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Editor's Desk

Dear Physios,

Greetings of the day to all Physiotherapy professionals and students.

It gives me immense pleasure to publish eighth issue of INDIAN JOURNAL OF PHYSICAL THERAPY. With this issue the journal is entering in fifth year of publication. Survival of the Journal for these four years is due to continuous support of researchers, readers and last but not the least our editorial team members.

Indian Journal of Physical Therapy invites authors for publication of their articles. Journal now also has international readers, reviewers and authors. The journal is now a very good platform for all active researchers to spread their contribution in wider area for upliftment of Physiotherapy field and to get blessings of patients by providing treatment with latest advances.

Dr Dinesh M Sorani
Editor
Indian Journal of Physical Therapy

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IMPACT ON PAIN OF A NEW MANUAL THERAPY IN PATIENTS WITH FIBROMYALGIA: A INTERVENTIONAL RANDOMIZED STUDY

E. UBEDA DOCASAR[1]; MJ FERNÁNDEZ-ACEÑERO[1]

1. *Department of Physical Therapy. Health Science College, University Alfonso X el Sabio (Madrid; Spain)*

ABSTRACT

Background: Fibromyalgia is a complex disorder characterized by generalized pain and tiredness. Physical therapy measures can help these patients to control pain, which is one of the most important symptoms, that deeply influences quality of life.

Objectives: To analyze the effect of a new manual therapy on pain in patients with fibromyalgia. To predict which factors can predict response to manual therapy in fibromyalgia.

Design: Double-blind cross-over randomized interventional study, comparing the classic myofascial therapy with a new manual therapy proposed by the authors.

Material and methods: 48 patients with fibromyalgia underwent manual therapy. In the first half of the study 24 patients received conventional myofascial therapy and the other half the new therapy. Before applying therapy, we measured pain with the visual analogue scale (VAS) and the algometer in 8 fibromyalgia points and then measured them again after therapy. The therapy consisted in 6 weekly sessions of 45-50 minutes. After a wash-up period, during which the patients received no kind of therapy, the groups were crossed and the patients received the other therapy. Once again VAS and algometer measures were taken before and after the second course of therapy. All data were recorded and analysed with the SPSS Statistical Software 21.0 for Windows.

Results: The new manual therapy developed for the study led to a significantly higher improvement on pain (both measured with VAS and algometer) compared to myofascial conventional therapy. The improvement remained for more than 2 months. Only older age seemed to predict better response to therapy in both therapy arms.

Conclusions: We herein propose a new manual therapeutic intervention for fibromyalgia patients that comes to broaden the therapeutic options for this chronic and progressive disease.

KEYWORDS: manual therapy; fibromyalgia; myofascial therapy; trigger points; tender points

INTRODUCTION

Fibromyalgia is a chronic disease, characterized by a variegated clinical picture[1]. Until recently, it was a rather underecognized entity, and some clinicians even doubted about its actual existence. However, since 2010 the American College of Rheumatologists (ACR) has settled clear diagnostic criteria, that can help clinicians recognize and treat this disease[2,3]. One of the most important features is generalized pain that severely influences on the quality of life but these patients can also present with insomnia, depressive symptoms, gastrointestinal disturbances, etc. Pain is difficult to manage and most patients try different therapies with varying results[4,5]. There is a clear clinical need to find non-invasive therapies, that are well accepted by patients and relieve pain[6,7].

MATERIAL AND METHODS

We have performed an interventional cross-over trial to compare two kinds of physical therapy in fibromyalgia. One is the conventional myofascial massage and the other is a new manual therapy aimed to progressively relieve tension and pain on the tender points. As it is well known[8,9]. tender points in fibromyalgia are extremely painful points on palpation and the ACR has described 18 different tender points in fibromyalgia. For our therapy we have selected the 8 tender points showing maximal sensitivity according to our experience (second costal space, greater trochanter, occiput and trapezium, all of them bilaterally). Both interventions were applied by an expert physiotherapist in weekly sessions of 45-50 minutes duration for 6 weeks.

The primary endpoint of our study was pain. To measure pain and changes in its intensity, we have chosen two kinds of measures. One is the subjective visual analogue scale (VAS) and the other is the more objective pressure tolerance using the algometer in the eight chosen tender points.

The inclusion criterion for the study was to have a medical diagnosis of fibromyalgia for more than 3 years. In the first visit the patients were interviewed and they gave informed consent for participation in the study. We assigned the patients in a randomized manner either to myofascial therapy or the experimental one. Before therapy we measured both VAS and algometer data and in the final session of both therapies we measured again the same data, to estimate improvement.

For correspondence:
Edurne Ubeda Docasar. C/ Las Rozas Madrid (Spain)
e-mail to: melbur78@hotmail.com

After a wash-up period of 2 months for the intervention, we crossed over the groups, so that the patients received the other intervention. Again, we measured pain both before and after the second course of therapy. Although all the patients had used analgesic drugs to control pain previously, they were asked to discontinue them for the whole study period.

Sample size was estimated with the Fisterra free calculator (www.fisterra.org), assuming a minimal difference of 15% between groups, a power of 80% and an alpha error 0.05, as usual. With these conditions, the sample size was 48 patients. We chose to work only with women, for this disease is almost ten times more frequent in females and it would be difficult to get a representative sample of men to obtain significant conclusions.

The study and all its documents have been reviewed and approved by the ethical committee on Scientific Investigation of Alfonso X el Sabio University in Villanueva de la Cañada (Madrid, Spain). This study agrees with all ethical and legal matters regarding patient security and personal data protection.

All the collected data were registered in a data base in SPSS Statistical Software Package 21.0 for Windows, which was used for the statistical analysis. First we described the demographic features of the sample and then we compared the outcome measures in both groups with Student's T for mean comparison or xi squared test, as indicated. All the results were considered significant at a value of $p< 0.05$ as usual.

RESULTS

TABLE 1: BASAL DEMOGRAPHIC CHARACTERISTICS OF OUR SERIES

Variable	Experimental arm (number, % or mean [SD])	Myofascial therapy (number, % or mean [SD])
Has a job at the moment	No: 16 (76.2) Yes: 5 (23.8)	No: 17 (63) Yes: 10 (37)
Use of antidepressive drugs	No: 11 (52.4) Yes: 10 (47.6)	No: 17 (63) Yes: 10 (37)
Cold intolerance	No: 8 (38.1) Yes: 13 (61.9)	No: 9 (33.3) Yes: 18 (66.7)
Marital state	Single: 1 (4.8) Married: 17 (81) Divorced: 2 (9.5) Widow: 1 (4.8)	Single: 1 (3.7) Married: 23 (85.2) Divorced: 3 (11.1) Widow: 0
Study level	Analphabet: 1 (4.8) Basic compulsory studies: 13 (61.9) College: 7 (33.3)	Analphabet: 0 Basic compulsory studies: 21 (77.8) College: 6 (22.2)
Age	44.57 [7.4]	41 [7.88]

SD, standard deviation

Table 1 summarizes the demographic characteristics of our patients.

Before comparing the results of the intervention we had to show that the baseline characteristics of both intervention arms were equivalent. Only in this case, we could attribute the changes in the outcome measures to the different interventions employed. With this aim we performed chi squared test for qualitative variables and Student's T for quantitative ones. The comparison yielded no significant differences between groups, both for the demographic characteristics and the intensity of basal pain (with VAS and algometer).

For the first half of the study we randomized the patients to receive either the new or the myofascial therapy. Pain was measured before therapy and after six sessions, again on the last day. The mean pain values are summarized in Table 2. As data show, the improvement in pain was significantly higher with the experimental therapy, both for VAS and for algometer parameters.

TABLE 2: MEAN VALUES (SD) FOR PAIN MEASURES IN BOTH STUDY ARMS FOR THE FIRST HALF OF THE STUDY

	Before therapy	After therapy	p value for the mean comparison (Student's t test)
VAS	EA: 7 (1.67) CA: 6.44 (1.71)	EA: 5.05 (1.88) CA: 6.22 (1.76)	0.03
Right suboccipital algometer	EA: 1.44 (0.53) CA: 1.32 (0.45)	EA: 2.2 (0.52) CA: 1.25 (0.37)	0.0001
Left suboccipital algometer	EA: 1.46 (0.55) CA: 1.32 (0.45)	EA: 2.23 (0.55) CA: 1.27 (0.37)	0.0001
Right trapezium	EA: 1.83 (0.65) CA: 1.65 (0.45)	EA: 2.99 (0.79) CA: 1.7 (0.51)	0.0001
Left trapezium	EA: 1.91 (0.58) CA: 1.65 (0.36)	EA. 3.19 (0.98) CA: 1.7 (0.44)	0.0001
Right second intercostal space	EA: 1.72 (0.42) CA: 1.45 (0.38)	EA: 2.3 (0.56) CA: 1.25 (0.35)	0.0001
Left second intercostal space	EA: 1.66 (0.36) CA: 1.5 (0.32)	EA: 2.15 (0.56) CA: 1.25 (0.38)	0.0001
Right greater trochanter	EA: 1.71 (0.56) CA: 1.81 (0.45)	EA: 2.92 (0.82) CA: 1.6 (0.39)	0.0001
Left greater trochanter	EA: 1.7 (0.54) CA: 1.7 (0.38)	EA: 2.76 (0.78) CA: 1.55 (0.35)	0.0001

SD, standard deviation; EA, experimental arm (new therapy); CA, control arm (myofascial therapy)

After showing the effect on pain of the experimental therapy, we let the patients without therapy for a 2-month wash-up period, during which they should not receive any kind of therapy for the pain they might show. After 2 months we interviewed them again and measured pain with the same methods. To our surprise, the basal state of the patients had not been reached and patients having received the experimental therapy showed still a significantly lower pain level as compared to the ones receiving myofascial therapy. The VAS values were 5.38 for the experimental group and 7 for the myofascial one and this difference was statistically significant. Nevertheless, as we had to cross over the intervention, we chose to continue with the analysis for the new situation

was against the experimental therapy, for now patients that were to receive this were in a significantly higher pain level.

Table 3 summarizes the results of the second half of the study after crossing over the interventions. As can be seen, the experimental therapy achieved a significantly better control of pain, while most of the patients receiving now the myofascial therapy worsened almost to baseline levels.

TABLE 3: MEAN VALUES (SD) FOR PAIN MEASURES IN BOTH STUDY ARMS FOR THE SECOND HALF OF THE STUDY. NOTE THE GROUP RECEIVING NOW THE EXPERIMENTAL THERAPY HAD PREVIOUSLY RECEIVED THE MYOFASCIAL ONE

	Before therapy	After therapy	p value for the mean comparison (Student's t test)
VAS	EA: 7 (1.6) CA: 5.38 (2.11)	EA: 4.81 (1.9) CA: 5.81 (1.5)	0.05
Right suboccipital algometer	EA: 1.32 (0.27) CA: 1.82 (0.63)	EA: 2.2 (0.4) CA: 1.57 (0.4)	0.0001
Left suboccipital algometer	EA: 1.32 (0.2) CA: 1.83 (0.61)	EA: 2.23 (0.56) CA: 1.51 (0.3)	0.0001
Right trapezium	EA: 1.6 (0.37) CA: 2.11 (0.7)	EA: 2.63 (0.67) CA: 1.82 (0.49)	0.0001
Left trapezium	EA: 1.6 (0.45) CA: 2.22 (0.78)	EA. 2.67 (0.57) CA: 1.9 (0.5)	0.0001
Right second intercostal space	EA: 1.4 (0.25) CA: 1.85 (0.43)	EA: 2.1 (0.47) CA: 1.57 (0.37)	0.0001
Left second intercostal space	EA: 1.31(0.3) CA: 1.82 (0.41)	EA: 2.1 (0.55) CA: 1.52 (0.33)	0.0001
Right greater trochanter	EA: 1.64 (0.29) CA: 2.22 (0.63)	EA: 2.8 (0.6) CA: 1.81 (0.54)	0.0001
Left greater trochanter	EA: 1.61 (0.28) CA: 2.1 (0.51)	EA: 2.7 (0.5) CA: 1.8 (0.5)	0.0001

SD, standard deviation; EA, experimental arm (new therapy); CA, control arm (myofascial therapy)

TABLE 4: PAIN CHANGES ACCORDING TO THE THERAPY GROUP FOR THE FIRST HALF OF THE STUDY

	Myofascial therapy	Experimental therapy	Total
No change	8	4	12
Pain improvement	11	16	27
Pain worsening	8	1	9

Last, we tried to determine which factors could influence response to manual therapy in these patients. With this aim we reclassified the outcome measures VAS and algometer as pain improvement, absence of change or worsening. Table 4 summarizes the results of the new variable. Statistical analysis of the factors that could be associated with the patients' response revealed that only age was significantly associated with response, in the sense that older patients showed a significantly better response both to myofascial and to experimental therapy.

DISCUSSION

As it is always the case with chronic pain, patients with fibromyalgia usually seek different therapies that can help them control one of the most relevant symptoms associated with disease[7]. Most of them use analgesics on a chronic basis, with the consequent risks of adverse effects and with eventual lack of control of symptoms on the long term, leading to an ever-increasing use of more powerful and dangerous drugs.

As for non-pharmacological therapies, chronic patients tend to accept better non-invasive therapies[5,6]. There are many studies confirming the efficacy of different therapies, but most are short case-series with little scientific evidence and there are not many randomized studies. In this sense there are many reports on qi-yong, acupuncture[10], massage[11] or exercise as potentially useful therapies for this disease. However, there are no standarized therapies and there are no head to head comparisons between therapies of different types.

In the present study we have randomly assigned patients to two different physiotherapeutic interventions. One is myofascial therapy, which we could consider as a standard therapy for pain. Although it is not specifically indicated for fibromyalgia, it has been used in some series with good results[4,5]. The second is a new experimental therapy we propose that aims to treat specifically the tender points involved in fibromyalgia, but also aims to treat the areas surrounding these points. The main distinguishing features of this therapy is that it progressively frees and relaxes these tender points and does not limit to a general massage of the area, but rather adapts to the degree of involvement in each case. This therapy can cause pain, but it is usually mild and short-lived, disappearing almost immediately. Our study has tested this new option in fibromyalgia female patients to show that it achieves a higher pain reduction than myofascial therapy and also that this improvement lasts longer than 2 months. This is extremely important, for most therapeutic measures only get a temporary pain relief and effect duration is of utmost importance for chronic pain patients. However, at this moment we cannot tell the exact duration of the effect, for the wash-up period has been too short in our study. In the near future we intend to perform further trials to try to define the effect duration better. It would also be important to compare this new therapy with other having shown some effect on these patients, like acupuncture or exercise, but they should be compared in a randomized trial to get sound conclusions.

Another peculiar result we have observed is that older patients seem to respond

better to both therapies employed in the present study. This might seem a bit surprising, for this is a progressive disease and with time patients usually get more and more desperate about their physical situation. This result should be confirmed in larger studies applying different types of therapy.

In short, we herein report a new physical therapy we propose for the treatment of tender points in fibromyalgia. The preliminary promising results we have found should be confirmed in larger studies that should also aim to define more precisely the duration of the effect on pain of these measures on the long term.

REFERENCES

1. Gerwin RD. Diagnosing fibromyalgia and myofascial pain syndrome: A guide. Chronic Pain Perspectives. Chronic pain perspectives: 2013;62(12):19-25.
2. Segura-Jiménez V, Aparicio VA, Álvarez-Gallardo IC, Soriano-Maldonado A, Estévez-López F, Delgado-Fernández M, et al. Validation of the modified 2010 American Colleague of Rheumatology diagnostic criteria for fibromyalgia in a Spanish population. Rheumatology. 2014;53(10):1803-11.
3. Triñanes Y, González-Villar A, Gómez-Perretta C. Profiles Fibromyalgia: algometry, auditory evoked potentials and clinical characterization of different subtypes. Rheumatol Int. 2014;34(11):1571-80.
4. Castro-Sánchez AM, Matarán-Peñarrocha GA, Arroyo-Morales M, Saavedra-Hernández M, Fernández-Sola Cayetano and Moreno-Lorenzo C. Effects of myofascial release techniques on pain, physical function, and postural stability in patients with fibromyalgia: a randomized controlled trial Clinical Rehabilitation. Clin. Rehabil. 2011;25(9):800-13.
5. Fernández de la Peñas C, Sohrbeck Campo M, Fernández Carnero J, Miangolarra Page JC. Manual therapies in myofascial trigger point treatments: a systematic review. Journal of Bodywork and Movements Therapies. 2005;9(1):27-34.
6. Kalichman L. Massage therapy for fibromyalgia symptoms. Rheumatol Int. 2010;30(9):1151-7.
7. Nijs J, Van Houdenhove B. From acute musculoskeletal pain to chronic widespread pain and fibromyalgia: Application of pain neurophysiology in manual therapy practice. Manual Therapy. 2009;14(3):3-12.
8. Scheneider MJ. Tender points/fibromyalgia vs. Trigger points/myofascial pain syndrome: a need for clarity in terminology and differential diagnosis. Journal of manipulative and Physiological Therapeutics. 1995;18(6):398-406.
9. Harden R. A critical analysis of the tender points in fibromyalgia. Pain Med [Internet]. [Acceso13 octubre 2013]. 2007; 8(2):147-56.
10. Lit Wan DW. Acupunture for treating fibromyalgia. Australian Journal of Acupuncture and Chinese Medicine. 2013;8(2):42-43.
11. Yan-hui L, Feng-yun W, Chun-qing F, Xia-feng Y, Yi-hua S. Massage Therapy for Fibromyalgia: A Systematic Review and Meta-Analysis of Randomized Controlled Trials. PLOS ONE. 2014;9(2):1-9.

IMPACT OF TEN MINUTES PASSIVE VIBRATION ON SKIN BLOOD FLOW, SKIN TEMPERATURE, AND BLOOD PRESSURE IN PERSONS WITH GOOD GLYCEMIC CONTROL AND POOR GLYCEMIC CONTROL TYPE 2 DIABETES

KANIKKAI STENI BALAN SACKIRIYAS[1], EVERETT B. LOHMAN[1], NOHA S. DAHER[1], LEE S. BERK[1], RAFAEL CANIZALES[1], ERNIE SCHWAB[1], GABRIEL PACHECO[1], DRASTI SHAH[1], BRIJESH SINGH[1], SAMIA ALGABBANI[1], CHARMI DESAI[1], FUMIAKI ISSHIKI[1]

1. *Dept. of Physical Therapy, School of Allied Health Professions, Loma Linda University, Loma Linda, California, USA*

ABSTRACT

OBJECTIVE: To study the impact of ten minutes passive vibration on skin blood flow (SBF), skin temperature (ST) and blood pressure (BP) in persons with good glycemic control and poor glycemic control type 2 diabetes.
MATERIALS AND METHODS: Seventeen good glycemic control (HbA1c < 7.5%) and fifteen poor glycemic control (HbA1c > 9%) type 2 diabetics received ten minutes passive vibration to their calf and foot on the same day. The SBF, ST and BP were measured before, immediately after vibration and 10 minutes post the vibration application.
RESULTS: There was a significant increase in the mean SBF in the calf from baseline to immediately after vibration in the good glycemic control and the poor glycemic control groups. The mean skin blood flow in the calf almost doubled from baseline (38.8 flux) to immediately after vibration (67.5 flux) and 10 minutes post rest (65.1 flux) in the good glycemic control diabetics (p=.02). The mean SBF in the calf more than doubled from the baseline (31.7 flux) to immediately after vibration (73.4 flux) and 10 minutes post rest (67.6 flux) in the poor glycemic control diabetics (p=.00). However, there was no significant difference in mean foot SBF over time in both good glycemic control and poor glycemic control diabetics. Baseline resting mean of SBF was higher in foot than in calf for both groups of diabetics. The percent change in calf SBF was higher in the poor glycemic control (131.6%) than the good glycemic control diabetics (71.2%) from baseline to immediately after vibration. However, foot SBF showed higher percent increase in the good glycemic control (91.3%) than the poor glycemic control (32.6%) diabetics from baseline to immediately after vibration. The percent increase was 99.5% in the calf and 63.8% in the foot irrespective of group. There was no clinically significant difference in the mean calf and foot ST and BP in both groups of diabetics.
CONCLUSION: Based on the results observed in this study, we suggest that passive vibration can be safely administered to the calf area and the foot area without significantly increasing the risk of burns, skin temperature and blood pressure in both good glycemic control and poor glycemic control type 2 diabetics.

KEYWORDS: Diabetes Mellitus; Vibration; Circulation; Blood Pressure; Temperature

INTRODUCTION

Diabetes Mellitus (DM) is a major health care problem around the world. According to the International Diabetes Federation, 371 million people are living with diabetes around the globe. North America and the Caribbean spent more healthcare dollars on diabetes than any other region in the world. The Unites States of America is the third leading country with 24.1 million diabetics, with China (92.3 M) and India (63.0 M) being the top two countries with diabetes[1]. Medical expenses and death rate are two times higher in diabetics than non-diabetics[2,3]. Type 2 diabetes (T2D) is the most common type of diabetes mellitus (90% to 95% of all forms of diabetes)[2,3,4]. Hemoglobin Assay A1c or Glycohemoglobin is a reliable test that reflects the average control of glucose over the past three months[5]. According to the Centers for Disease Control and Prevention (CDC), DM can be classified into good glycemic control (HbA1c <7.5%), fair glycemic control (HbA1c ≥7.5% to ≤9%) and poor glycemic control (HbA1c >9%), based on the Hemoglobin A1c (HbA1c) level[6,7].

For correspondence:
Kanikkai Steni Balan Sackiriyas
e-mail to: stenidsc@yahoo.com

CIRCULATION

Skin circulation is regulated by various physical and humoral stimuli[8]. It plays a key role in the regulation of temperature[9], baroreflex control of blood pressure (BP) [9] and tissue healing[10]. The central nervous system and the metabolic state of tissues controls the skin circulation[11]. The architecture of the micro vascular system is not uniform and varies in glabrous (non-hairy) and nonglabrous (hairy) skin[12]. The glabrous skin (palms, soles, lips, face, tips of fingers and toes) has deeply located numerous thick-walled thermo-regulating arteriovenous anastomoses (AVA)[13]. It is mainly

innervated by sympathetic vasoconstrictor nerves[9,12,14,15]. Numerous larger diameter arterioles and venules in these areas allow low resistance, high blood flow directly from the arterioles to venules[9,12,16,17,18,19]. In contrast to that, the nonglabrous skin (dorsal area of hand, foot) has more superficial nutritive (NUTR) perfusion through small capillaries with fewer AVA and is controlled by both the sympathetic vasoconstrictor and vasodilator nerves[15,20]. These differences may lead to differential SBF rates.

Resting skin blood flow in a thermoneutral environment is about 5%-10% of cardiac output (250 mL/min)[9,21]. This is because of the dominant activity of the vasoconstrictor system in thermoneutral environments[22]. The skin reaches about 50%-70% of cardiac output (6 to 8 L/min) during exercise or heat exposure[9,21]. The sympathetic vasodilator system is not active during normothermia but activated only during hyperthermia. The larger increase in the skin circulation during hyperthermia is primarily achieved by activation of the sympathetic vasodilator nerves (80%-90%) and to a smaller extent by withdrawal of the sympathetic vasoconstrictor nerves (10%-20%)[9,15,23]. Thus, subtle changes in the skin circulation play a crucial role in maintaining the normal human temperature (homeostasis) through heat dissipation (cutaneous vasodilation and sweating) and heat generation[9]. For example, a rise of as little as 8 ml per 100 ml/min over the entire body surface from the neutral level can double the heat transfer to the environment[24].

Aging, body mass index (BMI), and diabetes impair the function of endothelial cells and autonomic nervous system, hence decreases microcirculation[10,25,26]. Inabilities of the blood vessels to vasodilate in type 2 diabetes impair the normal heat dissipation and increase the risk of heat exhaustion[9,27,28]. Researchers believe SBF has no significant impact on the baroreflex control of BP unlike the skeletal muscles[29]. However, baroreceptor reflex is an important mechanism that rapidly adjusts BP changes. Receptors in the carotid sinus and aortic arch carry the afferent information to the nucleus tractus solitarii (NTS). Short interneurons connect the NTS to the dorsal motor nucleus of the vagus and nucleus ambiquus (parasympathetic efferent), and rostral ventrolateral medulla oblongate (sympathetic efferent). A rise in the BP stimulates the baroreceptors and in turn increases the vagal tone and decreases the sympathetic tone. The opposite happens when there is a decrease in the BP[30]. In recent years, research studies supported the role of sympathetic vasodilator and vasoconstrictor systems in the BP regulation[21,31,32,33,34]. For example, the skin vasoconstrictor system was active when unloading of baroreceptors was achieved using lower-body negative pressure. However, skin circulation is low in thermoneutral environments. During hyperthermia, the vasodilator system is active and skin receives 50%-70% of cardiac output. Studies show that skin vasoconstricts through withdrawal of the vasodilator system when lower body negative pressure is applied during hyperthermia[21,32]. This implies that sympathetic activity in skin plays an integrated role in thermoregulation and the regulation of blood pressure. Impairment in one system can affect the other system[9].

In research, the use of passive vibration (PV) to improve skin blood flow (SBF) without increasing the risk of burns has been performed and supported. A series of studies performed by Lohman et al and Maloney-Hinds et al showed that PV significantly improved SBF in hairy and non-hairy skin in healthy volunteers, healthy older individuals, good to fair glycemic control diabetics and non-diabetics[35,36,37,38,39,40]. However, there was no research study examining the effect of PV in increasing SBF in diabetics without affecting skin temperature and blood pressure. The purpose of this study was to examine the effect of PV on SBF, skin temperature (ST) and blood pressure (BP) in good glycemic control versus poor glycemic control diabetics. We hypothesized that SBF in the calf area and the foot area without significantly affecting the skin temperature and blood pressure would be higher in good glycemic control than in poor glycemic control type 2 diabetics as a result of passive vibration.

MATERIAL AND METHODS

STUDY POPULATION

Type 2 diabetics between the age ranges of 18-75 years were invited to participate in this study. Subjects with neurological disorders, orthopedic disorders, bleeding disorders, leg ulcer, chronically exposed to vibration, cardiovascular diseases, possible deep vein thrombosis (DVT) with a score of 2 (high risk) in well's criteria[41] or pregnant were excluded. Thirty seven subjects were recruited through fliers and word of mouth, and from the Diabetes Support Group and from the Diabetes Treatment Center at Loma Linda University (LLU) Medical Center. Five subjects were excluded because they did not meet the inclusion criteria. All the subjects were assigned to one of two groups: Group 1=Good glycemic control and Group 2=Poor glycemic control. Subjects received passive vibration to their calf and the opposite foot on the same day. All procedures were approved by the LLU's institutional review board and each subject signed a statement of informed.

INSTRUMENTATION

A Physio Plate® (Domino S.R.L, San Vendemiano, Italy) was used to deliver passive vibration at a frequency of 50 Hz for a total number of ten cycles (one cycle= 60s working time: 2s rest time) or approximately ten minutes. Skin blood flow was measured non-invasively by using a MOOR Full-field Laser Perfusion Imager (FLPI) (MOOR FLPI V 2.1, Oxford, England) that was pre-warmed for about 30 minutes. It uses a red light laser beam (632.8 nm) applied perpendicularly to capture SBF and the blood flow was measured in "Flux" unit. Skin temperatures were measured using a thermistor placed on the muscle belly of posterior calf muscle and on the plantar aspect of the first three metatarsal heads. The thermistor was manufactured by BioPac systems (BioPac Inc., Goleta, CA) and the output was sensed by an SKT 100 thermistor amplifier. This analog data was converted into a digital data by the BioPac systems (BioPac Inc., Goleta, CA). A mean temperature was taken to analyze the data. Blood pressure at the brachial artery was measured using a blood pressure cuff monitor (RITE AID, Camp Hill, PA).

PROCEDURE

SCREENING

The testing room temperature was maintained between 71.6°F-75.2°F (22°-24° C) for about 30 minutes before the subjects enters. Subjects were asked to take rest in supine position for about 30 minutes to stabilize their blood flow before intervention. Subjects were screened for exclusion and demographic data was collected.

Cutaneous sensation was assessed using a Semmes-Weinstein Monofilament (North Coast Medical, Inc, Morgan Hill, CA, USA) and the response, color of the handle and notations were noted on the sensory foot mapping. Vibration sense was assessed using a 128 Hz tuning fork and subjects with a score of 2 (absent sensation) were excluded.

Testing

A square shaped 3 cm x 3 cm area was marked on the posterior aspect of the calf (muscle belly) and on the plantar aspect of the first three (1-3) metatarsal heads while the subjects were in prone position on a plinth. Baseline SBF, ST and BP was measured. Then, subjects received passive vibration to their calf for about ten minutes (Figure 1). The second reading was taken immediately after vibration. Subjects were given a ten minutes rest before the third reading was taken. The same procedures were repeated for foot on the opposite leg (Figure 2).

FIGURE 1: CALF AREA VIBRATION.

FIGURE 2: FOOT AREA VIBRATION

DATA ANALYSIS

Data was analyzed using SPSS version 20.0[42]. The distributions of the continuous variables were examined using one sample Kolmogorov Smirnov test. The proportions of males & females, ethnicity and levels of physical activity by group were compared using chi-square test of independence. We compared mean age and body mass index (BMI) by group using independent t-test. Mixed factorial analysis of variance was used to compare the effect of passive vibration on SBF, ST and BP from baseline to post vibration and 10 minutes post rest in good glycemic control and poor glycemic control Type 2 diabetic subjects' calf and foot. Significant differences were further examined with Bonferroni test. The level of significance was set at $p<.05$.

RESULTS

Seventeen good and fifteen poor glycemic control type 2 diabetics participated in this study. The results of the Kolmogorov Smirnov test showed that the distribution of age, BMI and SBF were approximately normal. Results showed that there were no significant differences between the good glycemic control and poor glycemic control diabetics in terms of gender, race, physical activity, age and BMI ($p>.05$) (Table 1).

TABLE 1: DISTRIBUTION OF DEMOGRAPHIC DATA BY GROUP (N=32).

Variables		Good (n=17)	Poor (n=15)	p-value
Gender†	Male	10 58.8%)	7 (41.2%)	.49
	Female	7 (46.7%)	8 (53.3%)	
Ethnicity†	White	7 (63.6%)	4 (36.4%)	.37
	Others¶	3 (30%)	7 (70%)	
	Hispanic	4 (66.7%)	2 (33.3%)	
	African American	3 (60%)	2 (40%)	
Physical activity†	Very light	3 (30%)	7 (70%)	.15
	Light	6 (75%)	2 (25%)	
	Moderate & Heavy	8 (57.1%)	6 (42.9%)	
Age (Mean±SD)*		61.5±11.5	56.1±7.2	.12
BMI (Mean±SD)*		30.7±5.6	32.3±6.5	.47

†: Chi-square test
*: Independent t test
¶: Others: Asians, Middle eastern

SKIN BLOOD FLOW

Good Glycemic Control

A significant change in mean calf SBF was observed over time in good glycemic control diabetics (F2, 32=6.53, p=.02) (Table 4). A significant change was detected between baseline and immediately after vibration (p=.03) and between baseline and 10 minutes post rest (p=.03). However, the mean foot SBF did not significantly changed over time in good glycemic control diabetics (F2, 32=2.9, p=.09). The mean SBF was significantly higher in foot than in calf in the good glycemic control at baseline (130.4±22.2 vs 38.8±2.2; p<.01), immediately after vibration (181.0±28.0 vs 67.5±12.0; p<.001) and 10 minutes post rest (139.3±20.6 vs 65.1±11.0; p<.01).

Poor Glycemic Control

A significant change in mean calf SBF was observed over time in poor control diabetics (F2, 28=12.1, p=.01) (Table 2). A Significant change was observed between baseline and immediately after passive vibration (p=.01) and between baseline and 10 minutes post rest (p=.01). There was no significant change in mean foot SBF over time in poor glycemic control diabetics (F2, 28=.07, p=.86). The mean SBF was significantly higher in foot than in calf in poor glycemic control at baseline (140.0±28.6 vs 31.7±2.3; p<.01), immediately after vibration (146.9±27.8 73.4±12.7; p=.03) and 10 minutes post rest (145.1±31.0 vs 67.6±10.5; p=.03).

TABLE 2: MEAN (SE†) SKIN BLOOD FLOW OVER TIME BY GROUP AND SITE.

Site	Group	Baseline	Immediately after vibration	10 min post rest	p-value*
Calf	Good	38.8(2.20)	67.5(12.0)	65.1(11.0)	.02
	Poor	31.7(2.3)	73.4(12.7)	67.6(10.5)	<.01
Foot	Good	130.4(22.2)	181.0(28.0)	139.3(20.6)	.09
	Poor	140.0(28.6)	146.9(27.8)	145.1(31.0)	.86

*Analysis of variance
†SE: Standard error

Good Glycemic Control vs. Poor Glycemic Control

There was a significant difference in mean calf SBF over time in both good and poor glycemic control diabetics (F2, 60=18.20, p<.001). Based on the Bonferroni test, there was a significant difference in calf SBF between baseline and immediately after vibration (p<.001) and between baseline and 10 minutes post rest (p<.001) in both good glycemic control and poor glycemic control diabetics. There was no significant interaction between calf SBF and group (F2, 60=.56, p=.49). In addition, there was no significant difference between groups (F1, 30=.01, p=.97). There was no significant difference in mean calf SBF between immediately after vibration and 10 minutes post rest (p=.40). There was no significant difference in foot SBF over time in both good glycemic control and poor glycemic control diabetics (F2, 60=2.0, p=.16). There was no significant interaction between foot SBF and group (F2, 60=1.31, p=.27). Also, there was no significant difference in mean foot SBF between groups (F1, 30=.04, p=.85).

SKIN TEMPERATURE

Good Glycemic Control

There was no significant change in mean calf ST over time in good glycemic control diabetics (F2, 32=0.53, p=.50) (Table 3). However, a significant change was detected in mean foot ST over time in good glycemic control diabetics (F2, 32=6.1, p<.01). There was a significant change detected between baseline and immediately after vibration (p=.02), and between immediately after vibration and 10 minutes post rest (p=.04). There was a significant difference in mean ST between calf and foot in good glycemic control diabetics at baseline (t16=5.2, p<.001), immediately after vibration (t16=4.8, p<.001) and 10 minutes post rest (t16=5.5, p<.001). The mean ST in the good glycemic control was significantly higher in calf than in foot at baseline (88.5±0.8 vs 84.2±0.7; p<.001), immediately after vibration (88.6±0.3 vs 85.6±0.6; p<.001) and 10 minutes post rest (87.9±0.4 vs 84.6±0.7; p<.001).

Poor Glycemic Control

There was no significant change in mean calf ST over time in poor glycemic control diabetics (F2, 28=2.2, p=.13) (Table 3). Also, there was no significant change in mean foot ST over time in poor glycemic control diabetics (F2, 28=2.5, p=.10). However, there was a significant difference in mean ST between calf and foot in the poor glycemic control diabetics at baseline (t14=3.4, p<.01), immediately after vibration (t14=2.7, p=.02), and 10 minutes post rest (t14=3.1, p=.01). The mean ST in the good

glycemic control was significantly higher in calf than in foot at baseline (87.3±0.3 vs 84.8±0.8; p<.01), immediately after vibration (88.0±0.4 vs 86.2±0.8; p=.02), and 10 minutes post rest (87.5±0.5 vs 85.4±0.7; p<.01).

TABLE 3: MEAN (SE†) SKIN TEMPERATURE OVER TIME BY GROUP AND SITE.

Site	Group	Baseline	Immediately after vibration	10 min post rest	p-value*
Calf	Good	88.5(0.3)	88.0(0.4)	87.5(0.5)	.50
	Poor	87.3(2.6)	77.9(15.5)	70.9(12.5)	.13
Foot	Good	84.2(0.7)	85.6(0.6)	84.6(0.7)	<.01
	Poor	84.8(0.8)	86.2(0.8)	85.4(0.7)	.10

*Analysis of variance
†SE: Standard error

Good Glycemic Control vs. Poor Glycemic Control

There was no significant difference in mean calf ST over time in both good glycemic control and poor glycemic control diabetics (F2, 60=1.11, p=.31). Also, there was no significant interaction between group and calf temperature (F2, 60=0.45, p=.55). There was no significant difference between groups (F1, 30=1.79, p=.19). However, there was a significant difference in mean foot ST over time in both good glycemic control and poor glycemic control over time (F2, 60=7.3, p=.001). Based on the Bonferroni test, there was a significant difference in foot ST between baseline and immediately after vibration (p=.002) and between immediately after vibration and 10 minutes post rest (p=.04) in both good glycemic control and poor glycemic control diabetics. There was no significant interaction between foot ST and group (F2, 60=0.07, p=.93). There was no significant difference in mean foot ST between groups (F1, 30=.54, p=.47).

BLOOD PRESSURE

Systolic Blood Pressure

Good Glycemic Control

There was no significant change in mean systolic blood pressure (SBP) over time during calf vibration in good glycemic control diabetics (F2, 32=4.2, p=.06) (Table 4). There was no significant change in mean SBP over time during foot vibration in good glycemic control diabetics (F2, 32=.8, p=.44). There was a significant difference in mean SBP between calf and foot in the good glycemic control diabetics at immediately after vibration (p=.01). However, there was no significant difference in mean SBP between calf and foot in the good glycemic control at baseline (p=.23) and 10 minutes post rest (p=.1).

Poor Glycemic Control

There was no significant change in mean SBP over time during calf vibration in poor glycemic control diabetics (F2, 28=.5, p=.54) (Table 4). There was no significant change in mean SBP over time during foot vibration in poor glycemic control diabetics (F2, 28=.2, p=.76). There was no significant difference in mean SBP between calf and foot in the good glycemic control diabetics at baseline (p=.83), immediately after vibration (p=.65) and 10 minutes post rest (p=.13).

TABLE 4: MEAN (SE†) SYSTOLIC BLOOD PRESSURE OVER TIME BY GROUP AND SITE.

Site	Group	Baseline	Immediately after vibration	10 min post rest	p-value*
Calf	Good	124.7(2.4)	131.8(4.5)	128.5(3.4)	.06
	Poor	128.1(3.2)	128.7(4.7)	131.3(3.4)	.54
Foot	Good	122.5(2.3)	124.9(3.3)	124.7(2.4)	.44
	Poor	127.7(4.0)	126.7(2.8)	128.1(3.2)	.76

*Analysis of variance
†SE: Standard error

Good Glycemic Control vs. Poor Glycemic Control

There was no significant difference in mean calf SBP over time in both good glycemic control and poor glycemic control diabetics (F2, 60=2.1, p=.15). Also, there was no significant interaction between group and calf SBP (F2, 60=1.5, p=.23). There was no significant difference between groups (F1, 30=.1, p=.82). There was no significant difference in mean foot SBP over time in both good glycemic control and poor glycemic control diabetics (F2, 60=.3, p=.67). There was no significant interaction between foot SBP and group (F2, 60=.5, p=.54). There was no significant difference in mean foot SBP between groups (F1, 30=.8, p=.37).

Diastolic Blood Pressure

Good Glycemic Control

There was no significant change in mean diastolic blood pressure (DBP) over time during calf vibration in good glycemic control diabetics (F2, 32=.9, p=.34) (Table 5). There was no significant change in mean DBP over time during foot vibration in good glycemic control diabetics (F2, 32=5.5, p=.39). There was no significant difference in mean DBP between calf and foot in the good glycemic control at baseline (p=.53), immediately after vibration (p=.29) and 10 minutes post rest (p=.36).

Poor Glycemic Control

There was no significant change in mean DBP over time during calf vibration in poor glycemic control diabetics (F2, 28=4.8, p=.05) (Table 5). There was no significant change in mean DBP over time during foot vibration in poor

glycemic control diabetics (F2, 28=1.0, p=.37). There was no significant difference in mean DBP between calf and foot in the poor glycemic control diabetics at baseline (p=.11) and immediately after vibration (p=.50). However, there was a significant difference between calf and foot at 10 minutes post rest (p=.02).

TABLE 5: MEAN (SE†) DIASTOLIC BLOOD PRESSURE OVER TIME BY GROUP AND SITE.

Site	Group	Baseline	Immediately after vibration	10 min post rest	p-value*
Calf	Good	74.1(1.7)	75.8(1.8)	75.6(1.5)	.43
	Poor	79.6(1.8)	78.7(1.4)	83.3(1.8)	.05
Foot	Good	73.2(1.2)	74.2(1.4)	74.1(1.7)	.39
	Poor	77.7(2.0)	80.1(1.7)	79.6(1.8)	.37

*Analysis of variance
†SE: Standard error

Good Glycemic Control vs. Poor Glycemic Control

There was no significant difference in mean calf DBP over time in both good glycemic control and poor glycemic control diabetics (F2, 60=3.4, p=.07). Also, there was no significant interaction between group and calf DBP (F2, 60=2.6, p=.08). However, there was a significant difference between groups (F1, 30=7.2, p=.01). There was no significant difference in mean foot DBP over time in both good glycemic control and poor glycemic control diabetics (F2, 60=1.4, p=.26). There was no significant interaction between foot DBP and group (F2, 60=.2, p=.83). However, there was a significant difference in mean foot DBP between groups (F1, 30=7.4, p=.01).

DISCUSSION

Body temperature, skin blood flow (SBF) and blood pressure (BP) measurements can provide important information about the status of the cardiovascular and thermoregulatory systems. They provide the body's physiological status and their response to various stimuli such as physical activity, stress and environmental influences[43]. Studies from the Department of Physical Therapy in the Loma Linda University and others have shown that vibration can be effective in increasing SBF in diabetics as well as in non-diabetics[35,36,37,38,39,44,45,46,47].

Results of this study showed that the mean SBF in the hairy skin (calf) was improved in both good glycemic control and poor glycemic control diabetics. This improvement was detected from baseline to immediately after vibration, and from baseline to 10 minutes post vibration intervention with no significant increase in the ST and SBF. There was a significant difference in the mean DBP between the groups. However, the mean difference is 5.3 mm of Hg and can be considered clinically not significant. The increase in mean calf SBF was almost doubled between baselines (38.8) to immediately after vibration (67.5) and to 10 minutes post rest (65.1) in the good glycemic control diabetics. The increase in mean calf SBF was more than doubled from baseline (31.7) to immediately after vibration (73.4) and to 10 minutes post rest (67.6) in the poor glycemic control diabetics. However, the percent change in calf SBF was higher in the poor glycemic control (131.6%) than the good glycemic control diabetics (71.2%) between baseline to immediately after vibration. No significant difference in the mean calf SBF between immediately after vibration to 10 minutes post rest in both the groups were detected, suggesting that both groups responded to passive vibration similarly. The calf SBF remained elevated at ten minutes post PV and was beginning to decline in both the groups.

In contrast to the hairy skin (calf), the foot (non hairy) showed no significant increase in mean SBF across time in and between both good glycemic control and poor glycemic control diabetics. However, the highest percent change in the foot SBF was seen in good glycemic control (91.3%) as compared to poor glycemic control (32.6%). Although the percent change is less in poor glycemic control, we agree with Wiernsperger and Bouskela that distribution of blood in the microvascular bed is the primary factor and not the quantity8. The foot of the good glycemic control diabetics showed a mean temperature difference of 1.2°F. A mean temperature change of 1.2°F was not considered clinically significant although it was statistically significant. We did not notice any clinically significant rise or fall in the mean systolic and diastolic blood pressure in both groups.

These findings suggest that passive vibration can be used to improve SBF in the calf and foot without the risk of increasing skin burns, heat exhaustion and cardiovascular stress in both good glycemic control and poor glycemic control type 2 diabetics.

CONCLUSION

Based on the findings, we suggest that passive vibration can be safely administered to calf and foot without increasing the risk of burns; heat exhaustion and increase in blood pressure in both good glycemic control and poor glycemic control type 2 diabetics.

REFERENCES

1. Diabetes Atlas. 2012; Available from: http://www.idf.org/diabetesatlas/.
2. Centers for Disease Control and Prevention.

National diabetes fact sheet: national estimates and general information on diabetes and prediabetes in the United States, 2011. Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, 2011.
3. Ziegler D. Diabetic cardiovascular autonomic neuropathy: prognosis, diagnosis and treatment. Diabetes Metab Rev. 1994 Dec; 10(4):339-83.
4. Sumpio BE. Foot ulcers. New Engl J Med. 2000 Sep 14; 343(11):787-93.
5. National Diabetes Clearinghouse. (January 22, 2013). Insulin Resistance and Prediabetes. Retrieved March 22, 2013 from http://diabetes.niddk.nih.gov/dm/pubs/insulinresistance/index.aspx.
6. Hartemann-Heurtier A, Sultan S, Sachon C, Bosquet F, Grimaldi A. How type 1 diabetic patients with good or poor glycemic control cope with diabetes-related stress. Diabetes Metab. 2001 Nov; 27(5):553-9.
7. Juarez DT, Sentell T, Tokumaru S, Goo R, Dawis JW, Mau MM. Factors asscoiated with poor glycemic control or wide glycemic variability among diabetes patients in Hawaii, 2006-2009; 6: Available from: http://dx.doi.org/10.5888/pcd9.120065.
8. Wiernsperger NF, Bouskela E. Microcirculation in insulin resistance and diabetes: more than just a complication. Diabetes Metab. 2003 Sep; 29(4 Pt 2):6S77-87.
9. Charkoudian N. Skin blood flow in adult human thermoregulation: how it works, when it does not, and why. Mayo Clin Proc. 2003 May; 78(5):603-12.
10. Petrofsky J, Lee S. The effects of type 2 diabetes and aging on vascular endothelial and autonomic function. Med Sci Monit. 2005 Jun; 11(6):CR247-54.
11. Berne RM, Levy MN. Principles of Physiology. 4 ed. St. Louis, MO: Mosby; 2005.
12. Rendell MS, Milliken BK, Finnegan MF, Finney DA, Healy JC. The skin blood flow response in wound healing. Microvasc Res. 1997 May; 53(3):222-34.
13. Bornmyr S, Svensson H, Lilja B, Sundkvist G. Skin temperature changes and changes in skin blood flow monitored with laser Doppler flowmetry and imaging: a methodological study in normal humans. Clin Physiol. 1997 Jan; 17(1):71-81.
14. Lossius K, Eriksen M, Walloe L. Fluctuations in blood flow to acral skin in humans: connection with heart rate and blood pressure variability. J Physiol. 1993 Jan; 460:641-55.
15. Johnson JM, Proppe DW. Cardiovascular adjustments to heat stress. In: Fregly MJ, Blatteis CM, editors. Handbook of Physiology: Oxford University Press; 1996. p. 215-43.
16. Hales JR, Jessen C, Fawcett AA, King RB. Skin AVA and capillary dilatation and constriction induced by local skin heating. Pflugers Arch. 1985 Jul; 404(3):203-7.
17. Popoff N. The digital vascular system. Arch Pathol. 1934; 18:295-330.
18. Rowell LB. Reflex control of the cutaneous vasculature. J Invest Dermatol. 1977 Jul; 69(1):154-66.
19. Zweifach BW, Lipowsky HH. Pressure-flow relations in blood and lymph microcirculation. In: Renkin EM, Michel CC, Geiger SR, editors. Handbook of Physiology The Cardiovascualr System. Oxford: Oxford Univ; 1987. p. 251-308.
20. Johnson JM, Brengelmann GL, Hales JR, Vanhoutte PM, Wenger CB. Regulation of the cutaneous circulation. Fed Proc. 1986 Dec;45(13):2841-50.
21. Crandall CG, Johnson JM, Kosiba WA, Kellogg DL, Jr. Baroreceptor control of the cutaneous active vasodilator system. J Appl Physiol. 1996 Nov;81(5):2192-8.
22. Pergola PE, Kellogg DL, Jr., Johnson JM, Kosiba WA. Reflex control of active cutaneous vasodilation by skin temperature in humans. Am J Physiol. 1994 May;266(5 Pt 2):H1979-84.
23. Rowell LB. Cardiovascular aspects of human thermoregulation. Circ Res. 1983 Apr;52(4):367-79.
24. Savage MV, Brengelmann GL. Control of skin blood flow in the neutral zone of human body temperature regulation. J Appl Physiol. 1996 Apr;80(4):1249-57.
25. Ray CA, Monahan KD. Aging attenuates the vestibulosympathetic reflex in humans. Circulation. 2002 Feb 26;105(8):956-61.
26. Petrofsky JS, Alshammari F, Bains G, Khowailed IA, Lee H, Kuderu YN, et al. What is More Damaging to Vascular Endothelial Function: Diabetes, Age, High BMI, or all of the above? (in press). 2013.
27. Schuman SH. Patterns of urban heat-wave deaths and implications for prevention: data from New York and St. Louis during July, 1966. Environ Res. 1972 Mar;5(1):59-75.
28. Semenza JC, McCullough JE, Flanders WD, McGeehin MA, Lumpkin JR. Excess hospital admissions during the July 1995 heat wave in Chicago. Am J Prev Med. 1999 May;16(4):269-77.
29. Wallin BG, Sundlof G, Delius W. The effect of carotid sinus nerve stimulation on muscle and skin nerve sympathetic activity in man. Pflugers Arch. 1975 Jul 21;358(2):101-10.
30. Niederhoffer N, Hein L, Starke K.

Modulation of the baroreceptor reflex by alpha 2A-adrenoceptors: a study in alpha 2A knockout mice. Br J Pharmacol. 2004 Mar;141(5):851-9.
31. Johnson JM. Nonthermoregulatory control of human skin blood flow. J Appl Physiol. 1986 Nov;61(5):1613-22.
32. Kellogg DL, Jr., Johnson JM, Kosiba WA. Baroreflex control of the cutaneous active vasodilator system in humans. Circ Res. 1990 May;66(5):1420-6.
33. Rowell LB, Wyss CR, Brengelmann GL. Sustained human skin and muscle vasoconstriction with reduced baroreceptor activity. J Appl Physiol. 1973 May;34(5):639-43.
34. Tripathi A, Nadel ER. Forearm skin and muscle vasoconstriction during lower body negative pressure. J Appl Physiol. 1986 May;60(5):1535-41.
35. Maloney-Hinds C, Petrofsky JS, Zimmerman G. The effect of 30 Hz vs. 50 Hz passive vibration and duration of vibration on skin blood flow in the arm. Med Sci Monit. 2008 Mar;14(3):CR112-6.
36. Lohman EB, 3rd, Bains GS, Lohman T, DeLeon M, Petrofsky JS. A comparison of the effect of a variety of thermal and vibratory modalities on skin temperature and blood flow in healthy volunteers. Med Sci Monit. 2011 Sep;17(9):MT72-81.
37. Lohman EB, Sackiriyas KSB, Bains G, Calandra G, Lobo C, Nakhro D, et al. A comparison of whole body vibration and moist heat on lower extremity skin temperature and skin blood flow in healthy older individuals. Med Sci Monit. 2012;18(7):CR415-24.
38. Lohman EB, 3rd, Petrofsky JS, Maloney-Hinds C, Betts-Schwab H, Thorpe D. The effect of whole body vibration on lower extremity skin blood flow in normal subjects. Med Sci Monit. 2007 Feb;13(2):CR71-6.
39. Maloney-Hinds C, Petrofsky JS, Zimmerman G, Hessinger DA. The role of nitric oxide in skin blood flow increases due to vibration in healthy adults and adults with type 2 diabetes. Diabetes Technol Ther. 2009 Jan;11(1):39-43.
40. Lohman EB, Sackiriyas KS, Bains G, Dhamane KH, Solani KJ, Raju C, K., et al. Effect of Vibration on Skin Blood Flow in Type 2 Diabetes Mellitus (accepted). ijpot. 2013.
41. Wells PS, Owen C, Doucette S, Fergusson D, Tran HY. Does this patient have deep vein thrombosis? Jama-J Am Med Assoc. 2006 Jan 11;295(2):199-207.
42. SPSS 20.0 for Windows Manual. Chicago, I11: SPSS, Inc; 2013.
43. Schmitz TD. Vital Signs. In: O'Sullivan. S. B. Schmitz TJ, editor. Physical Rehabilitation. 5 ed. Philadelphia: F. A. Davis Company. p. 81-120.
44. Maikala RV, Bhambhani YN. In vivo lumbar erector spinae oxygenation and blood volume measurements in healthy men during seated whole-body vibration. Exp Physiol. 2006 Sep;91(5):853-66.
45. Bovenzi M, Lindsell CJ, Griffin MJ. Response of finger circulation to energy equivalent combinations of magnitude and duration of vibration. Occup Environ Med. 2001 Mar;58(3):185-93.
46. Stewart JM, Karman C, Montgomery LD, McLeod KJ. Plantar vibration improves leg fluid flow in perimenopausal women. Am J Physiol Regul Integr Comp Physiol. 2005 Mar;288(3):R623-9.
47. Skoglund CR. Vasodilatation in human skin induced by low-amplitude high-frequency vibration. Clin Physiol. 1989 Aug;9(4):361-72.

PERCEPTIONS & PLANS OF FRESH PHYSIOTHERAPY GRADUATES

SNEHA KALE[1], PRADEEP NEMADE[2], CHHAYA VERMA[3], VIJAYA KRISHNAN[4], HIRAL MASTER[5]

1. *Intern, Seth GSMC & Kem Hospital, Parel, Mumbai*
2. *Assistant Professor, Dept of Orthopedics, Seth GSMC & Kem Hospital, Parel, Mumba*
3. *Professor, Dept of Physiotherapy, Seth GSMC & Kem Hospital, Parel, Mumba*
4. *MPTh,Lokmanya Tilak Municipal Medical College & General Hospital, Sion, Mumbai*
5. *BPTh, Seth GSMC & Kem Hospital, Parel, Mumbai*

ABSTRACT

Background: Physiotherapy as a profession has its roots to earliest of time. The advances in technology & the recent transformation in global communication, which are increasingly reducing the spatial limitation in education, have influenced perspectives on how physiotherapy training is delivered. An awareness of emerging trends on the delivery of education broadens the horizon of professionals & enriches their perspectives. It provides insights into the future of professional training & practice. Understanding & application of work skill requirements from novice to advanced practitioner are fundamental to success in a health profession.

Methodology: 77 students participated in the study, which included final year B.P.Th, interns & externs. A survey was conducted using a questionnaire to be completed in 30 minutes. The data was then entered & analyzed.

Results: 76.6% students pursued the course to make a respectable career. 70.1% felt the respect for physiotherapist as healthcare professionals was poor while 63.6% felt there are fewer job opportunities. Many were dis-satisfied with the salary. 64.9% wanted to go abroad to pursue their career further where 68.29% chose USA over other countries.

Conclusions: Most physiotherapy students chose their course because of an interest in physiotherapy. They were not familiar with employment possibilities for graduates. In addition to this the graduates are not satisfied with the present scenario & there is an increasing trend for migration.

KEYWORDS: Physiotherapist perceptions; Future direction; International Education; Professionalism; Career; Employment

INTRODUCTION

"Learn from yesterday; live for today; hope for tomorrow; the important thing is not to stop questioning" - Albert Einstein

Development of a discipline owes - to its ability for a clear vision to look back to its roots. The emergence of physiotherapy as a distinct health discipline occurred during World Wars[1]. The World Confederation for Physical Therapy (WCPT) defines it as – providing services to people & populations to develop, maintain & restore maximum movement and functional ability throughout the life span[2]. Physiotherapy is concerned with identifying & maximizing movement potential, within the spheres of promotion, prevention, treatment & rehabilitation. Physical therapists have 3 basic functions as professionals – educator, clinician & researcher. The three roles coincidently develop in accordance with the continuous & progressive holistic development knowledge, experience & skill[3].

The WCPT recognizes considerable diversity in the social, economic, cultural & political environments in which physical therapy education is conducted throughout the world. It recommends physical therapist entry-level educational programs be based on university or university-level studies of a minimum 4 yrs, independently validated & accredited as being at a standard that accords graduates full statutory & professional recognition[4]. Professional education prepares physical therapists to be autonomous practitioners in collaboration with other members of the health care team. Physical therapist entry-level educational programs integrate theory, evidence & practice along a continuum of learning. This begins with admission to an accredited physical therapy program & ending with retirement from active practice[5]. Professional autonomy is achievable through -

- Definition of scope of practice
- Research
- Clinical doctorate programs
- Marketing
- Maintenance & advancement of autonomy[6]

It is extremely important to transform physical therapy profession from professionalization (practice in diverse fields of medicine from before birth till death)[7] into professionalism (accountability, altruism, compassion, excellence, integrity, professional duty & social responsibility)[8].

Thus, this study was undertaken to understand the perception & plans for career of the new graduates for their lifelong learning &

For Corresnpodense:
Vijaya Krishnan
Email: victoryv2@yahoo.co.in

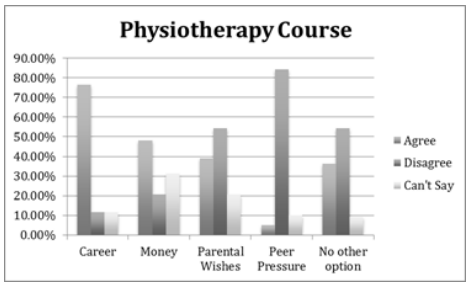
professional career development in physiotherapy.

METHODOLOGY

A departmental ethics committee approval was obtained prior to the commencement of this study. 77 fresh recently passed out graduates participated in the study. A structured questionnaire validated by 5 senior faculty members of 3 different colleges was developed for the study by the investigator after reviewing literature, college records & by discussion with experts in physiotherapy & medical education. The questionnaires were self-administered to the consenting participants & 30 minutes were given to answer them. The data is then entered & analyzed.

RESULTS

The physiotherapists' responses to the questionnaire items are listed below. Both frequencies of responses & percentages are included.

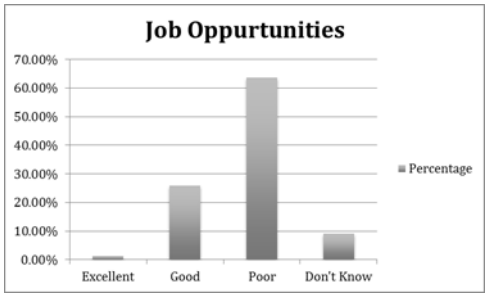


GRAPH 1: REASONS WHY STUDENTS JOINED THIS COURSE

Inference: 76.6% chose this field to make a respectable career.

GRAPH 2: DEGREE OF JOB SATISFACTION

Inference: 51.9% students found their job satisfaction to be good while very few (6.5%) had excellent reviews & 31.2% had poor satisfaction

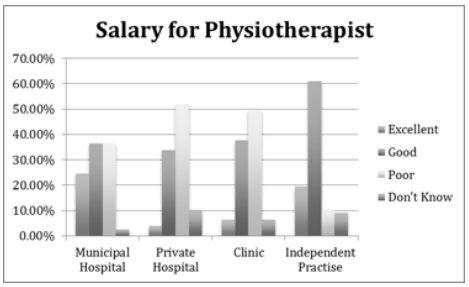


GRAPH 3: JOB OPPORTUNITIES FOR PHYSIOTHERAPISTS IN VARIOUS SECTORS OF COMMUNITY IN MUMBAI

Inference: 63.6% felt that the job opportunities were poor, 26% good but there were 9.1% students who still didn't know the scope of the course.

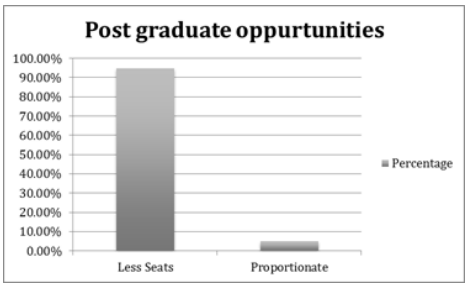
GRAPH 4: RESPECT FOR PHYSIOTHERAPISTS AS HEALTH CARE PROFESSIONALS

Inference: 70.1% felt the respect they received was poor while 29.9% felt it was good but could have been better.



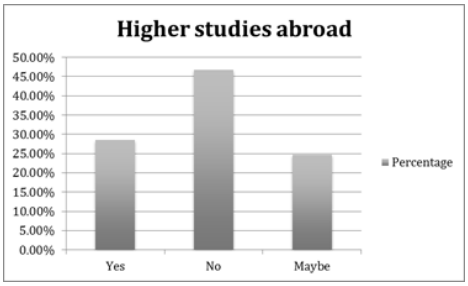
GRAPH 5: SALARY RECEIVED BY A PHYSIOTHERAPIST

Inference: 61% felt that one could earn good with independent practice than the other sectors of health care.



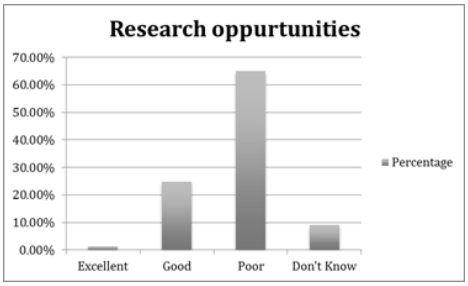
GRAPH 6: POSTGRADUATE EDUCATION IN MUMBAI

Inference: 94.8% students felt there the number of seats was less & also the stipend received during the course was poor



GRAPH 7: FURTHER STUDIES ABROAD

Inference: 46.8% refused to leave the country due to various reasons but 28.6% wanted to pursue studies abroad & 24.7% were not sure.



GRAPH 8: OPPORTUNITIES TO CARRY OUT RESEARCH

Inference: 64.9% felt research opportunities to be poor & 9.1% didn't have any knowhow about the same

DISCUSSION

Allied health professionals are required to be reflective practitioners & persistently generate knowledge to maintain competency & professional learning. Career development remains the ultimate responsibility of the individual. New graduates in addition to coping with a constantly changing world are faced with further uncertainty & challenges of transferring their skills, knowledge & practice to the professional environment. The need to validate professional development & its impact on an individual's career increases pressure on an individual to become competent reflective practitioners[9]. Therefore, while the perception of academic preparation for entry to professions is to equip graduates with basic skills, knowledge & behaviors, the employers' perception of work place preparedness focuses on professionalism, perspective & confidence[10].

The extent to which a university education prepares graduates for the workplace has become an important issue in the health science literature. Market expectations of physiotherapists reflect changing demands of health care for patient centered, community based management etc. The job market requires physiotherapy graduates to possess transferable skills, which can be applied to any situation. According to our study, many of the students didn't know or hadn't given much thought about the future – job opportunities (9.1%), job satisfaction (10.4%), salary difference in various setups, research opportunities (9.1%) etc. Most students chose their course because of an interest in physiotherapy. In this study we found that some were not familiar with employment possibilities for graduates. Hence, universities should prepare students to enter the job market & offer information on finding employment in their future profession & any associated problems. This might increase the degree of job satisfaction & create more job opportunities. The most satisfied graduates were goal oriented & developing a career path as evidenced by professional body membership, participation in more continuing professional development & finding better jobs[11,12,13,14] as illustrated in graphs 2, 3.

Graph 4 shows that the students' are not happy with the respect given to them & list this as a result of lack of awareness regarding the profession & its objectivities among the masses. Thus, believe that with more awareness people will value their services.

Professional education prepares physical therapists' to be autonomous practitioners in collaboration with other members of the health care team. Graph 5 illustrates that graduates feel that over the different institutions work with independent private practice is more lucrative.

Graph 6 shows that students 94.8% claim that the postgraduate seats are very less compared to the graduates who pass out every year. It is recognized that new graduates need a range of generic skills & knowledge & hence many of them wish to pursue higher studies. But due to various barriers & constraint they are unable to avail that chance & think of pursuing studies abroad as depicted in graph 7.

Also, 64.9% feel that research opportunities are very poor here. This too can be considered as one of the reason for migration of talented physiotherapists.

CONCLUSION

In this study, we found that the graduates were highly motivated in choosing physiotherapy as their career. They also reflected good job satisfaction but were unhappy about poor job opportunities, research environment & reduced seats for pursuing higher studies. Hence, we conclude that, objective of the university curriculum should be to facilitate a successful

transition of an allied health professional from a novice to advanced practitioner while focusing on key competencies & levels of autonomy through reflective practice, emotional & social sensitivity to the workplace. This should include more facilities & better prospectus leading to a bright future.

REFERENCES

1. Oyeyemi AY. Physiotherapy education: Global trends, perspectives & future direction; African Journal of Physiotherapy And Rehabilitation Sciences 2011; 3(1): 1-5. http://dx.doi.org/10.4314/ajprs.v3i1.1
2. Kumar SP. Physical therapy: past, present & future – a paradigm shift, J Phys Ther. 2010; 1: 58-67. www.scopemed.org/?mno=3479 [Access: July 06, 2015].
3. Sotosky JR. Physical therapists' attitudes towards teaching. Phys Ther. 1984; 64: 347-350 http://ptjournal.apta.org/content/73/11/787
4. WCPT. Entry-level physical therapy education programmes, London: World Confederation for Physical Therapy, 2010; available at http://www.wcpt.org/node/33154.
5. Solomon P. Problem based learning: a review of current issues relevant to physiotherapy education. Physiother Theory Pract. 2005; 21:37 – 49 http://dx.doi.org/10.1080/09593980590911499. PMid: 16385942.
6. Paris SV. Autonomy & the future of physiotherapy. New Zealand Journal of Physiotherapy. 2008; 36:67-75
7. Kumar SP. Physical therapy in palliative care: from symptom control to functional independence – a critical review. Indian Palliat Care. 2010
8. American Physical Therapy Association. Professionalism in physical therapy: core values. APTA, Alexandria, VA. Available at www.apta.org/documents/public/education/professionalism.pdf.
9. Bandaranaike S, Kimmerly A. Building career pathways in the allied health industry: a practical framework. Paper presented in 10th international symposium on cooperative & work-integrated education, 2014; Sweden 1-18
10. Sole G, Claydon L, Hendrick P, Hagberg J, Jonsson J, Harland T. Employers' perspectives of competencies & attributes of physiotherapy graduates: an exploratory qualitative study. New Zealand Journal of physiotherapy. 2012; 40 (3), 123-127.
11. Hunt A, Adamson B, Harris L. Physiotherapists' perceptions of the gap between education & practice. Physiotherapy theory & practice 1998; 14 (3): 125-138 http://dx.doi.org/10.3109/09593989809057157
12. Lindquist I, Engardt M, Garnham L, Poland F, Richardson B. Physiotherapy students' professional identity on the edge of working life. Medical teacher, 2006; 28(3): 270-276. http://dx.doi.org/10.1080/01421590600605272 PMid: 16753727
13. Jones M, McIntyre J, Naylor S. Are physiotherapy students adequately prepared to successfully gain employment? Physiotherapy 2010; 96(2): 169-175 http://dx.doi.org/10.1016/j.physio.2009.11.008 PMid: 20420964
14. Mulcahy A, Jones S, Strauss G, Cooper I. The impact of recent physiotherapy graduates in the workforce: a study of Curtin University entry-level physiotherapists 2000-2004. Australian health review 2010; 34(2): 252-259 http://dx.doi.org/10.1071/AH08700 PMid: 20497742

EFFECT OF CRYOTHERAPY ON POST-SURGICAL EDEMA FOLLOWING TOTAL KNEE REPLACEMENT IN OLDER ADULTS IN A SUB-ACUTE SETTING

GAURANGI SHAH[1], JEANANNE ELKINS[2]

1. *Physical Therapist*
2. *Jeananne Elkins, PhD, DPT, MPH NEU Faculty*

ABSTRACT

BACKGROUND AND PURPOSE: Total knee replacement (TKR) is the most preferred surgical treatment of choice for many patients with end stage arthritis to improve functional performance, and quality of life. In the year 2010, according to Center of Disease Control 719,000 TKR surgeries were performed, with 385,000 performed on older adults. The annual number of TKR performed in the United States are projected to increase to 3.48 million by 2030, with 1.2 million requiring post-acute rehabilitation. Post-surgical edema following TKR can decrease knee extensor strength, increase pain, and decrease functional performance. Cryotherapy is a commonly preferred modality in physical therapy clinical practice after orthopedic surgery procedures to control edema. However, studies in the literature on the effect of cryotherapy after TKR in older adults are limited and controversial.

CASE DESCRIPTION: A 71-year-old female, who underwent elective left total knee replacement, due to end stage tricompartmental degenerative joint disease of left knee after exhausting non-operative treatment, participated for the study.

INTERVENTION: Physical therapy intervention included cryotherapy in form of AirCast Cryo/Cuff, continuous passive movement (CPM), therapeutic exercises, therapeutic activities, balance training and gait training.

OUTCOMES: The difference between the girth measurements on day 1 and day 13 revealed that there was overall reduction in edema by ¾ inch to 1 ¼ inches. Also, length of stay was reduced by 7 days.

DISCUSSION: Reduction in edema allowed early gains in functional performance for the client to be able to return home to independent living, and in turn shortening the length of stay at the sub-acute facility.

CONCLUSION: Cryotherapy was found effective in reducing post-surgical edema after total knee replacement.

KEYWORDS: Cryotherapy; Total knee replacement; Edema; Older adults; Sub-acute rehab.

INTRODUCTON

Total knee replacement (TKR), a procedure to resurface the joint with joint implants in order to relieve pain and help restore function of damaged knees, is the most preferred surgical treatment of choice for many patients with end stage arthritis to improve functional mobility and quality of life[1,2,3,4,5]. In the year 2010, according to Center of Disease Control 719,000 TKR surgeries were performed, with 385,000 performed on older adults[6]. By 2030, the annual number of TKR performed in the United States are projected to increase to 3.48 million, with an estimation of 1.2 million requiring post-acute rehabilitation[7,8]. Admission to sub-acute rehab facility for total joint rehabilitation has been on the rise in the United States due to multiple reasons including pressure to reduce acute care hospital length of stay. For Medicare patients, reimbursement for sub-acute rehabilitation is based on the clients' length of stay, and hence, longer length of stay results in higher rehabilitation cost in this setting[8]. The average length of stay following TKR in complex case mix category is about 27 days[9]. In 2006, the cost of inpatient rehabilitation after routine TKR was reported to be $12,715 per patient[8]. In 2011, total Medicare spending was about $31.8 billion on sub-acute rehabilitation in skilled nursing facilities, with joint replacement as most commonly treated condition[10]. With increasingly limited resources, it is imperative to find the most cost effective methods to achieve the best rehabilitation outcomes following TKR in a sub-acute setting[8].

In total knee replacement procedure, surgical tissue damage is extensive, intraoperative blood loss is high, and acute post-operative phase is significant of severe edema, pain, restricted knee range of motion, and quadriceps arthrogenic muscle inhibition[2,5,11]. Knee edema, pain, and limited range of motion are potential barriers to early rehabilitation and discharge[2,12]. Knee edema, defined as excess fluid in the interstitium, after total knee replacement is due to intraarticular bleeding and inflammation of the periarticular tissues[1,13]. Also, extensive surgical tissue damage may lead to muscle tightness, and restrict tissue fluid movement creating edema. Further severe edema may cause local ischemia, causing

For Correspondence:
Gaurangi Shah, PT, DPT
Email: shahgaurangi@yahoo.com

This paper was submitted in partial fulfillment of the Doctor of Physical Therapy degree for the College of Professional Studies, Northeastern University, Boston MA 02115.

increased pain through nutritional deprivation of the affected soft tissues[1].

According to Holm et al., decreased knee-extension strength after TKR, is caused, in part, by postoperative knee edema in the very early postoperative phase, as edema leads to decreased excitability of the quadriceps motor neurons, and greater the postoperative knee edema, the greater the decrease in knee-extension strength[14]. After TKR, many patients are not able to fully activate the quadriceps muscle of the operated leg, possibly due to arthrogenic reflex inhibition of the muscle caused by knee edema, resulting in quadriceps weakness further leading to decreased functional performance[14]. Based on these relatively new findings, it is important to reduce knee edema to improve knee-extension strength after TKR, as knee-extensor strength is directly related to functional performance[14].

While edema can be measured in a variety of ways a standard tape measure provides almost perfect intra-tester and inter-tester reliability, and does not depend on the experience of the measuring physical therapist[15]. Also, standard tape measure is inexpensive, comfortable, convenient to carry, and provides measurement in a time efficient manner. Most reliability studies recommend repeated circumferential measurements should be recorded by the same physical therapist in individual patients with TKR[15].

One typical physical therapy protocol for edema management following acute soft tissue injury is ice, compression and elevation. Cryotherapy is a commonly preferred treatment modality in physical therapy clinical practice after orthopedic surgery procedures to control edema and reduce pain. The reported benefits of cryotherapy after a TKR include postoperative control of edema, inflammation, knee pain, and hematoma formation, which subsequently allows early rehabilitation[2,5,11,16]. Cryotherapy is a safe and relatively cheap intervention. Commercially available devices such as the Cryo/Cuff (Air/Cast, Vista, CA) cost around US$100 but may be labor intensive because ice exchange is regularly required[2].

The physiological effects of cryotherapy include decreased formation of edema, decreased accumulation of edema, decreased blood flow, decreased nerve conduction velocity, and increased anesthetic effects. These physiological effects justify the use of cryotherapy during acute swelling, inflammation, pain, and as well as to control edema[5]. Local application of cold suppresses the metabolic rate of the immediate surrounding soft tissue. This decrease in tissue metabolism is associated with a reduction in enzymatic activity, preventing tissue damage caused by hypoxia. Local hypothermia induces vasoconstriction and lowers microcirculation by more than 60%, an effect that can persist for up to 30 minutes after cessation of cooling. Cold induced vasoconstriction reduces extravasation of blood into surroundings tissues, local inflammation, and edema production[11,16].

Cryotherapy when applied over a joint, reduces intra-articular temperatures, thereby reducing local blood flow and slowing the conduction of nerve signals. These changes, in turn, reduce both the transmission of noxious signals, and the inflammatory response, subsequently affecting the level of blood loss, local edema, and perceived pain[2]. In addition, focal joint cooling of the knee (Pietrosimone and Ingersoll , 2009), shows the potential to improve quadriceps activation as well as quadriceps torque and force production in patients with arthrogenic muscle inhibition[5,17]. According to Rice and McNair, the cooling of the knee joint independently of the surrounding musculature produces quadriceps activation facilitation for up to 45 and 60 minutes after the initiation of the cryotherapy, and if quadriceps strengthening is performed during this period it will result in quality quadriceps strength training session as maximal quadriceps contraction is achieved[18]. This could allow for better strength gains resulting in better functional outcomes and would possibly prevent functional decline observed with aging due to delay in functional recovery[5].

While rehabilitating after TKR other common interventions to reduce edema include anti-embolism stockings, compression of the extremity, and elevation of the extremity. In addition both the contrast-effect of water temperature in the use of ice and the use of CPM have been explored as interventions to decrease edema. While these interventions show various levels of success, in recent years the application of cold via the Cryo/Cuff appears to be the primary treatment for edema.

PURPOSE

The purpose of this study is to observe effect of cryotherapy on the post-operative edema after total knee replacement in older adults in a sub-acute setting.

CASE DESCRIPTION

The client is an active 71-year-old female with long history of osteoarthritis, severe pain, and progressively disabling varus deformity of her left knee. Radiographic findings revealed end-stage tricompartmental degenerative joint disease. After exhausting non-operative treatment options, left total knee replacement was opted as a treatment of choice. Past medical history is

significant for right knee replacement, osteoarthritis, stroke, and obesity. Daily medications included Simvastatin, Hydrochlorothiazide, Metoprolol, and Tramadol. Due to known allergies to narcotics, Dilaudid was prescribed for pain management. Uncomplicated left total knee replacement was performed under femoral block plus general endotracheal anesthesia, and the client was transferred to sub-acute rehabilitation facility on postoperative day #3 for rehabilitation.

Cryo/Cuff and CPM were prescribed by the operating orthopedic surgeon for pain and edema management. Weight bearing as tolerated was allowed on left lower extremity. Elevation of leg, and anti-embolism stocking were not tolerated by the client due to discomfort.

CLINICAL FINDINGS

Left knee girth measurements were recorded on day 1, day 5, day 10 and day 13, by the same therapist and the same standard tape measure was used for all measurements. Upon initial evaluation bilateral knee measurements were recorded to identify true edema, and it was noted that there was about 2 inches of edema from the center of the knee to four inches above the center. There was approximately about 1.5 inches of swelling from center to four inches below knee. For girth measurements client was placed in supine position on exercise mat, center of the knee was marked at apex of the patella, and then there were markings made at one inch interval up to four inches above and below the center point. The findings of girth measurements are noted in table (See Appendix).

Pain assessment was completed using 11 point Numerical Rating Scale. The Numerical Rating Scale has good sensitivity[19]. Client's pain rating on a scale of 0 to 10, 0 being no pain and 10 being worst possible pain, was 10/10 in left knee with mobility and weight bearing on the left lower extremity.

Left knee active range of motion (AROM) was measured using universal goniometer. The intra-tester and inter-tester reliability is high for universal goniometers however, repeated measurements should be recorded by the same physical therapist in clients with TKR[20,21]. Left knee flexion was recorded at 41 degrees; left knee extension at -18 degree, and rest all joints including bilateral upper extremities active range of motion was within functional limits.

Left knee flexors and extensors were graded at -2/5 in available range of motion. Muscle grading was done by manual muscle testing. All other muscle groups were graded at 4/5.

FUNCTIONAL ASSESSMENT

Physical functioning and mobility was assessed using physical performance and mobility exam (PPME). PPME assesses 6 mobility tasks integral to daily life: bed mobility, transfer skills, multiple stands from chair, standing balance, step-up, and ambulation. The PPME is a reliable and valid performance-based instrument measuring physical functioning and mobility in hospitalized elderly[22]. Client required moderate assistance for bed mobility using half side-rails, and maximal assistance of two assist for functional transfers using four wheeled walker. Further, client was able to ambulate 2 feet with maximal assist using four wheeled walker with decreased step length, step height. Client's PPME score was 1. It was not possible to assess gait speed on evaluation since patient was not able to ambulate beyond 2 feet due to severe pain.

12 WEEK FOLLOW-UP

Follow-up at 12 week was conducted at client's residence to assess functional performance and community reintegration. Girth measurements were recorded at that time by same therapist. Functional outcomes, as well as range of motion were also assessed at that time.

INTERVENTION

Physical therapy intervention included therapeutic exercises, therapeutic activities, balance training and gait training. Modalities included cryotherapy, and continuous passive movement equipment daily for 2 hours 3 times a day. Therapeutic exercises as outlined in Table 1, were progressed from supine to sitting to standing as tolerated by the client, and were performed twice per day according to the client's tolerance but not exceeding twenty repetitions.

TABLE 1: THERAPEUTIC EXERCISES

Supine	Sitting	Standing
Hip-Knee Flexion	Hip-Knee Flexion	Hip-Knee Flexion
Short Arc Quad	Long Arc Quads	Hip Abduction/Adduction
Straight Leg Raise	Ankle Pumps	Hip Extension
Hip Abduction/Adduction		Hamstring Curls
Ankle Pumps		Heel-Toe Raises
Isometric Quad Sets with Knee in Extension		

Therapeutic activities focused on functional bed mobility training, functional transfer training, functional gait training, and functional balance training. Assistive device used for out of bed functional mobility was four wheeled walker. Goal was to progress functional mobility using least restrictive assistive device.

MODALITY OF INTEREST

Cryotherapy was provided for 13 days by using AirCast Knee Cryo/Cuff with cooler. It

consisted of anterior knee cuff with water channels which was secured over the knee joint by above knee and below knee straps. The knee cuff was filled with ice water as per the manufacturer's instructions. The Cryo/Cuff was applied on the anterior aspect of knee joint over a layer of clothing, four times a day for an hour each time. During this hour water was not chilled again in the cuff. The temperature of water upon application was 30 degrees Fahrenheit, and at the end of the hour the temperature was 56 degrees Fahrenheit. Skin assessment was performed before and after each application.

The Cryo/Cuff did not provide any compression effect, as the cuff covered only the anterior part of the knee and was secured around the knee with Velcro straps. Contrast-bath effect was not achieved with the water in the cuff, as the water temperature gradually increased in the cuff and there was no alteration of hot/cold water to gain pumping effect. Cryo/Cuff application did not interfere with functional mobility.

OUTCOMES

The difference between the girth measurements on day 1 and day 13 revealed that there was overall reduction in edema by ¾ inch to 1¼ inches. At 12 weeks it was noted that there was no significant difference in measurements between left and right knee. Girth measurements are noted in table (See Appendix).

As shown in Table 2, on day 13, client reported pain at 4/10 on 11 point numeric pain rating scale, which decreased by 6 points from 10/10 upon initial evaluation, and at week 12, pain rating was at 0/10 with mobility. On day 13, knee flexion measured at 75 degrees and extension at 0 degrees. There was a notable gain in knee flexion from 41 degrees upon evaluation to 75 degrees, and knee extension improved from -18 degrees to 0 degrees. Knee flexion measured at 90 degrees, and extension at 0 degrees at 12 week follow-up. Muscle strength improved to 3/5 in both knee flexors as well as extensors, which measured at 2-/5 upon evaluation. On day 13, gait speed improved to 0.9, and was measured at 1.0 at the 12 week follow-up.

TABLE 2 OUTCOME MEASURES

Outcomes	Readings			
	Day 1	Day 13	Difference (Day 1- Day 13)	12 Week
Pain	10	4	-6	0/10
Knee Flexion ROM	41	75	34	90
Knee Extension ROM	(-18)	0	18	0
Gait Speed	0	0.9	0.9	1
PPME	1	7	6	10

Client was independent with bed mobility, independent with transfers using four wheeled walker, independent with gait using four wheeled walker, and gait endurance improved to 400' with a seated break after every 100'. At 12 week follow up, client was independent with gait without assistive device for residential mobility and required a standard cane for community mobility. Functional mobility was reported to be pain free.

Length of stay after left knee replacement was 21 days, while length of stay after right knee replacement at the same sub-acute facility was 28 days. Client continued with home physical therapy services after being discharged home with both replacements. Length of stay after left knee replacement was shorter by 7 days.

DISCUSSION

Cryotherapy was found effective in reducing post-surgical edema after total knee replacement in this case study, however, there may be confounding variables. These include the use of CPM and contrast-effect of the water in Cryo/Cuff, however, the CPM was not applied in a time appropriate manner to decrease edema and, in addition, the client was not compliant with its usage. The contrast effect of the water was not measured and is a limitation of this study.

In this case study, cryotherapy was applied 4 times a day for 60 minutes for 13 days, whereas, in most studies application of cryotherapy has been once a day for duration of 20 - 30 minutes in a hospital setting for an average period of 3 days. For cryotherapy to be effective in reducing edema, application time and duration should be extended beyond acute phase of the surgery. Sub-acute setting provides length of stay required for the cryotherapy to be effective as well as labor required to change ice regularly.

Further, reduction in edema allowed early gains in functional performance for the client to be able to return home to independent living, and in turn shortening the length of stay at the sub-acute facility. With our client, length of stay for left knee replacement was shorter by 7 days, compared to right knee replacement at the same sub-acute facility. This is a significant difference when financial issues are concerned. A 12 week follow up visit was conducted to confirm there was no decline in client's functional performance after being discharged from sub-acute facility. It was noted, client was independent with residential as well as community mobility, had regained functional active knee range of motion, and was living a pain free life.

CONCLUSION

In conclusion, after controlling for possible confounders, including CPM, anti-

embolism stocking, elevation, compression, and contrast-effect of water in the Cryo/Cuff, cryotherapy was found effective in reducing post-surgical edema after total knee replacement. However, well designed randomized control trial are indicated to identify if cryotherapy reduced edema in the quadriceps muscle, examine quadriceps strength gains by providing strength training within 45-60 minutes of cryotherapy application, and establish a correlation between cryotherapy, reduction in edema, knee-extensor strength and functional outcomes. Further studies are significant as knee extensor strength is directly related to functional performance which could easily decline in older adults due to weak knee extensors, and cryotherapy may assist in gaining knee-extensor strength by reducing knee edema.

REFERENCES

1. Ebert JR, Joss B, Jardine B, Wood DJ. Randomized trial investigating the efficacy of manual lymphatic drainage to improve early outcome after total knee arthroplasty. Arch Phys Med Rehabil. 2013;94(11):2103-11
2. Adie S, Naylor JM, Harris IA. Cryotherapy after total knee arthroplasty a systematic review and meta-analysis of randomized controlled trials. J Arthroplasty. 2010;25(5):709-15.
3. Hohler SE. Total knee arthroplasty: past successes and current improvements. AORN J. 2008;87(1):143-58.
4. Markert SE. The use of cryotherapy after a total knee replacement: a literature review. Orthop Nurs. 2011;30(1):29-36.
5. Ewell M, Griffin C, Hull J. The use of focal knee joint cryotherapy to improve functional outcomes after total knee arthroplasty: review article. PM R. 2014;6(8):729-38.
6. Available at: http://www.cdc.gov/nchs/data/nhds/4procedures/2010pro4_numberprocedureage. Accessed February 7, 2015.
7. Friedman RJ, Hess S, Berkowitz SD, Homering M. Complication rates after hip or knee arthroplasty in morbidly obese patients. Clin Orthop Relat Res. 2013;471(10):3358-66.
8. Kathrins B, Kathrins R, Marsico R, et al. Comparison of day rehabilitation to skilled nursing facility for the rehabilitation for total knee arthroplasty. Am J Phys Med Rehabil. 2013;92(1):61-7.
9. Dejong G, Hsieh CH, Gassaway J, et al. Characterizing rehabilitation services for patients with knee and hip replacement in skilled nursing facilities and inpatient rehabilitation facilities. Arch Phys Med Rehabil. 2009;90(8):1269-83.
10. Linehan K. Medicare's post-acute care payment: a review of the issues and policy proposals. Issue Brief George Wash Univ Natl Health Policy Forum. 2012;(847):1-23.
11. Block JE. Cold and compression in the management of musculoskeletal injuries and orthopedic operative procedures: a narrative review. Open Access J Sports Med. 2010;1:105-13.
12. Available at: http://www.cdc.gov/arthritis/docs/oaagenda. Accessed February 6, 2015.
13. Munk S, Jensen NJ, Andersen I, Kehlet H, Hansen TB. Effect of compression therapy on knee swelling and pain after total knee arthroplasty. Knee Surg Sports Traumatol Arthrosc. 2013;21(2):388-92.
14. Holm B, Kristensen MT, Bencke J, Husted H, Kehlet H, Bandholm T. Loss of knee-extension strength is related to knee swelling after total knee arthroplasty. Arch Phys Med Rehabil. 2010;91(11):1770-6.
15. Jakobsen TL, Christensen M, Christensen SS, Olsen M, Bandholm T. Reliability of knee joint range of motion and circumference measurements after total knee arthroplasty: does tester experience matter?. Physiother Res Int. 2010;15(3):126-34.
16. Kullenberg B, Ylipää S, Söderlund K, Resch S. Postoperative cryotherapy after total knee arthroplasty: a prospective study of 86 patients. J Arthroplasty. 2006;21(8):1175-9.
17. Pietrosimone BG, Ingersoll CD. Focal knee joint cooling increases the quadriceps central activation ratio. J Sports Sci. 2009;27(8):873-9.
18. Rice DA, Mcnair PJ. Quadriceps arthrogenic muscle inhibition: neural mechanisms and treatment perspectives. Semin Arthritis Rheum. 2010;40(3):250-66.
19. Williamson A, Hoggart B. Pain: a review of three commonly used pain rating scales. J Clin Nurs. 2005;14(7):798-804.
20. O'driscoll SW, Giori NJ. Continuous passive motion (CPM): theory and principles of clinical application. J Rehabil Res Dev. 2000;37(2):179-88.
21. Brosseau L, Balmer S, Tousignant M, et al. Intra- and intertester reliability and criterion validity of the parallelogram and universal goniometers for measuring maximum active knee flexion and extension of patients with knee restrictions. Arch Phys Med Rehabil. 2001;82(3):396-402.
22. Winograd CH, Lemsky CM, Nevitt MC, et al. Development of a physical performance and mobility examination. J Am Geriatr Soc. 1994;42(7):743-9.

APPENDIX: GIRTH MEASUREMENTS IN INCHES

	Girth Measurements (in inches)									
	Left Knee						Right Knee		(Left Knee Day 1) - (Right Knee Day 1)	(Left Knee Week 12) - (Right Knee Week 12)
	Day 1	Day 5	Day 10	Day 13	Week 12	(Day 1) - (Day 13)	Day 1	Week 12		
4" above knee	21.75	21.5	20.9	20.5	19.25	1.25	20.25	20.25	1.5	-1
3" above knee	21.25	21	20.5	20	18.75	1.25	19.5	19.5	1.75	-0.75
2" above knee	20.75	20.5	20.05	19.75	18.5	1	18.75	19	2	-0.5
1" above knee	20.5	20.3	19.8	19.6	18.5	0.9	18.5	18.5	2	0
Center of knee	20	20	19.75	19.25	17.75	0.75	18	18.25	2	-0.5
1" below knee	19	18.25	18.5	18	17.5	1	17.25	17.25	1.75	0.25
2" below knee	18	18	17.25	17.05	16.25	0.95	16.5	16.5	1.5	-0.25
3" below knee	17.5	17.5	16.7	16.2	15.5	1.3	16	16	1.5	-0.5
4" below knee	17.25	17.3	16.5	16.1	15.25	1.15	16.25	16.5	1	-1.25

EFFICACY OF THERAPEUTIC ELECTRICAL MUSCLE STIMULATION IN TREATING AND REDUCING POST STROKE SHOULDER SUBLUXATION

KARTHIKEYAN T[1], MOORTHY A S[2]

1. *Physiotherapist, Department of Neuro Rehabilitation, NIMHANS University, India*
2. *Physiotherapist, JPN Apex Trauma Centre, AIIMS, New Delhi.*

ABSTRACT

Introduction: Stroke is an acute onset of neurological dysfunction due to an abnormality in cerebral circulation with involvement of focal areas of brain.

Aim and need of study: The purpose of study was to evaluate the effectiveness of electrical stimulation in reducing post stroke shoulder subluxation. The need of study was to determine whether effectiveness of Electrical stimulation is effective in reducing shoulder subluxation following stroke.

Methodology: The study was quasi experimental in nature, Twenty 20 person were selected by using simple random sampling technique. Pretest assessment was taken for subluxation measurement by using sliding caliper through clinical palpation. After the pretest assessment over, Treatment group receives Electrical stimulation for 4 weeks. The present study which included patient with age group are range from 45-84 years, both sexes were included in the study and hemiplegia patient with sub luxation shoulder, were recruited. Exclusion criteria of the study Patient with Diabetes, Hypertension, Head injuries, Cardiac pacemaker and Reflex sympathetic dystrophy were excluded.

Observation and analysis: The collected data were subject to paired "T" individually to the treatment group for subluxation in post stroke.

Conclusion: The result of the study concludes that electrical stimulation was found to be effective in reducing the shoulder subluxation following stroke. Electrical stimulation for the treatment of selected stroke patient is safe, low cost, and is advocated for use selectively in the early rehabilitation of stroke patients for the beneficial effect of the hemiplegic shoulder, restoration of motor function and quality of life and functional ability. However, it is recommended that centers utilizing this modality have trained personnel involved and also involves training care givers utilizing this modality in home rehabilitation programs.

KEYWORDS: Implementation; Inactivity; Intervention; Stroke; ES and SL

INTRODUCTION

Inferior gleno humeral joint displacement, generally referred to as shoulder subluxation, is one of the most common secondary musculoskeletal impairments in the upper limb after stroke. The incidence in the period soon after stroke ranges from 7% to 81% and this variation appears to be related to the degree of paralysis of the muscles in the upper limb[1]. For example, reported an 81% incidence, reported a 60% incidence and reported a 56% incidence in stroke patients who had no active motion at the shoulder. The incidence was lower (40%) in stroke patients who had some activity in their upper arm[2]. Similarly, reported only a 15% and 7% incidence respectively, in stroke patients who had activity of the upper limb muscles within one month[3]. Shoulder subluxation is considered to be a problem because it causes shoulder pain and hinders the recovery of upper limb function[4]. It has been suggested that subluxation causes shoulder pain by overstretching the soft tissues (such as the capsule, ligaments and muscles) surrounding the shoulder[5]. However, most studies report no significant correlation between subluxation and pain. It is now thought that subluxation is only one of several factors that can cause shoulder pain after stroke[6]. On the other hand, there is evidence to suggest that shoulder subluxation is associated with poor upper limb function and reflex sympathetic dystrophy. Therefore, its prevention should be an important part of upper limb rehabilitation. Stroke is a leading cause of long term disability in community. The recovery from stroke often slow and incomplete leading to partial or complete loss of locomotion, Activities of daily living, cognition and communication skills. The incidence of stroke rapidly increasing in the age group of 50-70 years in old groups. About 30 to 50% of patient following stroke will have a residual deficit[7].

Stroke is an acute onset of neurological dysfunction due to an abnormality in cerebral circulation with involvement of focal areas of brain.

Subluxation of the gleno humeral joint is a well-recognized complication experienced by stroke patients. Reported incidence of shoulder subluxation in stroke survivor is about 17 to 18%.

The gleno humeral subluxation basically is defined as a partial or complete dislocation that usually stems from changes in the mechanical integrity of the joint. The vulnerability of gleno

For Correspondence:
Karthikeyan T
Email: karthik_77in@yahoo.co.in

humeral joint to subluxation is because of functional anatomy of the joint. There are different treatment methods like, Positioning, Strapping, Tapping, that are widely used to reduce shoulder subluxation after stroke.

Recently Electrical stimulation has been applied to muscles, in an effort to treat shoulder subluxation, to maintain the gleno humeral joint stability. This study attempt to find out the efficacy of electrical stimulation in reducing shoulder subluxation in post stroke patients[8].

DEFINITION

The recommended WHO definition of stroke is "a focal (or at times global) neurological impairment of sudden onset, and lasting more than 24 hours (or leading to death) and of presumed vascular origin". This definition excludes transient ischemic attack (defined as focal neurologic symptoms lasting less than 24 hours), sub-dural hemorrhage, epidural hemorrhage, poisoning, and symptoms caused by trauma.

There are three major stroke sub-groups; ischemic stroke, intra-cerebral hemorrhage, and sub-arachnoid hemorrhage. Each of the types can produce clinical symptoms that fulfill the definition of stroke.

Electrical neuromuscular stimulation (ES) was first described over 35 years ago. Application of an electrical current to the skin stimulates lower motor nerves and muscle fibres resulting in improved contractility and greater muscle bulk. Decreased spasticity and sensory cortex activation occurs via afferent neuron stimulation, with additional information being provided by the proprioceptive and visual perception of ES induced joint movement. Clinical reports have suggested that ES can improve muscle group strength, joint mal alignment, muscle tone, sensory deficits, pain free range of passive humeral lateral rotation, as well as self-reported pain intensity. Most studies of hemiplegic shoulder pain have pursued an analgesic effect through the use of ES to reduce gleno humeral subluxation and obtain better shoulder positioning.

The electrical stimulation system consists of three parts - stimulator unit, electrodes and connecting wires. The electrodes are connected to the stimulator unit by leads that are snapped to the button of the electrode. The electrodes are commercially available, pre-gelled cutaneous electrodes with adhesive sponge backing. The electrical stimulator units are battery-powered and deliver a train of square wave pulses at 33 pps, with a 200-μsec pulse width.

Although ES is frequently administered via two methods, the distinction between them in the clinical setting is unclear.

ELECTRICAL STIMULATION IN STROKE

Electrical nerve stimulation is often used specifically as an analgesic technique to mask pain by giving lower intensity, higher frequency stimulation to cutaneous peripheral nerves without causing muscle contraction. However, regimens in between FES and TENS have been described, such as "high intensity TENS".

STATEMENT OF STUDY

To examine the efficacy of surface electrical stimulation which is help to prevention or reduction of shoulder subluxation after stroke

AIM OF STUDY

The purpose of this study was to evaluate the effectiveness of electrical stimulation in reducing post stroke shoulder subluxation.

NEED FOR STUDY

More than half of stroke survivor is having shoulder subluxation. The treatment physiotherapy all over the world use different techniques for treating shoulder subluxation. Traditionally positioning, strapping, Tapping have been widely used to reduce and to prevent shoulder subluxation after stroke.

Subluxation is common cause of post stroke shoulder dysfunction. Although different strategy used for treatment of the shoulder subluxation. There is a need to find out an effective method to reduce shoulder subluxation in post stroke patients.

RESEARCH DESIGN

This study was Quasi Experimental in nature. 20 patients were selected by using simple random sampling technique. Pretest assessment was taken for subluxation by using sliding caliper through clinical palpation.

After the pre assessment, Treatment group received electrical stimulation for period of 4 weeks. Post assessment was taken after 4 weeks in a similar fashion as that of pretest assessment.

CRITERIA FOR SELECTION

Inclusion criteria:

- Patients with age group were range from 45-84 yrs.
- Both sexes were included in the study.
- Hemiplegia patients with subluxation shoulder, were selected

Exclusion criteria:

Patients with

- Diabetes,
- Hypertension,
- Head injuries,
- Cardiac pacemaker,
- Reflex sympathetic dystrophy was excluded.

POPULATION

The patient who affected by stroke with shoulder subluxation have been taken as the population.

SAMPLE SIZE AND METHODS OF SELECTION

20 stroke patients with shoulder subluxation were selected as using simple random sampling technique.

VARIABLES

Independent variable: Electrical stimulation.

Dependent variable: Clinical palpation for subluxation by using sliding caliper.

Validity and reliability of tools used Treatment group: Clinical palpation by using sliding caliper is a valid tool for measuring shoulder subluxation.

METHODOLOGY

Twenty subjects those who met eligibility criteria were selected through by simple random sampling technique. The treatment group underwent a pretest assessment for shoulder subluxation using sliding caliper, through clinical palpation. It's a simple method to measure the gleno humeral subluxation in clinical practice. It has the ability to detect smaller difference in subluxation. Subluxation measurement was taken with patient in standing position and affected arms by his side.

PALPATION

External and clinical methods for measuring subluxation include the Following fashion.

1. Subacromial space was palpated and measured by using sliding caliper and the values are compared with that of the opposite shoulder.
2. A point was marked on acromion process and humeral head anteriorly and measuring the sub acromial space in (mm).

The Treatment group received Electrical stimulation for a period of four weeks. The patient was comfortably positioned in supine lying with adequate pillow support in the couch. The parameters for stimulation are pulse width-300 microseconds, Biphasic rectangular wave pulse: pulse frequency of 30 HZ, Intermittent faradic stimulation, Medium surge the duty cycle was 15 seconds ON which incorporated a ramp up time of 3 seconds, ramp down of 3 seconds and 15 seconds OFF.

The type of electrode which we used through pen and pad carbon rubber electrodes, size (2 x 3cm). Electrodes covered with sixteen layer of lint cloth, which is soaked with saline water. The position of pad electrodes was placed behind the nape of neck of patient. The pen electrode placed on the motor points over belly of muscles on posterior aspects of supraspinatus muscles on top of shoulder and posterior aspect of deltoid muscles. Before giving the treatment prior permission was taken from the consent and institute review board approval has made. The treatment part which was thoroughly evaluated and inspected through any contraindication which was present or not. All subject reported the sensation of muscles contraction. Minimum 30 contractions were given. The Electrical stimulation was given for a period of 4 weeks, with three times a day, with a minimum one hour per session. The length of each session increased gradually starting at 30 minute in week, 45 minutes in week, and progressed to 60 minute in week. The following treatment patient was advice to maintain shoulder position by using slings, strapping and tapping as a home program and family member are educated about proper transfer techniques.

RESULTS

There is significant reduction of shoulder subluxation and prevention of further reduction after 4 weeks prescribed specific treatment protocols which was given to the patient those who have been treated with Electrical stimulation.

TABLE 1: DISTRIBUTION GENDER AND AFFECTED STROKE EXTREMITY

		N	%
Sex	Female	6	30.0%
	Male	14	70.0%
Side	Left stroke	6	30.0%
	Right stroke	14	70.0%

TABLE 2: DESCRIPTIVE STATISTICS BETWEEN PRE AND POST TEST SCORE OF SLIDING CALIPER TECHNIQUE

	N	Mean
Pre test	20	9.100
Post test	20	1.150

TABLE 3: WILCOXON SIGNED RANKS TEST OF SLIDING CALIPER

	POSTTEST - PRETEST
Z	-3.976
P value	P < 0.001

DISCUSSION

The aim of the study was to evaluate the effectiveness of electrical stimulation in reducing post stroke shoulder subluxation. The result of this study showed that there is a significant improvement in reducing shoulder subluxation, following stroke. This effect may be due to the posterior deltoid and supraspinatus muscles holding the humeral head in correct alignment within the gleno humeral joint. This causes the muscle to contract and maintain muscle the bulk, and prevent the humerus from separating from the gleno humeral joint[9].

This finding coincides with evidence based study that demonstrated a mean subluxation of 6mm of subluxation shoulder is reduced by applying conventional therapy for 6 weeks[1].

Also other finding, reported that conventional therapy combined with electrical stimulation prevent shoulder subluxation on average by 6.5 mm[11]. Conventional therapy alone reduced subluxation on average by 1.9mm[10]. Hence the study results show that Electrical stimulation is effective in reducing shoulder subluxation following stroke. Clinically and statistically significant improvement in the range of motion and pain has been shown in patients treated with TENS.

There was also significantly less subluxation and pain found after the treatment period, but at the end of the follow-up period there were no significant differences between the groups treated with electrical stimulation or without. Another study showed that the therapeutic electrical stimulation therapy of the supra-spinatus and the deltoid muscle is an effective treatment modality for shoulder subluxation and shoulder abduction function in hemiplegic patients showed that there is statistically significant improvement in flexion, extension, and abduction and external rotation of shoulder recorded in patients treated with high TENS.

However, one study reported no significant change in pain incidence or change in pain intensity after ES treatment in treatment or control group, but there was a significant treatment effect in favor of ES for improvement in pain-free range of passive humeral lateral rotation. In this study, ES reduced the severity of glenohumeral subluxation but there was no significant effect on upper limb motor recovery or upper limb spasticity[10].

A review concluded that there is a positive effect of electrical stimulation (ES) on motor control, but no conclusions can be drawn with regards to the effect on functional abilities. A study on ES of the wrist extensors found that it enhances the recovery of isometric wrist extensor strength in hemiparetic stroke patients, with upper-limb disability being reduced after 8 weeks of ES therapy. However, the study could not verify how long the improvements in upper-limb disability are maintained after ES is discontinued. It has been found in a study on treatment with ES on the posture of the wrist, that there is an improvement in the passive range of extension, although there were no significant changes in the resistance to passive movement. However, these benefits appeared largely to be lost two weeks after ES was discontinued study on electrical stimulation of wrist and fingers for hemiplegic patients showed a statistically and clinically significant increase in wrist extension range, with increased extension noted at the metacarpophalangeal and proximal interphalangeal joints. Patients with some voluntary wrist extension before the treatment began were able to increase their extension strength during stimulation. No changes in skin sensation were noted.

RECOMMENDATION OF STUDY

1. The future research which is applicable large group of population or not.
2. Usage of X-Rays may be taken for subluxation measurement

Further research is needed to compare the effectiveness of Functional electrical stimulation with Tapping in reducing post stroke shoulder subluxation.

Electrical stimulation for the treatment of selected stroke patient is safe, low cost, and is advocated for use selectively in the early rehabilitation of stroke patients for the beneficial effect of the hemiplegic shoulder, restoration of motor function and quality of life. However, it is recommended that centers utilizing this modality have trained personnel involved and also involves training care givers utilizing this modality in home rehabilitation programs. Appropriate protocols and monitoring should be developed and utilized, as well as reviewed on a regular basis.

CONCLUSION

The result of the study shows that Electrical stimulation was found to be effective in reducing the shoulder subluxation following stroke. Electrical stimulation for the treatment of

selected stroke patient is safe, low cost, and is advocated for use selectively in the early rehabilitation of stroke patients for the beneficial effect of the hemiplegic shoulder, restoration of motor function and quality of life. However, it is recommended that centers utilizing this modality have trained personnel involved and also involves training care givers utilizing this modality in home rehabilitation programs. With respect to restoration of motor function, there is sufficient evidence that ES promotes recovery of muscle strength and improves motor function. The present study also demonstrated that early application of electrical stimulation applied in a way that produces a motor response in deltoid and supraspinatus muscles is effective in preventing 6.5 mm of shoulder subluxation. Therefore, electrical stimulation should be started as early as possible as part of best practice for those patients who are at risk of developing subluxation as a result of paralysis of shoulder muscles after stroke. This practice may also help to increase function and reduce another common secondary musculoskeletal side effect of stroke, shoulder pain. Electrical stimulation in the stroke patient is an efficient tool for the maintenance of muscle trophism, helping to reduce the appearance of edema and fibrosis in paretic muscles.

REFERENCES

1. Ada L, Foongchomcheay A. Efficacy of electrical stimulation in preventing or reducing subluxation of the shoulder after stroke: a meta-analysis. Australian Journal of Physiotherapy. 2002 Dec 31;48(4):257-67..
2. Goodgold, J. (1979), Muscles alive, 4th edition. By John Basmajian, 495 pp, Williams & Wilkins, Baltimore, MD, 1978. $32.95. Muscle Nerve, 2: 317. doi: 10.1002/mus.880020415.
3. Boyd EA, Goudreau L, O'Riain MD, Grinnell DM, Torrance GM, Gaylard A. A radiological measure of shoulder subluxation in hemiplegia: its reliability and validity. Archives of physical medicine and rehabilitation. 1993 Feb;74(2):188-93..
4. Chaco J, Wolf E. Subluxation of the glenohumeral joint in hemiplegia. American journal of physical medicine & rehabilitation. 1971 Jun 1;50(3):139-43.
5. Sydney W. There is strong evidence (level 1a) that electrical stimulation applied early after stroke, increasing from one to six hours per day, can prevent 6.5 mm of shoulder subluxation.
6. Faghri PD, Rodgers MM, Glaser RM, Bors JG, Ho C, Akuthota P. The effects of functional electrical stimulation on shoulder subluxation, arm function recovery, and shoulder pain in hemiplegic stroke patients. Archives of physical medicine and rehabilitation. 1994 Jan;75(1):73-9.
7. Jensen E .The hemiplegia shoulder .Scand J Rehabilitation Med 1980;7;113-19.
8. Robert Gould. Shoulder and hemiplegia, Do-2005
9. Linn SL, Granat MH, Lees KR. Prevention of shoulder subluxation after stroke with electrical stimulation. Stroke. 1999 May 1;30(5):963-8.
10. Siekierka-Kleiser EM, Kleiser R, Wohlschläger AM, Freund HJ, Seitz RJ. Quantitative assessment of recovery from motor hemineglect in acute stroke patients. Cerebrovascular Diseases. 2006;21(5-6):307-14.
11. Ring H, Rosenthal N. Controlled study of neuroprosthetic functional electrical stimulation in sub-acute post-stroke rehabilitation. J Rehabil Med. 2005;37(1):32-36.

COMPARING THE EFFECTS OF SEGMENTAL AND GLOBAL STABILIZATION EXERCISES ON PATIENTS WITH LOW BACK PAIN SECONDARY TO SPINAL INSTABILITY

RICHARD HAYDT[1], RYAN HASSICK[2], JAMES SCHREFFLER[3], JAMISON PERKINS[4], MICHAEL HENAHAN[5], RACHAEL RICHARDS[6]

1. *Misericordia University PT, DPT,OCS,MTC, FAAOMPT, Associate Professor*
2. *Misericordia University PT, DPT*
3. *Misericordia University PT, DPT*
4. *Misericordia University PT, DPT*
5. *Misericordia University PT, DPT*
6. *Misericordia University PT, DPT*

ABSTRACT

PURPOSE: To compare the effects of segmental and global stabilization exercises on patients with low back pain (LBP) secondary to spinal instability through a review of current literature, in order to establish an effective therapeutic exercise regimen to effectively resolve and prevent reoccurrence of LBP secondary to instability.

METHODS: A search of Academic Search Premier, the Cumulative Index of Nursing and Allied Health Literacy (CINAHL), and MEDLINE was performed. Articles found were restricted to information or clinical trials relevant to instability of the lumbar spine. Experimental intervention studies were restricted to those with human subjects. Keywords utilized for database searches include "instability of the lumbar spine", "stabilization exercise", "segmental stability of lumbar spine", "lumbar instability", "lumbar stability", "lumbar neutral zone", "segmental stabilization", "global stabilization" in combination with "physical therapy," "treatment," "efficacy," "stabilization," "transversus abdominus," and "multifidi." An article was included in the review of literature if it included content that pertained to understanding lumbar stability or clinical trials of patients with instability related low back pain.

RESULTS: The articles analyzed by the authors lend evidence for the effectiveness of both global and segmental therapeutic exercises for reducing low back pain secondary to instability. Segmental musculature appears to stabilize the spine at the local level due to close proximity to the lumbar segments and tonic contractility. Global musculature appears to stabilize the spine globally through compressive loading of the spine through all available segments and contribute greatly to gross motion. Both muscular groups appear to play distinct roles in spine stabilization.

CONCLUSION: There has been substantial research developed on clinical trials in which exercise was used in the treatment of patients with nonspecific acute LBP as well as chronic LBP, however little evidence is currently available on efficacy of specific exercises targeting stabilizing musculature in the effort to conservatively treat patients with LBP secondary to spinal instability. Our research shows that segmental musculature can be trained via core stabilization exercises to provide active support directly to the lumbar spine. Restoring the segmental muscles to their proper function will increase spinal stability and decrease pain. Global musculature can then be trained to provide further spinal stability.

CLINICAL RELEVANCE: Intra-abdominal pressure and muscle co-activation are effective means of increasing lumbar stability. Deep abdominal muscles offer significant increases in intra-abdominal pressure during contraction, and create a cylindrical corset to stabilize the lumbar spine. Muscle co-activation, particularly between lumbar multifidi and transversus abdominus stabilize the lumbar spine through opposing contraction.

INTRODUCTION

A common diagnosis that patients often present with is low back pain (LBP). Norris (1985) states that “80% of the population will suffer from LBP at some point during their lives”[1]. Furthermore, Panjabi (1992) states that “the total cost of LBP has been estimated to exceed $50 billion per year in the US”[2]. Injury to the low back can occur as a result of cumulative trauma from repeated use, prolonged positioning during sustained loading, or from a single load of high magnitude[3]. Numerous studies have been done on the treatment of patients with LBP, yet much controversy still exists on the topic. Therapeutic exercise is commonly used as conservative treatment in patients with LBP. There has been substantial research developed from clinical trials in which exercise was used in the treatment of patients with nonspecific acute LBP as well as chronic LBP. However, little evidence is currently available on the efficacy of specific exercises targeting stabilizing musculature in the effort to conservatively treat patients with LBP secondary to spinal instability. The authors attempted, through systematic review, to develop an appropriate regimen of therapeutic exercise for the treatment of instability related LBP as well as discuss its effect on antagonist co-contraction and intra-abdominal pressure as a means of stabilizing the spine. It is the duty of medical professionals to treat these patients effectively and efficiently. This requires knowledge of the latest evidence

based treatment options. The purpose of this systematic review is to provide an evidence based approach for the effective and efficient treatment of LBP secondary to spinal instability.

Though many authors have attempted to define spinal instability, a universal definition has not been agreed upon. Spinal instability has previously been defined by Wyke (1970) as "abnormally large intervertebral motions that cause either compression and/or stretching of the inflamed neural elements or abnormal deformations of passive structures, which are known to have a significant density of nocioceptors"[3]. Panjabi made the assertion that spinal instability can be thought of as "excessive motion of a spinal segment or segments that lacks normal restraint of capsules and ligaments"[2].

Spinal stability is dependent on both static and dynamic elements. Cholewecki (1996) stated that static structures (ligaments, discs, and vertebrae) are "incapable of providing sufficient spinal stabilization, and would buckle under their own weight without sufficient muscular tension"[4]. Through systematic review, Cleland, Schulte, and Durall (2002) found that lumbar spinal stability is truly created by dynamic elements. These dynamic elements were divided into two mechanisms; "antagonistic spinal muscle co-activation and increasing intra-abdominal pressure"[5]. These mechanisms function to limit the area of neutral zone available at the segmental level.

It is imperative that the reader have an understanding of the dynamic elements present to create stabilization of the spinal column. Antagonist stabilization is created through co-contraction of opposing muscle groups, for instance, flexors and extensors of the spine. In this example, rectus abdominus and erector spinae may both contract equally and oppositely to limit both flexion and extension in the sagittal plane. Similarly, opposing multifidi at a single segmental level may contract in tandem with transversus abdominus to limit flexion, extension, rotation, and shearing forces. Intra-abdominal pressure, achieved through a mechanism of volume and pressure, is mediated through muscle contraction. The lumbar spine is located within the abdominal cavity, a closed system. Superior and inferior boundaries include the diaphragm and pelvic floor respectively. Anteriorly the boundaries are formed by the abdominal wall lined with transversus abdominus which extends laterally and posteriorly as it blends with thoracolumbar fascia, subsequently inserting onto transverse processes and vertebral bodies. As any mentioned musculature, or furthermore, more superficial musculature contracts and decreases the volume of finite space within the abdominal cavity, pressure increases and thus provides stabilization to the lumbar spine.

MOTION SEGMENT

In order to further understand the mechanisms that create spinal stability, one must understand the components of the physiological intervertebral motion segment. The motion segment is the functional unit of the spine. The spinal motion segment is defined by Panjabi as "the adjacent halves of two vertebrae and the structures within"[2]. These structures include the intervertebral bodies, spinal ligaments, zygapophyseal joints and joint capsules, musculature including multifidi at the segmental level and erector spinae globally, neural structures to include dorsal and ventral roots, and finally vasculature.

SYSTEMS OF SPINAL STABILIZATION

Panjabi visualized three subsystems responsible for spine stabilization; passive, active, and neural subsystems. "The normal function of the stabilizing system is to provide sufficient stability to the spine to match the instantaneously varying stability demands due to changes in spinal postures, and static and dynamic loads"[2]. Within normal physiologic motion all systems coordinate efficiently to optimize stability by limiting aberrant translational, rotational, and shearing forces amongst motion segments. Compensation normally occurs when a flaw is present in any one of the three subsystems, however within limits[2]. When limits are exceeded via critical loading or end range motion, acute or chronic pathology arises. Instability related pathology is thought to be related to an increase in the neutral zone. The authors summarize this theory of subsystem stabilization in the following paragraphs.

PASSIVE SUBSYSTEM

The passive subsystem consists of the vertebral bodies, joint capsules, spinal ligaments, zygapophyseal joint and joint capsules. The passive subsystem does not create any significant stability while the motion segment is within the neutral zone. Increasing restriction to motion segment mobility is created as range of motion passes through the neutral zone and enters the elastic zone. Only near end range motion do the passive structures restrict motion[2]. The passive zone structures can be likened to that of a rubber band. When initially stretching the rubber band, little resistance is felt, but as the tissue, or in this instance the rubber band continues to lengthen, increasing resistance is felt. End range spinal flexion is primarily limited passively by posterior longitudinal, supraspinous, and interspinous ligaments, zygapophyseal joint and joint capsules,

and posterior intervertebral disk annulus. End range spinal extension in primarily limited by anterior longitudinal ligament, anterior intervertebral disk annulus, and the approximation of zygapophyseal joints. Passive stability may be compromised secondary to injury from critical loads and end range motion, as well as degeneration, and disease. All of which may require increased efforts of the active subsystem to maintain spine neutral[2].

ACTIVE SUBSYSTEM

The active subsystem consists of the musculotendinous units responsible for producing force, and in turn, active motion of the spine. The active subsystem functions to create spinal stability largely within the neutral zone as little passive resistance is provided[2]. The active subsystem is mediated through neural innervation. Muscles of the spinal column provide stability and motion through differing roles, which is later discussed in global and segmental musculature. Panjabi notes that the active subsystem may suffer from "inadequate feedback or tension information provided via neural mediation"[2]. Muscles may also weaken secondary to disuse, disease, or injury. As a result stability may decrease. The active subsystem is the force behind mobility and stability of the spine.

NEURAL SUBSYSTEM

The neural subsystem includes neural structures of the passive and active subsystem which allow the active subsystem to account for spine stabilization. The neural subsystem has the complex task of continually adjusting the force of the musculotendinous units of the active subsystem[2]. Force production may be inadequate or excessive, both with the possibility of critical loading on the spinal column. Panjabi theorized that faulty force production may be responsible for low back injuries resulting from a task as simple as picking up a pencil, where force production may be excessive, soft tissue is injured and pain ensues[2]. Likewise complex motions coupling flexion and rotation may exceed neural limits and result in a similar soft tissue injury. It is important to note that a large external force is not needed to created critical forces at the spinal column.

NEUTRAL ZONE

Panjabi categorized the motion that occurs at a spinal segment into two zones, which he respectively called the “neutral” and “elastic” zones[7]. He defined the neutral zone as “the region of physiological intervertebral motion around neutral posture where little resistance is offered by the passive spinal column”[7]. When the spine is in the neutral zone, there is minimal loading of passive structures, which is ideal for proper function of the spine. The neutral zone may be thought of as the zone of high flexibility. As a motion segment is moved further through physiological range of motion in the neutral zone, passive structures begin to restrict further mobility[7]. Damage to active and passive structures due to macro or microtrauma will increase the size of the neutral zone. Panjabi asserted that spinal stability is directly affected by the size of the neutral zone which is determined by the cooperative function of passive, active, and neural subsystems.

ELASTIC ZONE

Panjabi defined the elastic zone as “the region of physiological intervertebral motion measured from the end of the neutral zone up to the physiological limit. Within the elastic zone, spinal motion is produced against a significant internal resistance”[6]. Movement through the elastic zone creates loading of passive structures which results in increasing viscoelastic creep while approaching end range[7]. The spinal column is flexible at low loads and stiffens as the load increases into the elastic zone. For this reason the elastic zone may be thought of as the zone of high stiffness; the neutral zone may be thought of as the region of high flexibility. The neutral zone and elastic zone comprise a spinal segment’s physiological range of motion. Movement that exceeds the limits of the elastic zone enters the plastic zone. Movement into the plastic zone results in damage and subsequent dysfunction.

INTRA-ABDOMINAL PRESSURE

Through systematic review, Cleland et al. found stabilization of the lumbar spine to be dependent on two mechanisms, "antagonistic spinal muscle co-activation and increased intra-abdominal pressure”[5]. Intra-abdominal pressure (IAP) is not a common mechanism when referring to sources of instability. It has been included in a number of studies and has been found through models and theoretical calculations to be a benefactor to stability[4]. Cleland et al. noted during contraction of the deep muscles of the abdominal cavity (diaphragm, transversus abdominus, obliques, pelvic floor muscles), IAP increases. As previously mentioned, the abdominal cavity which houses the lumbar spine has finite volume, and any contraction which reduces the volume will increase pressure, thus providing stability. This potentially helps to constrain spinal movement in all directions by increasing the force per unit area (i.e. pressure) on the spinal segments[4].

CLINICAL PREDICTION RULE

Hicks, Fritz, Delitto, and McGill (2005) identified a clinical prediction rule to be used for classifying patients with low back pain as having lumbar segmental instability. Patients who have LBP are not a homogeneous group and thus, not all sources of low back pain benefit from a single intervention[7]. The authors sought to develop a tool clinicians may use to make an educated decision on whether or not a patient with lumbar symptoms would be likely to benefit from stabilization. Prior to development of the clinical prediction rule, a diagnosis of lumbar segmental instability was made largely through the traditional use of radiographs. This method was proven unsatisfactory and inefficient due to a high degree of false positive diagnoses[7]. This classification system is used to identify a patient population who would benefit from stabilization exercise. Hicks et al. state that "the goals of stabilization exercise are to train muscular motor patterns to increase spinal stability, restrain aberrant micro motion, and reduce associated pain"[7]. All subjects included were given the same treatment intervention which consisted of exercises targeting transversus abdominus, erector spinae, multifidus, quadratus lumborum, and oblique abdominals. The authors identified, through clinical trial, common characteristics in patient presentation who benefited from stabilization exercise. There variables included age > 40, average straight leg raise > 91°, aberrant movement present, and positive prone instability test[7].

Several classifications of LBP exist which identify a patient's pathology and promote a specific treatment strategy. Clinical classifications include manipulation, stabilization, specific exercise, and traction[7]. Fritz, Cleland, and Childs (2007) identified such a clinical prediction rule for the said categories of mechanical low back pain[8]. Similar to the previous study, the authors found classification for spinal instability to include all previous variables and added postpartum patients as pregnancy hormones are related to greater flexibility. The authors identified management should consist of education to avoid end range motion and to wear external bracing for most demanding tasks. Exercise should consist of a regimen that promotes isolated contraction of multifidus and transversus abdominus, the deep stabilizers, and strengthens the larger spinal stabilizers of erector spinae and oblique abdominals[8].

GLOBAL MUSCULATURE DEFINED

For our purposes, we will define global spine musculature as those muscles that span the length of multiple spinal segments. Global musculature includes illiocostalis, longissimus, and spinalis, collectively grouped as erector spinae, as well as iliopsoas, rectus abdominus, quadratus lumborum, and external obliques. Global muscles, being multisegmental, are the large guy wires that respond to external loads imposed on the trunk that shift the center of mass[9]. This global musculature can generally be thought of as the superficial prime movers of the spinal column due to their relatively large length and cross sectional area, as well as their ability to create large internal torque with inherently long moment arms. These muscles are fixated far from the vertebral axis of motion, have a greater density of type II fibers needed for strong contraction, and respond to direction of motion to control spine orientation[9]. However, these muscles are unable to provide significant stability to any single spinal segment as they lack direct attachment to any one vertebrae. According to Kisner and Colby (2012), global musculature can only stabilize the gross spine through comprehensive loading; however, "comprehensive loading may lead to or perpetuate a painful situation as stress is placed on the inert tissues at the end range of that segment"[9].

SEGMENTAL MUSCULATURE DEFINED

Conversely, we will define segmental musculature as such that is deep and positioned closely to vertebral bodies, as well as only spanning the length of a few spinal segments. Segmental musculature includes multifidi, internal obliques, and transversus abdominus. These muscles are fixated close to the vertebral axis of motion and have a greater density of type I fibers needed for muscular endurance[9]. Due to positioning and relatively short length, this musculatures' role is the adjustment of spinal arthrokinematics. Muscle spindles are abundant and necessary for fine tuning spinal alignment[9]. Both global and segmental musculature play separate necessary roles; global largely contributing to gross motion with segmental providing intersegmental stability needed to protect inert tissues.

METHODS

A search of Academic Search Premier (1960 – January 2015), the Cumulative Index of Nursing and Allied Health Literacy (CINAHL), and MEDLINE was performed. Articles found were restricted to information or clinical trials relevant to instability of the lumbar spine that were published in English. Experimental intervention studies were restricted to those with human subjects. Keywords utilized for database searches include "instability of the lumbar spine", "stabilization exercise", "segmental stability of lumbar spine", "lumbar instability", "lumbar stability", "lumbar neutral zone", "segmental

stabilization", "global stabilization" in combination with physical therapy, treatment, efficacy, stabilization, transversus abdominus, and multifidi. All articles were thoroughly read to determine if they contained information pertinent to segmental or global stabilization in the treatment of instability related low back pain. Reference lists from articles obtained through search criteria were also searched for literature and experimental studies relevant to the systematic review.

An article was included in the review of literature if it included content that pertained to understanding lumbar stability or clinical trials of patients with instability related low back pain. A study was included if it contained the following: Pedro score 4/10 or greater, supports or refutes the use of global or segmental stabilization in treatment of instability related LBP, information relevant to passive or dynamic stabilizing structures of lumbar spine, and randomized clinical trials utilizing exercise as the treatment for instability related low back pain. An article was excluded from the review of literature if it included only relevant information to chronic low back pain or non-specific acute low back pain. Studies that focused on the treatment of a diagnosis other than instability related low back pain were also excluded from review. Refer to Appendix A for search strategy.

RESULTS

Fourteen articles were originally included within the matrix. Of these articles, four were eliminated as they examined the effects of stabilization on patients with nonspecific or chronic LBP. The remaining 10 articles fulfilled the inclusion criteria. Two articles were systematic reviews. The remaining articles were randomized clinical trials. Reference lists of included articles were reviewed for relevant information pertinent to spine stabilization. Appropriate articles were included in our review. Refer to Appendix B for matrix.

DISCUSSION

INTRA-ABDOMINAL PRESSURE

A study by Hodges, Creswell, Daggfeldt, and Thortensson (2001) examined the effects of IAP on the spine10. This was achieved through electrical stimulation of the diaphragm and measuring the pressure within the abdominal cavity with a probe that traveled from the nose to the stomach of the subject[10]. They isolated IAP by stimulating the phrenic nerve at the neck in order to isolate diaphragm contraction. Their measurements were recorded with the subjects in sidelying. Subjects were secured to a hinged table in a neutral position, a flexed position, and during passive movement from extension into flexion. Hodges and authors suggest that “in addition to the direct mechanical forces exerted on the spine by muscle contraction, the IAP increase that occurs as a result of contraction of muscles surrounding the abdominal cavity may in itself have an effect on the spine”10. Although this study did not look at typical muscular function, it was able to demonstrate how IAP plays a role in overall spinal stability through volume and pressure.

A study conducted by Cholewicki, Juluru, and McGill (1992) utilized models and theoretical calculations in order to determine if the spine could be stabilized by increased IAP caused by muscle contraction11. Their results showed that increased IAP created by muscle contraction may contribute to spinal stability[11]. Though problems with IAP are generally not thought of as contributing to spinal instability, both of these studies, however, provide evidence to the contrary. When musculature contracts, it results in a decreased volume in the abdomen thereby causing an increase in overall pressure. This is thought to improve stability of the spine; hence why increased IAP is considered to have a favorable effect on spinal stability. However, due to the inert difficulties of measuring IAP, a definite conclusion requires further research.

Muscular contraction of the pelvic floor and lumbar corsets would appear to reduce abdominal volume in a similar mechanism, however, limited research existed within our search. Training of pelvic musculature and addition of lumbar corset may be considered for future research on the effects of the reduction of abdominal volume and subsequent effects on lumbar stabilization.

SEGMENTAL/GLOBAL STABILIZATION

A clinical trial conducted by Kumar (2011) demonstrated that quadruped positioning in patients with clinical spinal instability challenged spinal proprioception[12]. This improved control of the neutral zone of the spine through co-contraction of segmental musculature (multifidi and transversus abdominus). Subjects were included in the study if they had a clinical diagnosis of segmental instability, obtained through "tenderness to palpation, painful arc during spinal movements, positive prone segmental instability test, positive H-I instability test, and hypermobility detected on passive accessory intervertebral testing using central postero-anterior pressure on that lumbar spinal level"[12]. Segmental stabilization included abdominal hollowing with posterior pelvic tilting in the quadruped position while slowly lifting one

arm and maintaining activation to transversus abdominus and multifidi[12]. Placebo intervention included prone lying with pillows under legs[12]. The study showed significant changes for the experimental group in terms of VAS, joint play grading scale, and pressure pain thresholds. Placebo intervention had improvement in the VAS[12]. Kumar postulated this improvement occurred because prone lying relaxed the patients and reduced muscle spasm secondary to pain from injury[12]. The placebo intervention group had no change in joint play grading scale following intervention[12]. This clinical trial demonstrated that improving the coordination and co-contraction of the lumbar multifidi and transversus abdominis decreases motion within the neutral zone and increases dynamic stabilization. The study's results also show clinical relevance in that the placebo group had reduction in pain with only rest, however, stabilization was not achieved allowing the reader to question if future injury is likely to occur.

A clinical prospective study by Hides, Richardson, and Jull (1996) showed that the lumbar multifidi do not spontaneously recover following acute injury despite a remission of pain[13]. This experimental study included subjects with unilateral mechanical LBP. Control group received 1-3 days of bed rest and analgesics. Experimental group received re-education of the multifidus muscle in the form of isometric co-contraction of the multifidus and deep abdominals, which was achieved in standing with the lumbar spine in its neutral position[13]. At the end of 4 weeks, both groups displayed significant and parallel improvements in pain, disability, and range of motion[13]. The experimental group who received lumbar multifidi re-education displayed greater improvement in cross sectional area as compared to the control[13]. Results were repeated at 10 week follow-up. The study suggests that in an acute episode of mechanical and unilateral low back pain, the lumbar multifidi do not spontaneously recover despite decreased pain and disability and increased range of motion[13]. The authors, through their review of literature, imply that the decrease in muscle size is through reflex inhibition[13]. The authors state, "The clinical significance of this finding is that although these patients with LBP appeared fully recovered after initial acute pain subsided, their muscle system certainly had not recovered"[13]. The study's results are clinically important when the stabilization role of the multifidus is considered. Wilke, Wolf, Claes, Arand, and Weisend (1995) demonstrated that when compared with other muscles in close proximity to the L4-L5, the multifidus muscle contributed two thirds of the increased stiffness imparted by muscle contraction[14]. Due to the theory that the lumbar multifidi do not spontaneously recover after an injury, and given the role that they play in the active subsystem of spinal stabilization, patients with mechanical low back pain are susceptible to future bouts of low back pain secondary to deficits in lumbar stability. Hides et al. note that “this inhibition can be reversed with exercises that focus on activating the multifidus of the segmental level"[14].

A study performed by Puntumetakul, Areeudomwong, Emasithi, and Yamauchi (2013) used surface EMG instrumentation to compare the effectiveness of core stabilization exercises (CSE) to a control group[15]. The CSE group received a progression of stabilization exercises designed to isolate the transversus abdominus lumbar multifidi using an abdominal drawing in maneuver in a variety of positions and eventual progression to maintenance of stability during functional postures and movements[15]. The results of the study showed that the CSE group had a greater reduction in functional disability, and pain intensity during the instability catch sign as well as better satisfaction and health related quality of life. The most significant finding in this study was the difference in muscle recruitment patterns between the CSE group and the control group. Within the CSE group, there was an increase in the ratio of recruitment of the transversus abdominus and internal oblique muscle compared to the rectus abdominis and no change in the recruitment of the lumbar multifidi relative to iliocostalic lumborum pars thoracis[15]. The control group instead showed reduction of the LM/ICLT ratio as well as the transversus abdominus and internal oblique/rectus abdominus recruitment ratio[15]. At the end of the 10 weeks of CSE, the groups “normalized muscle activation levels of the deep muscles (transversus abdominus and lumbar multifidi) were greater than those measured at baseline15. In contrast, the normalized muscle activation level in superficial muscles (rectus abdominus and iliocostalic lumborum pars thoracis) was more deteriorated than those measured at baseline” [15]. The authors concluded from this study that "CSE helps promote the changes in activation ratio of the abdominal and back muscles, leading to a direct potential stabilization of the lumbar spine via generation of intra-abdominal pressure and increased thoracolumbar fascial tension” [15]. In patients with LBP secondary to spinal instability, it is possible to use core stabilization exercises to improve the recruitment ratio of deep trunk muscle stabilizers compared to superficial trunk muscles in order to decrease the neutral zone of spinal segments, thus reducing pain and disability within this patient population.

Through literature review and theoretical modeling, Cholewicki, McGill, and Norman (1991) identified that lumbar stability increases

during activities of high muscular demand and lessens with activities of low muscular demand[16]. This research identifies that the stability of the spine is not linear and is dependent on muscle activity which is gauged by the specific task at hand[16]. Deformation of the spine during heavy loading is easily understood, yet many times low back injuries occur from routine tasks which the author contributes to faulty coordination of intrinsic musculature (multifidi) and creates momentary loss of stability. Theoretical modeling displayed that during neutral postures, with near zero muscular activity, the lumbar spine was unstable. However, with just a 1-3% increase in muscular activity of the multifidus and erector spinae, the stability of the entire system was restored[16]. Clinical relevance of this research employs the multifidi musculature as the main stabilizer of the lumbar spine. Minute increases in muscular tension of the intrinsic multifidi create impressive stabilization of the spine. Furthermore, during cadaveric analysis, a spine without muscular stabilization is shown to deform and buckle under just 20N-90N of force[17,18]. Everyday activities push the spine near 6000N and competitive power lifting put nearly 18000N of compressive force on the thoracolumbar spine[17,18].

RECTUS ABDOMINUS

No single abdominal exercise is available to challenge all musculature of the abdominal wall (rectus abdominus, internal and external obliques, transversus abdominus). As a result, a comprehensive low back rehabilitation regimen may require several exercises targeting specific abdominal musculature. Various types of curl ups and sit ups including straight leg and bent knee variants, as well as straight leg raises, appear to mainly challenge the rectus abdominus and to some degree the external oblique with little recorded muscle activity present within internal oblique and transversus abdominus according to McGill (1998)[19]. These variants of curl up and straight leg raises are also associated with increased spine compression which may be detrimental to soft tissue[20]. Rectus abdominus is also shown to contribute little to the generation of intra-abdominal pressure[21]. Considering attachments, ability to generate pressure, and muscle activity during gross spine motion, the rectus abdominus appears to offer little stabilization properties to the lumbar spine aside from the sagittal plane during loading. The rectus abdominus may be thought of as global musculature and as a prime mover of spine flexion.

INTERNAL AND EXTERNAL OBLIQUES

Respectively deep to superficial, abdominal musculature is as follows, transversus abdominus, internal oblique, external oblique, and rectus abdominus. Transversus abdominus has been shown to provide the most substantial increases in intra-abdominal pressure, similarly, yet to a lesser degree, the internal oblique has the capability of increasing intra-abdominal pressure and thus unload the spine[20,21]. Internal oblique should be considered a segmental stabilizer as contraction generates the lumbar corset. This is again thought to be a result of more horizontally oriented fibers producing a cylindrical corset compression to the abdominal cavity. Fiber orientation less than that of 60° to the horizontal, as well as the proximity to the abdominal wall appear to correlate with musculature ability to increase intra-abdominal pressure[21]. External oblique has significantly less ability to increase intra-abdominal pressure, yet shows higher magnitude of contraction during similar trunk movements in which rectus abdominus is optimally activated[20,21,22]. External oblique appears to be primarily involved in gross trunk motion and is thus placed in global classification.

TRANSVERSE ABDOMINUS

Hodges (1991) asserted that "Transversus abdominus is controlled independently of the other trunk muscles and should be trained separately from the other trunk muscles"[20]. Through EMG testing performed by Hodges, transverse abdominus has been shown to be variably yet continuously active during all degrees of spine motion. Erector spine and rectus abdominus were shown to be phasically active to initiate and decelerate their respective trunk motions[20]. In a similar experiment using flexion perturbation, transverse abdominus was shown to be active prior to erector spinae as a means to control flexion movement[20]. The tonically active nature of transversus abdominis is shown to be deficient in individuals with LBP, with increased latency of contraction[20]. As previously demonstrated, transversus abdominus displays little increase in EMG activity during isolated spine flexion despite being located anteriorly to the spinal column[19]. The tonic nature of transversus abdominus appears to create a corset of musculature, providing stabilization against all planes of motion, and thus considered for the segmental classification. Contraction of the transversus abdominus, the deepest muscle of the abdominal wall, and to some degree the internal oblique have been shown by Mokhtarzadeth, Farahmand, Shirazi-adl, Arjmand, Malekipor, and Parniapour (2012) to substantially increase IAP[21]. This is thought to be a result of horizontal muscle

fiber orientation and transversus abdominus' attachment to thoracolumbar fascia. Due to attachment through the thoracolumbar fascia to lumbar vertebral bodies, it would appear the transverse abdominus fits with the segmental stabilization grouping, providing general stability to all degrees of motion.

In order to properly activate transversus abdominus for means of strengthening, a therapist can implement a maneuver known as drawing in or abdominal hollowing. Drawing in consists of the patient actively contracting the transversus abdominus in a fashion that will bring the umbilicus closer to the spine[20], similar to that of bearing down during bowel movement or restricting flow of urine. Voluntary contraction to transversus abdominus is similar to that of the diaphragm and pelvic floor musculature. Advanced positioning including, but not limited to, side lying and quadruped may provide a challenge to a spine stabilization program.

QUADRATUS LUMBORUM

McGill, Juker, and Kropf (1996) identified quadratus lumborum to be an important spinal stabilizer when performing upright holding activities (20- 40kg) and when lifting heavy loads (50-100 kgs)[22]. Isometric horizontal side support primarily isolated quadratus lumborum[5]. To perform this exercise the subject is positioned in side-lying, utilizing their elbow for support. The subject will then lift their pelvis from the plinth while engaging the core musculature[5]. Limited research exists on the role quadratus lumborum plays in lumbar stabilization. The authors reason that this musculature is likely the main force behind lateral bending of the spine, and this is applied to global classification. During bilateral contraction, the muscle may provide stabilization against flexion and lateral bending and should be considered when developing a stabilization regimen.

LUMBAR MULTIFIDUS

Biomechanical evidence gathered by MacDonalda (2006) supports the contribution of deep musculature of lumbar multifidi of stabilizing the lumbar spine while the superficial musculature of the lumbar multifidi and erector spinae extend and rotate the lumbar spine[23]. MacDonalda defined lumbar multifidi as the fibers "of multifidus that cross just two spinal levels and insert onto the lamina, mamillary process and zygapophyseal joint capsule"[23]. However, just as when an individual is asked to perform proper form during a squat or to pick up an object from the ground, without rounding their back, the individual must contract the lumbar multifidi, erector spinae, as well as the trunk flexors such as the rectus abdominus to prevent spinal instability and promote control[23]. When in this position, the individual has a very rigid and stable spine, beneficial to promote safe spinal mechanics. However, if the individual were asked to twist while maintaining the co-contraction of the erector spinae, lumbar multifidi and trunk flexor musculature to maintain the rigid spine, they would not be able to or would find it extremely difficult to do so. Due to the lumbar multifidi's attachments crossing only two spinal movements, the multifidus does not maintain tonic activity[23]. Instead, MacDonalda states that “it matches the spatial and temporal features of multifidus activity to the demands of spinal control, which vary with constantly changing internal and external forces"[23]. This allowance of spinal motion while maintaining stability is important in functional activities. It is advised that contraction of the multifidi musculature be taught first prior to advancement to more challenging core stabilization exercises[14]. Cleland et al as well as Puntumetakul et al recommend teaching contraction using biofeedback and electromyography devices while prone[5,15]. Lumbar Multifidus appears to be primarily involved in stabilizing individual spinal segments thus making it a segmental stabilizer.

ERECTOR SPINAE

The erector spinae musculature assumes a role in both moving and stabilizing the spine. Spinal extension is the primary action, with contribution to spinal side bending[9]. These muscles are considered global muscles whose main function is to create spinal motion. Though the erector spinae muscles do not directly attach to the lumbar vertebral bodies, they are collectively able to provide global spinal stability by acting as guy wires[9]. The multisegmental nature of the erector spinae muscles allows them to respond effectively to shifts in the spine’s center of mass. When an external load is placed on the spine, the erector spinae muscles provide reactive forces that are directional and multisegmental. These forces allow the spine to effectively dissipate external stressors placed on it. Erector spinae help to maintain upright posture[9]. Due to attachments of the iliac crest and thoracic vertebrae, erector spinae are unable able to provide significant contribution to spinal stability at any one vertebral body. Through bilateral contraction, the erector spinae, are able to provide stability via compressive loading. These compressive forces may become detrimental in the presence of a local instability. Kisner and Colby state that “if an individual segment is unstable, compressive loading from the global guy wires may lead to a painful situation as stress

is placed on inert tissues at the end range of that segment"[9].

CONCLUSION

Intra-abdominal pressure and muscle co-activation are effective means of increasing lumbar stability. Deep abdominal muscles, transversus abdominus and internal oblique, offer significant increases in intra-abdominal pressure during contraction, and create a cylindrical corset to stabilize the lumbar spine. Muscle co-activation, particularly between lumbar multifidi and transversus abdominus stabilize the lumbar spine through opposing contraction. Segmental musculature (transversus abdominis, multifidi, internal oblique) stabilize the spine at the local level due to close proximity to the lumbar segments and tonic contractility. Global musculature (rectus abdominus, external oblique, erector spinae, quadratus lumborum) stabilize the spine globally through compressive loading of the spine through all available segments and contribute greatly to gross motion. Both muscular groups play distinct roles in spine stabilization.

A lack of standardization for the treatment of instability related LBP currently exists. The authors believe, through evidence from systematic review, that the best approach to treating patients with LBP secondary to instability is to begin with focus on isolating the segmental stabilizers (multifidi, transversus abdominus) as a foundation for spine stabilization. Segmental stabilization should precede global stabilization. Rationale for this sequence is that local instability in the presence of global contraction will stress the unstable motion segment and damage soft tissue. Exercises to target this musculature include pelvic tilting, abdominal hollowing, and prone multifidi swelling. This foundation should then be progressed to include variable positioning and the addition of global musculature and gross movement while maintaining a stabilized lumbar spine (neither hyper- or hypo- lordotic but stabilized within the patient's normal degree of lordosis to limit end range movement.) The authors propose to begin with static stabilization exercise in order to retrain muscular co-contraction in a way that places less demand on coordinative contraction as used during more complex movement. The progression to movement and usage of global musculature allows for functional movements such as walking, lifting, and carrying, which are used in everyday activities. Repetitions and hold times should be kept within the higher range, hold times close to 10 seconds, as the segmental stabilizers are composed mostly of type I fibers needed for sustained contraction.

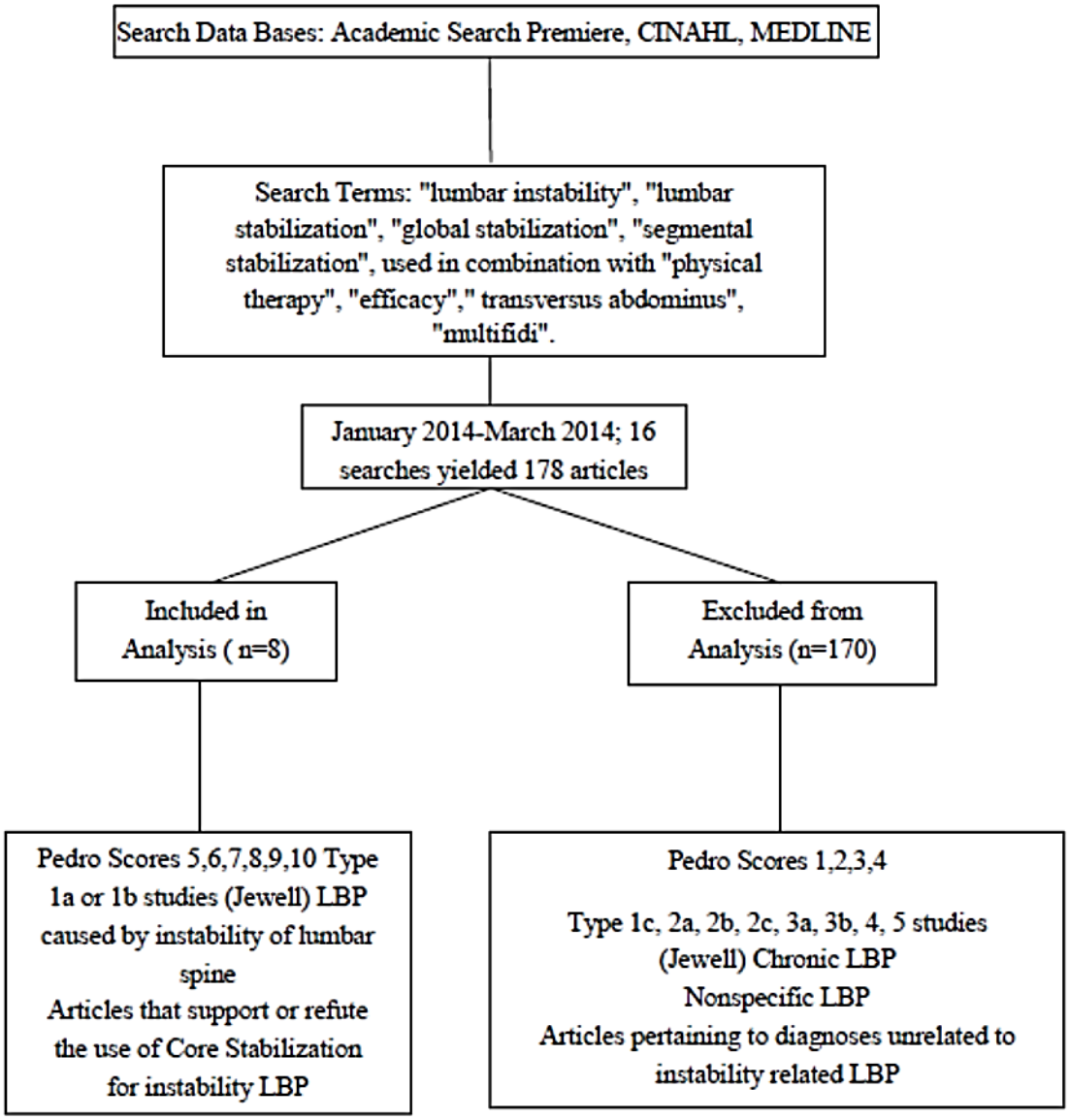
The low back may be injured from cumulative trauma as a result of repetitive usage, sustained loading at end range, and as a result of a single high magnitude load. In any instance soft tissue is susceptible to injury and compromises the subsystems of spine stabilization. Education on spine maintenance shows promise to be beneficial to any low back program. The authors believe that patients should have a foundational knowledge of the neutral position of the spine. Patients should be directed to avoid end range positioning and to avoid faulty body mechanics (primarily with flexion and rotation mechanisms during lifting, when translation and shearing forces are likely to occur). Patient education should be included in all therapeutic interventions and specifically may be used in a LBP program to reduce the risk of spinal tissue failure that may lead to instability. However, in the presence of spinal instability, the authors assert that segmental stabilization must precede global stabilization.

REFERENCES

1. C.M. Norris, Spinal Stabilization, Physiotherapy. 1995; 81: 61-77.
2. Panjabi M. The stabilizing system of the spine. part I. function, dysfunction, adaptation, and enhancement. J Spinal Disord. 1992; 5(4):383-389.
3. Wyke B. The neurological basis of thoracic spine pain. Riezmatol Phys Med. 1970; 10: 356.
4. Cholewicki J, McGill SM. Mechanical stability of the in vivo lumbar spine: implications for injury and chronic low back pain. Clin Biomech. 1996; 11: 1-5.
5. Cleland J, Schulte C, Durall C. The role of therapeutic exercise in treating instability-related lumbar spine pain: a systematic review. J Back Musculoskelet Rehabil. 2002; 16(2/3):105-115.
6. Panjabi M. The stabilizing system of the spine. Part II. Neutral zone and instability hypothesis. J Spinal Disord. 1992; 5(4):390-396.
7. Hicks GE, Fritz JM, Delitto A. Preliminary development of a clinical prediction rule for determining which patients with low back pain will respond to a stabilization program. Arch Phys Med Rehabil. 2005; 86: 1753-62.
8. Fritz J, Cleland J, Childs J. Subgrouping patients with low back pain: evolution of a classification approach to physical therapy JOSPT. 2007; 37(6):290-302.
9. Kisner C, Colby L. Therapeutic exercise: foundations and techniques. 6th ed. Philadelphia, PA: FA Davis; 2012.
10. Hodges PW, Cresswell AG, Daggfeldt K, Thortensson A. In Vivo Measurement of the

Effect of Intra-abdominal Pressure on the Human Spine, J Biomech. 2001; 34: 347–353.
11. Cholewicki J, Juluru K, McGill SM. Intra-abdominal Pressure Mechanism for Stabilizing the Lumbar Spine, J Biomech. 1992; 32: 13–17.
12. Kumar S. Efficacy of segmental stabilization exercise for lumbar segmental instability in patients with mechanical low back pain: A randomized placebo controlled crossover study. N Am J Med Sci. 2011; 3(10):456-461.
13. Hides JA, Richardson CA, Jull GA Multifidus recovery is not automatic after resolution of acute, first episode low back pain. Spine (Phila Pa 1976). 1996; 21: 2763-2769.
14. Wilke HJ, Wolf S, Claes LE, Arand M, Wiesend A. Stability of the Lumbar Spine with Different Muscle Groups: a Biomechanical in Vitro Study, Spine (Phila Pa 1976). 1995; 20: 192–198.
15. Puntumetakul R, Areeudomwong P, Emasithi A, Yamauchi J. Effect of 10-week core stabilization exercise training and detraining on pain-related outcomes in patients with clinical lumbar instability. Patient Prefer Adherence. 2013; 7: 1189-1199.
16. Cholewicki J, McGill SM, Norman RW. Lumbar spine load during the lifting of extremely heavy weights. Med Sci Sports Exerc. 1991; 23:1179-86.
17. Crisco JJ, Panjabi MM, Yamamoto I, Oxland TR. Euler stability of the human ligamentous lumbar spine: Part II experiment. Clin Biomech. 1992; 7: 27-32.
18. McGill SM, Norman RW. Partitioning of the Lj-s dynamic moment into disc, ligamentous and muscular components during lifting. Spine (Phila Pa 1976). 1986; 11: 666-78.
19. McGill S. Low back exercises: Evidence for improving exercise regimens. Phys Ther. 1998; 78(7):754.
20. Hodges PW. Is There a Role for Transversus Abdominus in Lumbo-pelvic Stability? Man Ther. 1991; 4: 74–86.
21. Mokhtarzadeth H, Farahmand F, Shirazi-adl A, Arjmand N, Malekipor F, Parniapour M. The effects of intra-abdominal pressure on the stability and unloading of the spine. J Of Mechanics In Medicine & Biology. 2012; 12(1)
22. McGill SM, Juker D, Kropf P. Quantitative Intramuscular Myolelectric Activity of Quadratus Lumborum During a Wide Variety of Tasks, Clin Biomech (Bristol, Avon). 1996; 11: 170–172.
23. MacDonalda D. The lumbar multifidus: Does the evidence support clinical beliefs? Man Ther. 2006; 11(4): 254–263.

APPENDIX A


Search Data Bases: Academic Search Premiere, CINAHL, MEDLINE
Search Terms: "lumbar instability", "lumbar stabilization", "global stabilization", "segmental stabilization", used in combination with "physical therapy", "efficacy"," transversus abdominus", "multifidi".
January 2014-March 2014; 16 searches yielded 178 articles
Included in Analysis (n=8)
Excluded from Analysis (n=170)
Pedro Scores 5,6,7,8,9,10 Type 1a or 1b studies (Jewell) LBP caused by instability of lumbar spine
Articles that support or refute the use of Core Stabilization for instability LBP
Pedro Scores 1,2,3,4
Type 1c, 2a, 2b, 2c, 3a, 3b, 4, 5 studies (Jewell) Chronic LBP
Nonspecific LBP
Articles pertaining to diagnoses unrelated to instability related LBP

APPENDIX B

Question: Comparing core segmental stabilization versus global stabilization in the treatment of instability related LBP.								
	Study		Methods				Reviewer Comments	
Citation	Study Type (LOER)	Pedro Score	Subject # and groups	Intervention	Assessment Tool	Outcomes	Limitations	Conclusion
Cleland J	1a		N=7 articles meeting inclusion criteria	The purpose of the systematic review is to find evidence to support the efficacy of core stabilization as a means of therapeutic exercise for patients with instability related LBP1.	Article specific, specific assessment tool was not an inclusion criteria.	The systematic review resulted in evidence to support the use of therapeutic exercise in patient with instability related LBP and also provided evidence for specific muscles and their role in stabilizing the lumbar spine.	It is possible some relevant trials may have been missed due to database selection, key words, and inclusion/exclusion criteria.	The article supports the use of TE2 in the treatment of instability related LBP. Targeting specific muscles is more beneficial due to recruitment patterns and anatomical differences. The article provides evidence to suggest that targeting the deep segmental musculature provides the greatest increase in lumbar stability.
Panjabi M	1a			The purpose of the article was to discuss the stabilizing structures of the spine (inert, dynamic, neuromuscular) and how micro/macro trauma to either of the systems negatively affect lumbar stability.	Article specific	The review discussed the stabilizing structures of the lumbar spine and suggested a hypothesis that mechanoreceptors are important in the regulation of the lumbar neutral zone.	No methods of article criteria listed	The articles suggest LBP is multi-factorial in design as well as pathology, and suggests retraining the musculature may be beneficial by dynamically stabilizing the lumbar spine.
Aluko A 2013	1b	7/10	33 participants (5male,28female) a mean age of 35.8 (SD of 9.1) years (2 groups)	1-Control, Regular exercise (global and specific) 2- Treatment, Intervention (transversus abdominus, multifidi training) The purpose of the study was to identify what stabilization exercises were beneficial as there is formally defined of best practice regarding stabilization.	Lumbar Motion Monitor, VAS3, Roland Morris Disability Questionnaire (baseline, 3 and 6 weeks, and a 3-month follow-up)	Differences in mean trunk sagittal acceleration between the regular exercise and intervention groups was not statistically significant at any time point The effects on neither pain score nor disability score were significant Outcome measures for both groups improved over Time	Small sample size Possible instructor bias Instability was not utilized as an inclusion criteria, however, many other spinal pathologies were excluded such as DJD4, DDD5, recurrent LBP, and underlying neurological involvement.	The study showed no benefit to stabilization as compared to control group. Recruitment acceleration increased and pain decreased in both groups.
J Suni 2006	1b	7/10	n=106 (2 groups) Majority of which with risk factors-vibration, smoking, inactivity	1- training group (n=52) *10 exercises for control of the lumbar neutral zone 2- control group (n=54) *no exercise	Oswestry, VAS, Pain and Disability Index	intensity of LBP (39% reduction) and negative expectations decreased significantly in the TG, balance increased in TG	-attrition -lack of blinding -lack of measuring tool to assess a wide variety of ADLs -clinical instability was not a defined inclusion criteria however the study supported the use of stabilization exercises the	-Controlling lumbar NZ6 is a specific form of exercise and daily self-care with potential for prevention of recurrent nonspecific LBP and disability among middle aged working men.

							secondary prevention of LBP by means of stabilizing the lumbar neutral zone.	
Puntumetakul R 2013	1b	8/10	N=42 2 groups	1 – CSE7: stabilization exercises 2- Conventional: stretching and hot pack	VAS during catch sign, Roland Morris, satisfaction, EMG8 of trunk muscles	CSE significantly improved in all outcomes including recruitment of TA9 and IO10, decreased Roland Morris Disability, decreased pain during ICS11. CSE continued to display improvement 3 months following intervention.	-EMG may have interference from superficial muscles - No focus on multifidi	CSE proved superior treatment versus stretching and MHP12 in the case of lumbar instability.
Kumar SP 2011		5/10	N= 18 2 groups	1 - experimental (lumbar stabilization) (12) 2- control (prone lying) (6)	VAS, pressure pain threshold, joint play	Experimental group, focusing treatment on quadruped positioning, significantly improved in all outcomes vs control prone lying.	small sample -joint play by means of PA13 approach is not specific - placebo group did not make for strong competition (unstable spines will not benefit solely from prone lying)	Quadruped training is an effective means of training the multifidi which improves segmental stabilization in patients with clinical lumbar instability.
Akbari A 2008	1b	7/10	49 patients diagnosed with chronic LBP *25 intervention *24 control	*8 weeks, 2x per week, 30 minutes per session for each group (Total training time 480 min) *Intervention: motor control exercises *Control: general exercises	7.5 MHz B-mode transducer ultrasound (to assess LM14 and TA muscle thickness), VAS, BPS15	*Intervention and control group both showed decreased pain and increased TA and LM muscles thickness * there was no significant difference between two groups, with the exception of pain (decreased more in intervention group)	*Small sample size *Heterogeneity of groups *Possible influence by extraneous variables *Only looked at thickness of TA and LM *No long-term follow-up	Motor control exercises and general exercises are equally as effective at increasing TA and LM thickness.
Kachanathu, Zakaria, Sahni, Jaiswal 2012	1b	7/10	30 fast bowlers w/cLBP, avg age 20.79 non-specific LBP w/ or w/o referred pain; avg pain intensity over the last 2 weeks ≥3 and ≤8 on a 0–10 VAS (0% to 40%) on the Oswestry Low Back Pain Disability Questionnaire (OLBPDQ)	A.CSE B. CCE Both groups performed ex 45min 4x/wk for 8wks	*VAS * Oswestry Low Back Pain Disability Questionnaire (OLBPDQ)	*Both groups improved in outcome measures *core stabilization group had a greater range of improvement vs conventional ex group	*small sample size * no true control group -results could have been due to normal progression of disorder *researchers/testers/pt's were not blinded to group assignment *external validity is limited to a population of Fast Bowlers in the sport of cricket	Clinicians and researchers theorize that improved activation of the segmental trunk muscles, with the goal of achieving higher segmental to multisegmental synergistic ratios of activation, is the most efficient means of attaining needed trunk stability, reducing pain and improving functions
Hides J 2001	1b	4/10	N=39 2 groups	1 – control(19)-received medical management, including advice on bed rest, absence from work, prescription of medication, and advice to resume normal activity as tolerated 2-experimental (20) additionally performed specific	McGill Pain Questionnaire and VAS, Roland Morris Disability Index, inclinometers, habitual activity levels, 2 and muscle crosssectional area	Control recurrence rate at 1 year 84%. Specific exercise group reported only 30% recurrence at 1 year	-small sample -some patients did not follow up with survey - some patients had a recurrence of LBP due to a traumatic event	Training of the multifidi with co-contraction of transverse abdominus lowers the reoccurrence of LBP in individuals with damaged spinal stabilization muscles

				localized exercises aimed at restoring the stabilizing protective function of the multifidus	using ultrasound imaging			
Javadian, Behtash, Akbari, Taghipour-Darzi, Zekavat	1b	4/10	13 patients18-45yrs w/atleast 3months LBP1, and positive instability catch, Gbbowern's sign or aberrant movement patterns.	A. Control-routine exercises B. Experiment group- same routine exercises and stabilization	*VAS *Modified Schober's test- Lumbar flx/ext rom *modified Oswestry	-SE16 plus routine exercises were more effective than routine ex alone in reducing pain intensity, functional disability and inc mm endurance in pts w/signs and symptoms of LSI17. -SE16 plus routine exercise group had longer last effects than control group.	-small sample -no true control group, no comparison of just routine exercise vs stabilization exercise	Stabilizing exercises increase activity level and decrease fatigability of local muscles thus reducing LBP1 due to LSI17

1: Low back pain, 2: Therapeutic exercise, 3: Visual analog scale, 4: Degenerative joint disease, 5: Degenerative disc disease, 6: Neutral zone, 7: Core stabilization exercises, 8: Electromyography, 9: Transversus abdominis, 10: Inferior oblique, 11: Instability catch sign, 12: Moist heat pack, 13: Posterior Anterior, 14: Lumbar multifidus, 15: Back pain scale, 16: Stabilization Exercises, 17: Lumbar Spine Instability

EFFECT OF MIRROR THERAPY ON HEMIPARETIC UPPER EXTREMITY IN SUBACUTE STROKE PATIENTS

ROSHINI RAJAPPAN[1], SYED ABUDAHEER[1], KARTHIKEYAN SELVAGANAPATHY[1], DINESHRAJAN GOKANADASON[2]

1. *Senior lecturer, Department of Physiotherapy, Faculty of Therapeutic Sciences, Asia Metropolitan University, Cheras, Selangor, Malaysia.*
2. *Physiotherapist, Department of Physiotherapy, Faculty of Therapeutic Sciences, Asia Metropolitan University, Cheras, Selangor, Malaysia.*

ABSTRACT

BACKGROUND AND OBJECTIVE: Stroke is one of the most common causes for chronic disability. Only 5 to 20% of stroke survivors attain complete functional recovery of their affected upper extremity. The primary objective of this study was to investigate the effect of mirror therapy on hemiparetic upper extremity motor recovery and functions in patients with subacute stroke.

MATERIALS AND METHODS: A total of 30 participants were selected for the study. They were randomly assigned to Mirror Therapy Group (MTG) and Sham Mirror Therapy Group (SMTG) with fifteen participants in each group. All the participants equally took part in conventional stroke rehabilitation program 5 days a week for 4 weeks. In addition to the conventional stroke rehabilitation program, MTG participated in 30 minutes of mirror therapy and SMTG received 30 minutes of sham mirror therapy for the affected hemiparetic upper limb. The participants were measured for upper extremity motor recovery and functions by Fugl-Meyer Assessment (FMA-UE) and Upper Extremity Functional Index (UEFI) scales respectively.

RESULTS: Wilcoxon signed ranks test and Mann Whitney U test were used to statistically analyze the data. Spearman correlational technique was used to analyze the relationship between upper limb functions and motor recovery of hand. Based on Wilcoxon signed ranks test, the results were highly significant ($p<0.05$. On the basis of Mann Whitney U test, Mirror therapy group showed high significance ($p<0.05$) than sham mirror therapy group. The spearman's rho value was 0.65 which indicated moderate to maximum positive correlation between the two variables and the alpha level was set at 0.01. CONCLUSION: This study concludes that incorporating mirror therapy in subacute stroke rehabilitation program improves the hemiparetic upper extremity motor recovery and its functions and also motor recovery of hand can directly influence the upper limb functions

KEYWORDS: Mirror therapy; Hemiparesis; Motor recovery; Upper extremity function

INTRODUCTION

Stroke contributes to a major proportion of morbidity and mortality in developed and developing countries. Stroke produces a major economic burden to both the family and the country. In Malaysia, stroke ranks among the five leading causes of fatality including ischemic heart disease, septicemia, malignant neoplasms and pneumonia. It is also one of the top 10 causes for hospitalization in Malaysia. Patients affected with stroke in Malaysia are within the age range of 54.5 and 62.6 years. Globally, stroke leads to a greatest disease burden based on Disability-Adjusted Life Years (DALY)[1]. Stroke is one of the most common causes for chronic disability. About one third of the survivors is functionally dependent and experience difficulties in most of the activities of daily living (ADL). Stroke survivors constitute the largest group of patients admitted in hospitals. Another indicator of disability due to stroke is the fact that approximately 26 percent of patients with stroke are institutionalized in a nursing home. The direct and indirect costs of stroke are estimated around 56.8 billion U.S. dollars in the year 2005[2].

Loss of upper limb function is one of the direct consequences of stroke. It is proved in research that about 83% of stroke survivors learn to walk again, but only 5 to 20% of stroke survivors attain complete functional recovery of their affected upper extremity. Approximately 70% to 80% of people who sustain a stroke have upper extremity impairment and most of them do not regain functional use of their paretic upper limb, which can make them dependent in their activities of daily living and participation in community life. Overall it brings reduction in the quality of life[3]. Coordination of joints and muscle functions at multiple levels is required to restore the function of affected extremity. The recovery of proximal joints functions are often faster than distal joints. Activities of daily living are much limited due to failure of recovery of distal joints (wrist and fingers) even though regaining of strength and coordination at proximal joints has occurred (shoulder and elbow). Thus, recovery of hand function is a critical component in stroke rehabilitation[4,5].

The severely paretic arm is one of the most devastating syndromes that occur following

For Correspondence:
Karthikeyan Selvaganapathy
Email: skpsg@rediffmail.com

a stroke episode. Few therapeutic options are available to treat it effectively. The extent of structural damage and the level of cortical stimulation during active or passive movement of the affected limb are the two main factors that determine the functional deficits after stroke[6]. Most of the interventions need intensive labor and require one to one manual interactions with therapists for several weeks to months, which make the provision of complete treatment for all patients difficult. Mirror therapy can be recommended to improve upper-extremity functions in stroke patients as it is simple, inexpensive and patient-directed. The human brain is capable of significant recovery after a vascular insult. Among its sequelae, hemiparesis has been treated with mirror-therapy for promoting cortical changes. This method is thought to use the concentration of brain on movement to stimulate the motor processes that is involved in that movement[7,8].

Only limited studies are available which includes mirror therapy in the management protocol for improving motor recovery and hemiparetic upper extremity functions in subacute stroke patients. The primary objective of this study was to investigate the effect of mirror therapy on hemiparetic upper extremity motor recovery and functions in patients with subacute stroke. The secondary objective of this study was to find out the relationship between hemiparetic upper extremity functions and motor recovery of hand.

MATERIALS AND METHODS

STUDY DESIGN, SETTING AND POPULATION

This study was a prospective comparative study. A total of 30 participants were selected for the study on the basis of inclusion and exclusion criteria from nursing homes in Petaling Jaya, Malaysia and were randomly assigned to mirror therapy group (MTG) and sham mirror therapy group (SMTG) with fifteen participants in each group. The duration of intervention for each subject was 4 weeks (5 times / week).

The inclusion criteria were male and female patients aged between 50 to 70 years, first episode of unilateral stroke with hemiparesis, duration of 2 months to 12 months post stroke, diagnosis of stroke with involvement of middle cerebral artery on MRI or CT scan by neurologist. Participants with poor cognitive function as assessed with Mini Mental State Examination score < 24, uncontrolled systemic hypertension, perceptual or apraxic deficits, visual deficit such as homonymous hemianopia, reflex sympathetic dystrophy, severe shoulder subluxation, contracture in the affected upper limb and botox injection within past 6 months to the affected upper limb were excluded from the study. The university research ethical committee approved the study and informed consent was obtained from all subjects after the study protocol had been clearly explained to them.

INTERVENTION

All the participants equally took part in conventional stroke rehabilitation program 5 days a week, 1 hour a day, for 4 weeks and rest intervals were given whenever necessary. In addition with the rehabilitation program, the mirror therapy group participated in 30 minutes of mirror therapy and sham mirror therapy group received 30 minutes of sham mirror therapy for the affected hemiparetic upper limb.

The procedure had been carried out with the patient in close sitting to a table and the mirror placed vertically in midsagittal plane. The paretic upper limb was positioned behind the mirror and the normal limb was placed parallel to the mirror to reflect the mirror image. Only the normal limb can be seen by the participants in the mirror while the paretic limb was hidden from sight. The movements involved on the non paretic hand were simple movements such as finger flexion, finger extension, finger abduction, finger adduction, wrist flexion, wrist extension, wrist ulnar deviation and radial deviation and task specific movements such as power and prehension grip using different size and weighted objects.

Participants need to focus their full attentiveness on the mirror when the movement of the non paretic hand is performed. Observing the reflection of their non involved hand on the mirror, the similar movement was stimulated over the involved hand as a result of seeing the mirror. With this the participants were asked to make an effort to achieve the same movements with the paretic hand while they were moving the non-paretic hand. In the sham mirror therapy group, the similar procedures were followed for the same duration, but the non-reflecting side of the mirror was used in such a way that the paretic hand was concealed from vision.

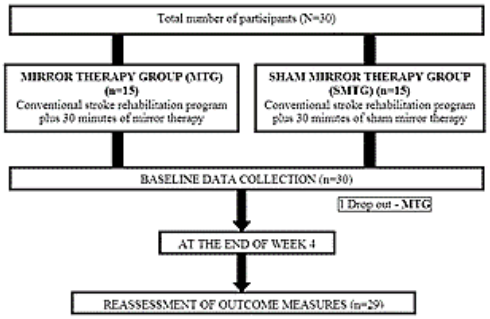


FIGURE 1: FLOW DIAGRAM SHOWING THE PROCEDURE USED IN THE STUDY

FIGURE 2: FOCUSING MOVEMENT OF NON PARETIC HAND ON THE MIRROR IN MTG

OUTCOME MEASURES

Hemiparetic upper extremity motor recovery was assessed by Fugl-Meyer Assessment (FMA-UE) scale and its functions were assessed by the Upper Extremity Functional Index (UEFI) scale.

STATISTICAL ANALYSIS

Data analysis is the method by which the validity of a research study is evaluated. Data were analyzed using SPSS version 23 (Windows 10). Demographic statistics were analyzed for both groups. As all the variables were non-parametric in nature, non-parametric statistical analysis was done. Within group comparison was statistically analysed using Wilcoxon signed rank test and between groups comparison was analyzed using Mann Whitney U test. Moreover, the relationship between hemiparetic upper extremity functions and motor recovery of hand was analyzed using Spearman correlational technique.

RESULTS

Descriptive statistics was used to evaluate the subject's demographic and clinical characteristics which are explained in Table 1. In within group analysis, data were arranged based on ranks. Rank mean and sum of ranks were seen based on Wilcoxon statistics. Furtherly, positive and negative ranks were analysed. Based on Wilcoxon signed ranks test, the results showed high significance with an alpha value of 0.05. These are explained in Tables 2 and 3. Mann Whitney U test was used to analyze the data between groups. The results showed that there were highly significant values between the two groups in all variables. So, Mirror therapy group mean ranks are higher than the Sham mirror therapy group. Mirror therapy group showed high significance than sham mirror therapy group. These changes are explained in Table 4 and Table 5.

TABLE 1- DEMOGRAPHICS AND CHARACTERISTICS OF SUBJECTS

VARIABLES	MTG	SMTG
Gender: Male/Female	11/4	10/5
Hemiparetic side: Right/Left	13/2	14/1
Lesion type: Ischemic/Hemorrhagic	9/6	11/4
Age (Years)	57.8±5.3[a]	58.2±5.7
Duration (Months)	5.06±2.1	4.93±2.4
FMA-UE score (Motor Function)	23.8±5.5	17.6±7.0
UEFI score	17.2±7.7	13.4±3.7

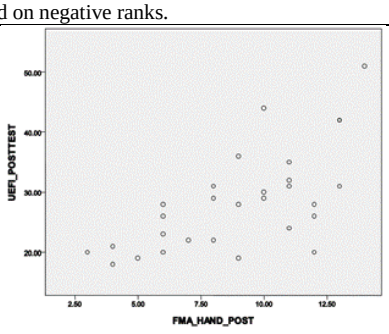
FMA-UE: Fugl-Meyer Assessment Upper Extremity, UEFI: Upper Extremity Functional Index, [a] Mean ± SD

TABLE 2 – WILCOXON RANK TABLE FOR ALL VARIABLES

		N	Mean Rank	Sum of Ranks
UEFI Post Test – Pre Test	Negative Ranks	0[a]	.00	.00
	Positive Ranks	29[b]	15.00	435.00
	Ties	0[c]		
	Total	29		
FMA – UE Post Test – Pre Test	Negative Ranks	0d	.00	.00
	Positive Ranks	29[e]	15.00	435.00
	Ties	0[f]		
	Total	29		
FMA-WRIST Post Test – Pre Test	Negative Ranks	2[g]	7.75	15.50
	Positive Ranks	23[h]	13.46	309.50
	Ties	4[i]		
	Total	29		
FMA – HAND Post Test – Pre Test	Negative Ranks	0[j]	.00	.00
	Positive Ranks	27[k]	14.00	378.00
	Ties	2[l]		
	Total	29		
FMA - SPEED Post Test – Pre Test	Negative Ranks	0[m]	.00	.00
	Positive Ranks	26[n]	13.50	351.00
	Ties	3[o]		
	Total	29		
FMA- TOTAL Post Test – Pre Test	Negative Ranks	0[p]	.00	.00
	Positive Ranks	29[q]	15.00	435.00
	Ties	0[r]		
	Total	29		

TABLE 3 – WILCOXON INFERENTIAL STATISTICS

TEST STATISTICS[a]						
	UEFI Post - Pre	FMA-UE Post - Pre	FMA-Wrist Post – Pre	FMA-Hand Post - Pre	FMA-Speed Post - pre	FMA-Total Post - Pre
Z	-4.707[b]	-4.706[b]	-3.984[b]	-4.554[b]	-4.520[b]	-4.705[b]
Asymp. Sig. (2-tailed)	.000	.000	.000	.000	.000	.000
a. Wilcoxon Signed Ranks Test						
b. Based on negative ranks.						



GRAPH 1 - SCATTER PLOT FOR CORRELATION COEFFICIENT FOR UEFI AND FMA – HAND

TABLE 4 – MANN WHITNEY U RANK TABLE

	Group	N	Mean Rank	Sum of Ranks
UEFI POST TEST	Mirror Therapy	14	19.93	279.00
	Sham Group	15	10.40	156.00
	Total	29		
FMA – UE POST TEST	Mirror Therapy	14	21.64	303.00
	Sham Group	15	8.80	132.00
	Total	29		
FMA – WRIST POST TEST	Mirror Therapy	14	21.29	298.00
	Sham Group	15	9.13	137.00
	Total	29		
FMA – HAND POST TEST	Mirror Therapy	14	22.07	309.00
	Sham Group	15	8.40	126.00
	Total	29		
FMA – SPEED POST TEST	Mirror Therapy	14	21.96	307.50
	Sham Group	15	8.50	127.50
	Total	29		
FMA – TOTAL POST TEST	Mirror Therapy	14	22.39	313.50
	Sham Group	15	8.10	121.50
	Total	29		

TABLE 5 – MANN WHITNEY U INFERENTIAL STATISTICS

TEST STATISTICSa						
	UEFI Post Test	FMA UE Post Test	FMA Wrist Post Test	FMA Hand Post Test	FMA Speed Post Test	FMA Total Post Test
Mann-Whitney U	36.00	12.00	17.00	6.00	7.50	1.50
Wilcoxon W	156.00	132.00	137.00	126.00	127.50	121.50
Z	-3.018	-4.069	-3.951	-4.343	-4.355	-4.523
Asymp. Sig. (2-tailed)	.003	.000	.000	.000	.000	.000
Exact Sig. [2*(1-tailed Sig.)]	.002b	.000b	.000b	.000b	.000b	.000b
a. Grouping Variable: GROUP						
b. Not corrected for ties.						

TABLE 6 - SPEARMAN'S CORRELATION COEFFICIENT

			UEFI Post Test	FMA - Hand Post test
Spearman's Rho	UEFI	Correlation Coefficient	1.000	.650**
		Sig. (2-tailed)		.000
		N	29	29
	FMA Hand	Correlation Coefficient	.650**	1.000
		Sig. (2-tailed)	.000	
		N	29	29
**. Correlation is significant at the 0.01 level (2-tailed).				

Spearman's Correlation Coefficient was used to find out the relationship between upper extremity functions and motor recovery of hand. The spearman's rho value is 0.650 which indicate moderate to maximum positive correlation between the two variables (Table 6). This statistical analysis was done in alpha level 0.01 and it showed that it was highly significant in 2-tailed ($P<0.01$). In graph 1, scatter plot analysis was done based on the results of Spearman's Correlation Coefficient analysis and it showed a positive correlation effect. So, the results showed that improving motor recovery of hand can directly influence on improving the upper limb functions.

DISCUSSION

The aim of this study was to investigate the effect of mirror therapy on hemiparetic upper extremity motor recovery and functions in patients with subacute stroke. Totally 30 participants were recruited in this study and were randomly assigned to mirror therapy group (MTG) and sham mirror therapy group (SMTG) with fifteen participants in each group. There was one drop out from MTG due to medical emergency. The results of the present study showed that there was a significant improvement in both groups in terms of upper extremity motor recovery and functions. When compared the improvement between groups, MTG showed significant improvement than SMTG in both upper limb motor recovery and functions.

Mirror neurons constitute a part of the nervous system. Execution or observation of motor action has produced changes over the adjacent cortical penumbra area in post-stroke patients with sensorimotor disorders. When using the mirror box, these mirror neurons get stimulated and help in recovery of the affected limb8. Similar findings were found from previous studies on upper extremity motor recovery and functions. Mirror therapy principle is based on the visual illusions that make patients feel as their two hands are symmetrically moving simultaneously. This delusion may activate a hemispheric cortical motor network that accelerates recovery[9-13]. The results of this study also showed a positive correlation between the hemiparetic upper extremity functions and motor recovery of hand. Thus motor recovery of hand influences hemiparetic upper extremity functions. The control group also showed significant changes over motor recovery and functions and the reason might be due to the conventional stroke rehabilitation program.

The study limitations were an inability to generalize the results to all types of stroke patients, not identify the influence of spasticity on hemiparetic upper extremity motor recovery and functions and absence of follow-up. Further studies are necessary to evaluate the effectiveness of mirror therapy as a part of stroke management in a long term basis on hemiparetic upper extremity motor recovery and its functions in stroke patients.

CONCLUSION

This study finding concludes that incorporating mirror therapy in subacute stroke rehabilitation program improves the hemiparetic upper extremity motor recovery and functions. In addition, motor recovery of hand has a great impact on the hemiparetic upper extremity functions.

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We would like to extend our heartfelt thanks to all the participants.

REFERENCES

1. Loo KW, Gan SH. Burden of stroke in Malaysia. International Journal of Stroke. 2012 Feb; Vol 7:165–167.
2. O'Sullivan SB, Schmitz TJ. Physical rehabilitation. 5th Edition. Philadelphia: F.A. Davis Company; 2007.
3. Khandare SS, Singaravelan RM, Khatri SM. Comparison of task specific exercises and mirror therapy to improve upper limb function in subacute stroke patients. IOSR Journal of Dental and Medical Sciences. 2013 June:7(1);05-14.
4. Cauraugh, J, Light K, Kim S, Thigpen M, Behrmann A. Chronic motor dysfunction after stroke: recovering wrist and finger extension by electromyography-triggered neuromuscular stimulation. Stroke. 2000 June;31(6):1360-4.
5. Cooper BY, Glendinning DS, Vierck CJJr. Finger movement deficits in the stumptail macaque following lesions of the fasciculus cuneatus. Somatosensory and otor Research. 1993;10:17-29.
6. Dohle C, Pullen J, Nakaten A, Kust J, Rietz Cand, Karbe H. Mirror Therapy Promotes Recovery From Severe Hemiparesis: A randomized controlled trial. Neurorehabilitation and Neural Repair. 2008 Dec:1-9.
7. Carvalho D, Teixeira S, Lucas M, Yuan T-F, Chaves F, Peressutti C, Machado S, Bittencourt J, Menéndez-González M, Nardi AE, Velasques B, Cagy M, Piedade R, Ribeiro P, Arias-Carrión O. The Mirror Neuron System in Post-Stroke Rehabilitation. International Archives of Medicine. 2013 Oct;6(41):1-7.
8. Thieme H, Mehrholz J, Pohl M, Behrens J, Dohle C. Mirror therapy for improving motor function after stroke. Journal of the American heart association. 2013 Jan:e1-e2.
9. Yavuzer G, Selles R, Sezer N, Sutbeyaz S, Bussmann JB, Koseoglu F, Atay MB, Stam HJ. Mirror therapy improves hand function in subacute stroke: A randomized controlled trial. Arch Phys Med Rehabil. 2008 Mar;89(3):393–398.
10. Stevens JA, Stoykov ME. Using motor imagery in the rehabilitation of hemiparesis. Arch Phys Medicine Rehabil. 2003 Jul;84(7):1090-1092.
11. Park JY, Chang M, Kim KM, An DH. The effects of mirror therapy with tasks on upper extremity function and self-care in stroke patients. J. Phys. Ther. Sci. 2015 Jan;27(5):1499–1501.
12. Ramachandran VS, Altschuler EL. The use of visual feedback, in particular mirror visual feedback, in restoring brain function. Brain. 2009 Jun:1-18.
13. Park JY, Chang M, Kim KM, Kim HJ. The effect of mirror therapy on upper-extremity function and activities of daily living in stroke Patients. J. Phys. Ther. Sci. 2015 Feb; 27(6):1681–1683.

THE EFFECTS OF PHYSICAL THERAPY MODALITIES ON THE VITAL SIGNS

BAYRAM KELLE, ASST. PROF.[1]; FERDI YAVUZ, MD[2]; SELEN ÖZGÖZEN, MD[1]

1. *Cukurova University, Faculty of Medicine, Balcalı Hospital, Department of Physical Medicine and Rehabilitation, Adana*
2. *Fizyocare Medical Center, Ankara*

ABSTRACT

Objective- The present study aimed to investigate the changes of vital signs including blood pressure, pulse, respiratory rate and body temperature after the applications of physical therapy modalities.

Design- Patients (n=116) who had pain localized to the neck, lumbar and knee underwent physical therapy modalities. Blood pressure, pulse rate, respiratory rate and body temperature were measured two times per patient (before and after physical therapy application).

Results- There were found statistically significant differences for the systolic and diastolic blood pressure and respiratory rate between the pre-treatment and post-treatment sessions (p=0.03; p=0.02; p=0.02, respectively). There were no statistically significant differences for the other vital signs.

Conclusions- Arterial blood pressure may rise after the physical therapy application. Arterial blood pressure measurement should be a requested procedure prior to the start of a physical treatment session.

KEYWORDS: Physical Therapy Modalities; Blood Pressure; Respiratory Rate; Pulse

INTRODUCTION

The physical therapy modalities are commonly used for the management and treatment of musculoskeletal disorders. These physical therapy modalities can be classified as electrotherapy, cold and heat modalities and manual therapy[1]. There are few case reports about complications of physical therapy modalities although the contraindications are well known[2-7].

Previously reported complications were usually due to contact and superficial effects of used modalities (skin infections, dermatitis, allergic reactions, nerve injuries etc.). Interestingly, the vital sings such as pulse, blood pressure, respiratory rate, body temperature have not been investigated previously. There are a few reports demonstrating a significant short-term change in arterial blood pressure after physical and rehabilitative interventions. But these studies were about the other modalities than traditional modalities like hotpack, therapeutic ultrasound and analgesic currents[8,9].

The aim of this study was to investigate the changes of above mentioned vital signs including pulse, blood pressure, respiratory rate and body temperature after the applications of physical therapy modalities.

For Correspondence:
Ferdi YAVUZ, MD.
Address: The Clinic of Physical Medicine and Rehabilitation, The Fizyocare Medical Center, Ankara-Turkey.
Phone Number: +90 312 222 5523, +90 544 343 54 58
Fax Number: +90 312 222 5524
E-mail Address: ferdiyavuz@yahoo.com

METHODS

This prospective clinical trial was performed in the Department of Physical Medicine and Rehabilitation of XXXXX. The study protocol was approved by Institutional Review Board of XXXXX. The Declaration of Helsinki protocols were followed, and the patients provided written informed consent.

The patients who received physical therapy because of the pain localized to the neck, lumbar and knee were included in this study. The inclusion criteria for the study were as follows: (1) age older than 18 years; (2) no contraindications for application of physical therapy modalities; (3) sufficient cognitive communication. The exclusion criteria were as follows: (1) history of cancer; (2) installation of cardiac pacemaker; (3) pronounced sensory neuropathy; (4) attendance of any physical therapy session during the previous one month.

PARTİCİPANT AND INTERVENTİONS

A total of 200 potentially eligible patients with localized neck, lomber and knee pain, in the follow-up of our clinic, were evaluated. A total of 116 patients completed the study. All patients underwent the traditional physical therapy modalities. Hotpack was administered for 20 min for 10 sessions, therapeutic ultrasound (frequency 1 MHz, power 1W/cm2, continuous mode) was administered 5 min for 10 sessions. Transcutaneal electrical nerve stimulation was administered pulse duration of 70 µS and frequency of 75 Hz in the form of the unidirectional square wave.

ASSESSMENT OF VİTAL SİGNS

Blood pressure: The blood pressure was measured 2 times per patient (before and after the physical therapy application) on the same arm by sphygmomanometer. The measurement was performed after resting for 10 min in a sitting position and in a quiet room with a constant room temperature (22ºC). The measurement was taken by a trained nurse using an oscillometric method on the non-dominant arm of the patient.

Pulse: Pulse rate was measured 2 times per patient (before and after the physical application) on the radial artery for 1 minute. These measurement was performed after resting least 10 minutes.

Respiratory rate: Respiratory rate was measured 2 times per patient (before and after the physical application) by counting the number of times the chest rises in one minute. These measurement was performed after resting at least 10 minutes.

Body Temperature: Body temperature was measured 2 times per patient (before and after the physical application). The measurement was taken by a trained nurse using a thermometer on the patient's underarm.

STATİSTİCAL ANALYSİS

Statistical analysis was performed using SPSS v.15.0 (SPSS Inc., Chicago, IL). Qualitative variables are presented as proportion and percentage. Quantitative variables are presented as mean ± SD (range). Intra-group differences in vital parameters were compared with Wilcoxon test and inter-group differences were compared with Mann-Whitney U and Kruskal Wallis tests. The level of statistical significance was set at $P < 0.05$.

RESULTS

116 patients (34 males, 82 females) with a mean age of 62.67 ± 14.75 years who received physical therapy sessions were included in the study. Table 1 summarizes the baseline clinical and demographic characteristics of the participants in the study. Blood pressure values were above normal values in 56 patients. A total of 60 patients had no knowledge of the evidence of arterial hypertension.

Statistically significant differences were found among the mean systolic and diastolic blood pressure between the pre-treatment and post-treatment sessions (p=0.03; p=0.02, respectively). Statistically significant differences was found at mean respiratory rate at the pre-treatment and post-treatment sessions (p=0.02). There was no significant difference in the mean change in pulse rate and body tempeature between the pre- and post-treatment sessions (p=0.37; p=0.43, respectively) (Table 2).

TABLE 1: BASELINE DEMOGRAPHIC AND CLINICAL CHARACTERISTICS OF THE PARTICIPANTS

Characteristics	Patients (n=116)
Age (mean ± SD); years	62.67 ± 14.75
Sex (female / male); number	82 / 34
Treatment region (n)	
Neck	32
Shoulder	18
Low Back	40
Knee	26
Treatment Modalities (n)	
HP/US/TENS	102
HP/US/DD	12
IR/US/TENS	2
Concomitant Risk Factors (n)	
Diabetes mellitus	30
Hypertension	56
Cardiac disease	18
Hypothyroidism	6
Hyperthyroidism	2
Pulmonary disease	10
Liver disease	4
Renal disease	6
Blood disorders	8
HP: hot pack, US: ultrasound, IR: infrared, DD: Diadynamic current.	

TABLE 2. THE VALUE OF VITAL SIGNS BEFORE AND AFTER APPLICATION OF PHYSICAL THERAPY MODALITIES

	Pre-treatment	Post-treatment	P
Systolic blood pressure (mmHg)	121.45±13.48	143.24±14.70	**0.03**
Diastolic blood pressure (mmHg)	76.09±8.60	79.60±7.90	**0.02**
Respiratory rate (/min)	20.72±2.94	24.17±1.87	**0.02**
Pulse rate (/min)	81.45±7.59	81.36±8.03	0.37
Body temperature (˚ C)	36.34±0.35	36.41±0.30	0.43
Bold values indicate a P value < 0.05			

In this study was sub-classified the participants in groups according to the treatment modalities, the treatment region, and concomitant risk factors. Accordingly, there were no significant differences in any of the mean systolic blood pressure, diastolic blood pressure, respiratory rate, pulse rate or body temperature between the subgroups (p >0.05).

DİSCUSSİON

This is the first study to investigate the changes of vital parameters such as systolic blood pressure, diastolic blood pressure, respiratory rate, pulse rate or body temperature in patients admitted to an outpatient clinic of physical

medicine and rehabilitation. The measurement of vital parameters on admission has not been usually performed routinely in the outpatient clinic of physical and rehabilitative medicine. However, there are some case reports about the side effects due to some physical therapy modalities[10]. Deep heaters such as shortwave and ultrasound caused tachycardia and hypertension in three patients. So that, it may be reasonable to search for vital parameters, which may help to identify those patients including risk factors for cardiovascular complications prior to the physical treatment session.

The physiological effects of thermotherapy such as whirlpool, warm hydrocollator packs, paraffin baths, and fluidotherapy include vasodilation, increased blood flow and increased metabolic rate. Generalized peripheral vasodilatation is produced by heating a large surface area of the body. This elevation in skin blood flow requires more cardiac output in order to maintain blood pressure. The patients with impaired heart function may not tolerate the increased cardiac demand. So that, thermotherapy modalities should be applied precautiously in patients with cardiac insufficiency or failure[11].

The present study's results also showed that the mean systolic and diastolic blood pressure was higher in post-treatment than pre-treatment session. However, we could not find any difference in the mean change in pulse rate between the pre- and post-treatment sessions.

The physicians should be aware of these physical therapy modalities and their risks for cardiovascular complications.

In a review, the contraindications for superficial heat and therapeutic ultrasound were evaluated but their data sources about the contraindications were from health care provider. Prominent contraindication was malignancy. Cardiac impairment and unstable blood pressure were found to be moderate contraindications regarding health care provider[12]. In this review particularly, it was requested to avoid for application of TENS to carotid sinus. This area has baroreceptor and can autonomic dysfunction occur[13].

There were some limitations to the current study. One limitation was the age range of patients, which might have affected the response to treatment. Physical therapy modalities were used as combined (superficial and deep heating, electrotherapy). This condition may mask which modality can cause the change of vital signs. Other limitation was that the number of the cases were relatively small. There can be more accurate results with larger numbers.

CONCLUSİON

In conclusion, arterial blood pressure measurement should be a requested procedure prior to the start of a physical treatment session. Early detection of hypertensive patients prior to the physical treatment session may prevent the interruption of treatment and cardiovascular complications due to blood pressure elevation.

CONFLİCT OF INTEREST: NONE

There is no financial benefits to the authors.

This study was conducted in the Cukurova University, Faculty of Medicine, Department of Physical Medicine and Rehabilitation, Adana-Turkey.

REFERENCES

1. Weber DC, Brown A. Physical agents modalities, In: Braddom RL., editor. Physical Medicine and Rehabilitation 2nd ed. Philadelphia: W. B. Saunders; 2000. p. 440-445.
2. Sandanam J. Burns caused by heating pads (letter). Med J Aust. 1982;1(9):369.
3. Stevenson TR, Hammond DC, Keip D, Argenta LC. Heating pad burns in anesthetic skin. Ann Plast Surg. 1985;15:73-75.
4. Khabbaz RF, McKinley TW, Goodman RA, Hightower AV, Highsmith AK, Tait KA, et al. Pseudomonas aeruginosa serotype 0:9 new case of whirlpool associated dermatitis. Am J Med. 1983;74:73-77.
5. Bassett FH, Kirkpatrick JS, Engelhardt DL, Malone TR. Cryotherapy induced nerve injury. Am J Sports Med. 1992;20:516-518.
6. McGuckin MB, Thorpe RJ, Abrutyn E. Hydrotherapy. An outbreak of Pseudomonas aeruginosa wound infections related to Hubbard tank treatments. Arch Phys Med Rehabil. 1981;62:283-285.
7. Griffin JW, McClure M. Adverse responses to transcutaneous electrical nerve stimulation in a patient with rheumatoid arthritis. Phys Ther. 1981;61:354-355.
8. Hiramatsu K, Yamada T, Katakura M. Acute effects of cold on blood pressure, renin-angiotensin-aldosterone system, catecholamines and adrenal steroids in man. Clin Exp Pharmacol Physiol. 1984;11:171-179.
9. Lietava J, Vohnout B, Valent D, Celko J. Comparison of hemodynamics during hyperthermal immersion and exercise testing in apparently healthy females aged 50–60 years. Ital Heart J. 2004;5:511-516.

10. Nadler SF, Prybicien M, Malanga GA, Sicher D. Complications from therapeutic modalities: Results of a national survey of athletic trainers. Arch Phys Med Rehabil. 2003;84:849-863.
11. No author listed. Electrophysical agents-Contraindications And Precautions: An Evidence-Based Approach To Clinical Decision Making In Physical Therapy. Physiother Can. 2010;62(5):1-80.
12. Batavia M. Contraindications for superficial heat and therapeutic ultrasound: do sources agree? Arch Phys Med Rehabil. 2004;85(6):1006-1012.
13. Basford JR. Therapeutic physical agents. In: DeLisa JA, Gans BM., editors. Physical Medicine and Rehabilitation: principles and practices. 4th ed. Philadelphia: Lippincott Williams and Wilkins; 2005.p. 251-270.

EFFECT OF TENSOR FASCIA LATA STRETCHING IN LATERAL KNEE PAIN POST TOTAL KNEE REPLACEMENT

***ALPA PUROHIT*[1]**

1. *Vice-Principal of AIMS-Physiotherapy College, Ahmedabad, Gujarat*

ABSTRACT

Introduction: Post TKR (Total knee replacement) multiple causes for development of pain around knee joint-infection instability, malrotation, instability, weak extensor mechanism, soft tissue tightness, and impingement. The ITB (Iliotibial Band)/TFL (Tensor Fascia Lata) provides dynamic lateral stabilization of the patella & an internal rotator of hip. TFL/ITB complex tightness may contribute to the development of PFPS (Patellofemoral Pain Syndrome). A tight TFL through its attachment into the ITB, will cause lateral tracking of the patella, particularly at 20°of knee flexion. An over-tight ITB is not favorable, as this can cause lateral knee pain. Hence, keeping the TFL as flexible as possible, decreasing the pull it has on the ITB, will decrease the chance of lateral knee pain caused by ITB tightness. Multiple choice of treatment options are available-ice, massage, corticosteroids, stretching and bracing. Static stretch of TFL is effective in gaining of flexibility

Methodology: An Experimental study. 20 post-operative T.K.R., divided into 10 in each group according to criteria Group A – Conventional treatment + TFL stretching, Group B – Conventional treatment. Pre and post treatment pain &function were measured by VAS & HFKS (High flexion knee scale). Analysis was done by SPSS.

Result: Within and between group analysis shows p<0.05, significance in both groups for pain and function.

Discussion: Intra-articular steroids are also used for knee pain. Static stretching increased flexibility, so it reducing tension on lateral femoral condyle and reduce a symptoms of ITBS (Iliotibial Band Syndrome).

Conclusion: TFL stretching exercises showed improvement in pain and physical function and useful adjunct exercise therapy in person having a lateral knee pain and prevention of ITBS in post-operative TKR

KEYWORDS: TFL; TKR; ITBS; PFPS

INTRODUCTION

The ITB/TFL (iliotibial band /tensor fascia lata) and gluteus maximus, provides dynamic lateral stabilization of the patella. Since the TFL muscle is a lateral stabilizer of patella and an internal rotator of hip, and TFL/ITB complex tightness may contribute to the development of PFPS (patellofemoral pain syndrome)[1]. TFL merges into the iliotibial band. ITB then inserts into just below the outside of the knee joint. When the TFL muscle is in spasm it is pulling hard on the ITB and pain is felt at the insertion point on the outside of knee[2]. A tight TFL through its attachment into the ITB, will cause lateral tracking of the patella, particularly at 20°of knee flexion when the band is at its shortest. An over-tight ITB is not favorable, as this can cause lateral knee pain.

Post TKR (Total knee replacement) multiple causes for development of pain around knee are joint infection, instability, malrotation of component, patellofemoral instability, problem in extensor mechanism, soft tissue tightness, impingement and patellar clunk syndrome[3].

Multiple choice of treatment options are available for soft tissue dysfunctions like ice, massage, corticosteroids, stretching and bracing. Static stretch of TFL is effective in gaining of flexibility. Multiple choice of treatments are available for tightness of TFL/ITB Muscle in runners/athletes. In post TKR tightness of TFL/ITBS can also contribute to lateral knee pain which can be treated with the medical management like local corticosteroids, ice application and local application[8]. So the need of study is to see the effect of TFL stretching in lateral knee pain post TKR.

For Correspondence:
Alpa Purohit
Email: dralpaphysio@yahoo.co.in

AIM AND OBJECTIVES

Aim

To see the effect of TFL stretching on lateral knee pain post TKR

Objectives

- To see the effect of stretching of TFL on pain
- To see the effect of stretching of TFL on knee function.
- To compare the effectiveness of TFL muscle stretching exercises and conventional treatment with conventional physiotherapy treatment

HYPOTHESIS

NULL HYPOTHESIS

There will be no significant effect of TFL stretching on lateral knee pain post TKR.

EXPERIMENT HYPOTHESIS

There will be significant effect of TFL stretching on lateral knee pain post TKR.

MATERIALS & METHOD

MATERIALS

- Assessment Form
- Consent Form
- Examination Table
- Study design: An Experimental study
- Study Setting: All the patients were referred from Orthopaedic Knee replacement surgeon.
- Sample Size: 20, divided into 2 groups according to selection criteria
- Group A: Conventional treatment + TFL stretching
- Group B: Conventional treatment
- Sample design: convenience sampling

INCLUSION CRITERIA

- Age: 50-65 years, both male and females
- Operated primarily with high flexion knee prosthesis by single surgeon,
- Minimal postoperative duration 6 week,
- ROM ≥ 0-100°flexion,
- Full active knee extension,
- Positive Ober's test,
- Pain on lateral knee joint/lateral part of thigh,
- Those who receive a local injection at local site.

EXCLUSION CRITERIA

- Revision &Infected TKR
- Malalignment of joint
- Patellar clunk syndrome
- Patellofemoral instability
- Low back pain radiating up to knee joint
- Postural abnormalities e.g. kyphosis, scoliosis.

METHOD

Group A received Conventional treatment[4,5] in form of

- SQE (Static Quadriceps Exercise),
- Ankle pump exercises (15-20 repetitions, twice in a day),
- Straight leg raising (SLR),
- Passive and active knee bending,
- Strengthening exercises of quadriceps, hamstring & abductor muscles.
- Stretching to calf, and hamstring muscles -3 repetition,
- Gait training &stair training.
- TFL stretching for 30 seconds hold, 3 repetitions, 4 times in a week for 4 weeks[6]

TFL stretching:

With the patient side lying position, support the knee and flex it to 90 degrees. Then extend and abduct the hip. The examiner must continue to stabilize at the hip to ensure there is no movement

OUTCOME MEASURES

Pre and post treatment pain was measured by VAS, function was assessed by HFKS-High flexion knee scale.

RESULT

Data analysis was done using SPSS software version 16 and Microsoft Office Excel 2007.

Within group comparison of VAS and the HFKS

High flexion knee scale were analyzed by Wilcoxon Signed Ranks Test and between group comparison was done by Mann-Whitney Test.

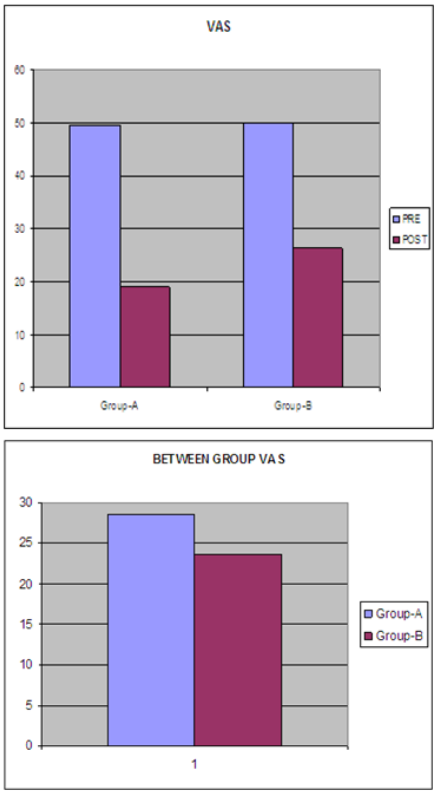


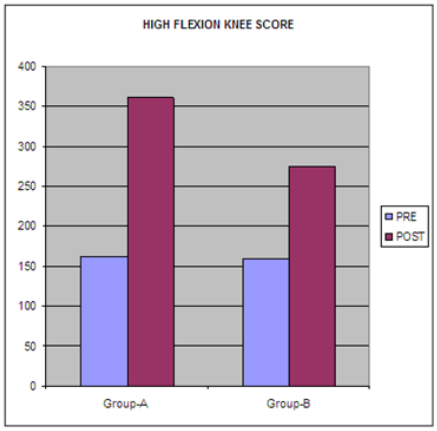
FIGURE 1 & 2: Bar Diagram of VAS

Table 1: VAS

GROUP	VAS MEAN±SD	Z-VALUE	P-VALUE
GROUP-A	4.95±1.012	2.821	<0.005
GROUP-B	5±1.081	2.814	<0.005
BETWEEN	2.6050±0.8394	1.194	>0.05

Table 2: HFKS

	HFKS MEAN±SD	Z-VALUE	P-VALUE
GROUP-A	16±0.6324	2.814	<0.005
GROUP-B	15±0.316	2.825	<0.005
BETWEEN	15.75±4.677	3.805	<0.005



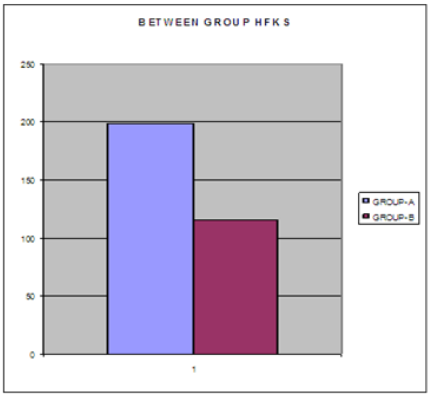


FIGURE 3 & 4: Bar diagram of high flexion knee score

DISCUSSION

Result of present study shows the significant difference in pain and HFKS within group A and B. But between group analysis shows non-significant difference for pain but between group analysis shows significant difference for HFKS. Thus, Null hypothesis was rejected and Alternate hypothesis holds true and it was found that there were significant effect of TFL stretching on lateral knee pain post TKR.

Cortisone knee injections provide more targeted, rapid and powerful relief from inflammation. Steroids are also used for knee pain relief in both group[10].

Static stretching increased flexibility, so it reduced tension on lateral femoral condyle and reduced the symptoms of ITBS.

Hence, keeping the TFL as flexible as possible, decreasing the pull it has on the ITB, will decrease the chance of lateral knee pain caused by ITB tightness[9].

TFL affects either the femur or the lower leg.

ITB receives part of insertion of the TFL and gluteus maximus muscle, in essence creating its role as a force transmitter from hip to knee.

Active stretching and strengthening is important in ITBS/TFL pain according to Cookingham CL et al[11].

LIMITATIONS

- Long term follow up was not conducted
- Small sample size

FUTURE RECOMMENDATION

Effect of additional electromodality can be assessed along with stretching

Different stretching techniques can be compared using this condition.

CONCLUSION

TFL stretching exercises showed improvement in pain and physical function and useful adjunct exercise therapy in person having a lateral knee pain and prevention of ITBS in post-operative TKR

REFERENCES

1. Ellis R, Hing W, Reid D. Iliotibial band friction syndrome—A systematic review. Manual Therapy. 2007 Jan 8;12(3):200-8.
2. Julie donnelly j., Dr. Steve chaney On exercise, hip pain treatment, muscle therapy and health ,March 15, 2016.
3. Barr L, Khanduja V, Owen J. An Unusual Cause of Lateral Knee Pain following Total Knee Replacement. Case reports in orthopedics. 2012 Jan 5;2011.
4. Lau SK, Chiu KY. Use of continuous passive motion after total knee arthroplasty. The Journal of arthroplasty. 2001 Apr 30;16(3):336-9.
5. Hewitt B, Shakespeare D. Flexion vs. extension: a comparison of post-operative total knee arthroplasty mobilisation regimes. The Knee. 2001 Dec 31;8(4):305-9..
6. T. Bowersock, S. Gaydos, B. Hagan, S. Sprockett, D. Cade, The Effects of a 6-week Passive Stretching Protocol on the Iliotibial Band Complex of Female Graduate Students
7. Mahomed NN, Barrett J, Katz JN, Baron JA, Wright J, Losina E. Epidemiology of total knee replacement in the United States Medicare population. J Bone Joint Surg Am. 2005 Jun 1;87(6):1222-8.
8. Nizar MN, Barrett J at al- Measuring functional improvement after2 total knee arthroplasty requires both performance-based and patient-report assessments. J arthroplasty. 2011 aug; 26(5): 728–737.
9. Kane RL, Saleh KJ, Wilt TJ, Bershadsky B. The functional outcomes of total knee arthroplasty. J Bone Joint Surg Am. 2005 Aug 1;87(8):1719-24.
10. Sofat N.Kuttapitiya A.,Alternative

corticosteroids shorts.Future directions for the management of pain in arthritis.Int. J Rheumatol.Apr 2014;9(2):197-276.
11. Cookingham CL, Chaudhari AM et al. Current Rev Musculoskeletal Med. Precipating factor the common occurances of ITBFS. Clinical Journal of Sports Medicine. Jul 20, 2010.

INFLUENCE OF CORE STRENGTH ON LOWER EXTREMITY BALANCE IN YOUNG HEALTHY ADULTS

HARDI SHAH[1], RAZIA NAGARWALA[2]

1. *BPTh, Sancheti Institute College of Physiotherapy*
2. *Professor, Sancheti Institute College of Physiotherapy*

ABSTRACT

Background: Core stability and core strength is of maximum importance in almost all the activities of daily living. This study is done to check the influence of core strength on lower extremity balance.

Method: 50 young healthy adults both males and females between the age group of 18-25 years with mean age of 21.73±1.45 years, were included in the study and those involved in any kind of sports activity were excluded. Then their core strength was checked by pressure biofeedback method and static balance was tested by Single Leg Balance Test.

Results: Pearson correlation test was used, which showed a significant correlation between core muscle strength and balance (p< 0.05).

Conclusion: Core muscle strength influences static balance.

KEYWORDS: Core strength; static balance; Single Leg Balance test

INTRODUCTION

The body's "core" refers to the muscles around the abdomen, pelvis, and back. The main muscles involved include the transverses abdominis, the internal and external obliques, the quadrates lumborum and the diaphragm[1]. 'Core stability' is defined as the ability to control the position and motion of the trunk over the pelvis to allow optimum production, transfer and control of force and motion to the terminal segment in integrated activities. From sitting to standing, walking to running, the core muscles are at work stabilizing our body from the force of gravity. Weak core muscles make one more susceptible to poor posture, back pain, and injuries during activity.

Core stability may provide several benefits to the musculoskeletal system, from maintaining low back health to preventing knee ligament injury[2]. It is predominantly maintained by the dynamic function of muscular elements. Core muscles strength can be tested using isometric and isokinetic methods. Appropriate intervention may result in decreased rates of back and lower extremity injury.

Core muscle activity is best understood as the pre-programmed integration of local, single-joint muscles and multi-joint muscles to provide stability and produce motion. These results in proximal stability for distal mobility, a proximal to distal patterning of generation of force, and the creation of interactive moments that move and protect distal joints. Rehabilitation should include the restoring of the core itself, but also include the core as the base for extremity function[2].

For Correspondence:
RAZIA NAGARWALA
Sancheti Institute College of Physiotherapy
Email: doc.ashokshyam@gmail.com

Balance is a key component of normal daily activities such as walking, running and climbing stairs. In the simplest terms, balance can be defined as “the ability to maintain the body’s centre of gravity within the limits of stability as determined by the base of support”. Balance, or postural control, can be described as either dynamic or static. Static postural control is attempting to maintain a base of support while minimizing movement of body segments and the centre of mass; while dynamic postural control involves the completion of a functional task with purposeful movements without compromising an established base of support. Dynamic activities can also be described as those that cause the centre of gravity to move in response to muscular activity[3].

The single leg balance test measures the overall balance. It highlights overall balance in the core.

As knowledge about the importance of core strength increases, clinicians are beginning to incorporate more core strengthening tasks into rehabilitation protocols and exercise prescriptions. According to Kibler et al, core stability and strength is an important component to maximize efficient balance and athletic function in upper and lower extremity movements. Core acts as a base for motion of the distal segments, or “proximal stability for distal mobility”. Core stability is a generic description that describes the training of the muscles of the abdominal and lumbopelvic region[3].

The involvement of the abdominal and lumbopelvic muscles in trunk stability has been researched and proven through various tests and

studies[4]. Logically, strengthening core muscles will improve stability of the lumbar spine.

AIM

To study the influence core strength on lower extremity balance in young healthy adults.

OBJECTIVES

- To measure core muscle strength by pressure biofeedback method
- To check lower extremity balance by using Single Leg Stance (SLS)
- To assess the effect of core muscle strength on lower extremity balance.

METHODOLOGY

This was an observational study. 50 young healthy adults, both males as well as females, within the age group of 18 to 25 years with a mean age of 21.73±1.45 years were included. Individuals involved in any kind sports activities were excluded from this study.

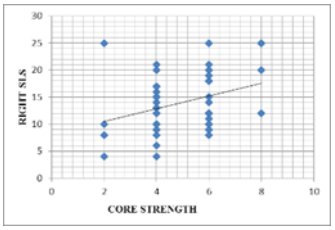
A verbal consent was taken from all the participants and they were explained about the procedure and purpose of the study. Their core muscle strength was measured by using pressure biofeedback method. A sphygmomanometer was used. The cuff was placed under the lumbar spine region and inflated to 40mmHg. Then they were instructed to press their back down or activate core by drawing-in maneuver and increase the pressure on the cuff to 42 mmHg (minimal superficial activation). This was repeated till the activation of 50 mmHg (total 10mmHg increase). The final one reading was recorded at which patient could hold for 10 seconds.

Balance was tested by using Single Leg Balance Test (SLS) wherein the person stood tall with his arms down by the sides but not touching the sides and elevates one leg until thigh is parallel with ground. Once stable he was asked to close his eyes and see how long he could maintain balance. Any repositioning of the foot was considered loss of balance. Time was recorded with the help of a stopwatch and the test was repeated on the other side. More than 25seconds is considered normal so the test was stopped after 25 seconds5.

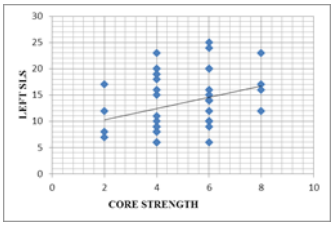
Then the core strength and balance were correlated.

RESULTS

The Pearson correlation test was used. The p value was set at 0.05.



GRAPH 1



GRAPH 2

The above graphs show positive correlation.

TABLE 1: CORE STRENGTH AND SINGLE LEG STANCE CORRELATION

	Mean ± standard deviation	Correlation coefficient (r)	P value
Right	Core strength: 4.97±1.53 SLS: 13.97±5.43	0.332	0.02
Left	Core strength: 4.97±1.53 SLS: 13.46±5.31	0.305	0.033

DISCUSSION

This study was done to check the influence of core strength on lower extremity balance.

The musculoskeletal core of the body includes the spine, hips, pelvis and abdominal structures.

The core muscles include muscles of trunk and pelvis that are used for maintaining stability of pelvis and spine and helps in transfer of energy from larger muscles to smaller muscles in sports or high velocity activities. The core acts as an anatomical base for movement of distal parts of the body. This is considered as proximal stability for distal mobility, for running, throwing or kicking activities. Before the limb movements, the spine is stabilized for muscle activation and stable base of motion. Fatigue of trunk muscle contributes to spinal instability over strenuous and prolonged physical tasks and therefore may lead to injury. The core is important to provide strength and balance and for injury prevention. The control of core strength, balance and motion helps in upper and lower extremity functions during sports activities2.

The present study results show that there is statistically significant correlation between core

strength and single leg balance test. (Table 1 and graph1, 2)

Amirhossein et al had studied relationship between trunk muscle endurance and static balance and found positive correlation between them6.

Balance is the ability to maintain the Center of Gravity (COG) of a body within the base of support with minimal postural sway. Maintaining balance is coordinated by three systems. The first input is from the vestibular system. The second balance coordinator is the proprioceptive system originating from somatosensory receptors in muscles, tendons, and joints for kinesthetic sense, body posture and spatial awareness. Finally, the visual system which sends visual signals about body's position. Postural control necessitates interaction of nervous and musculoskeletal system. Components involving control include the motor system providing musculoskeletal synergistic response, somatosensory system obtaining visual, vestibular and proprioceptive information and central nervous integrating system for converting sensory inputs into muscle coordination and adaptation6.

The mechanisms involved in Static balance activities are:

- Sufficient power in the muscles of the lower limbs and trunk to maintain the body erect.
- Normal postural sensibility to convey information concerning position.
- Normal impulses from the vestibular labyrinth concerning position.
- A central coordinating mechanism, the chief part of which is the vermis of the cerebellum.
- The activity of higher centers concerned in the willed maintenance of posture7

The Single Leg Stance measures postural stability and is a simple, easy and effective method to screen for any balance impairments. It is described as a method of quantifying static balance ability. It is a valid measure and is useful in explaining other variables of importance such as frailty and self-sufficiency in activities of daily living, gait performance and fall status8

Hodges and Richardson found that the co-contraction of the deeper-layer transverse abdominis and multifidi muscle groups occurs prior to any movement of the limbs, and believe that this neuromuscular pre-activation is critical in stabilizing the spine prior to any movement9. Thus core muscle strength plays an important role in maintaining static balance.

CONCLUSION

The core muscle strength has an important role in static stability. Hence, it is proven that the core stability influences static lower extremity balance.

ACKNOWLEDGEMENTS

I would like to thank all the subjects who were a part of this study.

CLINICAL IMPICATION

Core muscles strengthening should be a part of rehabilitation for improving static balance and prevention of injuries of back and lower extremities.

REFERENCES

1. John D. Willson, Christopher P. Dougherty, Mary and Irene McClay Davis; Core Stability and Its Relationship to Lower Extremity Function and Injury; J Am Acad Orthop Surg; 2005; 13:316-25
2. Kibler WB, Press J, Sciascia A The role of core stability in athletic function; Sports Med 2006; 36(3):189-98.
3. http://www.physio-pedia.com/Star_Excursion_Balance_Test (www.google.com)
4. Nagarwala Razia, Dhotre Prarthana, Gelani Isha. Correlation between core strength and breath holding time in normal young adults; Journal of Orthopaedics and Rehabilitation | January 2011 | Vol. 1 | Issue 1
5. Greg Rose; Single Leg Balance Test, May 28 2013; www.mytpi.com/articles/screening/ single leg balance test
6. Amirhossein Barati, Afsaneh Safar Cherati, Azar Aghayari, Faezi Azizi, and Hamed Abbasi; Evaluation of Relationship between Trunk Muscle Endurance and Static Balance in Male Students; Asian J Sports Med. 2013 Dec; 4(4): 289–294
7. Bannister R: Brain's Clinical Neurology, ed 3. New York, NY, Oxford University Press, Inc, 1969, pp 51-54, 102
8. Springer, Barbara A.; Marin, Raul MD; Cyhan, Tamara RN, Roberts, Holly , GCS; Gill, Norman W; Normative Values for the Unipedal Stance Test with Eyes Open and Closed; Journal of Geriatric Physical Therapy: April 2007;30 - Issue 1; 8–15
9. Hodges, T.W.; Richardson, C.A: Altered trunk muscle recruitment in people with low back pain with upper limb movement at different speeds. Archive of Physical Medical Rehabilitation. 1999 Sep; 80(9): 1005-

A COMPARATIVE STUDY TO FIND OUT THE EFFICACY OF MULLIGAN MOBILIZATION VERSUS THERABAND EXERCISE IN REDUCING PAIN AND FUNCTIONAL IMPROVEMENT IN PATIENTS WITH SUB-ACUTE LATERAL ANKLE SPRAIN

SUSAN ANNIE GEORGE[1], SENTHIL VIJAY S[2]

1. *Lecturer, Medical Trust Institute Of Medical Sciences, College Of Physiotherapy, Irimpanam, Cochin*
2. *Assistant professor, Laxmi Memorial College of Physiotherapy, Balmatta, Mangalore*

ABSTRACT

BACKGROUND: Physiotherapist frequently uses manipulative therapy techniques and theraband exercise to treat dysfunction and pain resulting from lateral ligament sprains of the ankle joint. The objective of this study was to compare the effectiveness of Mulligan's MWM and Theraband exercises in subjects with sub-acute lateral ankle sprain.

METHOD: 30 subjects aged 18-45 year with sub-acute lateral ankle ligament sprain were selected and were randomly divided into two experimental groups, that is group A Mulligan's MWM and Contrast bath and group B Theraband exercise and Contrast bath. These two techniques were performed three days in a week followed by 4 weeks. Contrast bath were administrated for both groups 10 minutes before the mobilization treatment. Outcome measures were Visual Analogue Scale (VAS) and Foot and Ankle Disability Index (FADI) scales, which is assessed before the first day of treatment and at the end of 4th week of treatment. At the end of 4th week, the data's were analyzed to find out the effective technique among the two.

RESULTS: Subjects in both groups were showed reduction in pain and improvement in leg function at the end of 4th week. Statistically no significant changes in scores were found in Mulligan's MWM group and Theraband exercise group for pain reduction ('t' value 0.196 and 'p' value 0.896) and leg function. ('t' value 0.119 and 'p' value 0.096). Therefore, Mulligan Mobilization with Movement and Theraband exercise are considered to be almost same effect in reducing pain and improving functions in subjects with sub-acute lateral ankle sprain.

CONCLUSION: The result indicates that Mulligan's MWM technique and Theraband exercise have almost same effect in reducing pain and improving functional abilities of foot and ankle in subjects with sub-acute lateral ankle sprain.

KEY WORDS: Lateral ligament sprain; Mulligan's MWM; Theraband; VAS; FADI

INTRODUCTION

Ankle sprains are one of the most common musculoskeletal injuries[1]. It is estimated that one ankle sprain occurs per 10,000 persons per day[2-4]. Ligamentous ankle injuries are the most common sports trauma, accounting for 10-30% of all sports injuries[5]. As most ankle sprains occurs during plantar flexion, supination, and inversion[6,7], they are most common in basketball, volley ball, and all sports that involve jumping and side stepping[8].

Most 85% ankle injuries are sprains[9], and only a small percentage are caused by ankle ligament rupture. The injuries originates from weaker lateral ligament in up to 85% and only 3-5% are isolated deltoid ligament sprain[9,10]. Plantar flexion/inversion sprains of the ankle being in part responsible for functional difficulties in walking on flat surfaces, down slopes and down stairs[11-13].

The lateral ligament complex of the ankle, described as the body's "most frequently injured single structure"[14], is mechanically vulnerable to sprain injury. Lateral ankle sprains most common occur due to excessive supination of the rear foot about an externally rotated lower leg soon after initial contact of the rear foot during gait or landing from a jump[15,16]. Excessive inversion and internal rotation of the rear foot coupled with the external rotation of the lower leg, result in strain to the lateral ankle ligaments.

Mobilization with Movement is the concurrent application of sustained accessory mobilization applied by a therapist and an active physiological movement to end range applied by the patient[17]. The techniques are always applied in a pain free direction and are described as correcting joint tracking from a positional fault[18,19]. Mobilization with movement (MWM) has been advocated for treatment of joint pain, stiffness and dysfunction[20].

Theraband and theratubes are often used for resistance training for the purpose of muscle strengthening and improvement of the function. Therapeutic exercises with the therabands is extremely easy and effective in promoting continuous exercises[21]. Rehabilitation exercises after ankle sprains include active and resisted exercises, often performed with Theraband.

For Correspondence:
Susan Annie George
Email id:- dr.susanannie@gmail.com

AIM OF THE STUDY

The aim of the study is to find out the effectiveness of mulligan mobilization versus theraband exercise in reducing pain and functional improvement measured by using VAS score and Foot and Ankle Disability Index in patients with sub-acute lateral ankle sprain.

OBJECTIVES OF THE STUDY

- To find out the effect of mulligan mobilization in the treatment of sub-acute lateral ankle sprain.
- To find out the effect of theraband exercise in the treatment of sub-acute lateral ankle sprain.
- To compare the effectiveness of mulligan mobilization and theraband exercise in the treatment of sub-acute lateral ankle sprain.

METHODOLOGY

STUDY DESIGN

Randomized Controlled Design - An Experimental study

SOURCE OF DATA

30 symptomatic subjects of both gender fulfilling inclusion criteria will be selected from Laxmi Memorial College of Physiotherapy – OPD, & A.J Hospital and Research Center, Kuntikana, Mangalore.

SAMPLE SIZE: 30

METHODS OF COLLECTION OF DATA

SAMPLING TECHNIQUE

To perform the study the patients were divided into 2 groups (group A & B) of each using purposive sampling technique and informed consent of each was taken.

GROUP - A: 15 subjects received contrast bath and Mulligan Mobilization for 4 weeks.

GROUP - B: 15 subjects received contrast bath and Theraband exercise for 4 weeks.

INCLUSION CRITERIA

- Age 18-35 years
- Both sex are included
- Pre- diagnosed cases of sub-acute lateral ligament ankle sprain
- Duration – sub acute (3- 14 days)

EXCLUSION CRITERIA

- Medial ankle sprain
- Acute and chronic stage
- Recent fractures and deformity at the sprained leg
- History of balance disorder

MATERIALS USED FOR THE STUDY

- Evaluation tools (VAS for pain assessment ranging from 0-10 points)
- Foot and Ankle Disability Index Scale to assess the functional abilities of foot and ankle.
- Theraband
- Plastic tub
- Thermometer
- Stop watch
- Pillow and towel
- Treatment table

TECHNIQUE OF APPLICATION

After thorough with the help of an inclusion and exclusion criteria, 30 participants were selected for the study and were randomly divided into two experimental groups. Group A- Contrast bath and Mulligan's Mobilization with Movement. Group B- Contrast bath and Theraband exercise. Before starting the treatment their intensity of pain over the ankle were assessed by using Visual Analogue Scale (VAS) and the functional abilities of the foot and ankle were measured by the Foot and Ankle Disability Index items. The Foot and Ankle Disability Index consist of 26 items.

Subjects were given the following instructions: Please answer every question with one response that most closely describes your condition within the past week. Subjects rate the activity as no difficulty at all – 4 points, slight difficulty -3 points, moderate difficulty -2 points, extreme difficulty -1 point, unable to do – 0 point or N/A – not applicable. These scores were as a percentage of 104 points.

Contrast bath were administrated for both groups of subjects 10 minutes before the mobilization treatment about the ratios of 4:1 for four times per session. The hot and cold water were kept at the temperature of about 40°-45° C and 15°-20° C respectively in the basin which enable immersion of the extremity to cover at the level of distal one third of the leg.

EXPERIMENTAL GROUP A: CONTRAST BATH & MULLIGAN MOBILIZATION WITH MOVEMENT

MWM includes:

Dorsiflexion:

Subject position:

Patient lying in supine position with the ankle joint level at the end of the bed, and placed a small pad to fill the tendoachilles space. Other lower limb is flexed at hip and knee, foot at bed.

Operator position and Hand placement:

- Stand in front of the treatment table faces patients' foot

- Grasp the posterior aspect of the calcaneum securely with one hand, and wrap other hand over the front of the foot so that lies over the talus.

Mobilizing force:

- Hand placed over the calcaneum pull downwards the floor.
- Hand placed over the talus glides it posteriorly.

Plantarflexion:

Subject position:

- Reclines on a couch with the affected side knee flexed and heel on the bed.
- Operator Position and Hand Placement:
- Stands at the level of treatment side of the foot.
- One hand is placed just proximal to the ankle joint line, thumb and fingers of that hand wrap around the lower leg.
- Webbing between the thumb and index finger of other hand is placed around the talus, so that they lie just below the malleoli.

Mobilizing Force:

- Tibia and fibula is glided posterior as far as possible by the hand which is placed over the distal leg through the body weight (this locks the ankle joint)
- Without releasing this glide –Roll the talus ventrally with other hand.

Inversion:

Subject position:

- Subject lying in the same side with the underneath leg extends out off the couch and the uppermost leg flexed at knee over a pillow.

Operator Position and Hand Placement:

- Stands behind the affected side.
- Proximal hand is placed over the distal leg just above the medial malleolus, so that the four finger and the thumb wraps around anterior and posterior aspect respectively.
- Heel and thenar eminence of the distal hand is placed over the medial aspects of the calcaneum and thumb is directed forward, the four fingers of that hand wraps inferior and lateral aspects of the calcaneum.

Mobilizing Force:

- Hand over the calcaneum pushes it towards outward or down for exerting lateral glide.

Eversion:

Subject position:

- Patient lying opposite side with the underneath leg flexed at knee and the uppermost leg ankle extends out of couch over a pillow.

Operator Position and Hand Placement:

- Stands behind the affected side ankle.
- Proximal hand is placed over the distal leg just above the lateral malleolus, so that the four fingers and the thumb wraps around anterior and posterior aspect respectively.
- Heel and thenar eminence of the distal hand placed over the lateral aspect of the calcaneum and the thumb is directed forward, four fingers of that hand wraps the inferior and medial aspect of the calcaneum.

Mobilizing Force:

- Hand over the calcaneum pushes it towards down for exerting medial glide.
- Subjects were questioned frequently in an attempt to ensure that no pain is produced, and the magnitude of force applied is based on this feedback.
- These mobilization technique were performed three days in a week followed by four weeks.
- End points of each technique, this mobilization were sustained for 10 seconds and this process were repeated 3 times in succession follow by 20 seconds of rest period, constituting one set of the treatment technique. Three sets of each treatment techniques were performed or applied.

EXPERIMENTAL GROUP B: CONTRAST BATH & THERABAND EXERCISES

Theraband exercises includes:

Theraband (yellow in colour) exercises performed to Group – B followed by contrast bath for 10 minutes.

Dorsiflexion

- Ask the patient to pull the affected foot back toward him/her, against the resistance of the theraband (while keeping knees straight), by moving his/her ankle.
- Hold this position for 15 seconds
- Return to neutral position
- Repeat above steps 10 more times

Plantarflexion

- Ask the patient to push the affected foot forward away from him/her, against the resistance of the theraband (while keeping knees straight), by moving the ankle.
- Hold this position for 15 seconds
- Return to neutral position
- Repeat above steps 10 more times

Inversion

- Ask the patient to turn the foot inward by moving his/her ankle, against the resistance of the theraband.
- Hold this position for 15 seconds
- Return to neutral position
- Repeat above steps 10 more times

Eversion

- Ask the patient to turn the foot outward by moving his/her ankle, against the resistance of the theraband
- Hold this position for 15 seconds
- Return to neutral position
- Repeat above steps 10 more times

Contrast bath were administrated for both groups 10 minutes before the mulligan mobilization and theraband exercises. The hot and cold water were kept at the temperature of about 40-450C and 15-200C respectively in the basin which enable immersion of the extremity to cover at the level of distal one third of the leg.

The reduction in pain and improvement in leg were assessed by using VAS and FADI Scales before the first day of the treatment and at the end of 4thweek of the treatment from the collected data and effectiveness is statistically analyzed.

STUDY DURATION:

4 weeks

DATA ANALYSIS:

Statically Analysis of mean differences of Visual Analog Scale (VAS) and Foot and Ankle Disability Index Scale (FADI) is compared using Simple Random technique.

Between groups mean difference of Visual Analog Scale (VAS) and Foot and Ankle Disability Index is compared by using unpaired "t" test.

P value >0.05 is taken up for no statistical significance.

RESULTS

The sample taken for the study (n=30) was selected by simple random sampling and allotted randomly into two groups with equal size of 15 subjects in each.

TABLE 1: ANALYSIS OF PRE-POST COMPARISON BETWEEN BASELINE AND AT THE END OF 4TH WEEK OF VAS OF EXPERIMENTAL GROUP A & B.

VAS	Average improvement	t-value	p-value	Result
Group- A	3.73	14	0.00	P<0.05 sig
Group- B	3.66	17.392	0.00	P<0.05 sig

Table 1 show Pre-post comparison of average improvement in group A is 3.73 and in group B is 3.666. p value is 0.000. P< 0.05, which means there is highly significant improvement in both groups.

TABLE 2: ANALYSIS OF COMPARISON BETWEEN EXPERIMENTAL GROUP A AND B

VAS	Average improvement Group A	Average improvement Group B	t-value	p-value	Result
	3.733	3.66	0.196	0.896	P>0.05 not sig

Table 2 shows that between the group comparison, average improvement in group A is 3.7 and in group B is 3.6 with t- value of 0.196 and P- value of 0.896, which implies that there is no significance difference between both groups. i.e.; both are equal.

TABLE 3: DESCRIPTIVE MEASURES OF FADI FOR EXPERIMENTAL GROUP A

FADI (GROUP A)	Mean	SD
Baseline	49.6000	4.3883
4th week	79.6667	6.4550

Table 3 shows the descriptive measures of FADI scores for experimental group A. Experimental group A showed a baseline mean FADI score was 49.6000 with SD of 4.3883 and at the end of 4th week mean FADI score was 79.6667 with SD of 6.4550.

TABLE 4: DESCRIPTIVE MEASURES OF FADI FOR EXPERIMENTAL GROUP B

FADI (GROUP B)	Mean	SD
Baseline	48.9333	4.4636
4th week	79.2667	5.5481

Table 4 show the descriptive measures of FADI scores for experimental group B. Experimental group B showed a baseline mean FADI score was 48.9333 with SD of 4.4636 and at the end of 4th week (after the treatment) mean FADI score was 79.2667 with SD of 5.5481.

TABLE 5 ANALYSIS OF PRE-POST COMPARISON BETWEEN BASELINE AND AT THE END OF 4TH WEEK OF FADI SCORES OF EXPERIMENTAL GROUP A & B

FADI	Average improvement	t-value	P	Result
Group- A	30.0667	15.672	0.00	P<0.05 sig
Group- B	30.3333	25.932	0.00	P<0.05 sig

Table 5 show Pre-post comparison of average improvement in group A is 30.0667 and in group B is 30.3333. p value is 0.000. P< 0.05, which means there is highly significant improvement in both groups.

TABLE 6: ANALYSIS OF COMPARISON BETWEEN EXPERIMENTAL GROUP A AND B

FADI	Average improvement Group A	Average improvement Group B	t-value	p-value	Result
	30.0667	30.3333	0.119	0.906	P>0.05 not sig

Table 6 shows that between the group comparison, average improvement in group A is 30.066 and in group B is 30.33 with t- value of

0.119 and P- value of 0.906, which implies that there is no significance difference between both groups. i.e.; both are equal

DISCUSSION

Ankle sprains are one of the most common musculoskeletal injuries. This study was done to compare the efficacy of Mulligan Mobilization versus Theraband Exercise in reducing pain and functional improvement in patients with sub- acute lateral ankle sprain.

The different tools where used - one to assess pain and one for functional improvement. Pain was measured using the VAS and functional improvement was measured using FADI.

Mulligan BR (1999) stated that, Mobilization with Movement has been advocated for treatment of joint pain, stiffness and dysfunction. Rehabilitation exercise after ankle sprains include often performed with Theraband[20].

On comparing the scores of VAS between the groups at end of 4th week, Mulligan's MWM group shows almost similar improvement in pain as Theraband exercise group ($p>0.05$ not sig.). Similarly at the end of 4th week, post treatment session, the Mulligan's MWM group shows almost similar improvement in FADI score as Theraband Exercise group ($p>0.05$ not sig.).

Based on statistical analysis and results it has been found that there is no significant difference between Mulligan Mobilization with Movement technique and Theraband exercise in subjects with sub-acute lateral ankle sprain.

However, these result point towards the importance of Mulligan Mobilization with Movement (MWM) and Theraband exercise in the treatment protocol to reduce pain and functional improvement in patients with sub-acute ankle sprain. In short, comparison between both the groups (A&B), the study result clearly proved that both Mulligan Mobilization with Movement (MWM) along with Contrast bath and Theraband Exercise along with contrast bath has almost similar improvement in VAS scores and FADI scores across baseline and at the end of 4th week in subjects with sub-acute lateral ankle sprain.

LIMITATIONS

- The study has been done with smaller size population. The outcome measures were only VAS and FADI. To improve patient quality of life should also be the main aim of rehabilitation program, not just pain treatment which were not considered.
- Absence of control group
- Short duration of study
- In this study, only few exercises were practiced.

CONCLUSION

During the course of this study, it has been concluded that- Visual Analog Scale (VAS) and Foot and Ankle Disability Index (FADI) scores were very efficient in analyzing reduction in pain and functional improvement respectively in subjects with sub-acute lateral ankle sprain. There is significant decrease in VAS and increase in FADI scores after 4weeks of treatment duration in both the groups, thus there was no significant difference between both the groups.

Thus this study concluded that, both Mulligan Mobilization with Movement and Theraband Exercise have almost similar effect of VAS and FADI in subjects with sub-acute lateral ankle sprain.

ETHICAL CLEARENCE

The study was approved by ethical committee of Laxmi Memorial College of physiotherapy, Mangalore.

SOURCE OF FUND

Self

CONFLICT OF INTEREST

None

REFERENCES

1. Van Rijn RM, Van Os AG, Bernsen RM, Luijsterburg PA, Koes BW, Bierma-Zeinstra SM. What is the clinical course of acute ankle sprains? A systematic literature review. The American journal of medicine. 2008 Apr 30;121(4):324-31.
2. Brooks SC, Potter BT, Rainey JB. Treatment for partial tears of the lateral ligament of the ankle: a prospective trial. Br Med J (Clin Res Ed). 1981 Feb 21;282(6264):606-7.
3. McCulloch PG, Holden P, Robson DJ, Rowley DI, Norris SH. The value of mobilisation and non-steroidal anti-inflammatory analgesia in the management of inversion injuries of the ankle. The British journal of clinical practice. 1985 Feb;39(2):69-72.
4. Ruth CJ. The surgical treatment of injuries of the fibular collateral ligaments of the ankle. J Bone Joint Surg Am. 1961 Mar 1;43(2):229-39.
5. Mascaro TB, Swanson LE. Rehabilitation of

the foot and ankle. The Orthopedic clinics of North America. 1994 Jan;25(1):147-60.
6. Lynch SA, Renström PA. Treatment of acute lateral ankle ligament rupture in the athlete. Sports Medicine. 1999 Jan 1;27(1):61-71..
7. Ashton-Miller JA, Ottaviani RA, Hutchinson C, Wojtys EM. What best protects the inverted weightbearing ankle against further inversion? Evertor muscle strength compares favorably with shoe height, athletic tape, and three orthoses. The American journal of sports medicine. 1996 Dec 1;24(6):800-9.
8. Simpson KJ, Cravens S, Higbie E, Theodorou C, DelRey P. A comparison of the Sport Stirrup, Malleoloc, and Swede-O ankle orthoses for the foot-ankle kinematics of a rapid lateral movement. International journal of sports medicine. 1999 Aug;20(6):396-402.
9. Nyanzi CS, Langridge J, Heyworth JR, Mani R. Randomized controlled study of ultrasound therapy in the management of acute lateral ligament sprains of the ankle joint. Clinical rehabilitation. 1999 Jan 1;13(1):16-22.
10. Löfvenberg R, Karrholm J. The influence of an ankle orthosis on the talar and calcaneal motions in chronic lateral instability of the ankle A stereophotogrammetric analysis. The American journal of sports medicine. 1993 Mar 1;21(2):224-30.
11. Green T, Refshauge K, Crosbie J, Adams R. A randomized controlled trial of a passive accessory joint mobilization on acute ankle inversion sprains. Physical therapy. 2001 Apr 1;81(4):984-94.
12. Crosbie J, Green T, Refshauge K. Effects of reduced ankle dorsiflexion following lateral ligament sprain on temporal and spatial gait parameters. Gait & posture. 1999 Jul 31;9(3):167-72.
13. Kaikkonen A, Kannus P, Järvinen M. A Performance Test Protocol and Scoring Scale for the Evaluation of An kle Injuries. The American Journal of Sports Medicine. 1994 Jul 1;22(4):462-9.
14. Garrick JG. The frequency of injury, mechanism of injury, and epidemiology of ankle sprains*. The American journal of sports medicine. 1977 Dec 1;5(6):241-2.
15. Ekstrand J, Tropp H. The incidence of ankle sprains in soccer. Foot & Ankle International. 1990 Aug 1;11(1):41-4.
16. Bahr R, Bahr IA. Incidence of acute volleyball injuries: a prospective cohort study of injury mechanisms and risk factors. Scandinavian journal of medicine & science in sports. 1997 Jun 1;7(3):166-71.
17. Gerber JP, Williams GN, Scoville CR, Arciero RA, Taylor DC. Persistent disability associated with ankle sprains: a prospective examination of an athletic population. Foot & Ankle International. 1998 Oct 1;19(10):653-60.
18. Carolyn Kisner, Lynn Allen Solly. Therapeutic exercise, foundations and techniques .4th edition.
19. Miller J. The Mulligan Concept; The next step in the evolution of manual therapy. Orthopaedic division review: May/Jun. 1999 May.
20. Mulligan BR; Manual therapy NAGS,SNAGS, MWM's etc.ed4.plane view press, Wellington,1999.
21. Vicenzino BG, Prangley I, Martin D. The initial effect of two Mulligan mobilisation with movement treatment techniques on ankle dorsiflexion. InAustralian Conference of Science and Medicine in Sport 2001. Sports Medicine Australia.

AWARENESS OF ANTENATAL EXERCISES AMONG WOMEN IN PUNE

CHAITALI GADE[1], SUROSHREE MITRA[2], RACHANA DABADGHAV[3], SAVITA RAIRIKAR[4], ASHOK SHYAM[5]

1. *Physiotherapy BPTh, Sancheti Institute College of Physiotherapy.*
2. *Assistant Professor at Sancheti Institute College of Physiotherapy.*
3. *Research coordinator at Sancheti Institute College of Physiotherapy*
4. *Principal at Sancheti Institute College of Physiotherapy.*
5. *MS Ortho, Research Officer at Sancheti Institute of Orthopedic and Rehabilitation.*

ABSTRACT

AIM: The aim of the study was to explore awareness about antenatal exercises among women in Pune, Maharashtra.

METHODOLOGY: This study examined the awareness of antenatal exercises among women in Pune, Maharashtra. A self constructed questionnaire was distributed among sample size of 300 women in Pune from age group of 18 to 44. Their response on the questionnaire was analysed using the Microsoft excel 2010.

RESULTS: Among the sample population studied 59% of women were not aware about the antenatal exercises. Among the rest 41% who were aware the major source of awareness was found to be through relatives and friends followed by doctors then media and lastly books. 59% of the sample population stated that they don't know if it is important to consult a physiotherapist for exercises or not. Majority of them stated that they don't know when asked about benefits or harm obtained due to antenatal exercises. When asked about appropriate relaxation techniques, postures to be followed and bending and heavy weights lifting postures should be avoided during pregnancy, majority of them agreed.

CONCLUSION: The study revealed that there is lack of awareness about antenatal exercise among women in Pune and the major source of awareness is relatives and friends.

KEYWORDS: antenatal exercises; women in Pune; awareness

INTRODUCTION

A nine month process of reproduction to a new life divided into three trimesters consisting time period three months each is called pregnancy. During this process a lot of physiological as well as physical changes take place in women's body. The changes of pregnancy in a women's body are mainly the result of four factors: the hormonally mediated changes in collagen and involuntary muscle, the growth of foetus resulting in consequent enlargement and displacement of the uterus the increased total blood volume with increased blood flow to the uterus and the kidneys and the increase in body weight and adaptive changes in the centre of gravity and posture. The demands that these changes makes on women's body during pregnancy should never be underestimated. Increase in weight gain during pregnancy resulting in exaggerated lordosis of the lumbar spine, forward flexion of the neck, and downward moment of the shoulders to compensate for the enlarged uterus and change in centre of gravity leading to common musculoskeletal problem like low back pain, ankle pain and knee pain. A significant increase in the anterior tilt of the pelvis takes place, with excessive use of hip extensors, abductors and ankle plantar flexor muscles[1,2].

For Correspondence:
Dr. Suroshree Mitra,
Email: doc.ashokshyam@gmail.com, drsurmitra@gmail.com

Pregnant women should be advised to exercise for physical fitness during the antenatal period. Exercise is an activity requiring physical effort carried out to improve health; it is a physical or mental activity that is done to stay healthy and/or become stronger. Antenatal classes mainly help in advising postures related to rest and relief of common discomfort. There are foetal benefits from the maternal exercises in pregnancy which includes decreased growth of the adipose tissue, improve stress tolerance and advances neuro behavioural relaxation. General benefits of antenatal exercises for the mother are relief of pain, strengthening muscles in preparation for labour and support for loosened joints, enhanced circulation, increased flexibility, increased endurance, increased energy level, combats fatigue, decreases muscle tension, promotes relaxation and a positive self image[3].

Hence we should focus on the subject that there should be adequate awareness about antenatal exercises prescribed by physiotherapist, its benefits and importance among the female population belonging to reproductive age group so that utilization of this services takes place finally resulting in promotion of health[4].

AIM

To find out awareness about antenatal exercises among women in Pune, Maharashtra.

OBJECTIVES

- To explore awareness of antenatal exercises among women in Pune
- To find the source of awareness.

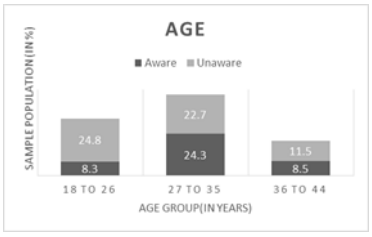
METHODOLOGY

This was a Questionnaire based cross-sectional study. A self constructed questionnaire was prepared and approved from the ethical committee. Consent was taken and these questionnaires was distributed among the sample size of 300 women of age group 18 to 44 years and women who did not give consent were excluded from the study. Sampling technique used was purposive sampling. These questionnaires were distributed in offices, parks, residential areas and market places among the targeted population and were then asked to fill the questionnaire and collected back. Their response was analysed using the Microsoft excel 2010.

RESULTS

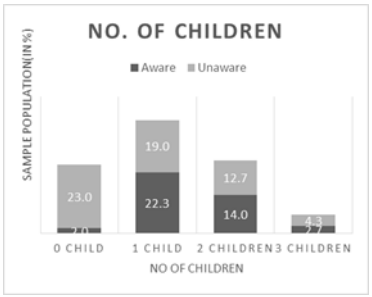
DEMOGRAPHIC DATA

Among the sample population 33.1% were in the age group of 18 -26 years, 47% were in the age group of 27 to 44 years and 20% were in the age group of 36-44 years.



GRAPH 1: AGE GROUP

In this study 25% of the studied population have no children, 41.3% have 1 child, 26.7% have two children and 7% have 3 children.

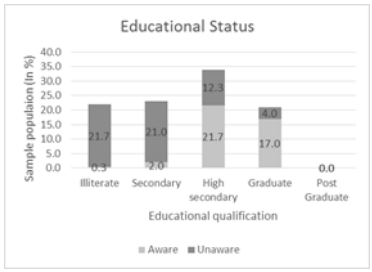


GRAPH 2: NO. OF CHILDREN

27% had family monthly income of less than 25,000 rupees, 44% had family monthly income between 25,000 rupees to 50,000 rupees and 29% had their family monthly income of more than 50,000 rupees.

GRAPH 3: SOCIO ECONOMIC STATUS

22% of studied population were illiterate, 23% had secondary level of education, 34% had higher secondary education, 21% had graduation level of education and 0.0 % had post graduation level of education.

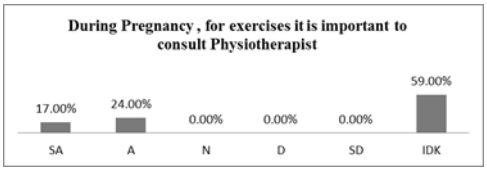


GRAPH 4: EDUCATION STATUS

41% had awareness about antenatal exercises and 59% had no awareness about antenatal exercises.

GRAPH 5: AWARENESS

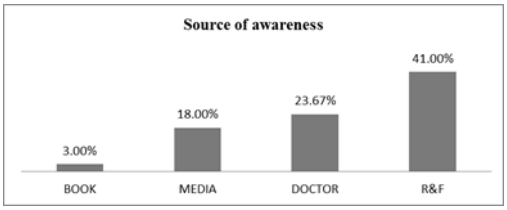
When asked if it is important to consult of physiotherapist for antenatal exercises 17% strongly agreed, 24% agreed, 0.00% neutral, 0.00 % disagreed, 0.00% strongly disagreed and 59% stated that they don't know.



GRAPH 6

Note:- SA-Strongly Agree, A-Agree, N-Neutral, D-Disagree, SD-Strongly Disagree, IDK-I don't know.

41% of sample population were aware about antenatal exercises from relatives and friends, 23.67% by doctor, 18% media and 3% by books.



GRAPH 7

DISCUSSION

In this study majority stated that they don't know if physiotherapy exercises during antenatal period lead to healthy pregnancy. Similarly when asked if physiotherapy exercises during pregnancy can harm the pregnant woman, the foetal growth or can cause complications during delivery majority of the studied sample stated that they don't know. This may be due to lack of literacy in our sample population. In contrast as seen in the studies done by O Makinde, about perception of pregnant mothers un usefulness of prenatal exercises, Sarfaraz et al studied perception of role of physiotherapy in antenatal care among pregnant woman in attending antenatal OPD and M Sajan, about awareness of physiotherapy interventions among pregnant female in antenatal clinic majority of sample showed positive response towards awareness of usefulness of prenatal exercise and importance of physiotherapy. This conflict between our and their study was may be because they had majority of sample population of higher secondary and tertiary level of education. Also in their study they stated that awareness of physiotherapy or antenatal exercises was associated with education level of the mothers[3,4,5].

We also found majority of the sample population agreed to consult a gynaecologist for exercises but when asked if one should consult a physiotherapist majority of the sample population said they don't know. This may be because of lack of awareness and lack of reference from the other health practitioners as stated in the study done by D Shete, only 34% doctors amongst their sample population are adequately aware of physiotherapy services and hence there is a need to create awareness on a large scale. In similar study done by M. Sarfraz majority of sample population did not attend physiotherapy session due to non referral and financial problems. Maximum scope of Awareness of physiotherapy is from doctors, medical practitioners, midwives and hence they should be highly aware about physiotherapy. N Odunaiya concluded from his study that there is a need of better interaction and communication between physiotherapists and obstetricians and gynaecologists. Sajan and Sangal et al in their respective study stated that utilisation of a service is associated with the level of awareness. If a woman is not aware about physiotherapy services she will not understand its importance and will not utilise it[4-8].

When asked if they are aware that there are appropriate relaxation techniques and postures that can be followed during pregnancy only few said they strongly agree followed by majority saying they agree, similarly when asked if they know that bending and heavy lifting postures should be avoided during pregnancy only 23 percent were neutral, but majority of them agreed. Relaxation postures or techniques like 'Shavasan' are practised in yoga. P Sengupta in his study states that in present day and age an alarming awareness of yoga was observed among people and a huge population of India is practising yoga since ancient times. It has been proved that it helps coping with stress. Hence in our study we found that people were aware about relaxation and postures to be followed during pregnancy[9].

Awareness about various common problems or pain experienced during pregnancy like low back pain, ankle pain, pain at tail bone, knee cap pain, urinary incontinence, neck pain and shoulder pain is present among majority of studied population. Majority of the sample population have 1 or more child and may be due to experience of pregnancy for at least once they must be aware about various musculoskeletal pain a woman experiences during pregnancy. Similar studies done by Sarfraz and by Sujindra found that majority of sample population were aware in their case as the study was done in pregnant women. Another study done by Yasobant done in pregnant women also shows a positive response towards awareness and experience of various musculoskeletal problems during pregnancy[1,4,10].

Majority of them answered that they don't know if these problems or pain can be prevented by physiotherapy/antenatal exercises. This may be due to lack of awareness, which may be due to low socio economic status, low educational level, lack of referral. In similar study done by N Sultana to find out common musculoskeletal problems among women during prenatal period found out that large number of participants complaint of various musculoskeletal problems but none of the participants received physiotherapy treatment during prenatal period hence there is need of awareness programme for obstetrician and gynaecological physiotherapy treatment. Kirsten Jack in his study to find out barriers to treatment adherence in physiotherapy includes poor social support. Also K Marwaha in her study to find out factors that influence adherence of Indian patients to physiotherapy

treatment stated that major factors are poor awareness of physiotherapy time, socio economic factors, social and cultural factors, high cost of treatment and poor communication[11,12,13].

Major source of awareness about antenatal exercises in our study was through relatives and friends, followed by doctors and then media. Lack of awareness and lack of referral from the doctors and other healthcare members to physiotherapy is the main reason of the population being unaware about the services as stated by D Shete from his study that only 34% doctors amongst their sample population are adequately aware of physiotherapy services and hence there is a need to create awareness on a large scaleIn other similar studies done by Sarfraz and Sajan found in their studies that major source was from healthcare practitioners. Maximum scope of Awareness is from doctors, medical practitioners, midwives and hence they should be highly aware about physiotherapy. N Odunaiya from his study concluded that there is a need of better interaction and communication between physiotherapists and obstetricians and gynaecologists. Also from ministry of health and family welfare govt. of India we found out that females are less exposed to media[4-7,14].

LIMITATIONS

- It was a time bound study.
- No open ended questions were asked to know the perception of the sample population towards their knowledge about antenatal exercises.

FUTURE RECOMMENDATIONS

- A longitudinal study can be done on the similar topic.
- View and perceptions of the population towards role of physiotherapy in antenatal exercises can be studied by asking open ended questions.

CONCLUSION

- There is lack of awareness about antenatal exercises among women in Pune.
- The major source of awareness is through relatives and friends.

ACKNOWLEDGEMENTS

We, take immense pleasure to express our sincere and deep sense of gratitude towards Dr. Parag Sancheti for his constant support & guidance. Also we would like to thank all the participants who participated in the study. Authors acknowledge the immense help received from the scholars whose articles are cited and included in references of this manuscript. The authors are also grateful to authors / editors / publishers of all those articles, journals and books from where the literature for this article has been reviewed and discussed.

CLINICAL APPLICATION

- To increase awareness about antenatal exercises among women in Pune.
- Use of media to spread awareness
- To increase awareness about antenatal exercises among the Health Practitioners.

REFERENCES

1. Yasobant S, Nibedita S, Sawasta S, Arnansu M, Kirti S Int J Med Res Health Sci 2014;3(2):358-363.
2. J Mantel, J Haslam, S Barton; Physiotherapy for obstetrics and gynaecology,2nd edition, Elsevier publications, New Delhi, chapter no. 2-5
3. O Makinde, F Adeyemo, B Ogundele Health science journal 2014;8(2)
4. M Sajan;Sajan_MSC_ University of Eastern Cape South Africa 2013
5. M.Sarfraz, D Islami, U Hameed, S. H. Danish, F Ahmad; Pakistan Journal of Medicine and Dentistry 2012, (01): 34-46
6. D Shete, J Thipse, R Kolase; American Journal of advances in medical science 2013.1(1)
7. N Odunaiya, T Ilesanmi, A Fawole, O Ogantibeju; International journal of women's health 2013:5 109-114
8. Sangal R, Srivastava R, Singh M.K.,Srivastava D.K., Khan; Journal of Advance Researches in Biological Sciences 2013:5(2), 159-163
9. P Sengupta; Int j Prev Med 2012 Jul;3(7):444-458
10. E Sujindra, A Bupathy, Suganya A, Praveens R; ijeprjournal 2015;1(3)
11. N Sultana Trina, Bangladesh Health Proffessional Institute 2012.
12. K Jack, S Mairi Mclean, J K Moffett, E Gardiner; J Math 2010
13. K Marwaha, Hazel, Horbin, Mclean, Sionnadh; ijptr 2010.1(1)9-18
14. Ministry of health and family welfare, Government of India, National family health survey (NFHS-3) India 2005-06, International Institute for Population Sciences Deonar, Mumbai-400 088.

APPENDIX

Questionnaire

Name : Number of Children :
Age : Family Monthly Income:
Education : Illiterate | Secondary | Higher Secondary | Graduate | Post Graduate
Occupation :

Sr. No.	Question	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	I don't know
1	Physiotherapy Exercises in antenatal period lead to healthy pregnancy.						
2	Doing physiotherapy exercises during pregnancy can harm the pregnant woman						
3	Doing physiotherapy exercises during pregnancy can harm the foetal growth						
4	Doing physiotherapy exercises during pregnancy can cause complications during delivery						
5	During Pregnancy, for exercises it is important to consult						
	Gynaecologist						
	Physiotherapist						
6	Appropriate relaxation techniques and postures can be followed during pregnancy for a healthy delivery.						
7	Bending and heavy weights lifting postures should be avoided during pregnancy.						
8	During pregnancy a woman may experience following problems						
	Low Back ache						
	Ankle pain						
	Pain at tail bone						
	Knee cap pain						
	Urinary incontinence						
	Neck pain						
	Shoulder pain						
9	The following problems can be prevented by physiotherapy exercises.						
	Low Back ache						
	Ankle pain						
	Pain at tail bone						
	Knee cap pain						
	Urinary incontinence						
	Neck pain						
	Shoulder pain						
10	I am aware about physiotherapy/antenatal exercises from. (skip if you are not aware)	Books	Media	Doctor	Relatives/ Friends		

Disclaimer:
1. This questionnaire is to know the awareness about antenatal exercises.
2. It is purely for research purpose.
3. Kindly fill this questionnaire to best of your accurate knowledge.

EFFECTS OF RESPIRATORY MUSCLE TRAINING IN POST CABG PATIENTS: PHASE 1 REHABILITATION

RAZIYA NAGARWALA[1], VIJAY P[2]

1. *Professor and HOD, Cardio vascular and respiratory physiotherapy, Sancheti Institute College of Physiotherapy, Shivaji Nagar, Pune*
2. *Principal, Shree Devi college of Physiotherapy, Mangalore.*

ABSTRACT

Background and Aims: Coronary Artery Bypass Grafting (CABG) carries a risk for serious non-cardiac complications, such as atelectasis, hypoxia and secretion retention. The purpose of this study is to compare the effect of both Respiratory Muscle Training (RMT) and conventional physio therapy techniques on improving respiratory muscle strength and thus preventing the pulmonary complication after CABG in Phase –I Rehabilitation.

Subjects and Method: Total 30 patients were included with average age of 59.6 ± 6.7years. They were randomly assigned into (C.G) control group (N=15) and (E.G) experimental group (N=15). In C.G patients were given chest expansion exercises, including Incentive spirometer, secretion removal maneuver and mobilization. The E.G underwent the same protocol and also the Respiratory Muscle Training (RMT). Patients were evaluated on first and seventh post-operative days for maximal inspiratory pressures (PImax), Peak expiratory flow rate (PEFR), oxygen saturation (SpO_2) for oxygenation and Visual analogue scales (VAS) for pain.

Results: All outcomes recorded showed significant improvements in both groups; however, the change of PImax was significantly higher between C.G and E.G group. (p=0.041). C.G and E.G both showed significant improvement in PEFR (p = 0.00). VAS with p= 0.00 in CG and in EG, and also SpO_2 with p = 0.00

Conclusion: RMT is effective in improving respiratory muscle strength. But deep breathing exercise with incentive spirometer also is as effective.

KEYWORDS: Coronary arteries bypass graft; maximal inspiratory pressure; expiratory peak flow rate; Inspiratory Muscle Training

INTRODUCTION

Pulmonary dysfunction and associated complications are the major cause of morbidity and mortality in the period following Coronary Artery Bypass Graft (CABG) surgery[1]. Patients undergoing cardiac surgery often have underlying illnesses, e.g., diabetes mellitus, Obesity etc. of which several are known to be risk factors for postoperative pulmonary complications (PPCs). The impairment of pulmonary function has multiple causes, including the effects of general anesthesia, use of a sternotomy, pleural drain insertion, diaphragmatic dysfunction and reflex dysfunction of the phrenic nerve caused by the use of cold cardioplegic solution. The incidence of atelectasis increases post cardiac surgery and atelectasis itself can result in a decrease in functional residual capacity (FRC), vital capacity (VC) and lung compliance[2].

Physiotherapy plays an integral part in the management of patients with cardio respiratory dysfunction. Goals of physiotherapy are to prevent or diminish PPCs and reduce length of hospital stay. The physiotherapy treatment during the hospital stay generally consists of breathing exercises, coughing, and incentive spirometry. It also includes range of motion exercises and early mobilization[3,4].

For Correspondence:
Raziya Nagarwala
Email: rnagarwala@yahoo.com

During cardiac surgery, due to sternotomy the respiratory muscles may be damaged, leading to weakness and respiratory muscle dysfunction. Brooks et al demonstrated a 30% decrease in PImax and PEmax after CABG and suggested that the respiratory muscle impairment observed after this surgical intervention might be a result of postoperative decline in respiratory muscle strength and concomitant pain[5]. This makes the evaluation of Respiratory Muscle Strength (RMS) of great clinical importance.

Maximal voluntary inspiratory (PImax) and expiratory (PEmax) pressures are probably the most frequently reported non-invasive estimates of respiratory muscle force and strength[6]. Both can be measured by a manometer, a classic instrument used to gauge the respiratory muscle strength at the mouth. This method was described by Black and Hyatt in 1969[7].

Respiratory muscles can be trained to increase strength and endurance. Training of respiratory muscle strength in patients may be helpful in restoring lung function. It may also promote more effectiveness in clearing the airway, through effective cough, and also potentially prevent respiratory muscle fatigue.

Respiratory muscle training (RMT) involves inspiration through resistive load. The most commonly used method is inspiratory threshold loading first described by Nickerson and Keens[6]. The THRESHOLD trainer requiring the

subject to generate and sustain a set inspiratory pressure in order to achieve airflow.

Improvement in the strength and endurance of the inspiratory muscles may lead to increased resistance to fatigue and improved ventilatory function by decreasing the work of breathing and increasing the respiratory reserve. Thus increasing exercise tolerance.

In view of the above, this study aims to study the effect of respiratory muscle training in post CABG patients.

Objective of this study was to compare the performance measures of the respiratory muscles through peak expiratory flow (PEF), oxygen saturation (SpO_2), inspiratory pressure (PImax), pain between a group undergoing conventional physiotherapy, and another group submitted to respiratory muscle training with threshold RMT.

METHOD

Approval for the study and study design was obtained from the ethical committee. Subjects were explained the purpose and general procedure of the study in the language they understood better and written consent was taken.

Thirty Subjects of both genders within age group of 42-68 years, haemodynamically stable were randomly assigned to two groups.

Group I (C.G) – Conventional Physical therapy (15 subjects) with average age 59.6 ±5.9 years

Group II (E.G) - Respiratory muscle training with Conventional Physical therapy (15 subjects) with average age 59.6 ± 7.77 years.

Patients with history of previous cardio thoracic surgery, any other cardiac surgery, pacemaker implantation, atrial fibrillation, Chronic heart failure, utilization of intra-aortic balloon pump, post operative mechanical ventilation longer than 24 hours, neuropathy/neuro muscular disease, existing pulmonary diseases, severe mental depression and uncooperative were excluded.

Patients in the both groups were assessed before starting treatment on the first and on the seventh post operative day. PImax with manometer, Peak expiratory flow meter for Peak expiratory flow rate (PEFR), Pulse oxymeter for oxygen saturation (SpO_2) and Visual analogue scales (VAS) for pain were taken.

In accordance with the protocol described by Black and Hyatt et al.[7] for obtaining PImax, the capsule-sensing pressure gauge (CSPG-V, Gauges Bourdon [I] Pvt. Ltd, India was used for measuring PImax (reliability 0.962)[8]. (Figure 1)

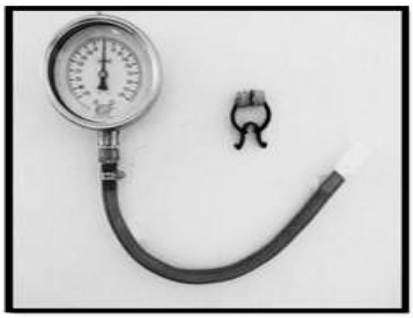


Figure 1: capsule-sensing pressure gauge (CSPG-V)

PImax for each patient was measured. Subjects were seated wearing a nose clip, and repeated maximal inspiratory maneuvers were performed at functional residual capacity. Three reading were taken with interval of one minute and the highest value was computed[9].

Patients in control group were given chest expansion exercises, including Incentive spirometer and secretion removal maneuver. (Huffing/coughing with wound support) Chest wall vibration and percussions, thoracic mobility and shoulder range of-motion exercise and postoperative ambulation were included in the physiotherapy management. Session was given for 20 – 30 minutes per day[3,4].

The experimental group underwent the same protocol and also the RMT using Threshold IMT (Respironics).(Figure 2) Threshold IMT is a spring-loaded valve, the Threshold opening pressure of which can be adjusted up or down by compressing or decompressing the spring, respectively. The device has a scale of threshold opening pressure printed on its side, allowing the opening pressure to be set according to these markings.

Figure 2: Threshold IMT (Respironics)

Subjects were given three sets of 10 repetitions with 30% of MIP measured on fist postoperative day which was obtained by manometer. (This protocol adapted from the study of Hulzebos et al.)[10].

Inspiratory load of the threshold device was increased by 5%. After 7 days again post treatment measurement were taken[11].

PEFR was measured using Wright's peak flow meter. The marker was set to zero. Patient was made to sit upright. The mouthpiece was placed in mouth and asked to form a tight seal around it with lips. Patient was asked to take as deep a breath in and breathe out as hard as possible. The process was repeated 3-4 times and the highest reading was recorded.

Oxygen saturation was measured using finger pulse oxymeter.

Visual analogue scales (VAS) was used for pain evaluation.

RESULTS

Data was analyzed on the Statistical Package for Social Sciences (SPSS 12).

The paired Student "t" test for pre and post treatment in control and experimental group.

Un-paired "t" test was used for comparing result between control and experimental group. A probability level of 0.05 was considered as statistically significant and the confidence interval was set at 95%.

Wilcoxon tests was used for non parametric variable for VAS scale.

Table 1: Effect on PImax (experiment Vs control group)

	Control-PImax	Experimental-PImax	p value between the group
Pre	-36.666 ± 5.232	-37.666 ± 4.577	0.581895
Post	-60 ± 6.267	-65 ± 6.546	0.041506
P value within the group	0.00	0.00	

Table 2 Effect on PEF (experiment Vs control group)

	Control - PEF	Experimental - PEF	p value between the group
Pre	141.466 ± 12.129	142 ± 12.649	0.907016
Post	174.8 ± 16.314	185.6 ± 21.330	0.131416
p value within the group	0.00	0.00	

Table 3 Effect on SpO_2 (experiment Vs control group)

	Control - SpO_2	Experimental- SpO_2	p value between the group
Pre	96.07 ± 2.251	96.60 ± 1.502	0.453
Post	98.53 ± 0.915	98.60 ± 0.986	0.849
p value within the group	0.001	0.00	

Table 4 Effect on VAS (experiment Vs control group)

	Control - VAS	Experimental-VAS	p value between the group
Pre	2.8666 ± 0.8333	3.2 ± 0.7745	0.190
Post	0.3333 ± 0.4879	0.4± 0.5070	1.000
p value within the group	0.00	0.00	

DISCUSSION

Post CABG factors such as anesthesia, sternotomy, cardiopulmonary bypass, can interfere with lung function by reduced lung volumes. Pain could be another major factor contributing in decrease respiratory function post operative.

As demonstrated previously, postoperative respiratory muscle dysfunction may contribute to reductions in FVC, tidal volume, and total lung capacity, and these changes may augment the incidence of atelectasis[1,2,10].

The aim of this study was to see the effects of respiratory muscle training and deep breathing exercises on respiratory muscle strength in CABG patients.

In the present study a respiratory device specifically aimed at strengthening respiratory muscles-Threshold device, added to chest physiotherapy, has proved to be effective over a 7-day period in patients recovering from CABG when compared with patients performing conventional breathing exercise.

Pre RMT base line value for PImax, PEFR, SpO_2 and VAS between C.G and E.G show that there was no significant difference. (Table 1, 2, 3, 4)

When compared post RMT (Table1) between C.G and E.G (p=0.041). It shows significant difference. Thus RMT with resistance load helps in strengthening respiratory muscles.

Conventional physiotherapy including breathing exercise and incentive spirometer has shown significant improvement in terms of PImax (p= 0.00). Thoracic expansion with breathing exercise is clearly associated with improvement of PImax and thus confirming the clinical usefulness of this chest physiotherapy[12].

In addition, use of a resistive RMT was associated with additional and specific improvement of performance as show by increase in PImax in E.G. (p=0.000). IMT with a targeted resistive inspiratory muscle training device can provide positive feedback for patients and improve their motivation.

According to Muller AP[13] RMT is efficient method in reducing the incidence of PPCs in CABG surgery.

In this study both conventional and RMT with threshold device were found to be effective, safe, and well tolerated in all patients.

In subjects recovering from CABG[10,12,13] the application of a rehabilitation course including specifically pulmonary re expansion, huffing, coughing and/or respiratory muscle training represents a potentially useful intervention.

In this study PEFR (Table 2) has shown no significant changes post RMT between C.G and E.G (p= 0.131)

PEF is a respiratory muscle strength dependent measure. Low PFR has been associated with inability to cough and eliminate secretions, and consequently inadequate cleaning of the tracheobronchial tree. In this study PEFR in both C.G and E.G has shown significant increase. Good coughing act also depends on respiratory muscle strength. Muller et al.[13] showed routine procedures such as movement in bed and the RMT, performed in the postoperative period, was effective in restoring the following parameters: MIP, MEP, PEF and tidal volume in this population. Adalgia et al[12] found that there was a significant reduction in all variables - Maximal respiratory pressures, tidal volume, vital capacity and peak expiratory flow measured on Post operative day 1 compared to preoperative values in both groups suggesting decrease in cough efficiency early post operative stage. Muscle training performed can retrieve TV and VC and PEF in the in the trained group. This concludes that Physiotherapy technique may help in the recovery of pulmonary function.

Acute FRC reduction results in arterial hypoxemia due to ventilation-perfusion mismatch and shunting. In the early postoperative phase, restoration of FRC and maintenance of adequate gas exchange is prime important.

In the present study there was no difference in the base line value of SPO_2 (Table 3) between C.G and E.G pre intervention (p = 0.453). The high PO_2 at extubation i.e. 1st post operative day was probably due to oxygen supplementation within the first 12-24 hours after surgery. Neither there was significant difference between C.G and E.G post intervention (p = 0.849). But both the group showed significant changes in p value post intervention (P = 0.00)

There is an inverse correlation between atelectasis area and arterial oxygenation (PaO_2) during the first and second postoperative days. Reduced lung function affects gas exchange. Pulmonary impairments after cardiac surgery create problems and are an important cause of postoperative morbidity.

In the present study thoracic expansion exercise and IMT has shown to be effective in improving SpO_2.

Evaluation of pain stands for a safety use of training in this population after surgery. The aim is that pain may decrease the individual's functional recovery, which may limit lung function, cough reflex and consequently favor the late pulmonary complication in the predisposed individuals.

Pain after sternotomy can be a major cause of disability. This can reduce lung volumes and affect the mucus clearance[5]. An essential element of postoperative care is the provision of adequate analgesia and sedation. This requires early postoperative administration of short acting medications for pain relief and sedation.

The base line value in the present study showed no significant differing suggesting same level of pain in C.G and E.G pre interventions. p = 0.190 (Table 4). This could be due to the fact that they received analgesia in the early post operative period.

Post intervention between C.G and E.G there was no significant reduction of pain (p =1.0). Interestingly enough, the reduction of the VAS score in thoracic pain during the active RMT period (E.G) was same that recorded during chest physiotherapy in C.G. Both the groups pre and post intervention showed decrease in pain level as evident by p = 0.00.

Improvements in blood flow to exercising muscle would be expected to reduce the intensity of peripheral sensations of pain[14].

Indeed, one could have potentially expected that training the inspiratory muscle against a substantial resistive load (30 cmH_2O) might have been associated with increasing pain, which was not the case in this study. This result stands for a safety use of this training device in this population after surgery. Pain may decrease coughing maneuver. Peak expiratory flow also shows significant improvement which reinforces reduction in level of pain.

CONCLUSION

In subjects recovering from CABG, the application of a rehabilitation including specifically pulmonary re expansion and/or respiratory muscle training represents a potentially useful intervention, especially if applied in a phase I cardiac rehabilitation. Bothe the group has shown post intervention significant changes in PImax, PEFR, SPO_2 and VAS. Though there was no significant changes between C.G and E.G in other outcome measure but showed significant change in PImax. Suggesting RMT is helpful post CABG. RMT is simple to carry out and is well tolerated by patients, and patients can actively contribute. However, implementing RMT in routine care is challenging, with substantial

consequences for involved staff in their daily administrative procedures and cost effectiveness.

REFERENCES

1. Wynne R, Botti M. Postoperative pulmonary dysfunction in adults after cardiac surgery with cardiopulmonary bypass: clinical significance and implications for practice. American journal of critical care. 2004 Sep 1;13(5):384-93.
2. Van Belle AF, Wesseling GJ, Penn OC, Wouters EF. Postoperative pulmonary function abnormalities after coronary artery bypass surgery. Respiratory medicine. 1992 May 31;86(3):195-9.
3. Johnson D, Kelm C, To T, Hurst T, Naik C, Gulka I, Thomson D, East K, Osachoff J, Mayers I. Postoperative physical therapy after coronary artery bypass surgery. American journal of respiratory and critical care medicine. 1995 Sep;152(3):953-8.
4. Ross J, Dean E. Integrating physiological principles into the comprehensive management of cardiopulmonary dysfunction. Physical therapy. 1989 Apr 1;69(4):255-9.
5. Brooks-Brunn JA. Postoperative atelectasis and pneumonia. Heart & Lung: The Journal of Acute and Critical Care. 1995 Apr 30;24(2):94-115.
6. Nickerson BG, Keens TG. Measuring ventilatory muscle endurance in humans as sustainable inspiratory pressure. Journal of Applied Physiology. 1982 Mar 1;52(3):768-72.
7. Black, Leo F., and Robert E. Hyatt. Maximal Respiratory Pressures: Normal Values and Relationship to Age and Sex American Review of Respiratory Disease 99.5 (1969): 696-702.
8. Jalan NS, Daftari SS, Retharekar SS, Rairikar SA, Shyam AM, Sancheti PK. Intra-and inter-rater reliability of maximum inspiratory pressure measured using a portable capsule-sensing pressure gauge device in healthy adults. Canadian Journal of Respiratory Therapy: RCTR. 2015;51(2):39-42.
9. Wen AS, Woo MS, Keens TG. How many maneuvers are required to measure maximal inspiratory pressure accurately?. CHEST Journal. 1997 Mar 1;111(3):802-7.
10. Hulzebos EH, Helders PJ, Favié NJ, De Bie RA, de la Riviere AB, Van Meeteren NL. Preoperative intensive inspiratory muscle training to prevent postoperative pulmonary complications in high-risk patients undergoing CABG surgery: a randomized clinical trial. Jama. 2006 Oct 18;296(15):1851-7.
11. ATS/ERS statement on respiratory muscle testing. Am J Respir Crit Care Med. 200 166:518–624
12. Moreno AM, Castro RR, Sorares PP, Sant'Anna M, Cravo SL, Nóbrega AC. Longitudinal evaluation the pulmonary function of the pre and postoperative periods in the coronary artery bypass graft surgery of patients treated with a physiotherapy protocol. J Cardiothorac Surg. 2011 Apr 27;6:62.
13. Barros GF, Santos CD, Granado FB, Costa PT, Límaco RP, Gardenghi G. Respiratory muscle training in patients submitted to coronary arterial bypass graft. Revista Brasileira De Cirurgia Cardiovascular. 2010 Dec;25(4):483-90.
14. Cain WS. Nature of perceived effort and fatigue: roles of strength and blood flow in muscle contractions. Journal of Motor Behavior. 1973 Mar 1;5(1):33-47.

SHORT COMMUNICATION

A SURVEY ON PREVALENCE OF DIASTASIS OF THE RECTUS ABDOMINIS MUSCLES IN PUERPERIUM: PRIMIPAROUS AND MULTIPAROUS AND IN SECOND TRIMESTER AND IMMEDIATE POSTPARTUM PERIOD

ASHWINI S KALSAIT[1], SHITAL N GARKAL[2], S M BHAVE[2], N K DESHPANDE[2]

1. *Post Graduate Student, Depart of physiotherapy, SGMCH, KEMH, Parel, Mumbai*
2. *Physiotherapy department, GMC, Nagpur*

ABSTRACT

Background: The objective of this study was to examine the prevalence of diastasis of the rectus abdominis (DRAM) in puerperium; a comparison of primiparous and multiparous and in 2nd trimester and immediate postpartum period. Methods: This observational one-time assessment study was conducted in Antenatal care unit (ANC) and postnatal care unit (PNC), wards among the 160 subjects between age group of 20-40 years. (60 primigravida, 34 multigravida, 37 primiparous, 29 multiparous) and the assessment of diastasis recti abdominis muscle was done.

Result: Prevalence of DRAM in second trimester of pregnancy was 18.75% and prevalence of DRAM in third trimester of pregnancy was 100%. Mean DRAM in second trimester of pregnancy was 0.43±0.95 and in third trimester of pregnancy was 1.21±1.42. By using z-test for difference between two mean statistically significant difference was found in mean DRAM among second and third trimester of pregnancy (z=3.83, p-value=0.0001). Mean DRAM in primigravida was 0.25±0.78, in multigravida it was 0.70±1.12, in primiparous it was 0.87±1.46 and in multiparous it was 1.60±1.30. By using one way ANOVA statistically significant difference was found in DRAM among primigravida, multigravida, primiparous and multiparous (F=9.38, p-value=0.0001). Conclusion: Prevalence of DRAM in third trimester was 100%. Statistically significant difference in DRAM among primiparous, multiparous, primigravida and multigravida. Therefore it is recommended that DRAM need to be carefully evaluated to ensure that in their presence, specific exercises are recommended in an attempt to avoid further problems.

KEYWORDS: Diastasis Rectus Abdominis; Primiparous; Multiparous; Second Trimester; Immediate Postpartum Period

INTRODUCTION

Diastasis recti abdominis muscle (DRAM) is defined as the removal or separation of the bundles of these muscles along the midline. Any separation larger than 2 cm or two fingerwidths is considered significant. The period after delivery is called postpartum period, when local and systematic changes due to pregnancy and child birth return to the situation of prepregnancy state. The postpartum period lasts 6 to 8 weeks after birth and is classified as immediate (1 to 10th days after birth), late (11th to 45th day) and remote (plus 45 days). Second trimester is the period of pregnancy from 13 to 28 weeks[1,2].

The occurrence of the DRAM is more common during pregnancy and immediate postpartum period. It can occur above, below or at level of umbilicus[2].

Predisposing factor: Obesity, Multiparity, Fetal macrosomia, sagging of abdominal muscles, Polyhydramnios, Multiple pregnancies, etc[2].

Significance: The condition of diastasis recti may produce especially musculoskeletal complaints…such as low back pain.., possibly as a result of decreased ability of the abdominal musculature to stabilize the pelvis and lumbar spine[1-4].

Functional limitations: Inability to perform independent supine to sitting transitions can also occur because of extreme loss of the mechanical alignment and function of the rectus muscle[5]. Severe cases of diastasis recti may progress to herniation of the abdominal viscera through the separation at linea Alba, less protection for the fetus[2].

This study was therefore designed to detect the prevalence of DRAM in second trimester and in multiparous and in primiparous women coming to antenatal clinics (ANC) and admitted in postnatal wards (PNC).

The objectives of this study were to examine the prevalence of DRAM in puerperium; a comparison of primiparous and multiparous and in 2nd trimester and immediate postpartum period.

METHODOLOGY

Approval for the study was taken from the Institutional Ethics Committee.

This prospective cross-sectional study was conducted in ANC & PNC, wards among the 160 subjects (purposive sampling) between age

For Correspondence: Ashwini Kalsait,
Email Id - ashwini.kalsait@gmail.com

group of 20-40 years. (60 primigravida, 34 multigravida, 37 primiparous, 29 multiparous). The subjects reported no previous caesarean section. All subjects read and signed an institutionally approved informed consent form before testing.

Assessment of diastasis recti abdominal muscle

Patient position – Patient is in crook lying position.

Procedure – Patient slowly raise her head and shoulders off the floor, reaching her hands towards the knee, until the spine off scapula is off the floor. Place the fingers of one hand horizontally across the midline of abdomen at the umbilicus[2].

If separation exists, the fingers will sink into the gap between the rectus muscles. The fingers that can be placed between the muscle bellies are then documented. The measurement for supraumbilical was 4.5 cm above the umbilicus and for infraumbilicus it was 4.5cm below the umbilicus. The DRAM was considered present if a separation > 2 cm in region above, below and at the umbilicus[2].

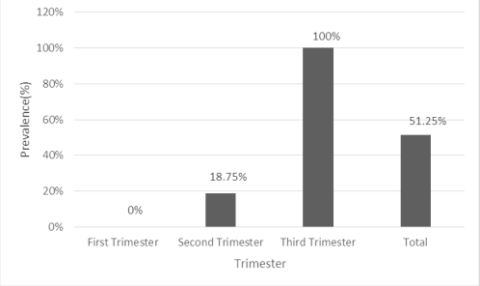
STATISTICAL ANALYSIS

Statistical analysis was done by using descriptive and inferential statistics using z-test for difference between two proportions, one way ANOVA and Pearson's Correlation Coefficient and software used in the analysis were SPSS 17.0 version, EPI-INFO and Graph Pad Prism 6.0 version and $p<0.05$ is considered as level of significance.

RESULTS

TABLE 1: Prevalence of dram in first, second and third trimester

Trimester	No of subjects	Percentage (%)
First (n=0)	0	0.0
Second (n=96)	18	18.75
Third (n=64)	64	100
Total (n=160)	82	51.25

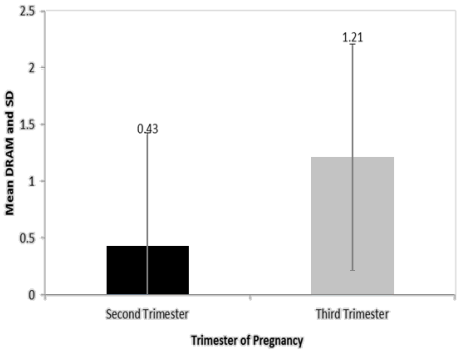


GRAPH 1: Prevalence of dram in first, second and third trimester

Prevalence of DRAM in second trimester of pregnancy was 18.75% and prevalence of DRAM in third trimester of pregnancy was 100%.

TABLE 2: Comparison of dram in first, second and third trimester

	N	Mean	Std Deviation	z-value	p-value
Second Trimester	96	0.43	0.95	3.83	0.0001 , S
Third Trimester	64	1.21	1.42		

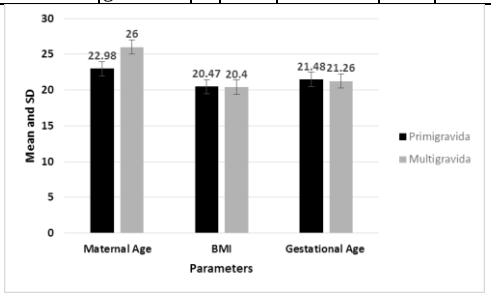


GRAPH 2: Comparison of dram in first, second and third trimester

Mean DRAM in second trimester of pregnancy was 0.43±0.95 and in third trimester of pregnancy was 1.21±1.42. By using z-test for difference between two mean statistically significant difference was found in mean DRAM among second and third trimester of pregnancy (z=3.83, p-value=0.0001).

TABLE 3: comparison of maternal age, BMI and gestational age in primi and multi gravida

		N	Mean	Std Deviation	z-value	p-value
Maternal Age	Primi-gravida	60	22.98	2.97	4.02	0.0001, S
	Multi-gravida	34	26.00	4.26		
BMI	Primi-gravida	60	20.47	3.27	0.10	0.91, NS
	Multi-gravida	34	20.40	2.44		
Gestational Age	Primi-gravida	60	21.48	4.04	0.24	0.80, NS
	Multi-gravida	34	21.26	4.26		



GRAPH 3: Comparison of maternal age, BMI and gestational age in primi and multi gravida

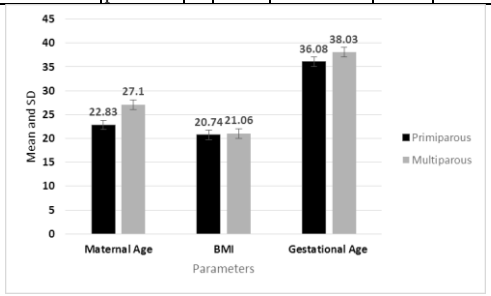
Mean maternal age in primigravida was 22.98±2.97 and in multigravida it was 26±4.26. By using z-test for difference between two means statistically significant difference was found maternal age between primi and multigravida (z=4.02, p-value=0.0001).

Mean BMI in primigravida was 20.47±3.27 and in multigravida it was 20.40±2.44. By using z-test for difference between two means statistically no significant difference was found BMI between primi and multigravida mothers (z=0.10, p-value=0.91).

Mean gestational age in primigravida mothers was 21.48±4.04 and in multigravida mothers it was 21.26±4.26. By using z-test for difference between two means statistically no significant difference was found gestational age between primi and multigravida (z=0.24, p-value=0.80).

TABLE 4: Comparison of maternal age, BMI and gestational age in primi and multi parous

		N	Mean	Std Deviation	z-value	P value
Maternal age	Primi-parous	37	22.83	2.71	4.66	0.0001, S
	Multi-parous	29	27.10	4.65		
BMI	Primi-parous	37	20.74	2.83	0.45	0.65, NS
	Multi-parous	29	21.06	3.08		
Gestational Age	Primi-parous	37	36.08	5.98	1.62	0.10, NS
	Multi-parous	29	38.03	2.78		

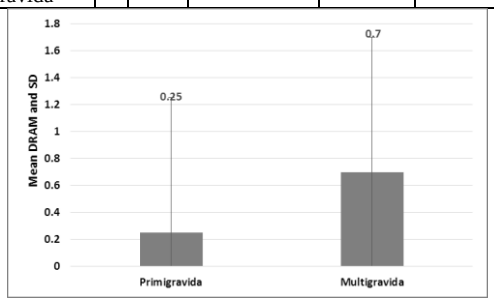


GRAPH 4: Comparison of maternal age, BMI and gestational age in primi and multi parous

Mean maternal age in primiparous was 22.83±2.71 and in multiparous it was 27.10±4.65. By using z-test for difference between two means statistically significant difference was found maternal age between primi and multiparous (z=4.66, p-value=0.0001).Mean BMI in primiparous was 20.74±2.83 and in multiparous it was 21.06±3.08. By using z-test for difference between two means statistically no significant difference was found BMI between primi and multiparous (z=0.45, p-value=0.65).Mean gestational age in primiparous was 36.08±5.984 and in multiparous it was 38.03±2.786. By using z-test for difference between two means statistically no significant difference was found gestational age between primi and multiparous (z=1.62, p-value=0.10).

TABLE 5: Comparison of DRAM in primigravida and multigravida

	N	Mean	Std Deviation	Std Error	z-value
Primi-gravida	60	0.25	0.78	0.10	2.06, p=0.044, S
Multi-gravida	34	0.70	1.12	0.19	

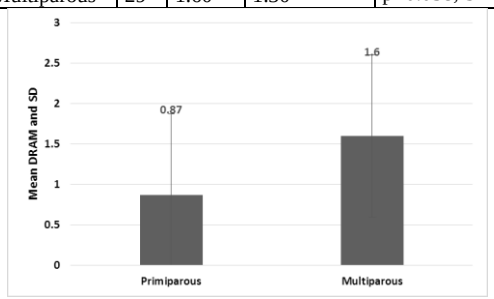


GRAPH 5: Comparison of DRAM in primigravida and multigravida

Mean DRAM in primigravida was 0.25±0.78 and in multigravida it was 0.70±1.12. By using z-test for difference between two mean statistically significant difference was found in DRAM amongst primi and multigravida (z=2.06, p-value=0.044).

TABLE 6: Comparison of DRAM in primiparous and multiparous

	N	Mean	Std Deviation	z-value
Primiparous	37	0.87	1.46	2.12, p=0.038, S
Multiparous	29	1.60	1.30	

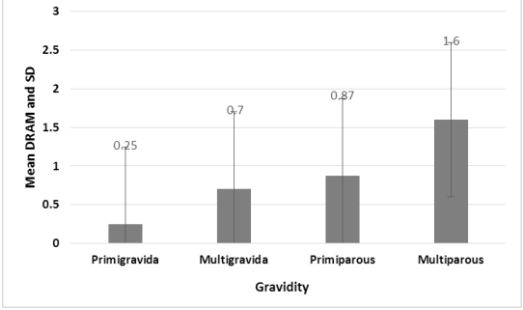


GRAPH 6: Comparison of DRAM in primiparous and multiparous

Mean DRAM in primiparous was 0.87±1.46 and in multiparous it was 1.60±1.30. By using z-test for difference between two mean statistically significant difference was found in DRAM amongst primi and multiparous (z=2.12, p-value=0.038).

TABLE 7: Comparison of DRAM in primigravida, primiparous, multigravida and multiparous

	N	Mean	Std Deviation	F-value
Primigavida	60	0.25	0.78	9.38, p = 0.0001,S
Multigravida	34	0.70	1.12	
Primiparous	37	0.87	1.46	
Multiparous	29	1.60	1.30	

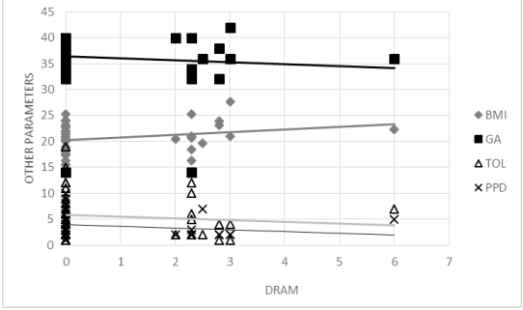


GRAPH 7: Comparison of DRAM in primigravida, primiparous, multigravida and multiparous

Mean DRAM in primigravida was 0.25±0.78, in multigravida it was 0.70±1.12, in primiparous it was 0.87±1.46 and in multiparous it was 1.60±1.30. By using one way ANOVA statistically significant difference was found in DRAM among primigravida, multigravida, primiparous and multiparous (F=9.38, p-value=0.0001).

TABLE 8: Correlation of dram with BMI, gestational age, total time of labor and postpartum day in primiparous

	Mean	Std Deviation	N	Correlation 'r'	p-value
DRAM	0.90	1.45	37	-	-
BMI	20.74	2.83	37	0.25	0.12 , NS
Gestational Age	36.08	5.98	37	-0.09	0.59, NS
Total time of labour	5.51	4.38	37	-0.09	0.52, NS
Postpartum days	3.72	2.24	37	-0.21	0.19 , NS

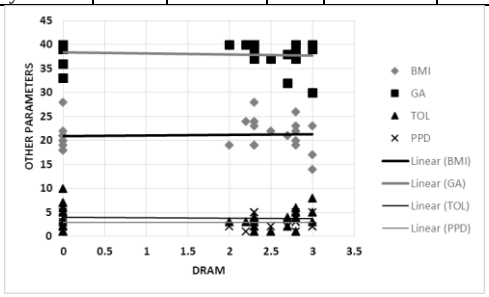


GRAPH 8: Correlation of dram with BMI, gestational age, total time of labor and postpartum day in primiparous

Positive correlation was found between DRAM and BMI (r=0.25, p-value=0.12), negative correlation was found between DRAM and gestational age(r=-0.09, p=0.59), total time of labor(r=-0.10, p=0.52) and postpartum days(r=-0.21, p=0.19).

TABLE 9: correlation of DRAM with BMI, gestational age, total time of labor and postpartum day in multiparous

	Mean	Std Deviation	N	Correlation 'r'	p-value
DRAM	1.60	1.30	29	-	-
BMI	21.06	3.08	29	0.06	0.73 , NS
Gestational Age	38.03	2.78	29	-0.09	0.61, NS
Total time of labor	3.75	2.35	29	-0.05	0.77 , NS
Postpartum days	2.86	1.35	29	-0.01	0.96 , NS



GRAPH 8: correlation of DRAM with BMI, gestational age, total time of labor and postpartum day in multiparous

Positive correlation was found between DRAM and BMI(r=0.06, p-value=0.73), negative correlation was found between DRAM and gestational age(r=-0.09, p=0.61), total time of labor(r=-0.05, p=0.77) and postpartum days(r=-0.01, p=0.96).

CONCLUSION

Thus we conclude that prevalence of DRAM in third trimester was 100%. Statistically significant difference in DRAM among primiparous, multiparous, primigravida and multigravida.

Therefore it was recommended that DRAM need to be carefully evaluated to ensure that in their presence, specific exercises are recommended in an attempt to avoid further problems.

CLINICAL IMPLICATION

The presence of diastasis recti indicates a number of changes to the integrity of abdominal wall which provides a circumferential support to the lumbar spine which incorporates central attachments to abdominals, may be weakened.

Such inadequacies could lead to muscle imbalances, inefficiency of movement, changes in posture and development of low back pain. A simple diastasis recti test assesses the state of abdominal muscles which is helpful for women's healthy functioning.

So diastasis recti test can be used as a health care part of ANC, PNC setup.

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CONFLICT OF INTEREST

None

REFERENCES

1. Cryolyn Kisner and Lynn Colby. Therpeutic exercise foundations & technique. 5th edition 2007
2. Ruth Sapaford Alia. Women's health; A Textbook for Physiotherapist 1st edition in India 1998
3. Boissonnault JS, Blaschak MJ. Incidence of diastasis recti abdominis during the childbearing year. Physical therapy. 1988 Jul 1;68(7):1082-6..
4. Parker MA, Millar LA, Dugan SA. Diastasis Rectus Abdominis and Lumbo-Pelvic Pain and Dysfunction-Are They Related?. Journal of Women's Health Physical Therapy. 2009 Jul 1;33(2):15-22.
5. Hodges PW, Richardson CA. Contraction of the abdominal muscles associated with movement of the lower limb. Physical therapy. 1997 Feb 1;77(2):132-42.

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