and then the rate of perceived exertion (RPE) was reported using Borg scale *Statistical analysis used:* Pearson's correlation were applied between VO_2 max and RPE *Results:* The mean VO_2 max and mean RPE of all participants were 58.22 (±6.79) (ml/kg/min) and 11.93 (±1.41) respectively *Conclusions:* The finding of the present study reveals that a person's rating of perceived exertion is not dependent on his or her maximal oxygen consumption or VO_2 max as there is no relation seen between VO_2 max and RPE of an individual

Keywords: Aerobic Capacity; VO_2 Max; Rockport 1 mile walk test; Rate of perceived exertion; Borg scale.

Introduction

Aerobic activity involves the activity with presence of oxygen. The common aerobic activities are walking, dancing, swimming, etc. that include continuous or rigorous respiration.[1] The best way to determine the aerobic capacity is calculating the VO_2 max. VO_2 max is also considered as cardio respiratory fitness, which is an important component of health-related physical fitness because its higher level enhances the ability to sustain moderate—to high-intensity exercise for prolonged periods of time, while lower levels elevate the risk of various disease conditions such as coronary artery disease, high blood pressure, stroke, obesity, and type 2 diabetes.[2] Cardiorespiratory endurance exercises help the body to become more efficient and better able to cope with physical challenges.[3,4] We can measure VO_2 max with different techniques either performed in the laboratory or in the field. Laboratory test are much accurate and have higher validity than the field test. But the tests performed for VO_2 max in the laboratory are much more expensive and cannot be performed for everyday practice. On the other hand, field test is much cheaper and can be performed on daily basis.[5,6]

Ratings of perceived exertion (or "effort and exertion") are important complements to

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physiological measurements. Of all single indicators of the degree of physical strain, perceived exertion is one of the most informative. It integrates a great amount of information, with cues from the peripheral muscles and joints, cardiovascular and respiratory functions, and the central nervous system.[7] Rating of perceived exertion (RPE) has been widely used for determining the intensity of resistance exercise because it is related to physiological markers of the stress response to exercise.[8] The guidelines of the American Heart Association (AHA) and the American College of Sports Medicine (ACSM) recommended monitoring cardiovascular responses to resistance exercise, including the heart rate (HR), blood pressure (BP), and perceived exertion, and using the RPE to set the intensity of strength training in both young and older adults.[9] However, physicians, physical therapists, and medical staff engaged in rehabilitation are largely unfamiliar with the use of the RPE for adjusting the intensity of resistance exercise.[10] The relationship of anaerobic exercise with rate of perceived exertion has been well documented in athletes. As well as the relationship of aerobic capacity with rate of perceived exertion has also been done previously among elite athletes in many countries[10], but there is a paucity of researches on the relationship of aerobic capacity with RPE among collegiate athletes in India. Therefore the purpose of this study is to find the relationship between aerobic capacity and rating of perceived exertion among the male and female collegiate athletes. Furthermore, the present research work will also compare the rating of perceived exertion between males and females collegiate athletes.

Materials and Methods

A total of 100 participants with 50 male and 50 female were randomly selected for this study. Initially, a total of 150 collegiate athletes (83 male and 67 female) between the age group of 18 and 25 with no history of recent injury or any disease and substance abuse, who volunteered to participate were selected for this study. All the participants first filled and submitted the written informed consent form and then they qualified PAR-Q for further participation. Out of these 150 participants only 100 (50 male and 50 female) were randomly selected with chit system for participation in this study.

The selected participants were asked to present on a prescribed date and time. Only ten people were asked to report at a particular date and time. The subjects were asked to report at least 30 min before the testing and asked not to ingest any food or caffeine within 3 hours of testing. The entire test was performed either in the morning or in the evening session. The environment temperature for the field test was maintained at 25 degrees Celsius. The height (cm), weight (kg) and resting heart rate (bpm) of all participants were recorded by using stadiometer, digital weighing machine and polar heart rate monitor respectively. Thereafter, the VO_2 max of all participants were measured by Rockport 1 mile walk test[11] and then the rate of perceived exertion was reported using Borg scale.[7]

Rockport 1 Mile Walk Test

This test is being used to measure VO_2 max.

Equipment required:

Smooth and level marked one -mile track

Stopwatch

Pulse oximeter

The participnats performed by walking as fast as possible for one mile. After walking one mile, immediately the pulse rate was measured.

Scoring: VO_2 max can be calculated by the formula-

Females- VO_2 max=139.168 - (0.388 x Age) - (0.077 x weight in lb.) – (3.265 x walk time in minutes) - (0.156 x heart rate).

Males- VO_2 max=139.168 - (0.388 x Age) - (0.077 x weight in lb.) - (3.265 x walk time in minutes) – (0.156 x heart rate)+6.318.

Rating of Perceived Exertion

The Borg scale is used for rating of perceived exertion. Perceived exertion is how hard the subject feel like his body is working. Borg scale was given to subject which is having ranges from 6 to 20, where 6 means "no exertion at all" and 20 means "maximal exertion".

Subject described level of exertion was noted.

Mean, SD, standard error and percentile were used to prepare summary statistics. Karl Pearson tests were used to determine the correlation between aerobic capacity and RPE and test were used to determine the mean differences of RPE between the both groups (males and females). The statistical analysis was done on SPSS v 16.00.

Results

A total of 100 individuals (50 males and 50 females) were participated in present study where mean

age 19.18 (±1.42) years, mean height 1.71 (±8.18) cm, mean weight 63.86 (±12.10) kg, mean VO_2 max 60.25 (±7. 73) ml/kg/min and mean RPE 11.72 (± 1.55) of males are shown in table 1.

Mean age 19.96 (±1.60) years, mean height 1.62 (±4.91) cm, mean weight 49.28 (±3.49) kg, mean VO_2 max 56.19 (±5. 00) ml/kg/min and mean RPE 12.14 (± 1.24) of females are shown in Table 2.

Mean VO_2 max 58.22 (±6.79) (ml/kg/min) and mean RPE 11.93 (±1.41) of all individuals are shown in Table 3.

Pearson's Correlation was applied between VO_2 max and RPE which is shown in Table 4. t test were applied between the both groups (male and female) to determine the mean difference of RPE which is shown in Table 5.

Discussion

The study was design to find the relationship between aerobic capacity and rating of perceived exertion among the male and female collegiate athletes and to compare the rating of perceived exertion between males and females collegiate athletes.

Statistical insignificant correlation (0.023) was found between aerobic capacity and RPE which leads to the null hypothesis of the study. It suggests that RPE has not any correlation with the VO_2 max which is quiet inconsistent with the findings of Chen et al. (2002)[12], and Habibi et al. (2014)[13], which suggests that RPE has highest correlation with the VO_2 max.

Table 1: Mean age, height, weight, VO_2 max and RPE of males

	N	Minimum	Maximum	Mean		Std. Deviation
	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic
Age	50	18.00	23.00	19.18	0.20	1.42
Height	50	157.50	190.50	1.71	1.15	8.18
Weight	50	45.00	98.00	63.86	1.71	12.10
VO_2max	50	43.21	71.00	60.25	1.09	7.73
RPE	50	9.00	14.00	11.72	0.21	1.55

Table 2: Mean age, height, weight, VO_2 max and RPE of females

	N	Minimum	Maximum	Mean		Std. Deviation
	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic
Age	50	18.00	24.00	19.96	0.22	1.60
Height	50	152.40	176.00	1.62	0.69	4.91
Weight	50	45.00	57.00	49.28	0.49	3.49
VO_2max	50	42.97	64.99	56.19	0.70	5.00
RPE	50	10.00	14.00	12.14	0.17	1.24

Table 3: Mean VO_2 max and RPE of all individuals

	Mean	Std. Deviation	N
VO_2max	58.22	6.79	100
RPE	11.93	1.41	100

Table 4: Correlation between VO_2 max and RPE.

		VO_2 max	RPE
VO_2 max	Pearson Correlation	1	023
	Sig. (2-tailed)		820
	N	100	100
RPE	Pearson Correlation	.023	1
	Sig. (2-tailed)	.820	
	N	100	100

Statistical no differences were found in Rate of perceived exertion between male and female collegiate athletes. It suggests that the exercise performed at same intensity will require same effort for both males and females as the intensity of exercise increases, level of exertion will increases at the same rate for both males and females. More will be the exercise intensity more will be the exertion for both male and female collegiate athletes. This finding is contradicting with the findings of Garcin et al. 2005[14], who showed that the female runners perceived exercise as being harder, felt that they could endure less and had higher heart rate values than males for a given absolute velocity ($km.h^{-1}$) whereas there were no difference between males and females for a given relative velocity

Table 5: *t* test for mean difference of RPE between both groups (males and females)

		t-test for Equality of Means						
-		-		-		-		95%
-		-		-		-		Confidence
-		-		-		-		Interval of the
-		T	df	Sig. (2-tailed)	Mean	Std. Error		Difference
-					Difference	Difference	Lower	Upper
RPE	Equal variances assumed	-1.492	98	0.139	-0.42000	0.28147	-0.97856	0.13856
Equal variances not assumed		-1.492	93.605	0.139	-0.42000	0.28147	-0.97889	0.13889

(%vVO_2 max). Moreover, the female runners perceived exercise as lighter and felt that they could endure more than the males for a given absolute time period (in s) whereas there was no difference between males and females for a given relative time period (%tlim), therefore they explained that the same exercise intensity or duration corresponded to higher %vVO_2 max and lower %tlim for the females compared to the males.

Conclusion

The finding of the present study reveals that a person's rating of perceived exertion is not dependent on his or her maximal oxygen consumption or VO_2 max as there is no relation seen between VO_2 max and RPE of an individual.

Also there is no difference found in rating of perceived exertion between males and females collegiate athletes. Therefore the aerobic exercise intensity on which athletes will perform, remain the same for both males and females.

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Original Article

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To Evaluate the Effects of Romson's Respirometer and Pursed Lip Breathing Exercise in Emphysema Patents

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Abstract

Objectives: Emphysema is a condition of lungs characterized by permanent dilatation of air spaces distal to terminal bronchioles with destruction of wall of this airways. Nearly associated with chronic bronchitis but different from it to a large extent. Emphysema is a common problem in both male and female population due to environmental and biological changes, ill habits, and so on. Effective treatment protocol includes only sedatives and bronchodilators but up to restrictions, thus most effective protocol is still lacking, this study is intended to find out an (effective treatment to normalize the V.C.) for treating emphysema in longterm or permanently through physiotherapy means both manually and mechanically: a comparative study. *Methods:* A sample of 30 subjects including both males and females of age group 30–55 years, as per inclusion and exclusion criteria, from SSSMC, Dr. K.K. B.M. Subharti Hospital, Dehradun and CSS Hospital, Meerut, were included in the study. The subjects were randomly divided into two groups. The subjects were assessed forced expiration by lungs in a particular time and measured for their forced expiratory volume of lungs, vital capacity and then asked to perform the Romson's Respirometer Exercise, Purse Lip Breathing Exercise and Chest Physiotherapy. The values of forced expiratory volume of lungs and vital capacity of the subjects were documented. *Results:* The data of both Groups (A and B), revealed the mean scores of forced expiratory volume and the vital capacity of lungs on 1st, 4th and 10th day. The mean scores of forced expiratory volume of lungs [F.E.V. 1] of Group A, was 1.5074 ± 0.5121, 1.8111 ± 0.5010 and 2.3740 ± 0.5151 and vital capacity of lungs [V.C.] was 3.0259 ± 0.3514, 3.1630 ± 0.3260 and 3.4259 ± 0.2930 on day 1st, 4th and 10th. The paired "t" test was applied to test the significant difference between 1st & 4 day and 4th & 10th day. A significant *p* - Value of < 0.001* was found when the comparison was done with the mean score of forced expiratory volume and the vital capacity of lungs on 4th and 10th day. Which shows the significant improvement in Emphysematous subjects. The mean scores of forced expiratory volume of lungs [F.E.V. 1] of Group B was 1.7037 ± 0.4792, 2.3674 ± 0.4236 and 2.9204 ± 0.3123 and vital capacity of lungs [V.C.] was 3.1296 ± 0.2524, 3.5481 ± 0.2376 and 4.0352 ± 0.2311 on day 1st , 4th and 10th. The paired "t" test was applied to test the significant difference between 1st & 4th day and 4th & 10th day. A significant *p* - Value of <0.001* was found when the comparison was done with the mean score of forced expiratory volume and the vital capacity of lungs on 4th and 10th day. Which shows the significant improvement in Emphysematous subjects. *Conclusions:* The results of this study indicate that there is significant improvement in the forced expiratory volume [F.E.V. 1] and vital capacity of lungs [V.C.] values in both the Groups - (A and B). Group - A receive chest physiotherapy (vibration+percussion+coughing) and Romson's respirometer while Group - B receive receives chest physiotherapy (vibration+percussion+coughing) and pursed lip breathing.

Keywords: Forced expiratory volume [F.E.V. 1]; Vital capacity [V.C.]; Romson's respirometer.

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Introduction

Emphysema is a condition of lungs characterized by Permanent dilatation of air spaces distal to terminal bronchioles with destruction of wall of this airways.[1] Nearly associated with chronic bronchitis but different from it to a large extent.

Anatomy of Lung

Respiratory system consists of air pathways and

Fig. 1: Emphysema view.

lungs— soft tissue organs divided into upper and lower tract[2].

- Upper respiratory tract— Nasal passage- Pharynx- Larynx – upper of Trachea comprises URT.
- Lower respiratory tract— Lower part of trachea- bronchial tree-alveoli.
- Nasal passage lies between cribriform plate of ethmoid bone. Air sinuses in maxillary, frontal, Ethmoidal and sphenoid bones open into nasal passages.
- Pharynx— Extends from nasal passage to Larynx and common pathway for air from nose and food from mouth.
- Larynx is between pharynx and trachea from level of 3rd cervical vertebra to lower border of 6th vertebra protected with epiglottis which prevents food and liquid from entry in respiratory passages vocal cord lies between epiglottis.
- Trachea lies between larynx and bifurcation of 2 main bronchi *(carina)***.** Extending from 6th cervical vertebra to 5th thoracic vertebra. Upper end lies just below skin. Its wall is made up of C – shaped cartilages and smooth muscles. Cartilage keeps the airway open, while muscular wall allows esophagus expansion for bolus of food.
- Oesophagus lies behind trachea.
- Bronchial Tree— Starts at bifurcations of trachea. Right bronchus more vertical.
- Wider and shorter than left. Each dividing into lobar bronchi which divide in segmental bronchi segmental bronchus lung tissue it supplies is Bronchopulmonary segment.
- Each bronchus continues to divide into branches of over-decreasing lumen until terminal bronchioles ever formed which do not have cartilage followed by respiratory bronchioles which leads to alveoli.
- Acinus is respiratory bronchioles, alveolar ducts and alveoli from one terminal bronchioles, alveolar ducts and alveoli from one terminal bronchioles.
- Gaseous exchange occurs across thin alveolar membrane.
- Alveolar membrane— Consists of epithelial lining elastic and collagen fibers and blood capillaries.
- Epithelial lining composed of basement membrane together with pneumocytes (lung cells) – Type I— across which diffusion takes place.
- Type II— reduces surface tension of alveolar walls lowering pressure within deflated alveoli and thus reduce collapse of alveoli. This reduced pressure expands the lungs well.
- Pores of Kohn— There are alveolar walls opening which allow collateral ventilation between neighboring alveoli of segments. These prevent segmental collapse and allow air to pass into alveoli so that secretions can be dislodged in bronchioles on forced expiation (force air).

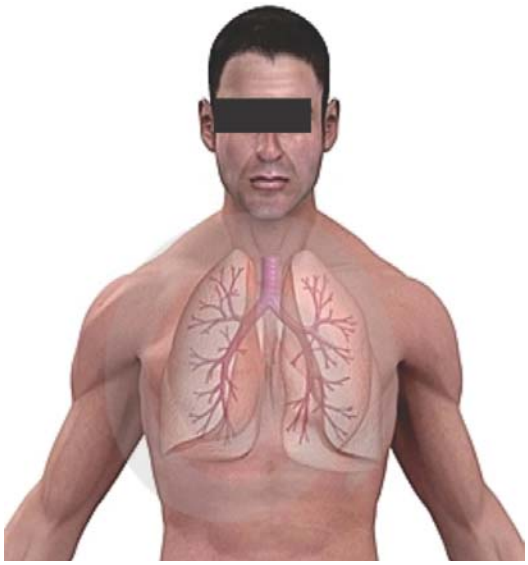
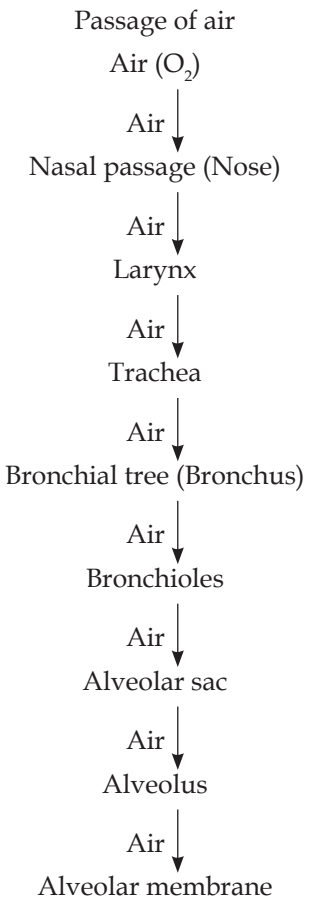


Fig. 2. Lungs in bronchioles in human body

Physiology of Respiration[3]



Objectives of the Study

Statement of study— Is Romson's respirometer and pursed lip breathing exercise increase the forced expiratory volume and vital capacity of Lungs to relive symptoms of Emphysema?

Hypothesis

Alternate hypothesis— There will be a significant difference in FEV_1 and vital capacity of lungs treating with Romson's respirometer and pursed lip breathing exercise to normalize symptom in Emphysematous subjects.

Null Hypothesis— There will not be a significant difference in FEV_1 and vital capacity of lungs treating with Romson's respirometer and pursed lip breathing exercise to normalize symptom in Emphysematous subjects.

Operational Definitions[3]

Emphysema

Emphysema is conditions in which forced expiratory volume of lung increase and thus more exertion is faced by lungs at level of terminal bronchioles with damage of wall of airways path.

Chest physiotherapy: Chest physiotherapy is the effective technique for treatment for various cardio - Pulmonary disease and thus clears lung airways and help in proper respiration; various techniques are indicated and included in chest physiotherapy.

Percussion: Technique designed to assess lungs density specifically air to solid in lungs. This technique is performed with cupped hands over the lung segment being drained. The therapist's cupped hands alternately strike the patient's chest wall in a rhythmic fashion.

Vibration: Airway clearance technique used in postural damage during expiration as the patient is deep breathing to move the secretion to larger airways Vibration is applied by placing both hands directly on skin and chest wall with one hand on top of other and gently compress & rapidly vibrate chest wall as patient breathes out.

Coughing: Patient is taught to take a deep breath in, tighten the abdominal muscles and cough. This ensures that the force of expired air is sufficient to clear secretions from the trachea and bronchi.

Respirometer: It is advice used to measure the rate of respiration of a living organism by measuring its rate of exchange of oxygen and CO_2.

***Pursed Lip Breathing*:** Gentle Pursed Lip Breathing with controlled expiration is useful procedure which has to be performed appropriately. It keeps the airways open and clear by creating back pressure. This technique is best experimented and then effectively applied for treatment of chronic obstructive pulmonary disease (COPD) dealing with multiple episodes of dyspnoea that is emphysema.

Effect

- Decreases Respiratory Rate
- Increases tidal volume
- Improves tolerance in reference to exercise and exertion.

Precaution

- Use of forced expiration during Pursed lip breathing must be avoided as it increase turbulence in the airways and cause further restriction of small bronchioles.

Forced Expiratory Volume (in second FEV1): This is obtained by measuring change in expired volume against time. When forced expiration is started from full inspiration flow rises rapidly to peak value because of progressive airway narrowing there is rapid fall of flow rate to zero when Residual volume is reached and no more air is expelled. Full volume expired in 4 sec in normal person is called-Forced expiratory volume and the volume expired in/sec it is FEV1 and is 75% of FEV.

Vital Capacity: Vital Capacity = Tidal volume + Inspiratory reserve volume + Expiratory reserve volume. Vital Capacity = 4500 ml.

Inspiratory Reserve volume: It is amount of air a person can breathe in after resting inspiration IRV = 3000 ml.

Expiratory Reserve volume: It is amount of air a person can exhale out after normal resting expiration ERV= 1000 ml.

Residual volume: Amount of air left in lungs after maximum expiation (≈ 1500 ml). R V increases with age and with restrictive and obstructive pulmonary disease.

Tidal volume: Amount of air exchanged during a relaxed inspiration followed by relaxed expiration.

Tidal Volume = 500 ml, 350 ml of Tidal Volume reaches alveoli and participates in gas exchange.

Materials and Methods

Design: This study is a comparative study design which intends to find out if there is any significant improvement in the forced expiratory volume [F.E.V. 1] and vital capacity of lungs [V.C.] in both the Groups - A and B, having physiotherapy treatment protocol, Group A receive chest physiotherapy (vibration + percussion + coughing) and Romson's respirometer use while Group B receive receives chest physiotherapy (vibration + percussion + coughing) and pursed lip breathing within the sample.

Sample: A sample of 30 subjects (26 males and 4 females) from SSSMC, Dr. K.K. B. M. Subharti Hospital, Dehradun, and CSS Hospital, Meerut, were included in the study. All the subjects were assessed for inclusion and exclusion criteria of the study.

Sample Selection: sample selection was done as per availability of Emphysema patient who were able to continue treatment regularly and properly with no surgical lesion. A baseline assessment of clinical and functional status was assessed before the subjects were assigned to do the task as per protocol.

Inclusion criteria

- Age 30 to 55 years.
- X-ray findings (Swelling over the affected bang, opaque shadow also seen as the condition become critical.
- X–rays findings.
- All Emphysematous patients who did not undergo any kind of thoracic surgery.
- Habits— Smoking (2 to 4 packets per day at least) Tobacco-chewing (last 10 years).
- Occupational hazards pollution.
- Patients administered with proper medications especially bronchodilators— Salbutamol.
- Spinal deformity—Kyphosis.

Exclusion criteria

- Patient underwent any other cardiopulmonary surgery.
- Any rib fracture.
- Asthma.
- T.B. chest.
- Pregnant women.

Instrumentation

Spirometer: It is an instrument used to assess forced expiration by lungs in a particular time and thus able to calculate the vital capacity, forced expiratory. Volume of lungs and hence FEV_1./V.C. ratio. With the help of spirometer lung function test can be done. Spirometer has been used for 1st, 4th &10th day of treatment to know the progression of FEV_1 & Vital Capacity in emphysematous patient. Now the Procedure is as follow without use of Salbutamol – bronchodilator with empty Stomach. Patient is made to sit comfortably in front of Spiro meter. Instructions have been given to have deep

Fig. 3-6. Various types of Spirometers used in Medical Laboratory

and complete exhalation through mouth piece. The graph has been shown on Monitor and can be taken by printer.

Romson's Respirometer: It is a respirometer first made by Romson's in year 2000, hence known as Romson's Respirometer. This instrument is a very simple instrument made up of fiber plastic, light weighted, easy to handle. It is latest, economical and simpler version of closed intermittent respirometer.

Components

- Three Transparent Broad tubes.
- Three Colorful light fiber balls- Red, Yellow, Blue of different weights.
- Three Blow Pipe.
- Mouth Piece.

Fig. 7. Romson's Respirometer

- Values at the base of each inverted in which Balls have been placed.

Principles of Respirometer

Maximum the forced vital capacity of lung, more will be the lift or raise of fiber colorful balls of respirometer. If more is FVC, more will be FEV_1, and Vital Capacity. Hence more FEV_1/ Vital Capacity ratio will nearly reaches to the normal value.

Group - A

- Breathing exercise to increase forced expiratory volume in one second and vital capacity with help of Romson's respirometer.
- Patient is asked to be in either high setting or long sitting with help of back support.
- Patient is now asked to sit in relaxed position without any chest exertion.
- Now patient is asked to blow into Romson's Respirometer through mouth piece, but before that patient is advised to have deep inspiration as much as he can.
- Immediately in first few days patient is able to lift the lightest (weight) ball-BLUE, this indicates the effective use of lungs to expire.
- Then he is asked to blow hard as much as he can and try to lift the YELLOW & the RED bolls which are of greater weight that BLUE ball.
- If the patient is able to lift the ball to the particular levels marked on the tubes of the respective balls their Vital capacity can be assessed in level of increase or decrease.
- Patient able to lift Blue and Yellow Balls to full and Red to certain level has been reported to gain normal level of vital capacity.

Duration: The treatment was given twice a day under the supervision of a Physiotherapist.

1st to 4th day, 8 to 10 times per session.

5th – 10th day, 18 – 20 times per session.

Both the Groups have given same few techniques.

1. Removal of secretion

- Postural drainage positions.
- Percussion– cupping.
- Vibration.
- Coughing restricted to 2-3 coughs.

2. Thoracic mobility exercise

- Free active spinal exercise.
- Free active exercise – setting, turning with loose arm swinging with relaxation of shoulder girdle.
- Postural awareness.

Re- Education of pursed lip Breathing – Group - B

- Made patient to be comfortable in high sitting and relax as much as possible.
- Patient is now asked to breathing slowly and deeply and inhale maximum air he can. And asked to purse his lips.
- Now therapist had placed his/her hands over the abdominal muscles to detect and avoid abdominal contractions.
- Now finally patient is asked to exhale out the air inspired through pursed lip mouth.
- The treatment is given under supervision twice a day with increase in repetition of PLB exercise

Fig. 8: 1st Day

Fig. 9: 10th Day

from 8 to 20 times as the day progresses.

- This technique is best for COPD, emphysema, asthma where repeated episodes of dyspnoea (Shortness of breath) with physical exertion or when contact with allergens seen.

Data Analysis – Data analysis was performed by using the SPSS version 10 for windows software descriptive statistics was used to analyze mean ± S.D. scores of forced expiratory volume and the vital capacity of lungs respectively on 1st , 4th and 10th day. The paired "t" test was used to find out the significant difference between forced expiratory volume and the vital capacity of lungs after 4th and 10th day in both the groups. In all cases a significance was set at $p < 0.001$. Further, one way ANOVA - F test revealed a high significant difference in the forced expiratory volume and the vital capacity of lungs in both groups which is $p < 0.001$, at different interval i.e. 4th and 10th day.

Results

Pre and post values of FEV1 and V.C. of subjects with chest physiotherapy and Romson's Respirometer (Group – A) were summarized in Table 1 and 2 and Fig. 10.

Table 1: showing mean, S.D. and difference between successive time points and probability of "t" (paired) values

S.No.	Days	F.E.V.1 (Mean ± S.D.)	Difference (Mean ± S.D.)	Probability of "t" (paired)	*p*- Value
1	1st	1.7037 ± 0.4792	--------	--------	--------
2	4th	2.3674 ± 0.4236	-0.6637 ± 0.2039	0.0000	$p < 0.001$*
3.	10th	2.9204 ± 0.3123	-0.5530 ± 0.2034	0.0000	$p < 0.001$*

***p* < 0.001 :** shows a high significant difference between different time points

Table 2: showing mean, S.D. and difference between successive time points and probability of "t" (paired) values

S.No.	Days	Vital Capacity (Mean ± S.D.)	Difference (Mean ± S.D.)	Probability of "t" (paired)	*p*- Value
1	1st	3.1296 ± 0.2524	--------	--------	--------
2	4th	3.5481 ± 0.2376	-0.4185 ± 0.1360	0.0000	$p < 0.001$*
3.	10th	4.0352 ± 0.2311	-0.4870 ± 0.1298	0.0000	$p < 0.001$*

***p* < 0.001 :** shows a high significant difference between different time points

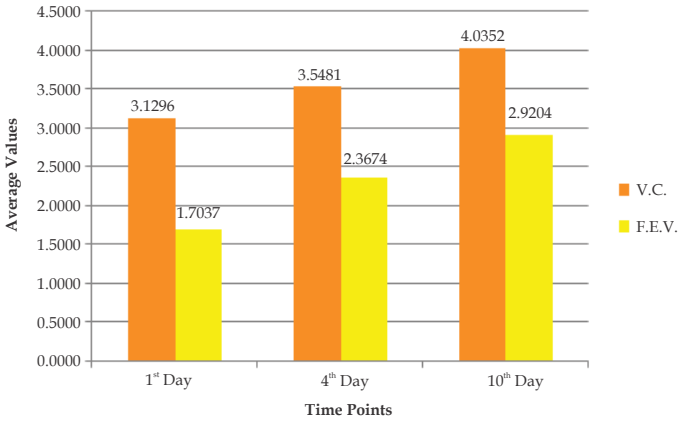


Fig. 10: The Bar Chart Showing the Mean Value of V.C. and F.E.V. at Different Time Points in Group B.

Table 3: showing mean, S.D. and difference between successive time points and probability of "t" (paired) values

S.No.	Days	F.E.V.1 (Mean ± S.D.)	Difference (Mean ± S.D.)	Probability of "t" (paired)	*p*- Value
1	1st	1.5074 ± 0.5121	--------	--------	--------
2	4th	1.8111 ± 0.5010	-0.3037 ± 0.1344	0.0000	$p < 0.001$*
3.	10th	2.374 ± 0.5151	-0.4963 ± 0.2696	0.0000	$p < 0.001$*

***p* < 0.001 :** shows a high significant difference between different time points

Table 4: showing mean, s.d. and difference between successive time points and probability of "t" (paired) values:

S.No.	Days	Vital Capacity (Mean ± S.D.)	Difference (Mean ± S.D.)	Probability of "t" (paired)	*p*- Value
1	1st	3.0259 ± 0.3514	--------	--------	--------
2	4th	3.1630 ± 0.3260	-0.1370 ± 0.1006	0.0000	$p < 0.001$*
3.	10th	3.4259 ± 0.2930	-0.2630 ± 0.1884	0.0000	$p < 0.001$*

* ***p* < 0.001 :** shows a high significant difference between different time points.

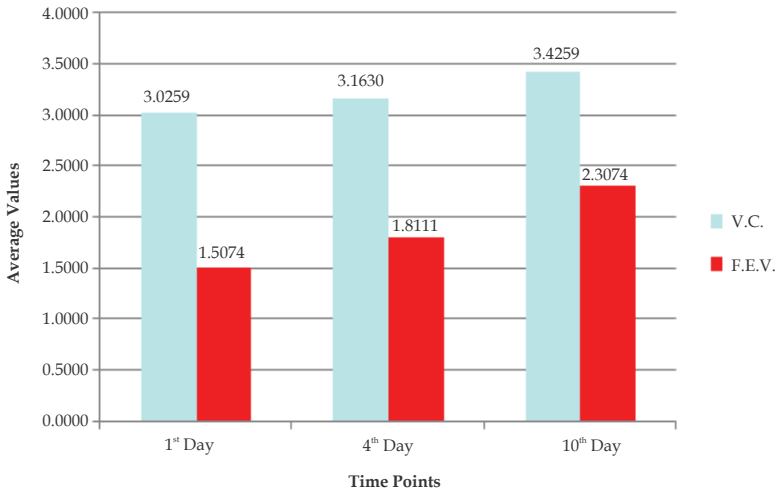


Fig. 11: The Bar Chart Showing the Mean Value of V.C. and F.E.V. at Different Time Points in Group A.

The comparison of mean value of FEV1 on 1st, 4th and 10th day is 1.7037 ± 0.4792, 2.3674 ± 0.4236 and 2.9204 ± 0.3123 with significant $p < 0.001$*, which shows improvement in FEV1 value.

The comparison has been made on 1st, 4th and 10th day of session in which mean value of VC is from 3.1296 ± 0.2524, 3.5481 ± 0.2376 and 4.0352 ± 0.2311 with significant *p* value < 0.001* which shows significant improvement in emphysematous patient.

The Figure 10 shows significant improvement in VC and FEV1 after 10th day of treatment which is approximately 70.46% as compared to its normal value 75%.

Pre and post values of FEV1 and VC of subjects with chest physiotherapy and Pursed Lip Breathing (Group - B) were summarized in Table 3 and 4 and Figure 11.

The comparison of mean value of FEV1 on 1st, 4th and 10th day is 1.5074 ± 0.5121, 1.8111 ± 0.5010 and 2.374 ± 0.5151 with significant $p < 0.001$*, which shows improvement in FEV1 value.

The comparison has been made on 1st, 4th and 10th day of session in which mean value of VC is from 3.0259 ± 0.3514, 3.1630 ± 0.3260 and 3.4259 ± 0.2930 with significant *p* value < 0.001* which shows significant improvement in emphysematous patient.

The Figure 11 shows significant improvement in VC and FEV1 after 10th day of treatment.

After comparison of both the groups, Group A has shown near normal values approx. 70.46% which is highly significant than Group B. Hence the study resulted that using Romson's respirometer along with chest physiotherapy for 10 days treatment, reduces the symptoms and improves the lung capacity.

Discussion

In this study 30 subjects without any previous history of any lung or pulmonary infection or surgery, with a age group of 30–55 years were selected. For better comparative analysis of the treatment technique the subjects were divided into two groups, Group A and B, 15 in each. Subject of both the groups were monitored for FEV1 and V.C. with help of Respirometer and chest deformity and level of chest expansion with help of x-ray findings.

For Group - A subjects, the treatment protocol includes chest physiotherapy (vibration

+ percussion + coughing) with Romson's Respirometer and for Group - B subjects, the treatment protocol includes chest physiotherapy (vibration + percussion + coughing) with pursed lip breathing exercise. *t* - Test has been performed to analyze the comparative study of the treatment of Emphysema.

The results supported the incomplete findings and research of MC Threat and O.K. Ethereal et al. in 2008, and clarify the result that in case of Emphysema both Romson's Respirometer and Purse Lip Breathing with other technique of chest physiotherapy help to cure the problem. But it is now cleared from the comparative study done with the help of Romson's respirometer the prognosis rate increases to about approx. 70.46% than that with Pursed Lip breathing exercise as both FEV_1 and V.C increases to maximum extent.

Future Research

It would be more challenging if the study will be done for longer duration with Romson's respirometer. If the number of subjects will be more than the better conclusion can be made regarding the affection of treatment protocol.

For better results advance regime of Breathing exercise can be included in the study.

Study could be done in early age groups depending on the environmental and habitual facts.

Conclusion

The results of this study indicates that there is significant improvement in the forced expiratory volume [F.E.V.1] and vital capacity of lungs [V.C.] values in both the Groups - A and B. Group - A receive chest physiotherapy (vibration+percussion+coughing) and Romson's respirometer while Group - B receive receives chest physiotherapy (vibration+percussion+coughing) and pursed lip breathing.

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Original Article

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Effect of Neck Posture on Abdominal Muscles Strength among University Students

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Abstract

Introduction & Background: The university students spend their quarter (6 hours) of a day in a classroom include hours of a day in sitting position. Thus it become very hard to maintain a posture erect throughout the day this leads to stress in the ligamentous structures and may produce pain. The aim of this study was to investigate the influence of neck posture on abdominal muscle strength among university students. *Method:* This study recruited 50 young adults and was divided into 2 groups. Group 1 included student with forward head posture and group 2 included student with normal neck posture. After meeting the inclusion criteria, neck posture was assessed using Ruler method. Then timed sit up and DLLT were also added to check the upper abdominal strength and the lower abdominal strength simultaneously. *Results:* The comparison was done in between Tragus and wall distance (normal-cued) and timed sit up test that shows significant result. Again, the correlation was found in between Tragus to wall distance (normal –cued) and double leg lowering test and this shows non- significant result in both the groups. *Conclusion:* It is concluded that there is a significant relationship between neck posture and upper abdominal strength and there is no relation between neck posture and lower abdominal strength.

Keywords: Neck posture, Normal neck posture, Forward head posture, Abdominal muscle strength

Introduction

The university students spend their quarter (6 hours) of a day in a classroom include hours of a day in sitting position.[1] Thus it become very hard to maintain a posture erect throughout the day this leads to stress in the ligamentous structures and may produce pain.[2] Correct posture is affected by several factors such as height of desk and chair, environmental factors such as room temperature and lighting, and other anatomical and anthropometric characteristics. But the major factor includes a time spent in sitting position as most of the academics are done in this position, this will lead to incorrect posture such as slouch posture.[3]

Posture can be defined as maintaining a position of different joint segments of the body in relative to other segments at a particular time.[4] Ideal posture is a posture in which the body segments are aligned vertically along with the LOG passed through all joint axes. In case of head, this LOG passes slightly anterior to transverse axis and incase of cervical, it lies posterior to the vertebrae.[5] Thus, correct posture is defined as maintaining such position in which minimum stress is induced on each joint which can be highly influenced by intrinsic and extrinsic factors. Intrinsic factors such as ligaments, muscles and other soft tissues and extrinsic factors such as mobile or laptop usage etc.[6]

When a posture is maintained against gravity by enabling the balance is known as postural control. It helps to stabilize the posture during voluntary movements and maintain a balance after

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disturbances. This allows a frame of proprioception i.e. Position of joint sense when placed in a position.[7]

Correct sitting posture is defined as when feet is flat on the ground, head and upper body is straight with shoulder by the side and knee bend to 90° to maintain a normal/neutral curvature of the spine.[8] This can be achieved by proper ergonomically made desk and chair which helps to maintain a proper posture and prevent musculoskeletal problems.[9]

Due to decrease in physical activity and wrong posture, muscular and skeletal structures adopt an incorrect posture. Forward head posture occurred if there is an anterior translation of head deviation from normal posture.[5] This occurs due to the increase usage of media devices such as smart phones and computer progressively.[10]

Prolonged use of these devices results in incorrect posture. Incorrect posture leads to forward head posture that increases the upper cervical lordosis and flatten the lower cervical.[10] Change in head balance causes the imbalance of muscle, increase in tension of neck extensors and deep cervical flexors weakness. Due to forward head posture leads to weakening of SCM and scalene anterior but lengthen the levator scapulae, semispinalis capitis and pectoralis major. This will leads to abnormal proprioception and kinesthetic sensation.[11]

This incorrect posture has an negative effect on posture such as tendon and muscle imbalance limits the movements of joints and causes pain that shows an insufficient balance of structures.[12] Therefore, it is suggested that maintaining a good posture helps to support the structure, allow a complete movements on a joint without having any pain.[13]

The prevalence of anterior head translation was found to be 37% out of which 58% were female and 42% were male and according to the study done in 2018 have been show that there was only 35% people heard about the forward head posture and out of which 21% individual actually know about the preventive measures.[14]

It is shown that students spend their maximum time in sitting position. Mckinley also claimed that sitting in slouched posture is the most frequent posture. If it becomes habit at an early age, it will lead to imbalance of muscle, tendon, joints, bones and discs which leads to upper cervical spine extension and lower cervical spine flexion along with there is increase in compressive loading on soft tissue structure around the cervico-thoracic region and it also cause the abdomen to protrude out due to the weakness of muscle and can also cause lower back ache.[15]

Szeto[16] et al. and Moore[17] stated that keeping up the head forward for a prolonged period of time may cause musculoskeletal musculoskeletal problems, example, 'upper crossed disorder', which includes having decreased lordosis of the lower cervical, related to kyphosis of the upper thoracic vertebrae. Burgess-Limerick et al. recommended that such posture causes shortening of muscle fibers around the atlantooccipitalis articulation and overstretching of muscles around joints and causes chronic neck pain.

Abdominal wall is made up of 4 muscles rectus abdominis, internal oblique, external oblique and transverse abdominis. Rectus abdominis is responsible for flexion of the trunk, obliques work while rotation of trunk, internal oblique rotates the trunk on the same side and external oblique rotates the trunk on opposite side and transverse abdominis work along with pelvic floor muscles support the pelvis.[18]

For trunk stabilization, abdominal muscles play a very important role and if it becomes weak, trunk stability decreases and low back occurs and when imbalance of trunk including abdominal muscle leads to abnormal posture.[19]

There have been studies showing effect of neck exercises on activation of core stabilizing muscles. Movement of neck provides exertional force onto the spine where magnitude of reactive force is directly proportional to the inertia of cervical movement. Restriction in activation of SCM appears to affect the activation of abdominal muscles.[20,21]

Strong abdominal muscles help in stabilizing the trunk and lessen lumbar spine stress. Abdominal muscles are usually activated by active flexion of the trunk through a concentric muscle contraction.[22]

According to the study done by jung Jh et al. in 2012 showed that forward head posture affect the neck muscles. Thus, posture is treated directly with neck management or indirectly by the treatment of neck posture including the treatment of the pelvic posture. Incorrect posture such as forward head posture, not only caused neck pain but also change spinal alignment and prevent efficient muscle recruitment that leads to the weakening of abdominal muscles. Murphy et al. suggested that the neck muscles are connected to the trunk structurally through fascia thus, trunk posture should be considered if neck problem should be considered.[23]

A recent study showed that change in the position of resting scapula resulting in change in the position of the position of cervical and thoracic

spine. During the elevation of arm, scapula has been found anteriorly tilted, downward rotated, and protracted in individual with FHP. It is due to the weakening of serratus anterior. This increase forward angulation leads to increase in thoracic curvature.[24]

Need of the Study: In recent few years, there is a sudden rise in use of electronic devices and it has tremendous effect on people around the world. Previous studies showed that prolonged use of these devices leads to change in neck posture. However, there is no specific study that evaluates the effect of neck posture on abdominal muscle strength. However this study aims to see Effect of neck posture on abdominal muscle strength among university students.

Aim: To study the effect of neck posture on abdominal muscle strength among university students

Hypothesis: the study was hypothesized to show association between neck posture and abdominal strength..

Materials and Methods

- ***Study Design:*** Correlational Study Design.
- ***Study Population & Sample:*** University student of age between 18-25 years.
- ***Place of Data Collection:*** Amity University, Noida.
- ***Sampling Method:*** Simple Random Sampling.
- ***Sample Size:*** 50
- ***Selection Criteria:***
  - Inclusion Criteria:
    - Subjects of age between 18-25 yrs
    - 50 healthy subjects (both male and female).
  - Exclusion Criteria:
    - History of any spinal pathologies such as stenosis.
    - History of any abdomen surgery in last 2 years.
    - Any cardiovascular disease
    - Psychological disorders
    - Scoliosis
- ***Independent Variable:*** Neck Posture.
- ***Dependent Variable:*** Abdominal Muscle Strength.
- ***Instruments Required:*** Ruler, Sphygmo manometer, Stop watch and Yoga mat.
- ***Group Allocation:*** It is divided into 2 groups with 20 participants each.
  - Group A comprises of patient with normal neck posture.
  - Group B comprises of patient with forward head posture.
- ***Procedure:*** Those who fulfill the inclusion criteria and willing to give consent form were selected. After meeting the inclusion criteria, neck posture was assessed by using *Ruler method*.[25] In this, tragus to wall distance was measured in normal and cued posture to check whether they have forward head posture or not.

Fig 1: Tragus to wall distance in normal posture

Fig 2: Tragus to wall distance in cued posture

Then abdominal strength was checked by using timed sit-up test and double leg lowering test.

Method to measure abdominal strength:

Timed sit-up test[26]*:* this test was performed in hook-lying position with arms across the chest. The subject was asked to do full sit-up as much as he couldl do in 1 minute.

Fig 3: Timed Situp Test (Ending Position)

Fig 4: DLLT (Step-3)

Double leg lowering test[27]*:* this test was performed in supine lying with their hip flexed to 90. BP cuff was placed under the L4-L5 region. The patient slowly lower the leg and maintain abdominal contraction. At the point where 40 mmhg pressure is dropped the range of hip was noted and compared with the grading table.

Results

Table 1: Table showing demographical details

Demographical Data (N= 50; M = 5, F = 45)	Mean ± SD
Age (years)	21.34 ± 0.94
BMI (kg/m^2)	21.59 ± 3.91

Table 2: Correlation between FHP and abdominal strength

S. No.	Variables	Mean ± SD	R Value
1.	Tragus to wall distance (normal-cued)	2.34 ± 0.57	0.32*
	Timed situp Test	15.56 ± 4.07	
2.	Tragus to wall distance (normal-cued)	2.34 ± 0.56	0.16
	Double leg lowering test	56.08 ± 11.92	

*Significant at $p < 0.05$

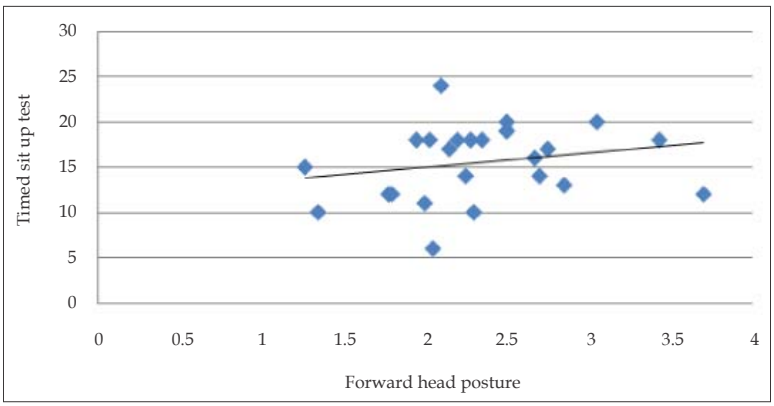

Fig 5: Correlation between FHP and TST

Table 2 shows the comparison in symptomatic individuals. The comparison was done in between Tragus and wall distance (normal-cued) and timed sit up test where mean was 2.34 ± 0.57 and 15.56 ± 4.07 respectively. The R value calculated was 0.22 that shows significant result at the level of 0.05. Again, the correlation was found in between Tragus to wall distance (normal –cued) and double leg lowering test. The R value was 0.16. and this shows non-significant result at the value of less than 0.05.

Table 3 shows the comparison in non-symptomatic individuals. The comparison was done in between Tragus and wall distance (normal-cued) and timed sit up test where mean was 1.46 ± 0.57 and 27.96 ± 3.64 respectively. The R value calculated was 0.324 that shows significant result at the level of less than 0.05. Again, the correlation was found in between Tragus to wall distance (normal –cued) and double leg lowering test. The R value was 0.16. and this shows non- significant result at the value of less than 0.016.

Discussion

The purpose of the study was to find out the effect of neck posture on abdominal muscle strength among university students. The study included two groups. Group A included .students with normal neck posture and group B included students with forward head posture. The subjects were of the age group between 18-25 years. Each subject was assessed according to the inclusion and exclusion criteria.

This study measured abdominal muscle strength through timed sit up test and double leg lowering test and neck posture through ruler measurement to determine the difference in abdominal muscle activities according to changes in the neck posture.

In this study, it is found that there is a significant relation between the neck posture and the timed sit up test that is relation between the two was significant in both the groups which suggested a relationship between the two variables. On the other hand, there was an insignificant relation

Table 3: Correlation between normal neck posture and abdominal strength

S. No.	Variables	Mean ± SD	R Value
1.	Tragus to wall distance (normal-cued)	1.46 ± 0.57	0.324*
	Timed situp Test	27.96 ± 3.64	
2.	Tragus to wall distance (normal-cued)	1.46 ± 0.57	0.016
	Double leg lowering test	48.70 ± 12.55	

*Significant at $p < 0.05$

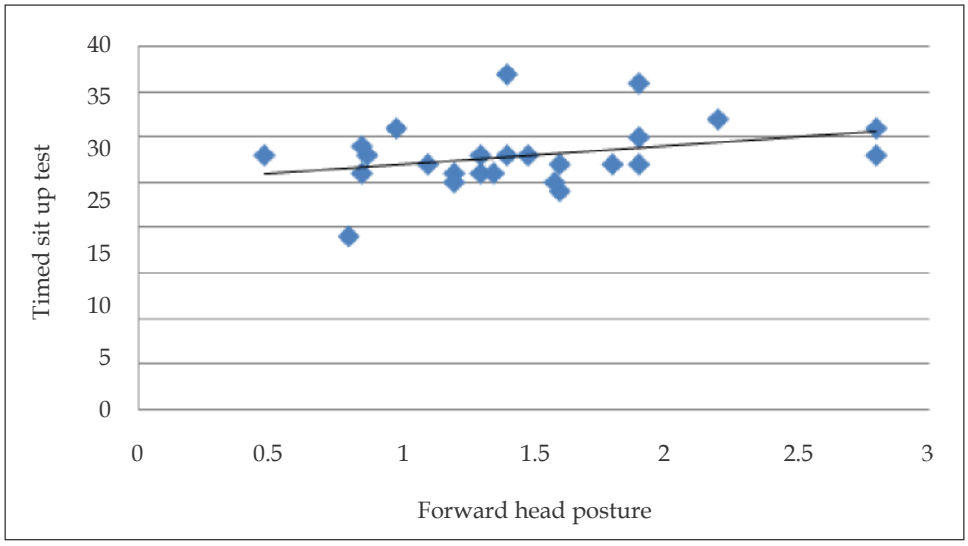

Fig 6: Correlation between normal neck posture and TST

between neck posture and double legged lowering test that meant that there was no relation between the two variables in both the groups.

In a Study Jung Gil Su et al. showed that there was a relationship between the neck posture and the upper abdominals as the subjects with normal neck posture were able to perform timed situp test up to the average numbers in one minute. On the other hand, subject with forward head posture found it difficult and were not able to perform test up to the average value. Fella et al. also suggested that If neck exercises were performed in good lumbar posture that help to recruitment the neck muscles. In the same context, subject with good neck posture can affect lumbar alignment, which leads to abdominal muscle recruitment as they are responsible for lumbar stabilization. This indicates that all structure is interconnected to each other by joints or muscles. A change in one region of the body can affect the other region. So, it can be said that incorrect postures, such as forward head posture not only causes neck pain but also leads to change in spinal alignment and prevents efficient muscle recruitment that leads to the weakening of abdominal muscles.

However in case of neck posture and lower abdominal strength, it was found that there was no relationship between them as the subjects with normal neck posture and subject with forward head posture were able to perform double legged lowering test below 45° without any difficulty. According to Alxex at. et al. this might be due to hamstring tightness which was not chosen as a parameter. it was found that subject with hamstring tightness found difficulty while doing DLLT. They were not able to take legs to optimal level (90°). Thus, we had to continue the test from the available range. So, hamstring tightness must be included for further studies.

Clinical Implication of the Study

- Mobile Phones must not be used in neck bend; it should be kept at eye level.
- One should avoid slouch sitting.
- After every 45 to 50 min, one should change his/her inertial position.
- One should do exercises on daily basis.
- One should include crunches exercise in order to strengthen abdominal muscle.

Limitation of the Study

1. Small number of subjects.
2. The study was done on young adults only.

Future Scope of the Study

In future we have to try for finding relation between neck posture and lower back muscles.This study was done for only the forward posture but In future, we have to try to find out relationship between sway posture and abdominal muscles and this study can be extended to different age groups also.

Conclusion

This study was done to find out the relation between the neck posture and abdominal strength. So, two groups are made one with normal neck posture and other with FHP and their upper abdominal strength and lower abdominal strength is checked. Thus, with this study it is concluded that there is a significant relationship between neck posture and upper abdominal strength and there is no relation between neck posture and lower abdominal strength.

Conflicts of Interest: Authors report no conflict of interest and no disclosures.

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Compare The Effectiveness of Modified Constraint Induced Movement Therapy (mCIMT) and Mirror Therapy (MT) in Stroke Patients Based on Severity

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Abstract

Introduction: Stork is a global epidemic and an important cause of morbidity and mortality. As defined by WHO stroke is "rapidly developing clinical sings of focal (or global) disturbance of cerebral function, with symptoms lasting 24 hours or longer or leading to death, no apparent cause other that of vascular origin."[1] 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 tumour.[2,3] *Aim of the Study:* Compare the effectiveness of mCIMT and Mirror Therapy (MT) on upper extremity and hand functions among individuals with stroke based on the severity as assessed by the UEFM and ARAT. *Methods:* It is an experimental study design. Sample of convenience of twelve (12) stroke subjects are selected and divided into group A and group B. Group A received Modified Constraint Induced Movement Therapy (mCIMT) and group B received Mirror Therapy in upper extremity and hand functions in stroke patients. *Discussion:* In our study Modified Constraint Induced Movement Therapy (mCIMT) is more effective than Mirror Therapy (MT) in upper extremity and hand functions in stroke patients. Joachim Liepert et al., 2000. The mechanism of this massive cortical reorganization probably reflects eitheran 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 infracted hemisphere, or both.[26] *Conclusion:* This study concluded that Modified Constraint Induced Movement Therapy (mCIMT) is more effective than Mirror Therapy (MT) in upper extremity and hand functions in stroke patients. In this study the patients from mild to moderate and moderate to severe post stroke disability improved better in stroke patients. So hypothesis is accepted that mCIMT is more effective than Mirror Therapy (MT) in from mild to moderate and moderate to severe post stroke disability.

Keywords: mCIMT, Mirror therapy (MT) UEFM, ARAT. (VAS) visual analog scale, Fugl-Meyer Assessment scale and Action research arm test (ARAT) scores

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Introduction

Stork is a global epidemic and an important cause of morbidity and mortality. As defined by WHO stroke is "rapidly developing clinical sings of focal (or global) disturbance of cerebral function, with symptoms lasting 24 hours or longer or leading to death, no apparent cause other that of vascular origin."[1]

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.[2,3]

Stroke is the leading cause of long term disability among adults and hemiparesis is the most common impairment after stroke. Longitudinal studies of recovery after stroke suggest that on 50% of patients with significant arm paresis recover useful function. 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). 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).[5]

Approximately 20 million people each year will suffer from stroke and of these 5 million will not survive (Dalal 2007).[6] In developed countries, stroke is the first leading cause for disability, second leading cause of dementia and third leading cause of death.

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).[7]

Stroke is a life-changing event that affects not only the person who may be disabled, but their family and caregivers. Utility analyses show that a major stroke is viewed by more than half of those at risk as being worse than death (AHA 2006). Organized provision 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).[8]

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).[9]

Patient diagnosed with stroke often present with a combination of muscle weakness or muscle imbalance, decreased postural control, muscle spasticity, poor voluntary control, and body malalignment.[10]

In many patients with severe stroke, the affected upper limb (UL) never becomes useful, even after therapy. Only about 15% of those suffering from severe stroke recover hand functions.[11.]

The paretic upper limb is a common and undesirable consequence of stroke that increases activity limitation. It has been reported that up to 85% of stroke survivors experience hemiparesis and that 55% to 75% of stroke survivors have continued to have limitations in upper extremity functioning. In many patients with severe stroke, the affected upper limp (UL) never becomes useful, even after therapy. Only about 15 percent of those suffering from severe stroke recover hand function.[12 &13]

Constraint-induced movement therapy is a form of rehabilitation therapy that improves upper extremity function in strokeand other Central nervous system damage victims by increasing the use of their affected upper limb.[14]

CIMT (constraint induced movement therapy) by Taub, CIMT is a neurorehabilitation approach developed by behavioral neuroscientist Dr. Edward Taub and colleagues.[15]

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 deferent 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.[16]

When a stroke patient puts his weakened hand in the mirror box and moves his strong hand, the mirror box gives the illusion movements occurring in the hand affected by the stroke. This is done through activation of mirror neurons in the premotor cortex of the brain. In essence the mirror tricks the mind and weak hand into working better.[17]

Review of Literature

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 3rd 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.[1]

Shama Praveen, (2018) et al. conducted study onMirror 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.[4]

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."[5]

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.[23]

Yue X Shi er 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.[24]

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.[26]

Kristina Laaksonen (2012) concluded that MEG (magnetoencephalography) provides a suitable tool to study cortical neuro-physiological 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.[27]

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.[28]

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.[29]

Holm Thieme et al. (2013) did study on "Mirror therapy for improving motor function after stroke". Concluded that the MT could be applied at least as an additional intervention in the rehabilitation of patients after stroke.[30]

Archana Chauhan, (2018) This study concluded that there is significant improvement in functional activity of upper extremity in hemiplegic subjects after kinesiotaping. On comparing group A and group B the results were significant in group A and there is not significant improvement was seen in group B when some components of taping were missed.[31]

Niranjan Kumar, (2019) 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.[32]

Materials and Methods

A twelve (12) patents were selected for this study on the basis of randomization selection criteria. The study was doneat Neuro-Medicine Department, Arunabh NGO, Indore were diagnosed with Stroke/Cerebrovascular Accident (CVA) were chosen purposively selected as subjects for the study. 12 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 constraint induced movement (CIMT) technique 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 compare the effectiveness of and Mirror Therapy (MT) and the significance of mean differences

between pre-intervention and after intervention 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 months 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 (MMSE) Mini Mental Status Examination, 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 & extensors, wrist flexors & extensors, finger flexors & 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 (VAS) visual analog scale, 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- (UEFM) Upper extremity Fugl-Meyer and (ARAT) Action research arm test & Goniometer.

Procedure

Patient's sensory integrity was assessed with touch of cotton ball, prick & hot and cold test tubes on dorsum of hand and fore arm. There after the ability of wrist to extend at least up to 20 degree 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 mid line of ulna and distal arm lateral to mid line of 5th metacarpal bone.

In ARAT patients were given a series of objects in hand to assess hand abilities such as grasp, grip, pinch & gross movements. The patients were given 3 or 0 scores for each the correct or incorrect action performed during test. This test had four sub tests 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 the final 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).

There after mCIMT & Mirror Therapy (MT) 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 news paper.

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 week days.

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

Fig. 1: mCIMT protocol, repetitive training practice

working day.

In line with the original mCIMT protocol, repetitive training consists of 'shaping' and 'task practice'. (Rinske Nijland et al., 2012) (Fig. 1).

(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. 2).

Patients are given homework, and patients also have to keep a diary, to encourage them to take the mitt practice seriously. The patient 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

Mirror Therapy (MT)

In Mirror Therapy (MT) the patient is standing close

Fig. 2: Constraining training session of affected hand

Fig. 3a & b: Showing patient doing exercises in mirror

to a mirror was placed side of the patient (affected side) as shown in Figure 3 (a,b). The involved hand is placed behind the mirror. The practice consisted of non-paretic side wrist and finger flexion and extension movements while patient looked into the mirror watching the image of their non-involved hand, thus seeing the reflection of the hand movements projected over the involved hand. Patients could only see the non-involved hand in the mirror; otherwise the noninvolved hand is hidden from sight. During the session the patient is asked to try to do the same movements with the paretic hand while he is moving the non-paretic hand. The subjects performed the exercises for 30 minutes for mirror therapy for 6 days per week for a consecutive 4 weeks.

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 compare the effectiveness between mCIMT therapy and Mirror Therapy (MT) of upper extremities Fugl-Meyr and ARAT at pre-intervention 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 probability value, $p > 0.05$ was considered as statistically insignificant .

Table 1: The UEFM assessment of Constraint Induced Movement Therapy (CIMT) 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*

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 & Figure 4 projected the stroke patients had improved functions after administration of Constraint Induced Movement Therapy (CIMT) 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 Constraint Induced Movement Therapy (CIMT) most of the subjects

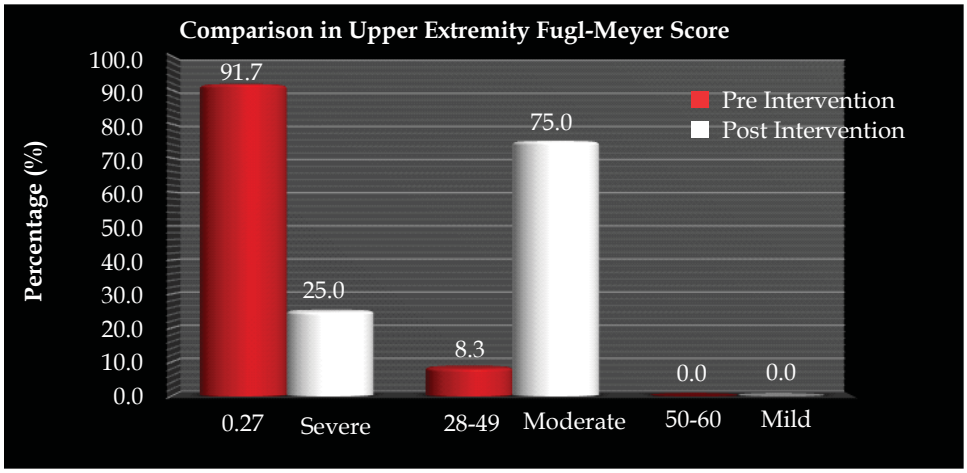

Fig. 4: Multiple Bar diagram depicting the comparison in Upper Extremity Fugl-Meyer score between Pre and Post Interventions of Constraint Induced Movement Therapy (CIMT) among stroke patients

found with reduction in severity of stroke as three-fourth 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 Constraint Induced Movement Therapy (CIMT) among stroke patients.

Table 2: The UEFM assessment of Mirror Therapy (MT) at pre and post interventions

Upper extremity Fugl-Meyer score	Pre Intervention		Post Intervention	
	N	%	N	%
0-27 (Severe)	11	85.7	3	21.0
28-49 (Moderate)	1	14.3	9	79.0
50-60 (Mild)	0	0.0	0	0.0
Total	12	100.0	12	100.0

Table 2 & Figure 5 projected the stroke patients had improved functions after administration of Mirror Therapy (MT) as the severity of stroke had reduced, easily seen by the increased score obtained after intervention.

Major proportion of sub jects 11 (79.7%) found with severe stroke while only 1 (14.3%) patient had moderate type severity of stroke at pre intervention stage.

After administration of Mirror Therapy (MT) therapy most of the subjects found with reduction in severity of stroke as three-fourth 9 (79.0%) subjects detected with moderate type of stroke while rest one-fourth 9 (21.0%) 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 Mirror Therapy (MT) among stroke patients.

Table 3 and Figure 6 focused on the percentage (%) of test allocated to stroke patients had improved functions after administration of Constraint Induced Movement Therapy (CIMT) 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-third 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

Table 3: The ARAT Percentage of Constraint Induced Movement Therapy (CIMT) at pre intervention and post intervention

Action Research (%) Arm Test Score	Pre Intervention		Post Intervention	
	N	%	N	%
(Mild) 0-30	2	16.7	4	33.3
(Moderate) 30-60	5	41.7	8	66.7
(Severe) 60-90	5	41.7	0	0.0
Total	12	100.0	12	100.0

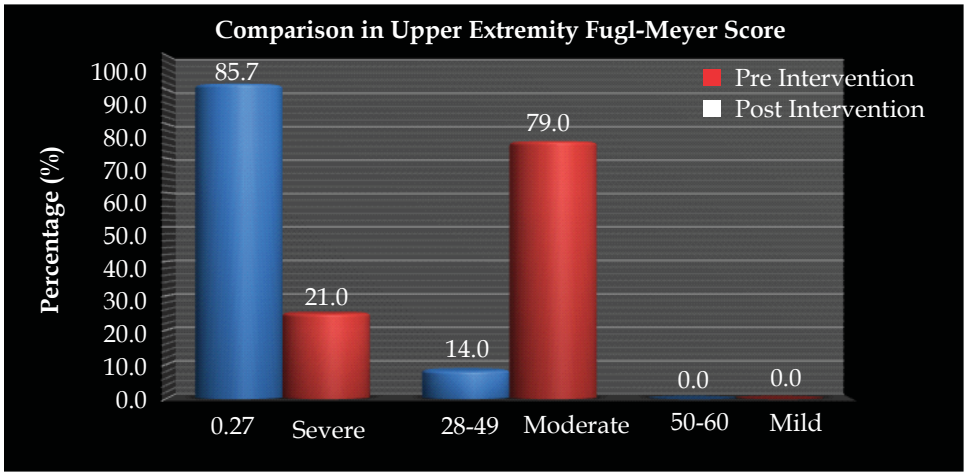

Fig. 5: Multiple Bar diagram depicting the comparison in Upper Extremity Fugl-Meyer score between Pre and Post Interventions Mirror Therapy (MT) among stroke patients

arm based on severity of stroke that impacted the effectiveness of CIMT therapy among stroke patients.

Table 4: The ARAT Percentage of Mirror Therapy (MT) 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

Table 4 and Figure 7 focused on the percentage (%) of test allocated to stroke patients had improved functions after administration of Mirror Therapy (MT) as the percentage (%) measured by ARAT was reduced after intervention.

Major proportion of subjects 5 (35.7%) diagnosed with moderate to severe dysfunction shown by percent recorded by Action Research Arm Test (ARAT) while only 2 (21.7%) patient had mild severity of stroke at pre intervention stage.

After administration of Mirror Therapy (MT) most of the subjects found with decreased percentage recorded on ARAT showed reduction in severity of stroke as two-third 8 (56.7%) subjects

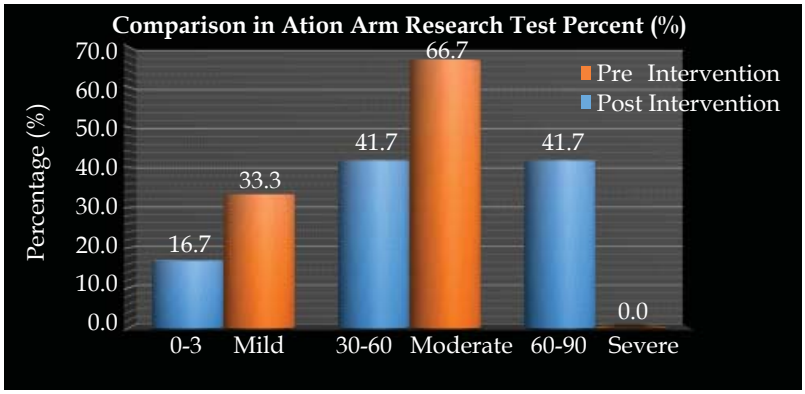

Fig. 6: Multiple Bar diagram depicting the comparison inAction research arm test (ARAT) percentage between Pre and Post Interventions of Constraint Induced Movement Therapy (CIMT) among stroke patients

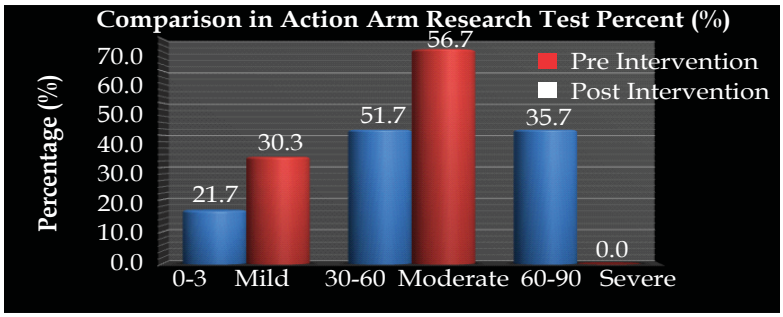

Fig. 7: Multiple Bar diagram depicting the comparison in Action research arm test (ARAT) percentage between Pre and Post Interventions of Mirror Therapy (MT) among stroke patients

Table 5: The Comparison in mean difference between pre & post intervention in UEFM (score) and ARAT (percentage)

Hand -Ness	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			

detected with moderate type of severity while rest one-third 4 (30.3%) 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 Mirror Therapy (MT) among stroke patients.

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 5 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 wasn't 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.

Discussion

Comparison in mean differences between pre intervention and post intervention in UEFM (score) and ARAT (%). The stroke survivors had improved functions after administration of Constraint Induced Movement Therapy (CIMT) and Mirror Therapy (MT) at post intervention stage and significantly different score for upper extremity Fugl-Meyer (UEFM) and reduced percentage for action research arm test (ARAT) when compared with the scores for UEFM and percentage for ARAT at pre intervention stage. But in our study Constraint Induced Movement Therapy (CIMT) is more effective than Mirror Therapy (MT), so our experimental hypothesis is true.

The mean for upper extremity Fugl-Meyer of stroke survivors at post intervention was higher than pre intervention and the difference (9.25 points) between pre intervention and post intervention was strongly significant at ($p<0.001$) statistical ground.

The percentage (%) of ARAT test allocated to stroke patients had improved functions after administration of CIMT and Mirror Therapy (MT), therapy as the percentage (%) measured by ARAT was reduced after intervention.

Major proportion of subjects 5(41.7% & 51.7) diagnosed with moderate and 5 (41.7% 35.7) with severe dysfunction shown by percent recorded by Action Research Arm Test (ARAT) while only 2 (16.7% & 21.7) patient had mild severity of stroke at pre intervention stage.

After administration of CIMT therapy & Mirror Therapy (MT), most of the subjects found with decreased percentage recorded on ARAT showed reduction in severity of stroke as two-third 8 (66.7% & 56.7) subjects detected with moderate type of severity while rest one-third 4 (33.3% & 30.3) were

measured in mild severity of stroke.

Therefore, it is inference that after intervention subjects had improved the functions of affected arm based on ARAT severity grading of stroke that impacted the effectiveness of CIMT therapy & Mirror Therapy (MT), among stroke patients. But CIMT therapy is more effective than Mirror Therapy (MT).

*T*he Pre Action research arm test % was strongly correlated with post Action research arm test % in positive direction confirmed statistically highly ($p < 0.001$) significant but moderately correlated with post upper extremitiy Fugl Meyer score in negative direction confirmed statistically not ($p > 0.05$) significant.

The Post upper extremity Fugl Meyer score was moderately correlated with post Action research arm test % in negative direction and the relation was confirmed statistically ($p < 0.05$) significant.

The present study "compare the effectiveness of modified constraint induced movement therapy (mCIMT) and Mirror Therapy (MT) in improving upper extremity and hand functions in stroke patients" has been started and find out the mCIMT is more effective than Mirror Therapy (MT) in different severity of stroke.

Rinskinijland 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).[23]

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. Lepert J. Mitner 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.[16]

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.[17]

Limitations of present study are

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

Future recommendations are

- Increase overall duration of study at least 1 year.
- Increase sample size at least 30 patients in each category (mild, moderate and severe disability post stroke)
- Increase number of parameters ,which can be : can add motor activity log or wolf motor scales and any functional scale for upper limb.
- Follow ups should be taken to assess long term effects.
- Measurements can also incorporate any automatic mechanical device if possible to avoid human errors.

Conclusion

This study concluded that Modified Constraint Induced Movement Therapy (mCIMT) is more effective than Mirror Therapy (MT) in upper extremity and hand functions in stroke patients.

In this study the patients from mild to moderate and moderate to severe post stroke disability mCIMT and Mirror Therapy (MT) both was improved better in stroke patients. But when we have compared than it showed Constraint Induced

Movement Therapy (mCIMT) is more effective than Mirror Therapy (MT) in upper extremity and hand functions in stroke patients. So hypothesis is accepted.

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Original Article

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Effect of PNF Versus Cyclic Stretching in Tendo-Achilles Tightness among College going Girls of Nashik

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Abstract

Context: Tendo Achilles tightness is the most common problem in normal healthy individuals who wear high heels or sit for prolong period of timewhich also leads to calf muscle tightness. Stretching is form of physical exercise in which a specific muscle or tendon (group of muscles) which are shortened are target for its lengthening. the muscles or tendon is stretched in order to improve its flexibility and elasticity and reduce tightness and achieve normal range of motion which is being restricted due to that tightness. *Aim:* Purpose is to compare the effectiveness of Cyclic stretching versus PNF stretching in TA tightness. Setting and Design: 40 healthy individuals (n= 40) between 18 to 25 years (female) with TA tightness were randomly divided into two groups equally. Each group consists of 20 subjects. *Methods and Material:* Ankle dorsiflexion of affected side was measure using universal goniometer. Subjects in group A were treated with PNF stertching and subjects in group B were treated with Cyclic Stretching. Treatment was given for 7 days on daily basis. Post treatment ankle dorsiflexion was recorded and compared. *Statistical analysis used:* After the intervention, difference the groups was compared using paired t Test and between the group it was compared using Unpaired T Test. *Results:* The PNF technique (group A) the value of ankle dorsiflexion was increased at the end of 7th day (19) compared to baseline value (12.15). *Conclusions:* Both the PNF an Cyclic stretching techniques are effective in improving TA flexibility and improving ankle range of motion, but PNF is more effective compared to cyclic stretching in reducing TA tightness.

Keywords: PNF stretching, Cyclic Stretching, Tendo- Achilles tightness, flexibility

Introduction

Stretching is therapeutic technique used to lengthen pathologically shortened soft tissue & to improve range of motion.[1] Factors that plays an important role neurologically are proprioceptors & golgi tendon organ. The nerve endings that send all the information about muscle and joint position in skeletal system to CNS are called as proprioceptors. It detects any change in physical displacement & rate of change in tension or force within body. Flexibility reduces the chances of injury, the reduction of soreness following a work out, & a general sense of well – being. There are different stretching techniques & protocols for improving TA flexibility. Afferent fibers arise from the muscle spindles, synapses on the other alpha or gamma motor neurons & facilitate contraction of the extrafusal & intrafusal fiber's.[2,3] GTO is located near the musculotendinous junction and wraps around the ends of extrafusal fibers of a muscle. It is sensitive to the tension in the muscle caused by either passive stretch or active muscle contraction. Pacinian corpuscles located closes to the GTO and is responsible for detecting changes in the movements & pressure within the body.[4,5] When

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the muscle is stretched, muscle spindle records the change in length & sends signals to the spine which triggers the stretch reflex which causes muscle contraction. When the muscle contracts, it produces tension at GTO which records the change in tension & rate of change of tension, it exceeds threshold, it triggers the lengthening reaction, which inhibits the muscle from contracting & causes them to relax that is inverse mitotic reflex, autogenic inhibition. When an agonist contracts, in order to cause the desired motion, it usually force the antagonist to relax.[6,7,8] This phenomenon is called as reciprocal inhibition or innervations because the antagonist is inhibited from contraction.[9] There are 5 types of stretching techniques- a) PNF stretching b) cyclic stretching c) dynamic stretching d) self stretching e) static stretching.[10] The second technique is "contract-relax-agonist-contract" method. There is active contraction of the antagonist, or opposite muscle to get into the stretched position. Reciprocal inhibition refers to relaxation of a muscle in response to activation of its antagonist: in PNF, contraction of opposing muscle is designed to induce reciprocal inhibition within the tight muscle & reduce the resistance to stretch. In hold relax the patient performs the end range before it is passively lengthened by autogenic inhibition, the GTO may fire inhibit the muscle so that it can be easily lengthen.[11,12] In hold relax with agonist contraction technique pre- stretch isometric contraction of tight muscle followed by a concentric contraction of the muscle opposite to tight muscle. In agonist contraction the patients dynamically contracts the muscle opposite the tight muscle against resistance.[13] Hold relax actually involves the use of dynamic or ballistic stretching in conjunction with static & isometric stretches. Cyclic stretching is a form of passive stretching, which is relatively of short duration & the stretch force is applied repeatedly but gradually.[14,15] Multiple stretch cycle are applied in one session. Each cycle lasts for 5–10 seconds. Speed of stretch, whenever slow facilitates the stretch reflex & decrease tension in muscle being stretched: low speed stretch affects the vaso elastic properties of connective tissue , making them more complaint.[15,16] Local relaxation like warming up of soft tissue will increase the extensibility of shortened tissue. Warm muscle relax & tighten more easily as the temperature of muscle increases the amount of force required to elongated non contractile & contractile tissue & time for which stretch force must be applied diseases warm up minimize the chances of minor trauma to the muscle & decreases DOMS.[19] Many cases like wearing high heeled shoes , in this calves are kept in a state of perceptually shortened length. Resisted plantarflexion is painful with loss of toe push off while walking. Though painful, it is possible for the patient to stand on the toes, raising heel from the ground. Spontaneous relief occurs with local ice application, compression bandage & avoiding over stretching activities along with medication. Functional recovery is seen within the week (7 days). Calf tightness can be symptomatic of weakness elsewhere in the leg, if the gluteus & hamstring are weak, calf will often try to make up for that weakness. This is mainly due to overused calf muscles, which in turn exacerbates calf tightness. In these causes given stretching for 1 week & 1-2 times per day that increases the flexibility of calf muscle [(20)]. There are various studies have been done on TA tightness but there is lack of study which compare the effect of various types of stretching in TA tightness among girls. Therefore the purpose of this study was to compare the effectiveness of Cyclic and PNF stretching in Tendo Achilles tightness among college going girls of Nashik.

Materials and Methods

A total of 60 college going girls between the age of 18 to 25 years with TA tightness were voluntarily participated in the study. The participants who were having any recent leg and foot injury, metabolic diseases or congenital deformity were excluded from the study. All participants were first filled the written informed consent form. Out of all 60 participants total 40 participants were randomly selected for further participation in this study. All these 40 participants were randomly divided into two equal groups of 20 participants each. Group A consists of 20 participants, were given PNF stretching for 7 days and Group B consists of 20 participants, were given Cyclic stretching for 7 days. The time of exercise and room temperature for the exercise was kept same for all the participants. All the exercises for group A and group B were done at 25^{o}C between 10:00am to 12:00 noon.

Procedure

Procedure was well explained to all the participants before starting the intervention.

Assessment of all the included participants was done as per the assessment form. Interventions and exercises as per their specific groups were given for 7 days. Post passive ankle dorsiflexion was then measured.

Intervention

Group A (Pnf Stretching)

Participants in the group A were receiving stretching of affected leg, and was performed in sitting.

Patient was asked to sit in a chair upright with straight back and head centered over your shoulders. Loop a towel around the ball of your foot. Straighten your knee and pull the towel tight to target Tendo- Achilles. Patient was asked to hold this for 5 secs followed by voluntary relaxation for 10 secs repeat 10 times.

Group B (Cyclicstretching)

Participants in the group B were receiving passive stretching of the Tendo Achilles of their affected leg.

Patient was asked to stand about 3 feet from a wall and put your right foot behind you ensuring your toes are facing forward.

Patients were asked to keep her heel on the ground and lean forward with your right knee straight. Rotating the toes in and out slightly will target the medial and lateral parts of this muscle separately. Hold this for 30 to 60 seconds 10 sets.

Data analysis

Mean and standard deviation were calculated for descriptive statistics. Students paired t test was used to calculate difference between pre and post values among the group and students unpaired t test was used to calculate difference between both the groups. The statistical analysis was done by SPSS v 16.

Results

The average age of participants in group A was 21.23 (±2.78) and group B was 21.84(±1.93).

The comparison of pre and post treatment in group A is shown in Table 1.

Table 1: Comparison of pre and post treatment in group A

Paired T Test	Rom (Dorsiflexion)	
	Pre	Post
Mean	12.15	19
SD	2.084	0.3162
p Value	0.00	
t Value	-17.160	
Significance	Statiscaly Significant	

The comparison of pre and post treatment in group B is shown in Table 2.

Table 2: Comparison of pre and post treatment in group B

Paired T Test	Rom (Dorsiflexion)	
	Pre	Post
Mean	12.65	18.65
Sd	1.461	1.137
P Value	0.00	
T Value	-15.916	
Significance	Statiscaly Significant	

The differences in ROM after intervention in both the groups is shown in Table 3.

Table 3: The differences in ROM after intervention in both the groups

Unpaired T Test	Mean (Difference)	Sd	*p* Value	*t* Value
Group A	6.9	1.714	0.102	1.674
Group B	6	1.686		

As the *p* value for group A regarding pre and post treatment ROM was <0.0001, group A proved extremely statistically significant in improving dorsiflexion ROM in subjects with calf tightness.

As the *p* value for group B regarding pre and post treatment ROM was <0.0001, group B proved extremely statistically significant in improving dorsiflexion ROM in subjects with calf tightness.

ROM comparison between groups showed a *p* value of 0.102 which is considered to be not statistically significant. Thus, both the groups are equally effective in improving the dorsiflexion ROM in subjects with calf tightness.

Discussion

The purpose of the study was to explore the effect of PNF stretching versus CYCLIC stretching on calf tightness in college going girls. In this study, 40 subjects with calf tightness were selected. They were divided into 2 groups, where 20 subjects werein group A (PNF Stretching) and 20 subjects were in group B (CYCLIC stretching) and outcome measure used was active dorsiflexion ROM. From the data analysis of this study, it is found that there is no statistically significant difference between PNF stretching and CYCLIC stretching in improvement of dorsiflexion ROM after 7 days since the '*p*' value between the group was 0.102.

College going girls are more prone to get calf tightness due to prolong standing, sitting, wearing

high heels and lack of physical activity. When they wear heels the gastrocnemius muscle undergo temporary shortening which leads to restriction of ankle dorsiflexion ROM. According to the previous study the results were like that PNF stretching was more effective. Stretching is the general term designed to lengthen pathologically shortened soft tissue stretches and thereby to increase range of motion. Factors responsible neurologically are proprioceptors and golgi tendon organ. Golgi tendon organ is located near the musculoskeletal junction and wraps around the ends of extrafusal fibres of muscles.[23] Pacinian corpuscles located close to GTO are responsible for detecting changes in the movement and pressure within the body. When the muscles was stretched the muscle spindle used to records the change in the length and sends the signals to the spine Stretching of muscle fiber begins with the sarcomere (the basic unit of contraction in muscle fiber).[22] The area of overlap between thick and thin myofilaments increases with the sarcomere contraction. As the muscle stretches, this area of overlap decreases. allowing the muscle fiber to elongate. When the muscle is stretched, the fibers are pulling out to its full length sarcomere and the connective tissues takes up the remaining slack thereafter. This helps to realign any disorganized fibers in the direction of the tension. This realignment is helping in rehabilitating scarred tissue back to health. When we stretch a muscle some fibers get stretched but some remains at rest. The current length of the muscle depends upon the number of stretched fibers.[15] PNF stretching is an advanced method of stretch training used to increase flexibility.It intersperses static stretching with series of muscle contractions or isometric activations. The goal was to improve dorsiflexion ROM. The method used was HOLD RELAX technique. During PNF stretch and isometric contraction of stretched agonist for extended period may cause activation of its neuromuscular spindle.[10] The increase in tension created during the isometric contraction of the pre lengthened agonist contract concentrically. These impulses travelled after causing post synaptic inhibition of the motor neuron to agonist which increases the tension from the GTO. These impulses may override the impulses which are coming from the neuromuscular spindles thus arousing the muscle to reflex resist to the change in length, and helping in lengthening the muscle.[25] The nerve ending that relay all the information of musculoskeletal system to central nervous system are called as proprioceptors. The proprioceptors are detecting and changing in physical displacement (movement or position) as well as in any changes in tension or force within the body. Reason of holding a stretch for prolonged period of time is that by holding the muscle in stretched position, the muscle spindle becomes accustom to the new length and reduces its signalling. Gradually we can train the stretch receptors to allow greater lengthening of muscle.[21] Muscle spindle are small encapsulated receptors composed of afferent sensory fiber endings, efferent motor fiber endings and specialized muscle fibers called intrafusal fibers and extrafusal fibers are bundled together and lie between parallel to the extrafusal fiber that make up main body of skeletal muscle. Cyclic stretching is a type of passive stretching, which is relatively of short duration and the stretch force is applied repeatedly and gradually. The multiple repetitions of stretch cycles are applied in 1 session speed of stretch affects the viscoelastic properties of connective tissue, making them more complaint. Local relaxation like warming up of soft tissue will increase the extensibility of shortened tissue.[24]

Warm muscle relaxes and tightens more easily because the temperature of muscle increases the amount of force required to elongate the non contractile and contractile tissue and time for which stretch force must be applied decreases warm up minimize the chance of minor trauma to the muscle and decreases domes.[26]

Conclusion

The finding of the present study suggested that both the techniques showed significant improvement in improving the dorsiflexion ranges with TA tightness in college girls of Nashik.

Both the PNF anf Cyclic stretching techniques are effective in improving TA flexibility and improving ankle range of motion, but PNF is more effective, but not statistically, compared to cyclic stretching in reducing TA tightness.

Conflict of Interest: No conflicts of interest

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Indian Journal of Waste Management	2	10000	9500	781	742
International Journal of Food, Nutrition & Dietetics	3	6000	5500	469	430
International Journal of Forensic Science	2	10500	10000	820	781
International Journal of Neurology and Neurosurgery	4	11000	10500	859	820
International Journal of Pediatric Nursing	3	6000	5500	469	430
International Journal of Political Science	2	6500	6000	508	469
International Journal of Practical Nursing	3	6000	5500	469	430
International Physiology	3	8000	7500	625	586
Journal of Animal Feed Science and Technology	2	8300	7800	648	609
Journal of Cardiovascular Medicine and Surgery	4	10500	10000	820	781
Journal of Emergency and Trauma Nursing	2	6000	5500	469	430
Journal of Food Additives and Contaminants	2	6000	5500	430	391
Journal of Food Technology and Engineering	2	5500	5000	430	391
Journal of Forensic Chemistry and Toxicology	2	10000	9500	781	742
Journal of Global Medical Education and Research	2	6400	5900	500	461
Journal of Global Public Health	2	12500	12000	977	938
Journal of Microbiology and Related Research	2	9000	8500	703	664
Journal of Nurse Midwifery and Maternal Health	3	6000	5500	469	430
Journal of Orthopedic Education	3	6000	5500	469	430
Journal of Pharmaceutical and Medicinal Chemistry	2	17000	16500	1328	1289
Journal of Plastic Surgery and Transplantation	2	26900	26400	2102	2063
Journal of Psychiatric Nursing	3	6000	5500	469	430
Journal of Radiology	2	8500	8000	664	625
Journal of Social Welfare and Management	4	8000	7500	625	586
New Indian Journal of Surgery	6	8500	7500	664	625
Ophthalmology and Allied Sciences	3	6500	6000	508	469
Pediatric Education and Research	4	8000	7500	625	586
Physiotherapy and Occupational Therapy Journal	4	9500	9000	742	703
RFP Gastroenterology International	2	6500	6000	508	469
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