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Electromyographic Activity Profile of Transverse Abdominis and Multifidus Muscles During Bridging Exercise Variants in Collegiate Cricketers

Irshad Ahmad*, Saurabh Sharma**,

Abstract

Purpose: The purpose of the study is to investigate activity of local muscles of the trunk during back bridging exercise using ball (BUB), bridging using sling (BUS) & normal bridging (NB) exercises and conduct the effectiveness of different unstable stable surface during bridging exercise. **Subject:** Twenty nine healthy male cricketers were recruited in the study. **Methods:** The EMG activity of transverse abdominis (TA) and multifidus (MF) were recorded during lifting of the pelvis with legs or feet in contact with the floor, ball or sling using surface electrodes. Normalisation were done by taken maximal surface EMG activity during maximal voluntary isometric contraction (MVIC) maneuver. The EMG data of each bridging exercise were recorded in percentage MVIC (%MVIC) and analyse using repeated measure analysis of variance. **Results and Discussion:** %MVIC of transverse abdominis during BUB is significantly higher than NB and BUS ($p < 0.05$) but no such difference is found in between NB and BUS ($p > 0.05$). For multifidus no significant difference was found in any types of bridging exercise. **Conclusion:** The athletic population did not had discernible effects on activity of the local muscles of the trunk by using various unstable surfaces except back bridging using swiss ball.

Key words- bridging exercise using ball (BUB), bridging using sling (BUS) exercise, normal bridging (NB) exercises, EMG, MVIC, transverse abdominis, multifidus

Introduction

Anatomically, the core is the musculature surrounding the lumbar-pelvic region like a natural corset. The core muscles and the thoracolumbar fascia play a role in the stability of the lumbopelvic region¹. The definition of spinal stability is not definitive but many researchers have defined it as coactivation of local and global muscles². Spinal stabilization through the coactivation of trunk muscles is crucial preventing and rehabilitation of damage caused by lumbar instability³. Increase in the dynamic stabilization of this lumbopelvic complex is gained by the of dual muscular systems¹. The local system is based on the muscle consisting which have direct connection to the spine that control inter-segment movement between adjacent vertebrae or act by increasing intra-abdominal pressure. These muscles have short lever

arms due to the proximity to the spine and must be activated before the global muscles with the purpose of stabilizing the lumbopelvic region^{4,5,6,7,8}, whereas global muscles are located near the surface and produce power and torque⁹. Spinal stabilization can be achieved through specific training exercises designed to enhance the coactivation of both local and global muscles. Among such exercise, the back bridging is very common and most frequently used^{10,11}. Numerous studies of stabilization exercises that strengthen spinal stability have been conducted and conflicting result have been presented concerning unstable surfaces¹².

Low back pain (LBP) is one of the most common representative musculoskeletal disorder^{13,14}. There is a large emphasis on strengthening the trunk muscles as part of rehabilitation programmes to provide support for the spine in patients with LBP. In patients with acute and chronic LBP, physical deconditioning of the musculature is evident and manifests as muscle atrophy, decreased muscle strength and endurance¹⁵. Research has shown localized and unilateral reduced cross-sectional area (CSA) of multifidus in patients with LBP at the painful level¹⁶. Active rehabilitation of trunk musculature has been shown to reduce LBP symptoms, increase muscle strength, CSA and

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endurance^{17,18,19}. Bridging exercises are a commonly used form of training the trunk muscles and they can be applied to a large spectrum of patients with LBP¹⁰. It was demonstrated that incorporating unstable conditions in these exercises led to increased muscle activation²⁰.

Training devices which challenge stability, such as balls, can be used to increase the difficulty of exercises employing diverse body weight and free-weight resistance²¹. The use of balls therefore can improve the dynamic balance ability, the flexibility and stability of the spine, and the sense of balance as ways to prevent damage²². Marshall and Murphy^{23,24} reported that a 12 week regimen of spinal stabilization exercises using balls by LBP patients brought about pain relief and decreases in flexion-relaxation disorders as well as improvements in the ability to control balance through the strengthening of the multifidus muscle, which has an important role in stability. However, other previous studies reported that spinal motions did not change and revealed no increase in trunk muscle activity during core stability exercises on unstable surfaces^{25,26,27}.

In most of sports activities, the human body act as in the form of a kinetic chain and the core serves as the centre of this functional kinetic chain. The kinetic chain is the coordinated, sequenced activation of the body segments that places the distal segment in the optimum position at the optimum velocity with the optimum timing to produce the desired athletic task. On the other hand, stability is required at the proximal part of kinetic chain i.e. the core. For the kinetic chain to function at its maximal capabilities, athletes must maximize the relationship between providing sufficient stability while producing forceful motions of sports performance. Since the core is the central to almost all kinetic chains of sport performance tasks, control of core stability, core strength and motion will maximize upper and lower body extremity function²⁸.

This article aims to determine the effects of using unstable surfaces on the transverse abdominis (TA) and multifidus (MF) activity in athletic population during the back bridging exercise. The study has following Clinical relevance

- ★ Clinically these results may have implications for the selection of the exercises indicated.
- ★ The ball bridging exercise is used as the progressive stabilization exercise after the normal bridging or sling bridging exercise when strength

training of trunk is implicated to the athletic population.

- ★ Normal bridging exercise can be easily applicable during stabilization exercise rather than the sling bridging exercise because it required equipment to apply.

Methology

Subject

Twenty nine healthy collegiate male cricketers from JamiaMilliaIslamia and other universities were recruited by convenience sampling aged between 18 to 28 (21.65 ± 3.05) years, 171.41 ± 5.97 cm height, 63.91 ± 10.13 kg weight. The inclusion criteria were healthy cricketer players playing at university level for at least 2 months of training and exclusion criteria were included low back pain since 6 months, history of spinal, abdominal and lower limb surgery, history of neurological disorder, pulmonary and cardiovascular dysfunction, scoliosis, kyphosis, ankylosis, limb length discrepancy and postural asymmetry. All subjects gave their informed consent to participate in the study after explanation about nature and procedure of study and all the doubts from the participants were cleared before starting of procedure.

Procedure

Ethical clearance was taken from Institutional Ethical Committee of JamiaMilliaIslamia, New Delhi, by giving details of the research and consent required for the study. Subjects who met the inclusion and exclusion criteria were selected for the study. Prior to participation, all subjects were explained the purpose of the study. Height and weight of the subjects will be measure by digital weighing machine and stadiometer respectively.

Surface EMG preparation

Before the experimental procedure, each subject was prepared for EMG recording. The skin will be prepare by shaving excess hair and rubbing the skin with skin abrasive and alcohol swabs to reduce impedance (typically $d'' 10$ kOhm). Disposable bipolar Ag/AgCl surface electrodes with a diameter of 1cm were attached parallel to the muscle fibre orientation, unilaterally (the side was randomly selected) over the following so called local trunk muscles:

The inferior fibres of the Internal Oblique (IO) were considered to represent local muscle activity^{29,30} because it was shown that on the site medial and inferior to the anterior superior iliac spine, the fibres of the transverses abdominis and the IO are conjoined, so a distinction between the muscle signals cannot be made at this location³¹. The site of the electrode for Transverse Abdominis/Internal Oblique muscles is 2 cm anteromedial from the anterior superior iliac spine^{32,33} and for lumbar Multifidus is lateral to the midline of the body, above and below a line connecting both posterior superior iliac spines³⁴.

The maximum inter-electrode spacing between the recording electrodes was 2.5 cm as recommended by Ng³⁵. The ground electrode was placed over superior aspect of the left iliac crest of same side¹¹.

Maximal voluntary isometric contractions (MVIC) assessment

The MVIC of the muscles were measured in three trials before the experimental tasks. These exercises were performed to develop readings for EMG signal amplitude normalization^{36,37,38,39,40,41,42}.

Normalization of EMG corresponding maximal EMG amplitude allows inter individual comparison to the individual maximum⁴³. Failure to normalize EMG data before quantitative analysis introduces confounding variables not related to muscle function (for example skin impedance, electrode orientation and amount of subcutaneous tissue)⁴³. Two different isometric exercises were performed in which manual resistance is given. Verbal cues are given to ensure maximal effort.

The maximum activation of the transverse abdominis was recorded when performing a maximal expiratory maneuver with abdominal hollowing in a sitting position⁴⁴ (Figure 10) whereas the maximal multifidus activation was obtained by applying manual resistance to the posterior aspect of the scapula while the subject lay in the prone position, with the legs tied to the table to prevent them from moving and the subject was asked to perform trunk extension^{37,39,40,45,46}.

MVIC trials help to ensure a maximum effort throughout the 3 seconds, and the subjects was asked after each MVC that it is the maximum effort. If not, the MVIC will be repeated. MVIC trial will be performed with a 1-minute rest between each trial.

EMG data was collected for the 3-second period of the isometric phase. The MVIC was calculated for the 1 second period that consisted of the highest signal activity⁴⁴.

Exercise procedures

The subjects executed 3 experimental exercises in a random sequence. All the exercises are performed in supine position. After a specific explanation of each exercise followed by a guided trail, the exercises were recorded. The bridging exercise on the 3 surfaces in supine position is presented. Instructors provided feedback to ensure that a consistent spine and lower limb posture was maintained during the exercise.

Normal back bridging

The subject was supine on the floor, with the feet flat on the ground, knees bent at 90° and toes facing forward. The hands were positioned directly underneath the shoulders, with the fingers facing forward. The angle of the shoulder joint and trunk was approximately 30° and the lumbar spine in neutral position as measured manually by goniometer. The subject raised the pelvis to achieve hip flexion angle to zero degree.

Back bridging using swiss ball

The subject was supine on the floor, with the legs and heels in contact with the swiss ball, knees straight and toes facing upward. The hands were positioned directly underneath the shoulders, with the fingers facing forward. The angle of the shoulder joint and trunk was approximately 30° and the lumbar spine in neutral position as measured manually by goniometer. The subject raised the pelvis to achieve hip flexion angle to zero degree.

Back bridging using sling

The subject was supine on the floor, with the ankles were placed in two separate slings that was suspended from the ceiling, knees straight and toes facing upward. The hands were positioned directly underneath the shoulders, with the fingers facing forward. The angle of the shoulder joint and trunk was approximately 30° and the lumbar spine in neutral position as measured manually by goniometer. The subject raised the pelvis to achieve hip flexion angle to zero degree.

At the beginning of the each exercise, a neutral position of lumbar spine was determined by the examiner (anterior and posterior iliac spines in line) and the subject was instructed to maintain this position during all the exercises. To standardize the subject and equipment positions, markers were placed on the floor and the goniometer measured the position.

The dynamic phases, lifting and lowering of the pelvis and the extremities, lasted 2 seconds. The bridged positions in the exercises were held for 5 seconds. The pace of 60 beats/min was set by a metronome. Three trials for every exercise were performed. A pause of at least 15 seconds was allowed between the trials.

Instrumentation

The raw surface EMG signals were band pass-filtered between 10 and 500 Hz and amplified 1000 times. The sampling frequency was 1000 Hz. The signals were analogue/digitally (A/D) stored in a personal computer.

Normalization of data

EMG data were collected during both dynamic and isometric phases of exercise performance. The root-mean-square (RMS) of EMG amplitude was calculated for a second period of the isometric phase of each exercise. The mean RMS of three MVC trials for each muscle was used to provide a basis for EMG amplitudes normalization of data obtained during the experimental exercises (%MVC). The static phase of the experimental exercise were analysed, using mean of three trials of different exercise for each muscle of 4700-4800 ms after starting point of the holding position. The mean of root mean square (RMS) for the 3 repetitions of different bridging exercises after normalization (%MVC) were used for the comparison.

Data Analysis

The SPSS version 21.0 software program was used for the data analysis. The Shapiro-Wilk test was used to verify the normality of variables distribution. When the requirements did not met to normal distribution then the data was log transformed. After that one way analysis of variance (ANOVA) with repeated measures was used to compare the difference in transverse abdominis and multifidus during back bridging exercises using 3 different surfaces. And post hoc least significance difference (LSD) tests was performed using Bonferroni correction were used for the analysis significant differences between individual muscles in each exercises. We also used paired t-test for the analysis of the significant differences in between the two muscles concerning both MVIC and experimental exercises. The confidence interval used was 95% with level of significance was set at $p < 0.05$.

Results

Activation of transverse abdominis in BUB was significantly higher than the NB and BUS ($p < 0.05$), whereas no significant difference was found in between NB and BUS ($p > 0.05$). No significant difference were found in the activation of multifidus in variants types of back bridging exercises ($p > 0.05$). In comparison between TA and MF, there was significantly lower activity of transverse abdominis with the multifidus in all variants of bridging exercise $p < 0.05$.

Discussion

The aim of this study was to evaluate the muscle activity during performance of sets of bridging stabilisation exercise. Due to this investigation, the exercises are supposed to be helpful for the stabilization at lumbar region, so that the kinetic chain to function at its maximal level for the sports activities. It is important to understand the muscle activity in healthy athletic conditions. In the current study the muscle activity is expressed as relative EMG (%MVIC). Some researcher and clinicians reported that the optimal stabilization of the lower back during basic stabilization exercise may be created by good activation of the local muscles^{5,47,48,49}. The present study explored the effects of using different support surfaces for the back bridging exercise on the activity of transverse abdominis and multifidus muscles.

The current study shows no significant differences in between MVIC of the transverse abdominis and multifidus ($p > 0.05$), whereas Stevens et al¹¹ found MVICs of the abdominal muscle and back muscles did not differ significantly except MVIC of RA is higher in comparison with the MVIC of the IO and EO which is similar to current study.

Concerning transverse abdominis muscle, the present study found that the activity in Bridging exercise using ball is significantly higher than the Normal Bridging exercise and Bridging exercise using Sling ($p < 0.05$) which is still a question of debate that previous studies have increased²⁰ as well as unchanged^{10,12} in the activity of the ball bridge exercises. However, they have reported about the activity of internal oblique. Stevens et al¹¹ researched on the various bridging exercise (normal bridging, ball bridging and unilateral bridging exercises) in healthy adults to compare %MVIC showed higher %MVIC values in the unilateral bridging than in the

normal bridging and ball bridging. In addition to this, the ball bridging had increased %MVIC values of IO (local muscle), RA, and ES than normal bridging which is quite similar to this study considering transverse abdominis, one of the local muscles. Imai et al⁴⁴ found that the RA, TA, EO, ES and MF were highly activated during an elbow-toe exercise on unstable support surfaces. They did not find any significant difference in the back bridging when performed on an unstable support surface which is contrast with the result of present study. However, the back bridging exercise describe in latter studies were performed with the feet flat on the ball, in contrast to them the lower calves were positioned on the ball in the present study. Due to the calf positioned on the ball there might be higher activation of transverse abdominis to prevent the limbs from rolling of the ball and making the trunk to more stable position by increased intra-abdominal pressure via tension produce in the thoracolumbar fascia^{50,51}.

The present study reported no significant difference in the activation of TA in bridging exercise using sling and normal bridging ($p = 1.000$) which is different in previous study reported %MVIC values of the IO, RA, MF and ES muscles during sling bridging exercise were significantly higher than those during the ball bridging and normal bridging exercise⁵², the study is conducted on the low back pain patients, making it difficult to apply on the healthy athletic adults. Stuge et al⁵³ reported that the use of sling exercises increases the use of local muscles focussing on transverse abdominis, internal obliquus and multifidus, whereas Dannelly et al⁵⁴ reported that application of the sling exercise is closed to kinetic chain exercise method that contributes to balance improvement because it uses both local and global muscles, present study only consider about the two common local muscles.

In this research, there is no significant difference in the activation of multifidus in all different ways of bridging exercises ($p > 0.05$), which is similar to the previous studies^{11,44}. Lehman, Hoda & Oliver¹⁰ and Kim & Kim¹² also reported no difference in the activation of erector spinae during stable and unstable back bridging exercises. In addition to this, other study also shows no difference in the activities of trunk muscles were seen in various stabilization exercises with the swiss ball²³. Kang, Jung, Yu⁵² research showed higher %MVIC values in the MF muscle in back bridging exercise using sling than those other two positions and also ball bridging exercise is higher than the normal bridging exercise which is different in the present study. However, the study is done on the low back patients. Behmet al²⁰

also claimed the unstable surface using ball have higher activity in erector spinae during supine bridging exercise.

This study shows that the ball bridging is probably more effective than normal bridging as well as bridging exercise using sling in terms of stabilization of the trunk due to disturbed in balance because of ball rolling whereas no difference in multifidus. The ball used in the study was 55cm in diameter and the sling length form the ceiling to the leg was around 1m 50 cm. The sling length was lesser might be the limitation of the study because the increment in the moment arm result into increased in instability⁵²but it is clear that the mechanism of the ball exercise is better than the sling exercise.

The study also mentioned about the difference between the activation of multifidus and TA which is found as higher activation of MF as compare with the activation of the TA in all types of the bridging exercises ($p < 0.05$). The previous studies mentioned about the activation ratio of IO/RA have highest values compared to the other abdominal and back muscle activity ratios during bridging exercise¹¹ which is similar to current study. Carvalho et al⁵⁵ was reported difference in activation ratio of TA and MF during various Pilates exercises. This suggests that there is a force creating a trunk into the extension (i.e. gravity attempts to decrease the lordosis which is resisted by the muscle activity) due to fact that the centre of mass of the trunk and head segment comes closer to the axis of the trunk. The amount of muscle activation required for stability of the trunk varies to the spinal posture and spinal stiffness. Thus, stability either as a constraint or as part of a physiological cost function which might provide more physiological coactivation patterns and better activities of safe postures during unstable loads.

An important observation from all exercises tasks was large variability in muscle activity between subjects that can greatly influence the interpretations of the results. This indicates that some subjects shows large changes in the muscle activity while some showed minimal changes when change in the to exercise was done. It could be due to subjects volitionally contracting their trunk muscles to provide stability while others may have not. It is also possible that individuals may be able to influence their trunk muscle activity through verbal encouragement and EMG feedback.

Perspective for future study

- ★ Biomechanical model including kinematic data with subsequent force data to determine the

Fig. 1 : Placement of surface electrode for Transverse abdominis muscle.



Fig. 2 : Placement of surface electrode for multifidus muscle



Fig. 3 : MVIC procedure for Transverse abdominis muscle



Fig. 4: MVIC procedure for multifidus muscle



Fig. 6 : Holding position for the normal bridging exercise



Fig. 5 : Starting position for normal bridging exercise



Fig. 7 : Starting position for the bridging exercise using swiss ball



Fig. 8 : Holding position for the bridging exercise using swiss ball



Fig. 9 : Starting for the bridging exercise using sling



Table I: Mean relative muscle activity (%MVIC) and standard deviation (SD) during bridging exercise.

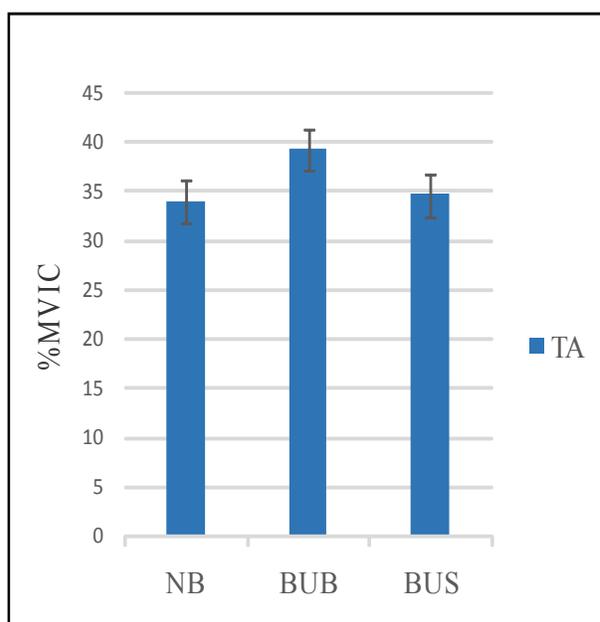
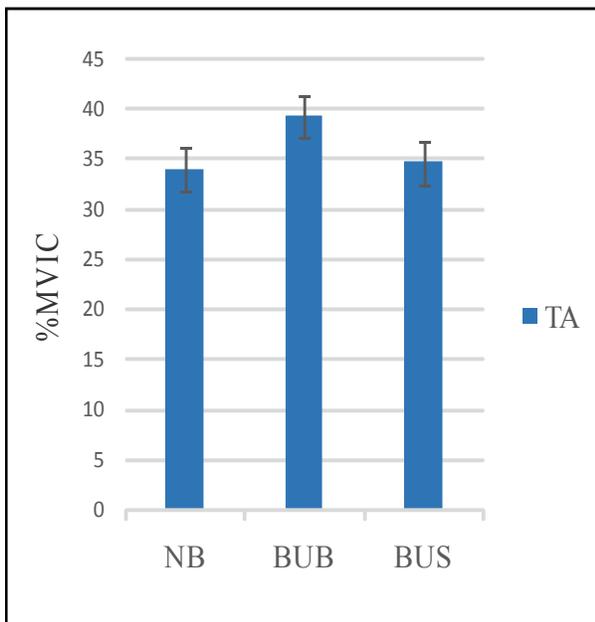
Dependent variables	TA		MF	
	Mean	(SD)	Mean	(SD)
NB	33.97	2.13	50.82	1.74
BUB	39.18	2.08	54.83	1.83
BUS	34.61	2.15	56.18	1.94

Fig. 10 : Holding position for the bridging exercise using sling

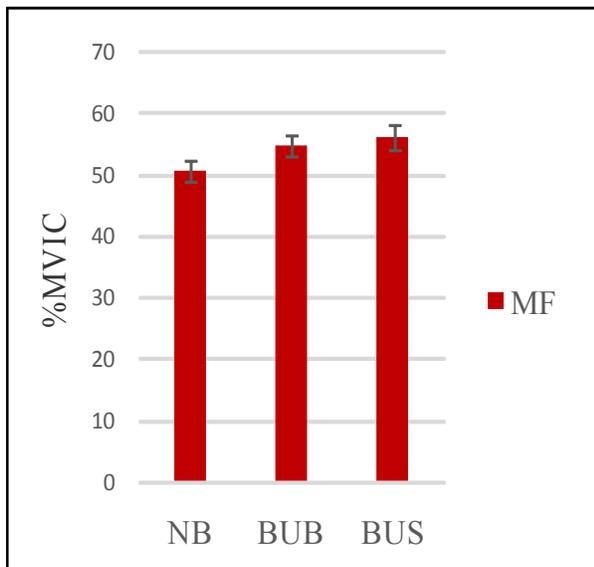
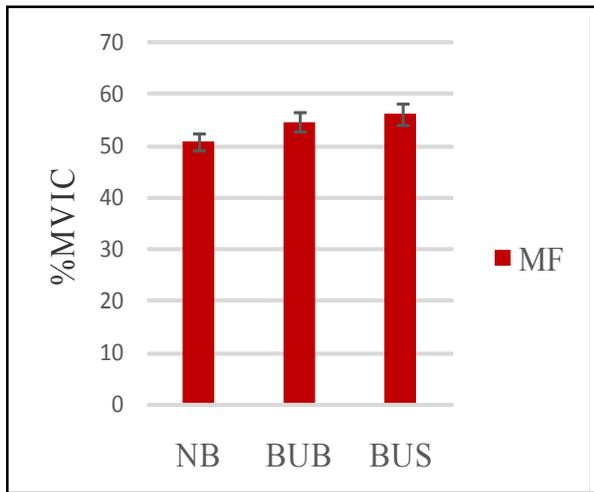


NB: Normal bridging exercise, BUB: bridging exercise using ball, BUS: Bridging exercise using sling.

Graph 1. : Comparison of %MVIC of Transverse abdominis during bridging exercise



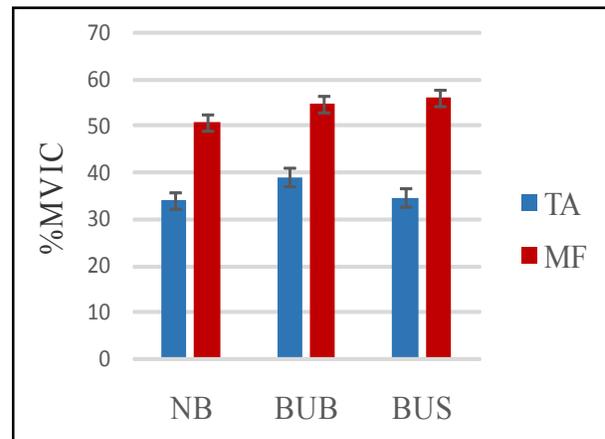
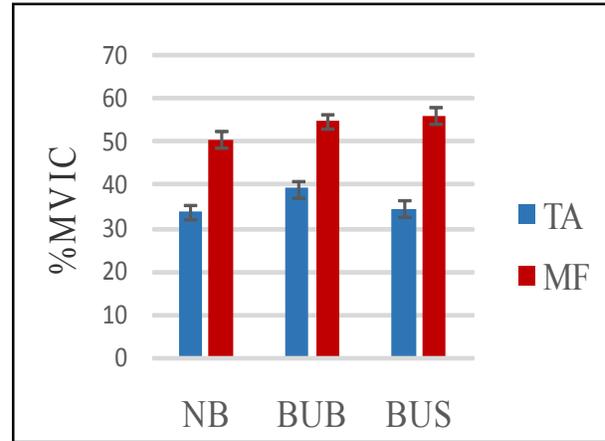
Graph 2 : Comparison of %MVIC of Multifidus during bridging exercise.



compressive and shear loading on the spine during these activities.

- ★ Large diverse population, including female athletes, older individuals should be conducted for the conformation of our findings.
- ★ Acute or chronic low back pain patients might give different results due to pain adaptation or spasm caused by pain.
- ★ Increased length of sling might give different results because increase in the moment arm results in increase in instability.
- ★ Use of thera band in replacement of the sling results in increase in instability too.

Graph 3 : Comparison of %MVIC of Transverse abdominis and Multifidus



Conclusion

It was concluded from this study that the athletic population did not had discernible effects on activity of the local muscles of the trunk by using various unstable surfaces except back bridging using swiss ball. Therefore, it is unnecessary to use bridging exercise using sling in an attempt to increase the local trunk muscle activity instead of normal bridging exercise.

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Beneficial Effects of Forty Days of Pranayama Training on Cardiorespiratory Parameters

Sanjay Biswas*, Varun Malhotra**, Usha Dhar***, Rinku Garg****,

Abstract

Rapid industrialization, environmental pollution, overcrowding, sedentary lifestyle and various stress factors are responsible for the deterioration of the physical health of a person. Also, prevalence of obesity in developing countries is believed to be on the rise. This requires special and specific techniques to transcend the limits of our physical and mental abilities experienced in everyday life. Hence, in the present study beneficial effect of Pranayama on cardio-respiratory function was studied. MATERIALS AND METHOD: Study was conducted in Santosh Medical College and Hospital in Ghaziabad after the institutional ethical clearance and written consent from each participant. A total of 50 normal subjects were recruited in the study, were divided into study and control groups, each group containing 25 subjects. The study group was asked to perform Kapalbhathi Nadishuddhi and Bhramari pranayama for duration of 40 days. Cardio-respiratory parameters were assessed before and after 40 days in both the groups. STATISTICAL ANALYSIS: Paired t- test was applied for statistical analysis and p value <0.05 was considered the level of significance. RESULTS AND CONCLUSION: In study group, heart rate, respiratory rate, systolic blood pressure decreased whereas peak expiratory flow rate increased significantly as compared to that of control group. This shows that Bhramari, Nadishuddhi and Kapalbhathi pranayama have improving impact on these cardio respiratory parameters.

Key words : Pranayama Cardiorespiratory function

Introduction

“Yoga” is Sanskrit word derived from the root “yuj” which means union. Yoga is a psycho-somatic-spiritual discipline for achieving union & harmony between our mind, body and soul and the ultimate union of our individual consciousness with the Universal consciousness.¹

Pranayama, the fourth limb in the Ashtanga Yoga, is made up of two words, *Prana* and *Ayama*. *Prana* stands for the capacity to keep body alive by air, i.e breathe and *Ayama* means expansion, stretching or

extension and control of breathe². Thus, Pranayama means the art of controlling prana. *Pranayama* is basically undertaken for somatic and psychic purification, regulation of *prana* to each body organ and to optimize the cardio-pulmonary and autonomic functions.³

Pranayama is the first step towards re-orienting and improving the functioning of mind and body by learning to utilize the air we breathe. Pranayama implies correct breathing and control over prana².

The cranial and spinal nerves spread throughout the body. These nerves send out and send in to the brain pain and motor impulses. Prana flows throughout these pathways. It also flows through all the nadis, or energetic pathways, which have been studied by ancient Yogis. *Nadis* means channels or vehicles. These are astral nerve channels which are beyond the physical body that regulate various functions of the body. Some texts describe 72,000 nadis in the body, but fourteen are considered important, and only six of them are the most important of all. They are called the *ida*, *pingala*, *sushumna*, *brahmuni*, *chitrana*, and the *vijnana*. Among these six, three are even more important than any others. The techniques of Pranayama are designed

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to bring the central nadi, the sushumna, into primary function, rather than the ida or pingala dominating the functions of prana flow. With activation of the sushumna as the primary flow for prana, the Yogi experiences freedom from the human condition, and joy. However these are very subtle (*suksham*) and cannot be scientifically seen or their presence proved by our gross instruments. However, their effects can be felt and their beneficial effects measured on the physical body. Pranayama involves systemic and disciplined inspiration and expiration with retention or holding of breathe in specific proportion or specific manner. It also aims at conditioning the speed of breathing. When we breathe very fast the storehouse of power that sustains life dries up speedily and thus a long life span is not possible. The more the breathing is slow the more our life span attains longevity.^{3,4}

Various studies are there correlating our ancient scriptural knowledge with science. However, we found no study in our city of Ghaziabad. To help understand the beneficial effects of yoga on our subjects this study was designed. This study attempts to assess the effect of 40 days of Pranayama training on cardiovascular and respiratory system in normal young healthy individuals in Ghaziabad.

Material and Methods

Ethical clearance for the study protocol was obtained from institute ethical committee. 50 healthy subjects of age group 18-30 years, who were willing to complete the study were selected. Subjects who were trained in yoga before, subjects with history of previous surgery, recent cardio-respiratory diseases, diabetes, asthma, atopic skin diseases and with any major chronic illness or drug therapy (ATT etc) were excluded from the study. The health of the subject was assessed by noting the present, past, family and personal history and also by a thorough general and systemic examination. The subjects were explained about the importance and procedure of the study. An informed written consent was obtained from all the members. The subjects were informed about the procedures in brief. Subjects were divided in 2 groups, **Yoga Group A** (Case): 25 subjects who were subjected to Pranayama training for a period of 40 days were compared with **Non Yoga Group B** (Control): 25 subjects who were not subjected to any Yoga training. The various parameters compared are:

→ HR (heart rate) was measured by counting the Radial pulse

- Blood Pressure was measured by standard mercury Sphygmomanometer (Prolix, Primepack Meditech Industries, New Delhi, India)
- RR (respiratory rate) by inspection / palpation of chest movement
- PEFV by was measured in Lit/min by Wrights Peak Flow Meter (Lifeline Surgicals, New Delhi, India).

In this study the subjects were trained for Pranayama for two weeks. Then they practiced the same under our direct supervision, twice per week for 40 minutes, for a total duration of 40 days. They were encouraged to practice pranayama in their house. Monitoring was done after two weeks. Pranayama was practiced in Padmasana or Sukhasan position. The Yoga practice consisted of:

- Warm up (5 min)
- Pranayama (25 min), Pranayamas adapted for study purpose were:
 - Nadishuddhi (ratio 25:12:25 of inhalation, holding and exhalation)
 - Kapalabhati and
 - Bhramari
- Meditation (10 min). The subject was asked to merely watch the course of the incoming and outgoing breath.

The first phase of the recording of the parameters was done at the beginning of their course. The second phase of the recording was done after 6 weeks of the regular pranayama practice. The parameters were measured after pranayama practice on the 40th day.

Both groups were matched in age, sex and height and weight. Age is equally distributed across both groups. Matching the age is necessary as pulmonary function decreases with age. For statistical analysis of data, paired samples 't' test was employed for the present study using SPSS 17.0 for Windows. The level of significance was set at 0.05 so 'p' value less than 0.05 was considered statistically significant.

Results

There is statistically significant decrease in heart rate, respiratory rate and systolic blood pressure and a significant increase in peak expiratory flow rate of Yoga Group after 40 days of Pranayama training.

Effect on Heart Rate

The decrease in mean \pm SD of heart rate before Pranayama training in Yoga Group was 78.88 ± 2.83 beats per minute as compared to 73.56 ± 1.41 beats per minute after 40 days of Pranayama training is statistically significant, $p < 0.05$ as seen in Fig 1.

Effect on Respiratory Rate

The decrease in mean \pm SD of respiratory rate before yoga was 16.64 ± 0.81 per minute as compared to decrease in respiratory rate to 15.08 ± 0.70 per minute after 40 days of Pranayama training which is statistically significant, $p < 0.05$ as seen in Fig 2.

Effect on Blood pressure (Systolic & Diastolic)

There is a reduction in mean \pm SD systolic blood pressure before Pranayama Training in Yoga Group 122.56 ± 4.49 mm of Hg to 116.88 ± 4.20 after Pranayama is statistically significant, $p < 0.05$. Diastolic blood pressure mean \pm SD decreased in Yoga Group from 76.24 ± 4.29 mm of Hg before Pranayama to 74.56 ± 2.61 mm of Hg after 40 days of Pranayama, which is statistically insignificant, $p > 0.05$ as seen in Fig 3 & 4.

Effect on PEFR

The increase in mean \pm SD of peak expiratory flow rate before Pranayama in Yoga Group was 427.6 ± 60.01 as compared to 484.4 ± 41.03 after 40 days of Pranayama training is statistically significant, $p < 0.05$ as seen in Fig 5.

Fig. 2 : Effect of Pranayama on Respiratory Rate

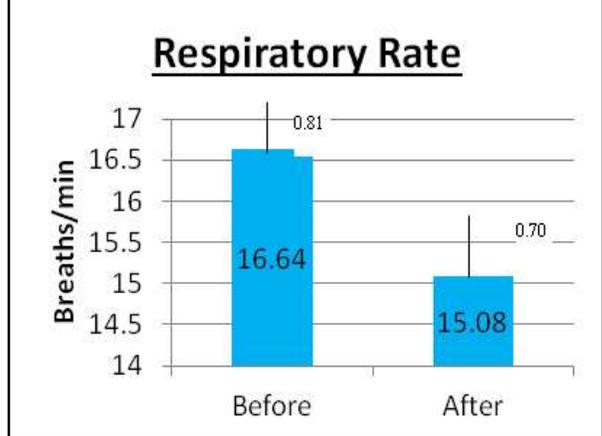


Fig. 3 : Effect of Pranayama on Systolic Blood Pressure

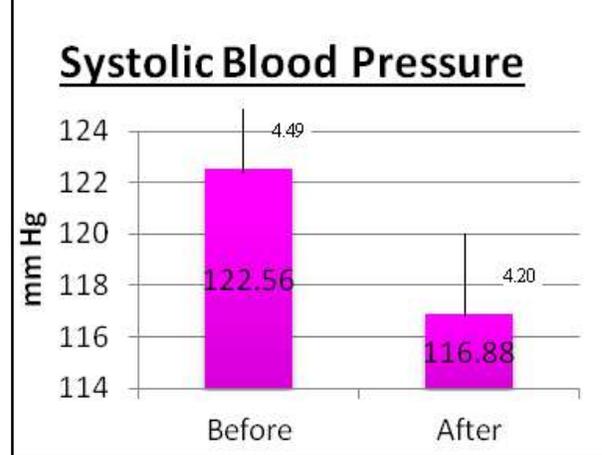


Fig. 1 : Effect of Pranayama on Heart rate

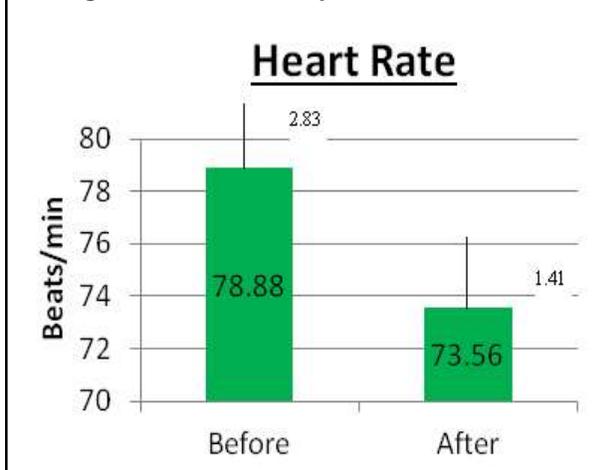
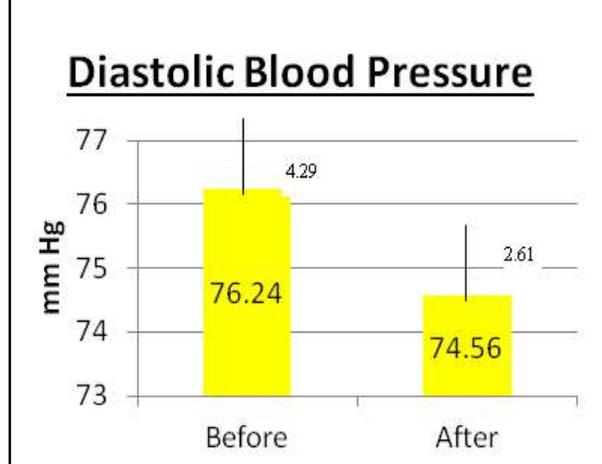
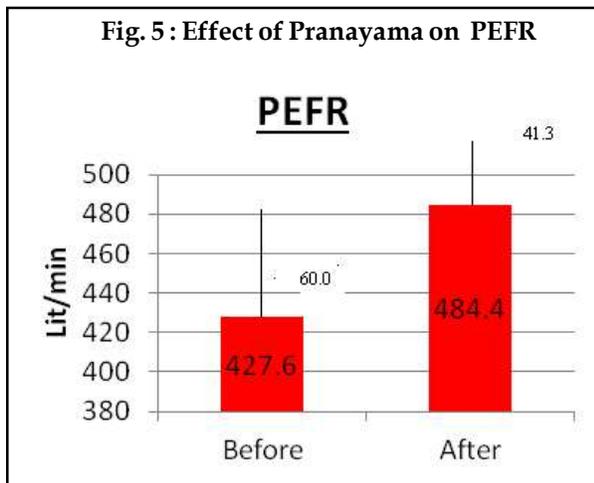


Fig. 4 : Effect of Pranayama on Diastolic Blood Pressure





Discussion

Cardiac Parameters

Our study showed *significant decrease in heart rate* in Yoga Group A (Case) after 40 days Pranayama training. The findings are supported by the studies of K Upadhyay Dhungel et al⁴, Madanmohan⁵, Udapa et al⁶, Pal et al⁷, Subbalakshmi et al⁸, Singh et al⁹ and Indla Devsana et al¹⁰ showed significant decline.

Bal Baljinder et al¹¹ and Vinayak and Anil¹² also showed statistically significant reduction in pulse rate after regular practice of yoga and it is attributed to increased vagal tone and decrease in sympathetic activity.

We observed a *significant decrease in systolic blood pressure* in our study in Yoga Group A (Case). Significant decline in systolic blood pressure in our study is in accordance with findings of Singh et al⁹, A Singh et al¹³ and Dandekar Pradnya Deepak.¹⁴ The former studies suggest that significant change in the results after yoga might be due to immediate effect on peripheral vascular resistance to reduce heart rate.

Indla Devsana et al¹⁰ and Vinayak and Anil¹² showed highly significant decline in systolic blood pressure as well as significant decline in diastolic blood pressure after yoga for 6 months and 12 weeks respectively.

Our study reported non-significant decrease of diastolic blood pressure in Yoga Group A (Case) and the findings are in accordance with study of Singh et al⁹ and Dandekar Pradnya Deepak.¹⁴

Diastolic blood pressure mainly varies with the degree of peripheral resistance (Guyton, 1996) and

heart rate.¹⁵ Non significant change in diastolic blood pressure observed in the present study suggested that Nadi-shodhana Pranayama might have not any long term effect on peripheral vascular resistance or it has some roles, but is obscured by a slow heart rate⁹ but it may need practice for longer periods.¹⁴

There might be a few possible reasons for the significant improvement in cardiac function. Blood pressure and pulse rate related with cardiovascular system is controlled by autonomic nervous system. Pranayama increases cardiac output, decreases hepatic renal blood flow and increases peripheral vessels blood flow¹⁴. Nadishuddhi brings a balance in autonomic nervous system.⁴ Yoga practitioner not only tries to breathe, but at the same time, also tries to keep his attention on act of breathing, leading to concentration. These acts of concentration remove his attention from worldly worries and de-stress him. In this relaxed state, parasympathetic activity overrides sympathetic activity.⁶ Lung inflation has been known to decrease systemic vascular resistance. This response is initiated by pulmonary stretch receptors which bring about withdrawal of sympathetic tone in skeletal muscle blood vessels leading to wide spread vasodilatation thus bringing up decrease in peripheral resistance.¹⁴

The reduction in blood pressure is due to parasympathetic dominance as observed by a decrease in heart rate also.²⁹ This may be due to improved vagal tone after slow stretch exercises like Suryanamaskar that were performed in the warm up (5min) of our study protocol.

Changes of heart rate and respiration accompanying a yogic subjective activity are intended to alter the state of mind alone³⁰

It has been seen that certain yogis such as Sadhu Haridas can alter the patterns of their cardiovascular functions voluntarily create atrial fibrillations or stop their heart at will.³¹ Other types of voluntary control of heart such as tachycardia, bradycardia, reduction of P wave amplitude, achieving T wave amplitude more than that of R wave and atrial flutters have been recorded.³²

Blood pressure in Hypertensive subjects after two or three weeks of yoga practice. This is associated with significant reduction in drug requirements. The relief from high blood pressure diminishes gradually if meditation is discontinued. The Blood pressure is observed to return to normal in patients who restarted the yoga asanas. This confirms the cause and effect relationship between yoga asanas and the blood pressure reduction.³³

Respiratory Parameters

Practice of Yoga brings decline in respiratory rate by decreasing sympathetic activity. In the present study, respiratory rate decreased significantly in Yoga Group A. Our results have been supported by Dolly et al¹⁶, K Upadhyay Dhungel et al⁴, Fareedabanu et al¹⁷, Shivraj P Manaspure et al¹⁸ and Tiwari et al¹⁹, Vinayak and Anil¹² and Sunitha et al²⁰ demonstrated significant decrease in respiratory rate after practice of Pranayama.

A significant improvement in peak expiratory flow rate was observed in the present study. The findings are supported by the studies conducted by Joshi et al²¹, Yadav and Das²², Dolly et al¹⁶, K Upadhyay Dhungel et al⁴, Puja Dullo et al²³, Bal Baljinder et al¹¹, Fareedabanu et al¹⁷ and S Panwar et al²⁴ showed a significant increment in Peak expiratory flow rate.

The effects can be explained on the following basis that increased power of respiratory muscles that is due to work hypertrophy of the muscles during pranayama and other exercises²² due to which the chest and lungs inflate and deflate to the fullest possible extent. The maximum inflation and deflation near to total lung capacity is an important physiological stimulus for the release of lung surfactant and prostaglandins increasing the alveolar spaces thereby increasing lung compliance and decreasing bronchial smooth muscle tone activity respectively. ²⁵ Stimulation of pulmonary stretch receptors by inflation of the lung reflexly relaxes smooth muscles of larynx and tracheobronchial tree; probably this modulates the airways calibre and reduces airway resistance via bronchodilation.⁴ Slow and deep inhalation and prolonged exhalation as in Anulom-vilom causes efficient use of intercostals and diaphragmatic muscle. This trains the respiratory apparatus to get emptied and filled more completely. Yogic breathing raises and descends the diaphragm a lot more, increasing vertical diameter of thoracic cavity.²⁶ This allows in inhaling more, thus pulling more oxygen lower into the lungs, resulting in more perfusion of lungs thus increasing the efficiency of oxygen infusion into the blood stream because the oxygen is exposed to more of the blood. In breathing exercises like kapalbhati powerful strokes of exhalation in quick succession with contraction of abdominal and diaphragmatic muscle trains the subject to make full use of diaphragm and abdominal muscles in breathing.²⁶ Procedures like Kapalbhati and Nadishuddhi help in removal of infective nasal secretions, clearing up respiratory passages and alveoli. Yoga with its calming effect on the mind can

reduce and release emotional stresses thereby withdrawing the bronchoconstrictor effect.²²

Yoga asanas and pranayama have been observed to lower rate of respiration, increase FEV1/FVC, increase slow vital capacity, maximal voluntary ventilation and PEFr, expansion of chest, vital capacity, ability to hold breath and reduce bronchial hyperactivity.^{34,35,36}

The exact mechanism involved in improvement of PEFr is not known, however nostril breathing releases epinephrine in patients reducing parasympathetic bronchomotor tone resulting in increased basal airway calibre.^{37,38}

The minimum production of carbon dioxide in the body decreased metabolic activity in meditation results in closing of respiratory rate and heart rate. The basic need for oxygen decreases muscle activity decreases in stillness observed during meditation that results in calmness.^{39,30}

Breathing out forcefully decreases the pCO₂ which act on the chemoreceptor area of the brain to modify neurons of respiration in the respiratory centre.⁴⁰

Other Benefits

Pranayama and relaxation stretch also result in a relative hypometabolic state and improvement of physical and mental efficiencies.⁴¹

The subjects felt relaxed. They have showed lower scores in excitability, aggressiveness, openness, emotional and somatic complaints. ⁴²

They felt happy which has been associated with increased levels of endorphins and enkephalins after yoga. ⁴³

Conclusion

India has a rich tradition of Yogic practices. Lifestyle modifications like yoga, the ancient practice of postures, breathing and meditation, are gaining importance by healthcare professionals. Considering the findings, the present study suggested that regular practice of Yoga improved cardio-ventilatory functions as shown by increase in PEFr and fall in RR, PR and SBP.

It revealed that Yogic practices decrease the risk of disease directly or indirectly by promoting health and fitness. Pranayamic breathing techniques can be used effectively for fitness, prevention and therapeutic purposes, either alone or as an adjunct therapy. It may obviate the need of drug therapy or

may decrease the dosage or reduce the number of drugs needed. It may be assumed that Yoga adjunctively with conventional therapy may lead to quicker control as well decreasing therapy dosage and duration.

Yoga reconditions the behaviour pattern in each of us ensuring unity and harmony, poise and calmness in the mind and serenity in the self. This is the best personality one likes to possess wherein, he not only lives within himself in perfect maturity, clarity and peace but also with society.

Prevention is not the best cure, it is the only cure. Daily regular correct practice (Abhyasa) of the yogic routine may condition the cardiac and respiratory system leading to prevention and onset of diseases like Asthma, COPD and Hypertension more importantly in the latter stages of life. In light of these facts, it can be said that Yogic practices can be adopted as a potent way of maintaining health and fitness, giving a feeling of well being, alertness, and attentiveness.

Lacunae and Further Studies

We would have liked to study the immediate effects of pranayama at regular intervals after 7, 21 and 40 days to understand the physiological changes scientifically that would have made it clearer as to how long does the beneficial effects take to make a change. However due to financial constraints and practical follow up issues, we were unable to do it. It is a matter that needs to be studied in future research. This will help us analyse the difference of immediate effects and as a result of adaptation, as a consequence of regular practice making it a habit inculcating it in daily routine of subjects.

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To Determine the Effect of a Muscle Energy Technique and Therapeutic Jaw Exercises on the Range of Mouth Opening

Sanjai Kumar*, Meenu Singh**, K. Nagaraju ***, Arvind Kumar Shukla****

Abstract:

Objectives: To evaluate whether a specific muscle energy technique (MET) would have an effect on the vertical range of mouth opening compared to therapeutic jaw exercises and non interventional control group? **Subjects:** Twenty-one (N=21) subjects aged at least 20 years were recruited in the study. **Design:** An experimental design study. Pre-test and post-test match subject design. The participants were randomly divided into three groups (Group A, Group B and Group C). Group A received Therapeutic Jaw Exercises, Group B received specific MET and Group C was non-interventional control group. Instruments for jaw opening distance were obtained prior to the application of any therapy. All groups completed a Temporomandibular dysfunction checklist, to determine the symptoms of temporomandibular joint dysfunction, before the intervention, immediately after the intervention, 5 minutes after the intervention, 10 minutes after the intervention, 20 minutes after the intervention, 30 minutes after the intervention and one week post intervention. A questionnaire to determine the patient's own perception of pain was administered prior to the intervention, immediately after the intervention, 5 minutes after the intervention, 10 minutes after the intervention, 20 minutes after the intervention, 30 minutes after the intervention and one week post intervention. In this study only the outcome of range of jaw opening is discussed. **Data analysis:** The collected data was mean and standard deviation and has been analyze using STATA software. The t-test was used to analyze the difference in the vertical mouth opening improvements in Group A, Group B and Group C. Intra group analysis between pre-intervention, immediate after, 5 minutes, 10 minutes, 20 minutes, 30 minutes and one week after the intervention scores was also done for all the groups. A significance level of Pd"0.05 was fixed. **Results:** The result of my study showed that there is a gradual significant improvement in Group A and immediate significant improvement in Group B while there in no significant improvement in control group i.e. Group C. So, MET and therapeutic jaw exercises are useful techniques in improving TMJ range of opening. **Conclusion:** The results of my study supports the hypothesis, within the limitation of this study, that, the application of MET and Therapeutic Jaw Exercises improves the range of opening of the TMJ. The result of this study provides a base for further research as they presents valuable outcomes for practitioners treating TMJ dysfunctions.

Keywords: Muscle Energy Technique, Therapeutic Jaw Exercises, Temporomandibular Dysfunction.

Introduction

Temporomandibular dysfunction comprises an assortment of signs and symptoms including the pain on function, joint tenderness, restricted jaw

movement, clicking, jaw locking and tenderness in muscles of mastication.¹ Hypertonicity of the primary muscles of the mastication (masseter, medial and lateral pterygoids, temporalis), regardless of etiology, may reduces the mobility of temporomandibular joint (TMJ) resulting in a reduced range of mouth opening. This restriction is one of the sign of the temporomandibular dysfunction, as is pain, locking, headache and tinnitus. Studies has reported that 75% of the general population will have some type of TMD symptoms² and it is estimated that more than 85 to 90% of people will display one or more of the TMD symptoms in their lifetime^{3,4,5}.

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Aims and Objectives

To evaluate whether a specific muscle energy technique would have an effect on the vertical range of mouth opening on the TMJ compared to therapeutic jaw exercises and non interventional control group?

Operational Definition

Linear Technique of Measurement of Range of Mouth Opening

Range of mouth opening is the distance, which is measured from the incisal surface of the mandibular central incisor and the corresponding maxillary central incisor edge when the mouth is maximally opened, has been used extensively in research conducted by Carlson⁶. Although, in the previous research it has been determined that the measurement should include the amount of overlap between the upper and lower central incisors when the teeth are in occlusal position, plus the inter- incisally range of opening⁷⁻¹⁴ and as this study is an evaluation of mouth opening ability we considered the inter-incisal measure as the most appropriate measurement method. It is inexpensive, non-invasive easy to use and applicable for use in general practice⁴. An inter-incisal distance of less than 40 mm represent a restricted range of motion^{7,8,10,11,15,16} while normal range of mouth opening is expected in between 45 to 60mm in males and 40 to 55mm in females⁹. Mouth opening should be free of joint noise, smooth and without deviation⁷.

Therapeutic Jaw Exercises

Muscles exercises are of great value in the treatment of TMD. Therapeutic manual therapy and exercises have yielded favorable results in the rehabilitation of TMD^{13,23,25}. Stretching exercises are designed to increase the range of motion of the mandible. The purpose of exercises for the masticator system are (1) to achieve the relaxation of the tense muscle, (2) to retain the coordination and rhythmic muscle function, (3) to increase mandible range of motion(isotonic exercises), (4) to increase muscle strength(isometric exercises). Such activity stimulates the muscle spindles and Golgi tendon organ reducing the excessive activity. The principle is that when a muscle is actively contracted, it's antagonists are reflexly relaxed. Therefore opening of the mouth against resistance tends to relax the contracted elevator muscles and vice versa for opening muscles. The fact that physical therapy is non invasive and

does not appear to be fraught with irreversible changes makes it a very applicable vehicle in the area of clinical TMJ dysfunction management^{17,26}.

Muscle Energy Technique

Muscle energy technique (MET) is a technique whereby the patient actively uses their muscles against a counterforce produced by the practitioner. The practitioner controls the intensity, time and direction. According to Greeman²⁷, MET can be used "to lengthen a shortened, contracted or spastic muscles, to strengthen a physiologically weakened muscle or group of muscles, to reduce localized edema and relive passive congestion(the muscles are the pump of the lymphatic and venous systems), and to mobilize an articulation with restricted mobility."

They are used primarily by osteopath to treat muscles with excessive tension that limits joint motion^{28,29}. However, the treatment of TMJ using MET has not commonly been documented, although it may have a beneficial outcome on the limited range of motion frequently associated with TMD³⁴. Malone⁸ advocates the uses of "hold-relax" techniques (similar to muscle energy technique) on the mandible elevator (temporalis, masseter, medial and lateral pterygoids), to improve the functional mobility of TMJ, and range of mouth opening. MET treatment of TMJ must be considered as a valid treatment approach for TMD if it can be shown to improve functional range.

Hypothesis

Null Hypothesis: There will be no significant difference in mouth opening after giving the specific MET and TJE in TMD.

Alternative Hypothesis: There will be a significant difference in mouth opening after giving the specific MET and TJE in TMD.

Limitation of study

The small sample size was one of the major limitations of the study. Also, most of the participants belonged to the same community and were leading an active lifestyle. Thus, results obtained cannot be generalized for all population types.

Inclusion Criteria

With a restricted mandibular range of motion of 40mm or less measured inter-incisally.

- ☉ Temporomandibular Disorders as-
- ☉ Pain on function,
- ☉ Joint tenderness,
- ☉ Restricted jaw movement,
- ☉ Clicking,
- ☉ Jaw locking and
- ☉ Tenderness in muscles of mastication.
- ☉ Hypertonicity of the primary muscles of the mastication (masseter, medial and lateral pterygoids, temporalis).

All volunteer signed the informed consent prior to participating in the study.

Exclusion Criteria

Subjects were excluded if they had been found previously diagnosed a systemic arthropathy such as-

- ☉ Rheumatoid Arthritis,
- ☉ Malignant Tumor of the face or jaw,
- ☉ Previous history of jaw or TMJ surgery,
- ☉ Fracture of jaw or TMJ.
- ☉ Subjects have/had dental/orthodontic treatment within past seven days.

Design

An experimental design study. Pre-test and post-test match subject design.

Instruments and Special Testing Tools

Standard transparent measuring scale, MET and TJE.

Materials

Couch and mouth opener.

Protocol

A sample of volunteer participants (N=21) with a restricted mandibular range of motion of 40mm or less measured inter-incisally were recruited for study. Symptomatic and asymptomatic participants (age 25.14±09.41 range 20-58 years, males 10 and females 11) were recruited from the Subharti Dental College O.P.D, Subharti College of Physiotherapy O.P.D. and Jai Physiotherapy and Dental Clinic, SF-06, Ansal Galleria, Ansal Town, Meerut. These subjects were

than randomly divided into 3 groups (i.e. Group A – TJE Group, Group B –MET Group and Group C – Control Group) each with an equal numbers of participants. The control group did not receive any treatment. Measurement of jaw opening were made pre-intervention, immediately after, after 5 minutes, after 10 minutes, after 20 minutes, after 30 minutes and one week after the application of intervention.

Procedure

The participants were divided into three groups randomly (i.e. Group A – Therapeutic Jaw Exercises, Group B – MET intervention Group and Group C – Control Group,) each with an equal numbers of participants. Then measurement of jaw opening were made pre-intervention, immediately after 5 minutes, 10 minutes, 20 minutes, 30 minutes and one week after the application of intervention.

Mandibular range of opening was measured inter-incisally by linear technique, and not including the degree of overlap between the teeth when in the closed position. This involved a measurement being taken with a transparent ruler as the participants opened their mouth to the maximum possible distance. The distance between the edges of the upper central incisors and the lower central incisors was determined as the inter-incisor range of opening^{6,8,10,15,16}.

The TJE technique used in this study included stretching, guided opening and closing movements and manual opening of jaw. At the start of the treatment period all participants were given a presentation and practical demonstration of the exercise program by the treating practitioner. Patient used a clenched fist under the jaw to provide the resistance to opening. With fingers holding lower teeth, patient resisted closing the mouth. Using a clenched fist held on the side of the jaw, the patient resisted the side movement (lateral excursion). By placing the thumb on the top row of teeth and index finger on lower teeth the patient actively stretched the mouth open. All movements held for a couple of seconds. All the movements were repeated 10 times to complete one set. Five sets were required for each movement. This regime occurred once^{17,25}.

The MET technique used in this study involved the treating practitioner placing gloved thumbs on the lower molars on both sides of the participants jaw, whilst the participants lay supine with the mouth open. The participants was asked to attempt closing the jaw using 20% of their total effort as the practitioner provided an equal resistance with the thumbs, so that no movement occurred. The treated

practitioner instructed the participants to ensure that the force of contraction was approximately 20% of their total effort and was not excessive or likely to cause pain or muscle soreness. After a 5 second contraction, the participant relaxed the jaw muscles and then the practitioner gently opens the jaw to the maximal distance possible and the participant was again asked to attempt closing the jaw using 20% of their total effort. This contract-relax procedure was repeated five times^{28,34}.

The non intervention group had also taken measurements of jaw opening again as taken previously in TJE and MET Groups. Participants were asked to lie on the couch in a comfortable position, while the physiotherapist stood on the right hand

side. All treatment were performed on the participants at the Subharti College of Physiotherapy O.P.D. and Jai Physiotherapy and Dental Clinic, SF-06, Ansal Galleria, Ansal Town, Meerut. All measurements were taken with the subject lying supine on the treatment table, while the physiotherapist stood on the right hand side.

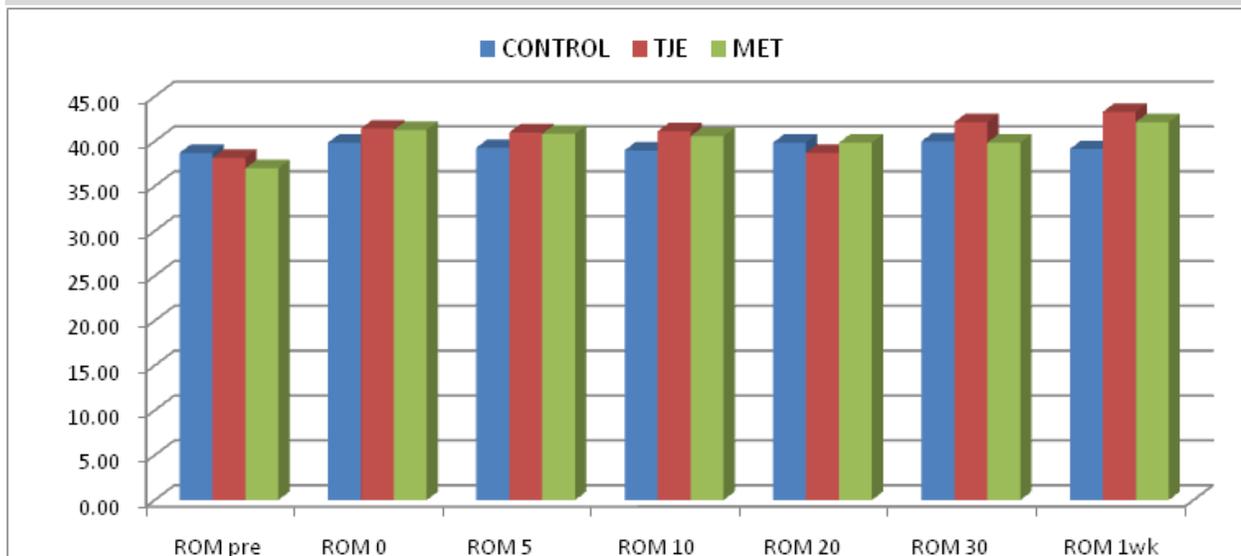
Analysis of the data

The collected data was mean (M) and standard deviation (S.D.) and has been analyze using STATA software. The t-test was used to analyze the difference in the vertical mouth opening improvements in Group A, Group B and Group C.

Table 1: Mean and SD of all the groups at different intervals.

Group		ROM pre Excs	ROM 0 Excs	ROM 5 Excs	ROM 10 Excs	ROM 20 Excs	ROM 30 Excs	ROM 1wk Excs
TJE	Mean	38.14	41.43	41.00	41.14	38.71	42.14	43.29
	SD	3.67	3.82	3.83	3.89	4.68	3.48	5.02
MET	Mean	37.00	41.29	40.86	40.57	39.86	39.86	42.14
	SD	3.70	3.68	6.77	5.32	4.95	4.49	5.40
CONTROL	SD	1.50	2.04	1.80	1.91	2.91	3.16	1.88

Fig. 1: Mean and SD of all the groups at different intervals.



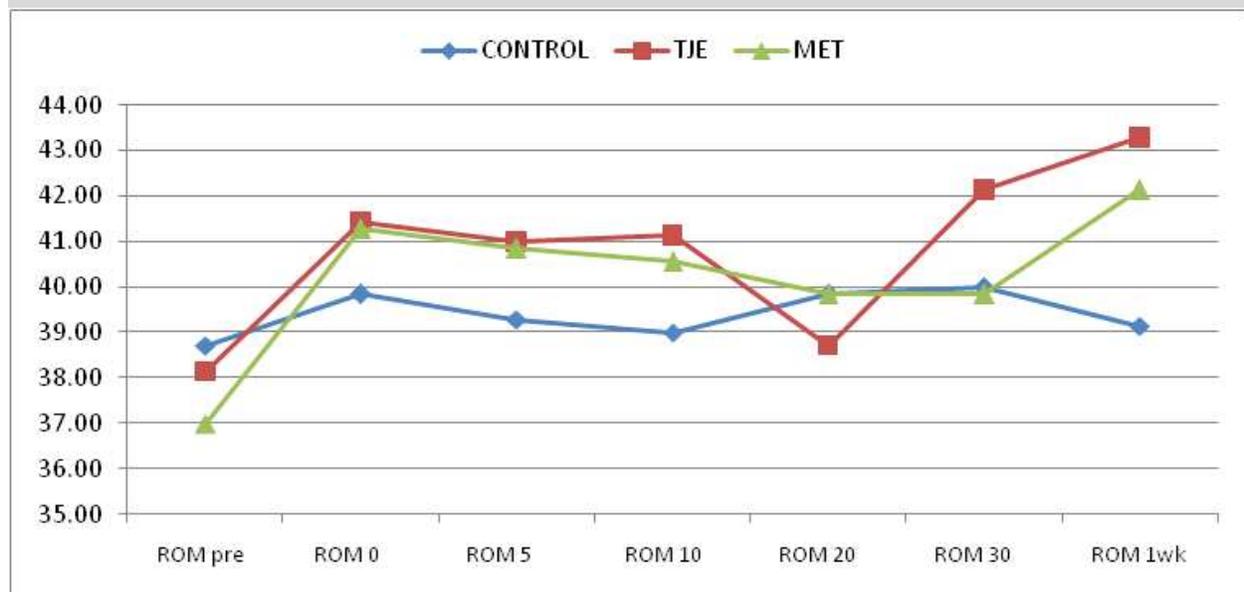
Mean Difference was (3.00,3.57,0.29) and P-Value was (0.163,0.170,0.757), which showed the improvement in mouth opening in both groups (A & B).

On comparing of TJE, MET and Control Group, the pre-intervention and 20 minutes after intervention Mean Difference was (0.57,2.86,1.14) and P-Value

Table 2 : Mean Difference and P-Values of TJE, MET and Control groups at different intervals.

GROUP	MEAN DIFF. (PRE VS IMM.)	P-VALUE	MEAN DIFF. (PRE VS 5 MIN.)	P-VALUE	MEAN DIFF. (PRE VS 10 MIN.)	P-VALUE	MEAN DIFF. (PRE VS 20 MIN.)	P-VALUE	MEAN DIFF. (PRE VS 30 MIN.)	P-VALUE	MEAN DIFF. (PRE VS 1-WEEK)	P-VALUE
TJE	3.29	0.126	2.86	0.179	3.00	0.163	0.57	0.804	4.00	0.058	5.14	0.048*
MET	4.29	0.050*	3.86	0.210	3.57	0.170	2.86	0.244	2.86	0.260	5.14	0.059
CONTROL	1.14	0.252	0.57	0.524	0.29	0.757	1.14	0.371	1.29	0.348	0.43	0.644

Fig. 2 : Mean Difference and P-Values of TJE, MET and Control groups at different intervals.



The t-test was used to analyze the difference in the vertical mouth opening improvements in Group A, Group B and Group C. Intra group analysis between pre-intervention, immediate after, 5 minutes, 10 minutes, 20 minutes, 30 minutes and one week after the intervention scores was also done for all the groups. A significance level of Pd"0.05 was fixed.

Results

All the participants completed the treatment and no adverse events were reported for any of the interventions. There was a significant improvement in vertical mouth opening after receiving the short term TJE and MET program that specifically emphasize for experimental group i.e. Group A and

Group B. MET and TJE both were given to the subjects in supine position on the couch, while the physiotherapist stood on the right hand side of the couch.

On comparing of TJE, MET and Control Group, the pre-intervention and immediate after intervention Mean Difference was (3.29,4.29,1.14) and P-Value was (0.126,0.050*,0.252), which showed the immediate significant improvement in mouth opening in MET group.

On comparing of TJE, MET and Control Group, the pre-intervention and 5 minutes after intervention Mean Difference was (2.86,3.86,0.57) and P-Value was (0.179,0.210,0.524), which showed the improvement in mouth opening in both groups (A & B).

On comparing of TJE, MET and Control Group, the pre-intervention and 10 minutes after intervention

was (0.804,0.244,0.371), which showed the improvement in mouth opening only in group A.

On comparing of TJE, MET and Control Group, the pre-intervention and 30 minutes after intervention Mean Difference was (4.00,2.86,1.29) and P-Value was (0.058,0.260,0.348), which showed the improvement in mouth opening in both groups (A & B).

On comparing of TJE, MET and Control Group, the pre-intervention and 1 week after intervention Mean Difference was (5.14,5.14,0.43) and P-Value was (0.048*,0.059,0.644), which showed the improvement in mouth opening in both groups (A & B). But the improvements in mouth opening was more significant in Group A (TJE).

It is interesting to note that in the TJE group the range of motion in fact decreased at 20 minutes interval. An explanation for this could be recognized to muscle fatigue and micro tearing of the muscles of mastication due to repetitive motion under load. This theory is supported by Pertes¹⁷ and Magnusson²⁵.

Both the TJE and MET group had an increase range of motion sustained for 7 days post intervention, which was 5.14mm in each but the P-Value was 0.048* and 0.059*. The control group also had an increase in range of motion immediately post intervention; this was sustained at the 20 and 30 minutes intervals but all was lost 7 days post.

Thus, after analysis of all the data, the result of my study showed that there is a gradual significant improvement in Group A (TJE) and immediate significant improvement in Group B (MET) while there is no significant improvement in control group i.e. Group C. So, MET and therapeutic jaw exercises, both, are useful techniques in improving TMJ range of opening.

Discussion

The results of this study suggests that a specific muscle energy technique to the muscles of mandibular elevation and the therapeutic jaw exercises, both, can improve the range of jaw opening in persons with restricted jaw movements.

Immediate to post intervention both MET and TJE groups had an increase in range of jaw opening of 4.29mm and 3.29mm respectively.

It is interesting to note that in the TJE group the range of motion actually decreased at the 20 minutes interval. An explanation for this could be recognized to muscle fatigue and micro tearing of the muscles of

mastication due to repetitive motion under load. This theory is supported by Pertes¹⁷ and Magnusson²⁵.

Both the TJE and MET group had an increase range of motion sustained for 7 days post intervention, which was 5.14mm in each but the P-Value was 0.048* and 0.059*. The control group also had an increase in range of motion immediately post intervention; this was sustained at the 20 and 30 minutes intervals but all was lost 7 days post.

The present study measures range of motion of the TMJ using <40mm of opening as a guide to dysfunction. In contrast other studies have focused on pain or the completion of the temporomandibular dysfunction checklist as an indication of dysfunction or a combination of all three³¹.

Pain is the most common presenting complaint and the most difficult to evaluate. It is an unpleasant sensory and emotional experience that is always subjective and therefore difficult to measure^{32,33}. The assessment of temporomandibular dysfunction using checklist strongly involves subjective data making it difficult to obtain reliable results³¹.

In comparison measurement of range of motion of temporomandibular joint using a plastic ruler and the protocol described in text involves objective measurements demonstrated to be reliable¹⁵.

Physiotherapy modalities aim to improve the range of opening to a liner measure greater than 40mm^{4,7}. This was supported in the current study by an increase in range of mouth opening in the TMJ group and in the MET group over a 7 days period. It is previously reported that a multi disciplinary approach to TMD is of the greatest benefit to the patient^{6,17,23,30}.

Conclusion

This study shows that applications of either a specific MET for the muscles of the TMJ or specifically designed TJE is produce an increase in range of motion in the TMJ. The MET application was mildly more effective being sustained 7 days post intervention. However, both MET and TJE seem to be useful in the treatment of TMD and should be practiced with caution in the clinical setting until further studies demonstrate the clinical effectiveness of the combined use of these treatment modalities in both asymptomatic and symptomatic populations.

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A study to compare the Delorme and DAPRE strength training regimens

Shalini Sharma*, Piyush Singh**, Saurabh Sharma***

Abstract:

The strength training is an essential tool for rehabilitation of patients and also as component of fitness. Hence it becomes important for a therapist to understand the strength development potential of various regimes available. This study is performed as a Pretest-posttest experimental research design. 50 subjects were included and were randomly assigned to one of the treatment group: Delorme group and Dapre group. Strengthening Regimen was conducted for a period of 6 weeks in both the groups. One repetition maximum was the outcome measure. This was assessed at baseline and reassessed at the end of 6 weeks. A paired t-test was used to evaluate results within the group. Student's t test was used for between the group analysis. The results of the study shows significant improvement in one repetition maximum with Delorme as well as the DAPRE group. DAPRE group shows statistically significant effects on strength gains on between group analysis ($t = p < 0.01$). Within the group both the groups were significantly effective in one repetition maximum after the intervention ($p < 0.01$).

The study concluded that Daily Adjustable Progressive Resistive Exercise (DAPRE) is recommended as it is having sustained effects at follow up.

Key words: One repetition maximum, Delorme regimen, DAPRE regimen

Introduction

Resistance training is a vital tool in rehabilitation and fitness and its growth has been exponential, as it is helpful in improving muscular strength, power, endurance and motor execution.¹

Progressive resistance training regimes are able to produce adaptations as per need analysis which is predetermined by assessment. The paramount conditioning principle of resistance training is overload, specificity and variations². Graded escalation in demand placed on body is required and can be gained by manipulating one of the below mentioned variables³. 1) Exercise intensity (load for a given exercise/movement) may be increased; 2) Total repetitions performed at the current intensity may be increased; 3) Repetition speed/tempo with submaximal loads may be altered according to

goals; 4) Rest periods may be shortened for endurance improvements or lengthened for strength and power training; and 5) Training volume (total work represented as the product of the total number of repetitions performed and the resistance) may be gradually increased (e.g., 2.5-5%).

The magnitude of improvement depends upon the individual's training status and genetic predisposition⁴. Traditionally, the 1-repetition maximum (1-RM), is the maximum load that can be moved through the full arc of motion in a proper and controlled manner with good posture. This has been the standard for dynamic strength assessment⁵. Researcher suggests that novice lifters should not be permitted to undergo 1 RM testing to prevent muscular injury⁶. The solution for novice lifters lies in prediction equation which help in estimating weight for larger muscle mass exercises for male subjects⁷. The injury chances associated with novice lifter testing for 1RM are eliminated by using the prediction equations. As per Delorme strength training exhibits swifter results in atrophied muscles if high load and less repetition are used. The authors concluded that magnitude of resistance is directly linked to muscular hypertrophy⁸. The above mentioned authors recommended upper limit of repetition as 20-30 as greater than this would lead

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to development of endurance⁸. Interfering factors for strength evaluation include learning aspect, inability to generate maximal force, and fear of discomfort⁹. Due to this, DeLorme was of the opinion that the initial 10RM was mostly wrong estimation of a subject's strength. Initial brief surge in strength occurred followed by lesser gains in strength⁸. Warm up lifts were conducted with lesser weights and lesser repetition in order to avoid fatigue⁸. These initial lifts served as learning tool, warm up measure, so that maximum exertion is performed. In performing the DeLorme technique, Zinovieff faced persistent trouble due to exhaustion of the quadriceps muscle during the last phase of the exercise regimen⁹. 10 RM was not completed due to temporary failure of muscle¹⁰. As the fatigue set in full ROM was not available and only the few trained could execute it. Many authors have suggested that the 10RM should not be the apex target in strength training^{12,13}. Instead, the target should be to generate muscle exhaustion¹⁴. Linnamo et al. looked at fatigue and recovery of a muscle with explosive loading¹⁵. Chilibeck et al. did research on women strength training and concluded that magnitude of hypertrophy was lesser than in males¹⁶. Charette et al. found that age is not a interfering factor to develop strength and hypertrophy in elderly females¹⁷.

Till the advent of the Daily Adjustable Resistive Exercise technique (DAPRE), there was no means to determine either the optimal time to increase resistance or the optimal amount of weight to increase the resistance²². The DAPRE technique is considered to overcome these pitfalls. The efficacy of strength training is proven but there are conflicting results for the most efficacious way to train. The aim of this study was to evaluate the efficacy of the two PRE regimes.

Methods

This study has a Pretest- posttest experimental design. Subjects were included as per following inclusion criteria: 18 to 26 years of age of either genders, within normal BMI (21-23), who had right-handed dominance, and who were willing to participate and abide by the instructions given for the purpose of the study. Exclusion criteria involved having any neuromuscular deficits, cognitive deficit, sensory dysfunction in the tested limb, soft tissue injury or skin laceration in arm and forearm region, any surgery in the tested side, had fracture in the test-side upper limb, any cardiovascular and

respiratory problems, any history in involvement in any kind of resistive training in the past 6 months.

Procedure

Sixty subjects were screened with the help of history taking for exclusion. The fifty four subjects met the inclusion criteria. A detailed explanation about the procedure was given. And subjects were then asked to read and sign the informed consent. Fifty subjects were recruited and participated in the study. The subjects were then divided into two groups by simple randomization. Demographic data and dependent variables were recorded. After randomization pre-intervention measures of 1 RM (Repetition Maximum) was taken. 1RM is the commonly used procedure to assess muscle strength. It is a reliable and valid method ($r = 0.79-0.99$)¹⁸. The subject was asked to sit on a chair (without arm rest) in high sitting position, elbow extended (right side) to facilitate the testing of biceps brachii muscle. Range of motion for testing was from 0 degrees (full elbow extension) of elbow flexion to 120 degrees. To prevent elbow abduction with training and testing, a Velcro strap was used to stabilize the elbow. Prior to the repetitions-to-fatigue attempt, the subjects performed 6 to 10 warm-up repetitions with 50% of the estimated workload. The subjects were told to try to perform the most of repetitions until the offered resistance was impossible to be sustained. The athlete is asked to develop synchrony between beep sound and movement. The beep timing is adjusted such that the subject can do the training with comfort without compromising exercise form. A metronome will time the performance of the movement so that the accuracy is further maintained. From the equations available in the literature, the mathematical model proposed by Bryzcki was chosen to estimate one repetition maximum from n-repetition maximum¹⁹:

$$1 \text{ RM} = \text{weight lifted during } n \text{ RM} / (1.0278 - .0278(n))$$

The subjects were familiarized before start of the study so that chances of reproducibility are higher. Each group respectively underwent an intervention for six weeks depending upon their designated group. Subjects in DeLorme group, on the days of exercise training (Monday, Wednesday, and Friday), performed some light stretching and warm-up exercises such as mild walk for 10-15 minutes¹⁰. The 10 RM was determined by using the prediction equation: 10 RM is 75% of 1 RM¹⁹. The group began their first set of ten repetitions at 50% of 10 RM, the second set of ten at 75% of 10 RM, and the third

set of ten at 10 RM (with a slow to moderate speed that is 2:2). Each lift was controlled in both concentric flexion and eccentric extension of the elbow corresponding to the “flex” and “extend” of the metronome 10. Inter set rest time was fixed at 1-minute. During each repetition the joint flexed and extended as fully as possible with a brief (one-third of a second) pause at the two extremes of the motion. At the beginning of the next week of training, a new 10 RM was established and based upon the established 10 RM the protocol was followed.

Subjects in the Daily Adjustable Resistive Exercise group (daily except on Sundays) performed four sets of exercises. 6RM was determined from the prediction equation of 1RM. 6 RM is 86% of 1 RM 20. The first two sets consisted of ten and then six repetitions, performed against one-half and three-fourths of the previously established working weight. These repetitions were performed deliberately (although not too slowly with a slow to moderate speed that is 2:2) During each repetition the subject had to move the joint through full range with a brief (one-third of a second) pause at the two extremes of the motion 21. These sets act both to warm-up and to educate the muscles and neuromuscular structures involved 21. The full working weight was used on the third set, and the subject performed as many repetitions as possible. The number of full repetitions performed on the third set was used to determine the adjusted working weight for the fourth set. Maximal repetitions were performed on the fourth set, and the number performed was used to determine the working weight for the next day 21. Subjects were instructed to refrain from a sudden jerk or explosive contraction at the beginning of extremes of flexion and

extension, and to control the weight during the eccentric phase of the repetition 10. Each lift was controlled in both concentric flexion and eccentric extension of the elbow corresponding to the “flex” and “extend” of the metronome with the normal breathing pattern (exhale while lifting the weight and inhale while coming back to the starting position) 10. 1-minute rest is provided between each set. The outcome variable (1 RM) was measured after 6 weeks of intervention.

Statistical analysis

Data analysis was done using SPSS software (version 10.5). Students’s t test was used for in between analysis and paired t test was used for within group analysis for both the groups.

Results

subjects in the two groups were homogenous with the mean age 22.12yrs., weight 61.46kg, height 1.67 m, and BMI 21.91. The results of the study shows significant improvement in strength (1-RM) with Delorme as well as Dapre groups in within group analysis. Dapre group shows more significant effects on strength gains (1-RM) which was analyzed with t-test as compared with Delorme group as shown in table and fig. . The level of significance was decided at p<0.01.

The table 1 shows, that the two groups Delorme and DAPRE are homogenous regarding demographic details as age, height, weight and BMI.

Percentage increase in the value of strength gains - Group 1(Delorme)

Table 1 : Comparison of Age, Weight, Height, BMI between two groups (Group 1=Delorme, Group 2=DAPRE)

	Grp.1(N=25)		Grp.2(N=25)		t-value
	Mean	SD	Mean	SD	
Age	22.12	1.53	21.72	1.69	.87
Wt.	61.46	7.79	62.83	8.03	.61
Ht.	1.67	.057	1.69	.076	1.30
BMI	21.91	2.16	21.73	1.77	.32

NS Non significant at p<=0.05

$\frac{\text{Post RM} - \text{Pre RM}}{\text{Pre RM}} * 100$

Pre RM

$\frac{5.68 - 4.82}{4.82} * 100 = 17.84\%$

4.82

Group 2 (DAPRE)

$\frac{\text{Post RM} - \text{Pre RM}}{\text{Pre RM}} * 100$

Pre RM

$\frac{6.08 - 4.18}{4.18} * 100 = 45.4\%$

4.18

Discussion

The backing of scientific evidence behind resistance training has popularised this means very

much. It helps in improving neuromuscular functions well as maintaining or improving fitness.

Strength gain is the aim of many resistance training regimes. Poor muscular fitness increases the chances of neuromusculoskeletal injuries and pathologies and impairments. Therefore experimenting to find the better regime for improving strength seems to be realistic for individuals of all ages and health levels. Thus, the present study emphasized on the determination of the optimal method of developing muscle strength. One group was administered Delorme while the other group performed the Daily Adjustable Resistive Exercise (DAPRE) regime. The effects of the interventions on Repetition Maximum was evaluated post-intervention. When analyzed within the groups, both the groups showed statistically significant improvement in Repetition Maximum (table 2, table 3).

Table 2 : Within group comparison of Pre and Post of 1RM in group 1 Delorme, paired t-test.(N=25)

1 RM	Mean	SD	t-value
Pre	4.82	.776	9.66**
Post	5.68	.828	

** : significant at .05 level.

Table 3 : Within group comparison of Pre and Post of 1RM of group 2 DAPRE, paired t-test.(N=25)

1 RM	Mean	SD	t-value
Pre	4.18	.802	26.87**
Post	6.08	.799	

** : Significant at .05 level

The subjects in the Daily Adjustable Resistive Exercise (DAPRE) regime showed statistically significant improvement in strength gains in terms of 1 Repetition Maximum, post-intervention (table 3, Fig 2). The Daily adjustable progressive resistive exercise technique utilizes the basic principal of progressive resistive exercise to a greater degree than do older programs.

The Daily adjustable resistive exercise technique allows for the individual differences in the rate at which a person regains strength in the muscle and provides an objective method for increasing resistance in accordance with strength increases. Thus this technique ensures that the subject works near his maximal capacity.

On within group analysis the subjects in the Delorme group also showed significant improvements in muscle strength in terms of 1 Repetition Maximum (table 2, Fig. 1). In 1945, Delorme introduced the concept of progressive resistive exercise to post surgical rehabilitation. One of Delorme's hypotheses is that the muscle should be warmed up by the time 10 RM is reached. The principle upon which it works is overload principle.

On between the group analysis both the Delorme and Daily Adjustable Progressive Resistive Exercise (DAPRE) protocol group's subjects improved muscle strength as demonstrated by the difference in the repetition maximum measurement (pre and post-test).

Table 4 : Between group comparison of 1 RM in two groups (Group 1=Delorme, Group 2=DAPRE).

RM	Group1(N=25)		Group2(N=25)		t-value
	Mean	SD	Mean	SD	
Pre	4.82	.78	4.18	.802	2.87**
Post	5.68	.82	6.08	.799	1.74**

** :Significant at .05 level

Fig. 1 : Graphical representation of 1 RM within Delorme group

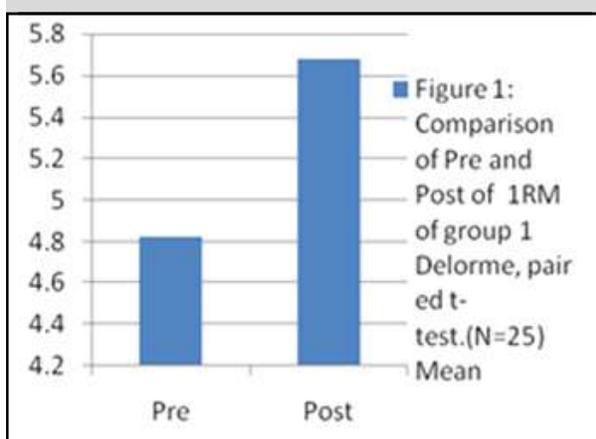


Fig. 2 : Graphical representation of 1 RM within DAPRE group

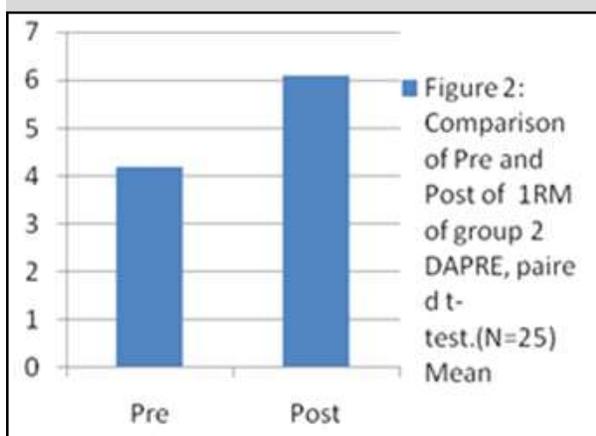
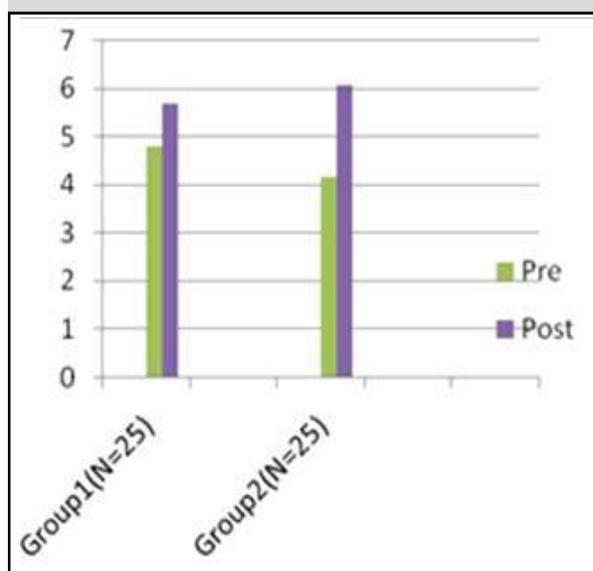


Fig. 3 : Graphical representation of 1 RM between two groups



during the 6-weeks of training. Subjects from both the protocols were able to maintain attendance and compliance with the required lifting assignments. The results of the present study show that Daily adjustable progressive resistive exercise (DAPRE) protocol can develop greater strength gains than the

Delorme protocol. The Daily adjustable resistive exercise group shows significant improvement which was analyzed with t-test as compared with Delorme group. Strength gains with the Daily adjustable progressive resistive exercise (DAPRE) technique have been concluded to be swifter in comparison to the Delorme technique. The basis for Daily adjustable progressive resistive exercise (DAPRE) technique is the regular feedback which the subject and therapist receive during the strengthening sessions, counting the number of repetitions performed on the third and fourth sets provides an objective measure of the amount of resistance to be used for that set 22. This allows for the muscle to exercise against required amount of resistance during the subsequent set 22. This technique allows tailor made method for increasing resistance in accordance with strength increases 22. This method helps in strength improvement

Clinical Implication

This research aimed to compare the two popular strength training regimes. strength training is a part of the rehabilitation program and it involves initially neural and later with continued training muscular adaptations. These adaptations translate into multiple health benefits ranging from systemic to musculoskeletal.

Future scope of the study

The muscle strength measurement with the electromyography is recommended. It is recommended that duration of the study be increased, more number of subjects be included, different muscle groups can be taken, performed on patient population. Future research can be focused on the long lasting effects of the intervention.

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State of the Journal: 2008-2013

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Abstract

Aim : To review the research articles published in POTJ from 2008-2013. **Methodology:** **1.** Articles published from the year 2008-2013 where collected from the journals website, **2.** 94 articles were classified into 13 areas of practice, 6 types of studies and lastly level of evidence for research of design using Liebermann. D & Scheer. J's 'Level of Evidence' **Results:** **1.** Of the 94 studies, only 27% where qualified as level 1 of evidence studies. **2.** Just 3% of the studies were of review type of studies. **3.** Musculoskeletal & Neurology area of practice contribute to almost 59% of the articles. **Conclusion:** Effectiveness studies contributed majorly (approximately 44%) to the journal in 5 years. However, a proportionate research on other wide areas of practice is encouraged.

Introduction

It has been almost 50 years, but still the two sister professions are not been recognized in India's health policy despite of their great relevance. Thus, there is a need to uplift our self with research based attitude and prove our efficacy via evidence based practice.

Research & Evidence based practice is the need of the day. There has been an enormous change in health care as well as the societal structure over the past few years. According to the investment commission of India, the health care sector has experienced a phenomenal growth of 12% per annum in last 5 years due to changing demographics', diseases profiles and the shift from chronic to lifestyle diseases in the country¹. Successful professions plan wisely and determine their own destinies². Thus, we as a profession need to provide strong evidence that substantiates the efficacy and value what we do.

Over the last decade, Physiotherapy & Occupational Therapy Journal (POTJ) has slowly but gradually developed as one of the leading journal in field of Physiotherapy & Occupational Therapy in

India. It has developed into solid research journal increasingly disseminating evidence based research able to inform practice. It is now indexed/ listed for its availability on many of the significant database³. Hence, it is the need of an hour that the professionals should contribute heavily to the field of research with quality papers and thus enrich the journal with articles from a wide spectrum of research areas.

Aim of the study

The aim of the review is to analyze the published articles on basis of -

- Level of evidence
- Type of study
- Area of practice

Methodology

Articles available online on journals' website, published in Physiotherapy & Occupational Therapy Journal from 2008-2013 were taken up for the review. These articles were classified on basis of Sharon Gutman⁴ classification of type of study (Table no. 1). Further to analyze the level of evidence, the articles were reviewed on basis of their research design using Liebermann. D & Scheer. J's 'Level of Evidence'⁵ (Table no. 2). Lastly, articles were classified according to their area of practice (Table no. 3).

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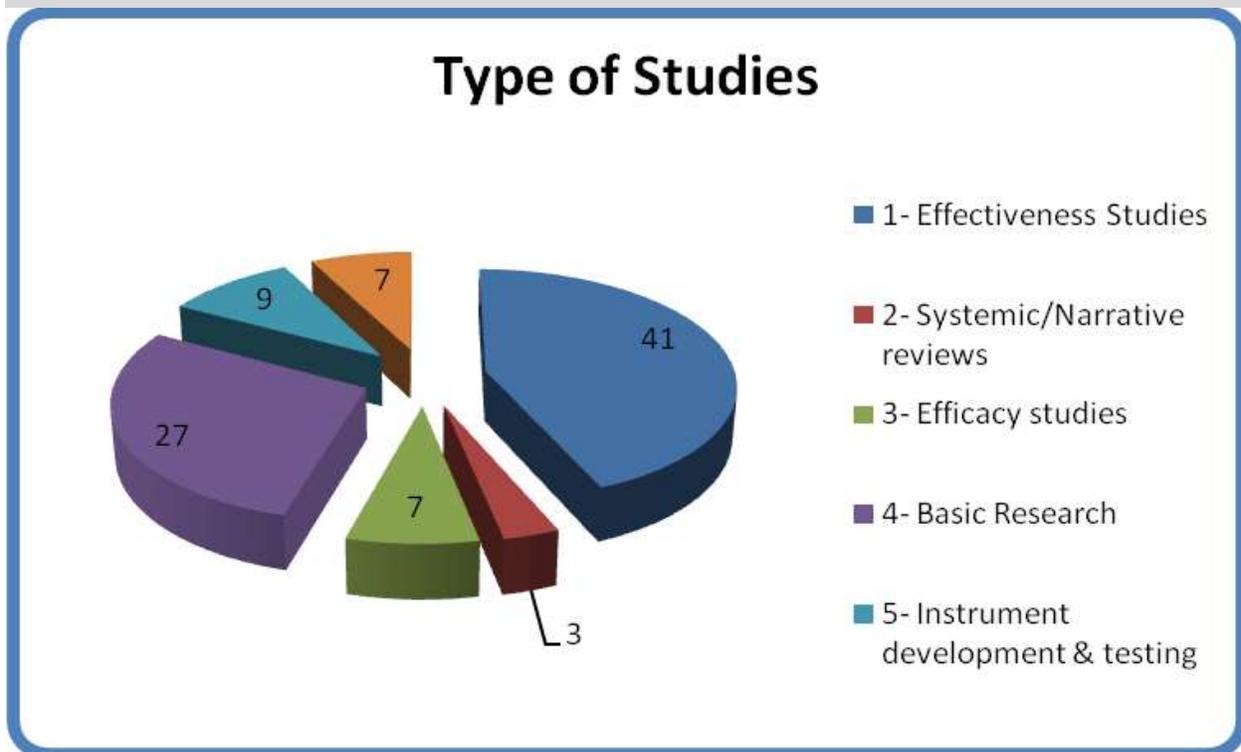
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Data Analysis

Table 1: Type of studies in POTJ, 2008-2013

Type of study	No. of studies	Percentage of studies
1- Effectiveness Studies	41	44
2- Systemic/ Narrative reviews	3	3
3- Efficacy studies	7	7
4- Basic Research	27	29
5- Instrument development & testing	9	10
6- Link between Occupation & health	7	7
Total	94	100

Fig. 1 : Type of studies result



The above table no. 1 & graph 1 represents the type of studies in POTJ from 200-2013. Out of 94 studies been published in journal 44% were

effectiveness studies while only 3 % of the studies were review type. Basic research accounted around second highest criteria with 29%.

Table 2 : Level of Evidence of studies in POTJ, 2008-2013

Level of evidence	No.of studies	Percentage of studies
I- Systemic Reviews, Meta-analyses & Randomized Controlled Trials	26	27
II-Two groups, non randomized studies	12	13
III- One group, non randomized	11	12
IV- Descriptive studies	28	30
V- Case report, Narrative studies	17	18
Total	94	100

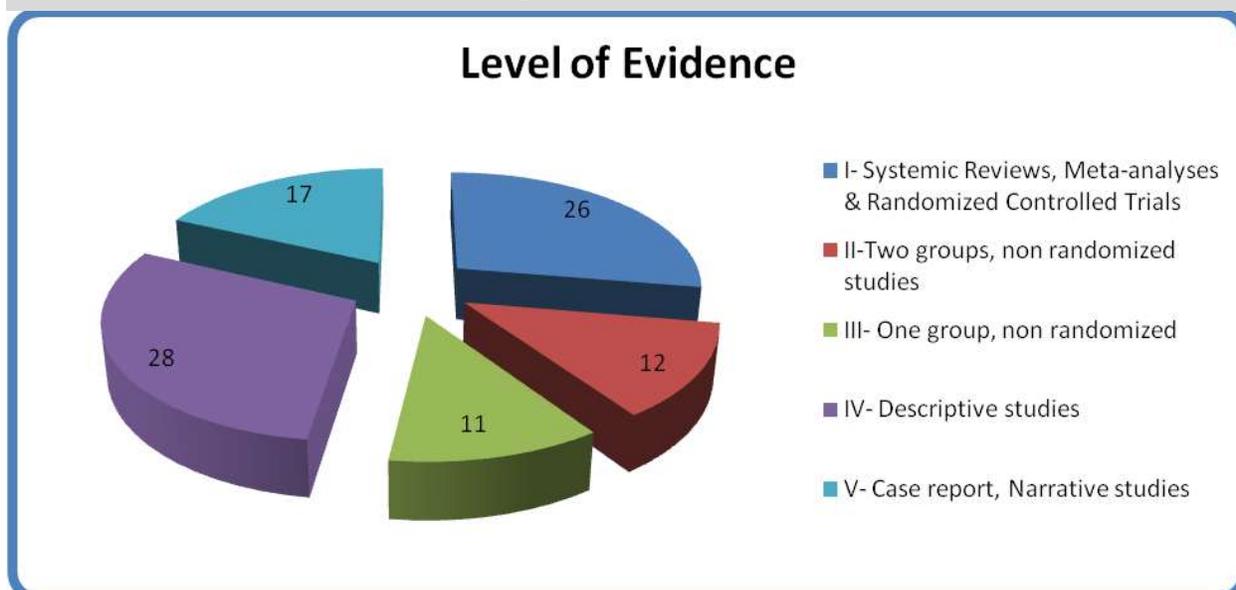
Fig. 2 : Level of Evidence

Table no. 2 & graph 2 represents level of evidence of the studies in POTJ from 2008-2013 where the highest level of study was descriptive study i.e. Level 4

accounting to 30% followed by level 1 which is 27% lastly 12% of level 3.

Table 3 : Areas of practice of studies in POTJ, 2008-2013

Area of practice	No. of studies	Percentage of studies
Musculoskeletal	28	30
Cardiac	7	8
Pulmonary	3	3
Gynaecology	3	3
Advances	5	5
Geriatric	2	2
Neurology	27	29
Pediatrics	4	4
Psychiatry	1	1
Academics	2	2
Scale or Biostatistics	6	7
Sports	2	2
Others	4	4
Total	94	100

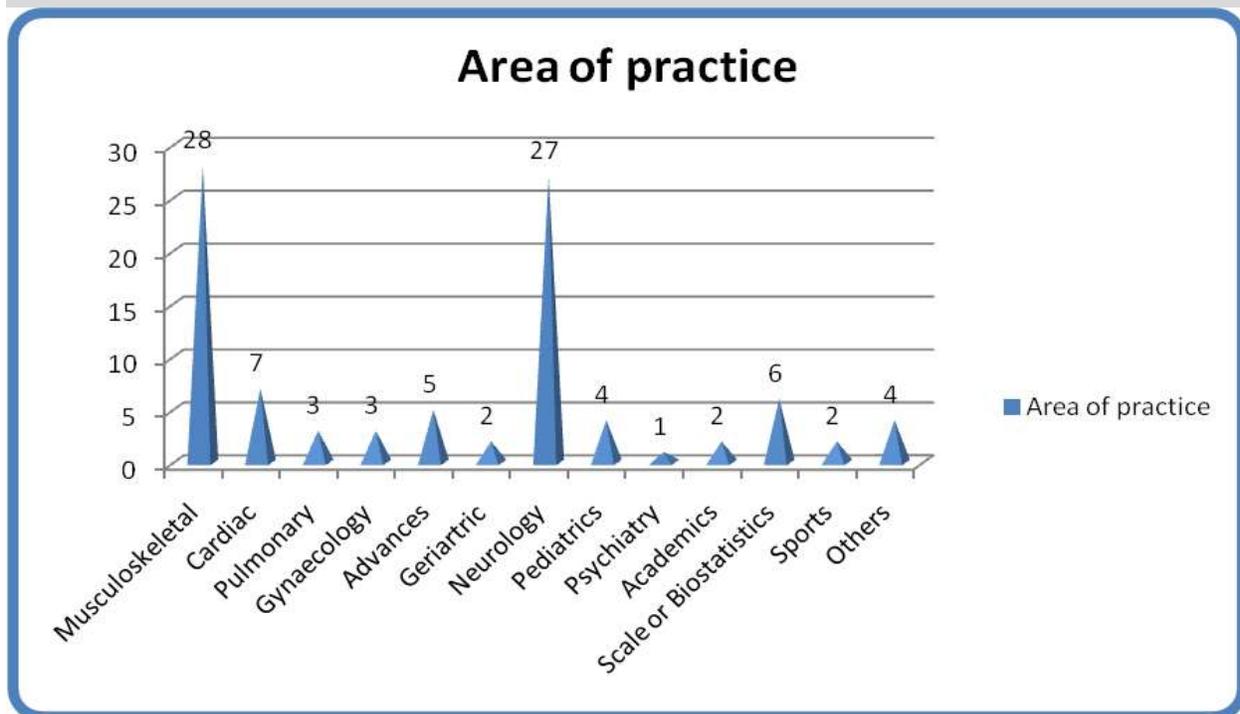
Fig. 3 : Areas of practice

Table no. 3 & graph depicts the areas of practice of articles in POTJ from 2008-2013. In this, musculoskeletal

and neurology together contributed maximally (59%). While psychiatry contributed minimally (1%).

Table . 4 : Type of studies, Level of Evidence & Areas of practice of studies in POTJ in each year from 2008-2013

	2008		2009		2010		2011		2012		2013	
	N=9		N=17		N=21		N=5		N=20		N=22	
	n	%	n	%	n	%	n	%	n	%	n	%
Level of evidence												
I- Systemic Reviews, Meta-analyses & Randomized Controlled Trials	4	44	2	12	5	24	2	40	6	30	7	32
II- Two groups, non randomized studies	0	0	2	12	3	14	0	0	6	30	1	4
III- One group, non randomized	2	22	3	18	2	10	0	0	1	5	3	14
IV- Descriptive studies	2	22	6	35	7	33	2	40	6	30	5	23
V- Case report, Narrative studies	1	12	4	23	4	19	1	20	1	5	6	27
Type of study												
1- Effectiveness Studies	4	44	6	35	12	57	2	40	8	40	9	42
2- Systemic/ Narrative reviews	0	0	0	0	0	0	0	0	0	0	3	14

3- Efficacy studies	1	12	1	6	0	0	1	20	4	20	0	0
4- Basic Research	3	22	6	35	8	38	1	20	2	10	7	32
5- Instrument development & testing	1	12	1	6	1	5	0	0	4	20	2	8
6- Link between Occupation & health	0	0	3	18	0	0	1	20	2	10	1	4
Area of practice												
Musculoskeletal	2	22	1	6	4	19	1	20	12	60	8	36
Cardiac	0	0	1	6	3	14	0	0	1	5	2	8
Pulmonary	0	0	0	0	2	10	1	20	0	0	0	0
Gynaecology	0	0	1	6	0	0	1	20	0	0	1	5
Advances	0	0	3	18	1	5	0	0	0	0	1	5
Geriatric	0	0	0	0	1	5	0	0	1	5	0	0
Neurology	6	66	9	52	6	27	0	0	2	10	4	18
Pediatrics	0	0	2	12	0	0	0	0	1	5	1	5
Psychiatry	0	0	0	0	1	5	0	0	0	0	0	0
Academics	0	0	0	0	1	5	1	20	0	0	0	0
Scale or Biostatistics	1	12	0	0	1	5	0	0	3	15	1	5
Sports	0	0	0	0	1	5	1	20	0	0	0	0
Others	0	0	0	0	0	0	0	0	0	0	4	18

Discussion

Over the period of the time, evidence based therapy is gaining a very important support in field of Physiotherapy & Occupational Therapy. It is generally been reflected in day to day practice where professionals are experimenting with newer techniques. This article focuses on the level of evidence, type of studies & areas of practice of the studies been published in one of the most leading journals in India.

From the above data analysis, it was observed that, level 1 articles of evidence have gradually been increasing from 2008 to 2013. This helps to create a strong evidence base in field of medical & rehabilitation in India. However, only 27 % of articles with level 1 of evidence were published which needs to be increased. It was also observed that over the period of 5 years only 3 review articles were published in the journal. Publishing the review articles increases the chance of citation in more research papers as well as improves journals' impact factor⁶. Hence, more articles of level 1 evidence i.e. systemic reviews, meta-analyses, and randomized controlled trials should be encouraged.

In near future, insurance industry will be one of the booming industries in India and world. Efficacy studies would play a major role in insurance industries as they help to determine cost and time effectiveness, patient satisfaction & safety of the treatment protocol⁴. However, in last 5 years, only 1 efficacy study was published. Thus, more articles of efficacy studies needs to be invited for publications in the near future.

With such a diversity of social, geographical and various factors of health, there is desperate need to have Indian assessment tools or scales for objective evaluation. Although 9 articles are published in the journal in period of 5 years on assessment & testing topics, more studies in this area is required. Thus, we should encourage young professionals under guidance of the senior staff to opt for standardization, validity, reliability, correlation of scales and also even development of scales or assessment tool.

The planning commission of India has projected a triple increase in above 60 years population by 2025 hence emphasizing need for functional independence⁷. This shows the need of research in this less explored field of geriatrics. However only 2 studies in field of geriatric were published.

By 2025, it is estimated that 10-20 individuals per thousand would suffer from mental illness and 3 to

5 times of emotional disorders⁷ but the much needed research in field of mental health is not seen in published articles. Only 1 article in 2010 on mental health is reflected in the journal.

Professionals must also focus on the areas of pediatrics, cardiopulmonary. Topics related to occupations & health as in future lifestyle disorders would be one of the major reasons of mortality.

Conclusion

In spite of being in its initial stage of journey in the publication world, the journal has contributed heavily to the field of research with its wide variety of quality papers. And in this short journey it has been indexed in many of the important databases.

Thus, focused research and maintaining the standard of the articles would help to improve the impact factor of the journal and also create a strong evidence base for the professions. To achieve the above stated goal, below are few recommendations journal can consider for-

- Publish more no. of randomized intervention studies
- Encourage systemic reviews
- Call for more research in field of lifestyle, aging, assessment tools, pediatrics and mental health.
- Introduction of special issues apart from regular 4 volumes
- Index of regular volume to be divided according to types of study.

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[1] Flink H, Tegelberg Å, Thörn M, Lagerlöf F. Effect of oral iron supplementation on unstimulated salivary flow rate: A randomized, double-blind, placebo-controlled trial. *J Oral Pathol Med* 2006;35:540-7.

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Corporate (collective) author

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