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Original Article

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Acute Hemodynamic Response to Acapella in Phase 1 Cardiac Rehabilitation Following Coronary Artery Bypass Graft Surgery

Fozia*, Jamal Ali Moiz, Divya M. Shama***, M. Ejaz Hussain******

Abstract

Purpose: The purpose of this study was to evaluate the acute hemodynamic response to Acapella in patients underwent coronary artery bypass graft surgery (CABG). **Methods:** Fifteen (n=15, mean age: 57.6±9.8 years) post CABG patients were selected for this study from cardiothoracic unit of Safdarjung Hospital, New Delhi. All patients used Acapella during their phase 1 cardiac rehabilitation program. They were asked to breath from diaphragm taking in a larger than normal breath, hold breath for 2 to 3 seconds and exhale actively but not forcefully, through the device, exhalation lasted approximately 3 to 4 times longer than inhalation. It was performed 10 to 20 PEP breaths. Patients were instructed to remove the mouthpiece and perform 2 to 3 'huffs' coughs to raise secretions as needed. These procedures had been repeated 3 to 4 times. Measurements of systolic blood pressure, diastolic blood pressure heart rate, rate pressure product, arterial oxygen saturation and respiratory rate were taken before, during, immediately after and 30 minutes after using Acapella. Rate of perceived exertion and sputum amount were taken after using Acapella. Data were analysed by SPSS (20) by comparing the means of outcomes, using repeated measure ANOVA. **Results:** As a result of use of Acapella during cardiac rehabilitation, a significant improvement was observed in the sputum volume mean (7.7 ml), respiratory rate (p<0.001) and SPO_2 (p<0.001). Acapella caused no significant hemodynamic response such as systolic blood pressure (p=0.239), diastolic blood pressure (p=0.360), heart rate (p=0.60) and rate pressure product. **Conclusion:** Use of Acapella during phase 1 cardiac rehabilitation seems to be safe, without alteration on hemodynamic variables; in addition, it seems an effective adjunct for the removal of bronchial secretions in patients underwent coronary artery bypass surgery.

Keywords: Acapella; hemodynamic; cardiac rehabilitation; Coronary artery bypass graft.

Introduction

Cardiovascular disease has become the leading cause of morbidity and mortality in India during the last three decades. The genetic predisposition and acquisition of traditional risk factor at a rapid rate as a result of urbanization seems to be the major cause. The facilities of modern diagnostic methods and new proven techniques to offer symptomatic relief and improve their prognosis are available.[1] Coronary artery bypass graft (CABG) surgery is the most frequently studied of all surgical procedures, probably in part due to it expense, the frequency with which it is performed, and the fact that it relates to coronary heart disease, the most common cause of death.[2]

Despite the success of these efforts, postoperative pulmonary complications (PPC) account for a substantial proportion of morbidity and mortality related to surgery and anaesthesia and lead to longer hospital stays. [3] Relating to cardiac surgery are the effects of anaesthesia, median sternotomy incision, topical cooling for myocardial protection, internal mammary artery dissection and use of cardiopulmonary bypass.[4]

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Cardiac rehabilitation programs are generally divided into three main phases inpatient, early outpatient, long term outpatient cardiac rehabilitation. Phase 1 delivers preventive and rehabilitation services to hospitalized patients and last for one to two weeks.[5] At this early phase, the focus of physiotherapy is prescription to avoid inactivity, and to maintain or improve pulmonary capacities and muscular strength. [6,7,8]

The effectiveness of standard chest physiotherapy (CPT) has been confirmed by many studies. Airway CPT is considered the base of physiotherapy and is characterized as "gold standard" of physiotherapy.[9] Chest physiotherapy is a routinely used therapy to prevent post operative pulmonary complications after cardiac surgery. The techniques used improve respiratory mechanics, pulmonary re-expansion and bronchial hygiene. Chest physiotherapy is given to maintain or improve alveolar ventilation. In cases where alveolar ventilation is reduced secondary to retained secretions, various techniques are available to the therapist to assist with secretion removal. These include gravity assisted drainage, positioning, percussion and vibrations, manual hyperinflation and airway suctioning. [10-12]

However, standard CPT is very labour–intensive and time–consuming both for hospitalized and non-hospitalized patients with impaired airway clearance. For this reason many patients refuse to do daily physiotherapy and interrupt it with all bad consequences. In recent years, devices of respiratory physiotherapy have emerged which offer alternatives to standard CPT which are less time–consuming and offer greater independence to the patient with lung disease. According to recent literature, devices of respiratory physiotherapy are introduced as alternative therapy methods[13-16] in order to facilitate and improve mobilization of mucus from airways, through which better lung ventilation and improved pulmonary function can be achieved. These devices are safe and offer acceptable airway clearance to conventional CPT. Patients use devices of respiratory physiotherapy because of their benefits, such as the independent application and the reduced cost of therapy.[9]

One of the current devices of respiratory physiotherapy is positive expiratory pressure. [9] PEP device may give independence to patients as it can be carried out without an assistant and is easy and convenient in use.[17-19] Small clinical studies have reported improved tracheobronchial clearance and patient comfort with PEP devices compared to standard CPT.[20-21] Reduction in pulmonary infections/antibiotic courses and improved bronchodilation is also reported.[21-23] In addition, there has also been reported improvement in compliance and shorter hospital stays.[24] Other studies report PEP as an acceptable and effective treatment regimen to lung function.[16,25,26] There are different types of devices used to deliver PEP but one of the most commonly used is Acapella. The Acapella (Smiths Medical Inc, Carlsbad, California, USA) is a handheld airway clearance device that operates on the same principle as the Flutter, *i.e.* a valve interrupting expiratory flow generating oscillating PEP. Utilizing a counterweighted plug and magnet to achieve valve closure, the Acapella is not gravity dependent like the Flutter. The Acapella comes in three models, a low flow (<15 L/min), high flow (>15 L/min) and the Acapella Choice. The high and low flow models have a dial to set expiratory resistance while the Choice model has a numeric dial to adjust frequency. All models can be used with a mask or mouthpiece and can be used in line with a nebulizer. While these attributes may offer the Acapella some advantage over the Flutter A bench study of the performance characteristics of the two devices showed a slight advantage for the Acapella, with more stable wave form and a wider range of PEP at low air flow.[27]

The lack of evidence together with inconsistence responses of Acapella on hemodynamic were the requirements of this study. To our knowledge there is no research

describing the acute effect of Acapella on hemodynamic following coronary artery bypass surgery, the present study aimed to see the same. The present study therefore investigated the acute hemodynamic effect of Acapella in phase I cardiac rehabilitation following coronary artery bypass graft surgery.

Material and Methods

The Study was conducted in a cardio thoracic and vascular surgery unit, Safdarjung hospital, New Delhi. Signed consent of patient prior to surgery was considered as willingness to participate in study. Inclusion criteria were elective CABG procedure, age of between 35 to 75 years, candidates for early extubation (6-8 hours after surgery), Temperature < 99^0F. Exclusion criteria were, current smoking, Pulmonary embolism, Pneumothorax and hemothorax, Hemodynamic instability- Patients having mean arterial pressure less than 60 mm Hg and more than100 mm Hg, cardiac arrhythmias, heart rate more than 160 beats per minute, Ventricular tachycardia ventricular fibrillation, Emergency surgery, Cerebral edema, Prolong ventilation > 24 hours, Left ventricular ejection fraction less than 35%, Intraoperative or postoperative CVA. Eligible patients were allocated to receive Acapella during their phase 1 cardiac rehabilitation.

The following pre-operative risk factors were assessed: patient age, sex, body mass index, history of smoking, lung function, and functional capacity. Pre and post-operative characteristics including number of arteries that have been changed, amount of transfusion, total amount of drainage, duration of the drains, duration of intubation, perfusion, and aortic clamping were recorded. The Acute Physiology and Chronic Health Evaluation II (APACHE II) score was calculated in the first 24 hours of surgery (Table1).

Study design

The study was single group pre and post test experimental design. Independent variables were Acapella and Phase 1 cardiac rehabilitation. The dependent variables were heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), oxygen saturation (SpO_2), respiratory rate (RR), Rate pressure product (RPP), Sputum amount (ml), Rate of perceived exertion (RPE) and Hospital stay.

Protocol

To study the acute hemodynamic effect of Acapella in phase 1 cardiac rehabilitation following coronary artery bypass surgery, 15 patients are randomly selected after detailed cardiovascular and respiratory assessment; suitable patients were included after inclusion and exclusion criteria. Reading of heart rate, arterial oxygen saturation, systolic blood pressure, diastolic blood pressure, respiratory rate, rate pressure product, rate of perceived exertion and sputum amount were taken

Table 1. Demographic and operative variables of the patients

Subject Characteristics	(n=15)
Age (years)	57.6 (9.8)
Height (cm)	158.6 (7.9)
Weight (kg)	65.4(9.9)
BMI (kg/m^2)	26.1(4.7)
Number of graft used(n)	3.07(0.4)
Duration of intubation (hours)	7.6(2.9)
Hospital stay(days)	16.2(9.3)
APACHE II	7.6(2.5)
APACHE II=Acute Physiology and Chronic Health Evaluation II, data presented as mean and Standard deviation	

before using Acapella, during the time of using Acapella, immediately after using Acapella and 30 minutes after Acapella.

Subjects were evaluated before the surgery by the investigator, who explained the physiotherapeutic protocols and interventions to be followed after the surgery. Routine physiotherapy treatment according to hospital protocol was given. Subjects were encouraged to clarify any questions regarding the study.

Procedure

Acapella device was selected depending upon the patient's ability to maintain an expiratory flow of 15 liter per minute (LPM) or grater for three seconds. All patients enrolled for the study (n=15) were able to maintain expiratory flow $\geq$15 LPM therefore, green Acapella were used for all of them. At initial setting of the device frequency adjustment dial was turned counter-clockwise to the lowest frequency-resistance setting, then frequency/ resistance increase clockwise. Proper resistance range was selected to produce the desired I: E ratio of 1:3 to 1:4.[11]

Patients were explained with complete procedure prior to examination. Patients were asked to sit comfortably and place mouthpiece in mouth and maintain a tight seal on mouthpiece during exhalation. Patients were asked to breath from diaphragm taking in a larger than normal breath. Hold breath for 2 to 3 seconds. Patients were instructed to exhale actively but not forcefully, through the device, exhalation should last approximately 3 to 4 times longer than inhalation. They were asked to Perform 10 to 20 PEP breaths and then asked to remove the mouthpiece and perform 2 to 3 'huffs' coughs to raise secretions as needed. This procedure had been repeated 3 to 4 times. All the dependent variables were taken pre-test before using Acapella, during test at the time using Acapella, post-test immediately after using Acapella and 30 minutes after using acapella.[29]

Statistical analysis

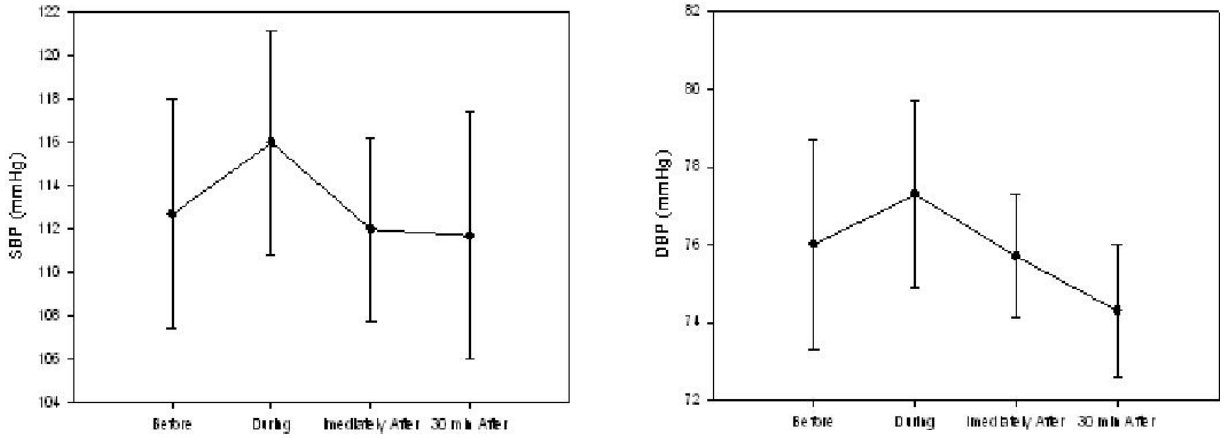
Statistical analysis was obtained by using SPSS version 20. Demographic data of the patients including age, height, weight, BMI, number of grafts used are summarized in table1. A repeated measure analysis of variance (ANOVA) was used to determine the effect of Acapella. A multiple test readings were taken, a post hoc analysis was performed using a Bonferroni test, to compare the difference between each reading. An alpha value of 0.05 was set to significant difference.

Table 2. Effect of Acapella on hemodynamic variables

Variables		SBP Mean+SE	DBP Mean+SE	HR Mean+SE	RPP Mean+SE	RR Mean+SE	SPO_2 Mean+SE
Before		112.7±5.3	76.0±2.7	85.4±3.1	9585.3±534.5	19.1±0.5	95.4±0.5
During		116.0±5.2	77.3±2.6	84.6±3.4	9793.3±575.8	19.3±0.5	96.1±0.4
Immediately after		112.0±4.5	75.7±1.6	84.8±3.1	9434.3±421.9	17.7±0.5	97.4±0.3
30 minutes after		111.7±5.7	74.3±1.7	84.0±3.3	9340.0±552.2	17.8±0.5	97.7±0.2
ANOVA	F	1.46	1.10	0.62	2.13	17.36	18.05
	P	0.239	0.360	0.608	0.11	<0.001	<0.001
Post Hoc analysis	before vs. during	1	1	1	1	1	0.5
	before vs. immediately after	1	1	1	1.0	0.0001*	0.0010*
	before vs. 30 minutes after	1	1	0.4	0.4	0.0013*	0.0007*

*** Significant difference; SBP : Systolic Blood Pressure; DBP: Diastolic Blood Pressure; HR : Heart Rate, RPP: Rate Pressure Product, RR : Respiratory Rate, SPO_2: Arterial Oxygen Saturation, Before : Reading before using Acapella, During: Reading during using Acapella, after doing two sets of PEP breathing, Immediately after: Reading immediately after using Acapella, 30 minutes after: Reading 30 minutes after using Acapella, SE : Standard Error,**

Figure 1: Shows changes in hemodynamic variables 1A:Syatolic blood pressure,1B:Diastolic blood pressure at before, during, immediately after and 30 minutes after using Acapella in patients following CABG surgery



Results

Fifteen patients (n=15), two female and thirteen male who had undergone off-pump coronary artery bypass surgery, were finally enrolled in the study. The demographic and operative characteristics of the patients shown in table 1. A one-way repeated measures ANOVA was conducted to compare the hemodynamic effect of Acapella on systolic blood pressure, diastolic blood pressure, heart rate, rate pressure product, respiratory rate and SpO_2 in post CABG patient during phase1 cardiac rehabilitation at before, during, immediately after and 30 minutes after using Acapella.

Repeated measure ANOVA could not find any difference between the readings of systolic blood pressure (F=1.46, p=0.239), diastolic blood pressure (F=1.10, p=0.360), heart rate (F=0.62, p=0.608) and rate pressure product (F=2.13, p=0.110) in response to Acapella. However, there were significant improvement in respiratory rate which was 19.1$\pm$0.5 before using Acapella and17.8$\pm$0.5 after using Acapella (F=17.36, p<0.001), and SpO2 (F=18.5, p<0.001). (Table 2) (fig 1,2,3)

Mean amount of sputum collected after using Acapella is 11.4 ml. Mean of rated perceived exertion after using Acapella is 2.8 and the mode of hospital stay of fifteen patients were 16 days.

Figure 2: Shows changes in hemodynamic variables 2A:Heart rate, 2B:Rate pressure product at before, during, immediately after and 30 minutes after using Acapella in patients folowwing CABG surgery

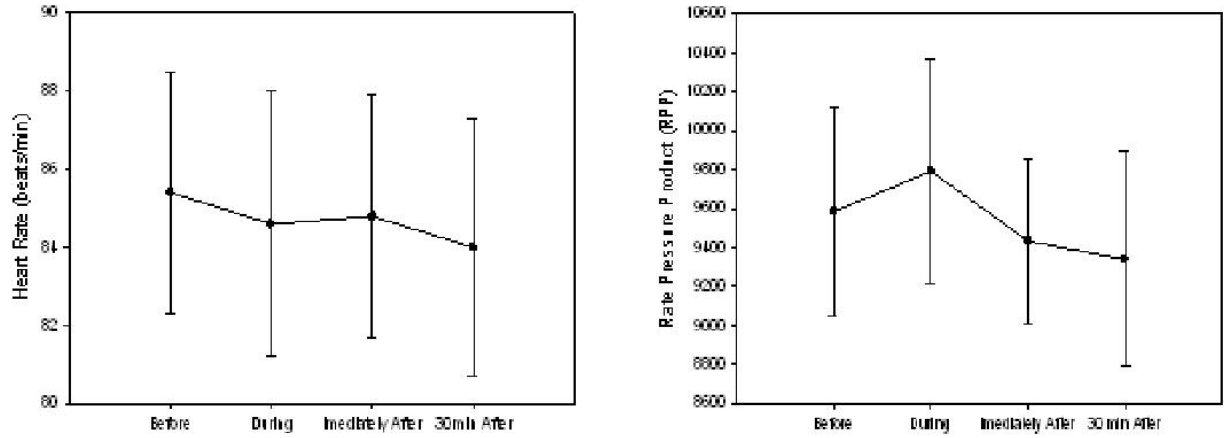
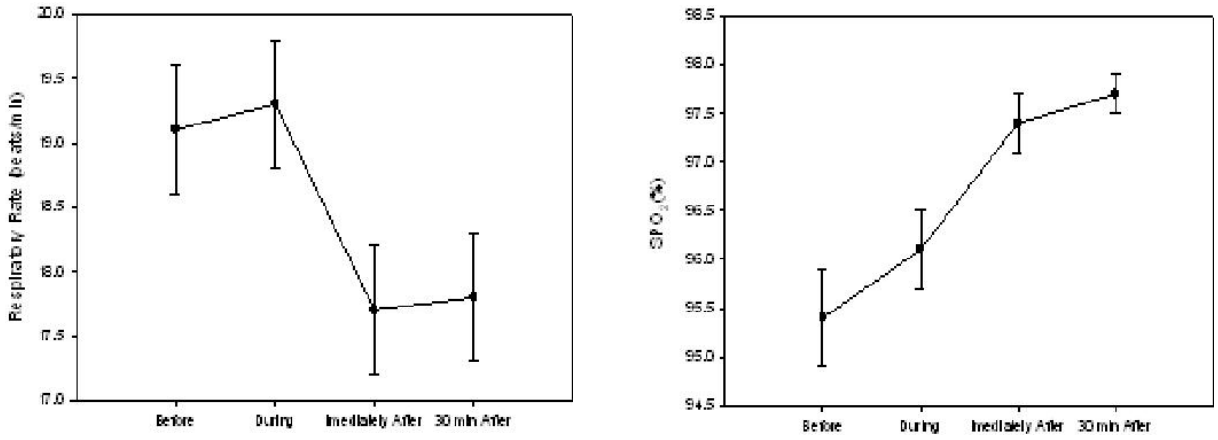


Figure 3: Shows changes in hemodynamic variables 3A:respiratory rate, 3B:SPO_2 at before, during, immediately after and 30 minutes after using Acapella in patients following CABG surgery



The result suggests that Acapella really does not have any abnormal hemodynamic effect in post CABG patients. Specifically, our results suggest that Acapella can safely be used in post CABG patients without any abnormal hemodynamic changes. Additionally, there were a substantial improvement in oxygenation, respiratory rate and expectorated sputum volume (11.4 ml) this further suggest that Acapella is effective in removing bronchial secretion and improving oxygenation in post CABG patients.

Discussion

The effect of Acapella on hemodynamic performance was evaluated in a group of patients who underwent coronary artery bypass graft surgery (CABG). The result shows that in coronary artery bypass grafts patients there were minimal changes in systolic blood pressure, diastolic blood pressure, heart rate, rate pressure product during treatment, immediately after treatment and 30 minutes after treatment. However, there were statistically significant improvement in respiratory rate and SPO_2 following immediately after using Acapella and 30 minutes after using Acapella.

This study considered a clinically significant change one that was greater than 10 percent. When examining the systolic blood pressure, diastolic blood pressure, heart rate, rate pressure product was no significant ($p > 0.05$). This can possibly be explained that Acapella could not demonstrate any change in these hemodynamic variables. Rate pressure product (RPP) is the best non-invasive index which results from multiplying systolic blood pressure by heart rate, has been recognized as a relevant parameter in evaluating ventricular function. It has been speculated that high values at peak exertion thus reflecting cardiac work are more likely related to good ventricular function and no ischemia.[19-21] Low rate pressure product value before using Acapella denotes normal myocardial oxygen consumption. As the values of rate pressure product during, immediately after and 30 minutes after using Acapella provide no significant changes in values denotes that the use of Acapella do not increase myocardial oxygen demand.

As per our knowledge there is no study available to date to demonstrate the hemodynamic changes specifically in coronary artery bypass surgery patients. Most of the studies done on the patients with pulmonary diseases; however the results of these studies are in accordance of present study. The present study demonstrated an improvement in SPO_2 and respiratory rate ($p<0.05$) after using Acapella. This result is in accordance with the studies of Darbee *et al* in 2005[30] in which the research evaluated the

physiological responses to two airways clearance intervention high frequency chest wall oscillation and low positive expiratory pressure breathing in subjects who have moderate to severe cystic fibrosis demonstrated improvement in ventilation distribution, gas mixing and increase in SPO_2 during positive expiratory pressure breathing Study done by Padkao *et al* in 2010[31] demonstrated that the conical PEP device decreases lung hyperinflation, is safe to use and trends to increase the duration of exercise in chronic obstructive pulmonary disease patients compared to normal breathing. This study is in accordance with the studies of Thompson *et al* in 2002[32] who concluded that the daily use of flutter device is effective as active cycle of breathing in patients with non cystic fibrosis bronchiectasis and has high level of patients acceptability. This study is in accordance done by MAH Abu-Rayan *et al* in 2009[33] demonstrated that Acapella is the good representative of all conventional multimodality chest physiotherapy procedures resulted in significant improvement in oxygenation. Another study of Van der Scahns *et al* 1993[34] is in accordance with study concluding that in healthy subjects positive expiratory pressure increases tidal volume by the activity of both inspiratory and expiratory muscles, while functional residual capacity remains unchanges.

Use of cardiopulmonary bypass in on-pump CABG shows significant effect on cardiovascular system, due to inflammatory responses, manipulation of heart, frozening . One common problem after CPB is arrhythmia which further causes hypotension, tachycardia, heart failure and stroke. As this study is done on off-pump coronary artery bypass surgery patients hemodynamic consequences occurring in surgery due to displacement of heart is marked decreased in cardiac output (cardiac index <2 litre $min^{-1}m^{-2}$) leading to reduced mixed venous saturation, often <70%. The present study demonstrate no significant changes on hemodynamic parameters like heart rate, systolic blood pressure, diastolic blood pressure, rate pressure product, this study is in accordance with MAH Abu-Rayan *et al* in 2009[33] also found that there were significantly lesser hemodynamic effect regarding heart rate and mean arterial pressure.

Our study result demonstrate that the mean sputum volume of patients expectorated after using Acapella were 7.7 ml. The study of Naraparaju *et al* in 2010[35] is in accordance with concluded that there is increased sputum clearance following the use of Acapella when compared to the threshold inspiratory muscle trainer in bronchiectasis patients. Another study done by MAH Abu-Rayan *et al* 2009[33] found that there were significant increase in mean values of sputum amount in comparison with multimodality chest physiotherapy. In contrast, van der Scahns *et al* in 1993[34] in a study were not in accordance with present study, who demonstrated that changes in lung volume in relation with positive expiratory pressure breathing did not lead to improvement of mucus clearance in cystic fibrosis patients.

The result of this study would yield future insight into the use of Acapella as a therapeutic intervention in phase 1 cardiac rehabilitation in patient following coronary artery bypass surgery. These effects become relevant to physiotherapist when determining the relative cardiovascular risk to pulmonary benefits of Acapella in respiratory patients who have undergone coronary artery bypass surgery.Such an understanding is crucial to minimize its adverse effect when prescribing Acapella to remove secretions of patient in phase 1 cardiac rehabilitation, who have undergone Coronary artery bypass surgery.

There were several limitations encountered during the study. The first was minimal amount of information on Acapella device itself. We could find no studies that directly establish the safety efficacy of Acapella in cardiac surgery patients. In addition due to lack of time and resources we were limited in number of patients that could participate in the study.

The study sample was too small to make determinations about the relative hemodynamic safety of the device

additionally; we could not collect waveform on Acapella device that shows the device is vibratory.

This study suggests the need for additional studies to be performed on large scale to proof the safety and efficacy of Acapella to mobilize secretions in persons with coronary artery bypass surgery.

Conclusion

The overall results of the study lead us to the conclusion that the uses of Acapella during phase 1 cardiac rehabilitation seems to be safe, without alteration on hemodynamic variables, in addition, it seems an effective adjunct for the removal of bronchial secretions in patients undergone coronary artery bypass surgery. It can be concluded that Acapella may be considered safe and effective in coronary artery bypass graft patients during phase 1 cardiac rehabilitation.

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Conflict of interest

The authors have no conflict of interest to declare.

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Original Article

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Role of Pressure Biofeedback in Lumbar Stabilization Exercises in Management of Mechanical Low Back Pain

P. Pragya*, S.A. Khan*, V. Chorsiya, N. Quddus***

Abstract

Mechanical low back pain (LBP) is the most common complaints in the urban society causing to absent from the work and activity limitation. Its health, social and economic burden is hefty. Despite developments in modern medicine in general and growing knowledge of spinal diseases, problem of nonspecific low back pain remains unsolved. In India, occurrence of LBP is also alarming; nearly 60% of the people have significant back pain at some time or the other in the lives and responsible to cause work-related disability in persons younger than 45 years. Even though there is ample evidence stating the efficacy of lumbar stabilization training but the evidence based practice are lacking that establish the role of pressure biofeedback training in lumbar stabilization. The present contribution intends to study whether pressure biofeedback in lumbar stabilization exercises has any role in the pain management and decreasing the relatedness disability as measured by Visual Analogue Scale (VAS) and Modified Oswestry Low back Pain Questionnaire (MOLBPQ) respectively. An intervention including lumbar stabilization exercises of 3 week protocol was given to 2 groups of 15 patients. Both groups showed decrease in pain and disability after intervention but the group involving lumbar stabilization exercises using pressure biofeedback group showed significant improvement as compared with the other group. Conclusively, lumbar stabilization exercises using pressure biofeedback are more beneficial than lumbar stabilization exercises alone in mechanical low back pain patients.

Keywords: Lumbar stabilization exercises; Pressure bio feedback; Mechanical low back pain.

Introduction

Musculoskeletal disorders (MSD), with back pain accounts for more than half of the cases, are now the most common cause of chronic incapacity in industrialized countries.[1] Low back pain is associated with substantial morbidity for 80% of the general population at some stage during their lives.[2] Back pain is one of the most common reasons people go to the doctor or miss work. Annually, 7%of the adult population will present to their general practitioner with low back pain, with 32% presenting for repeated consultations with back pain.[3] Self-reported disability in adolescents with LBP varies from 18% to 94%. [4] However, most adolescents reporting LBP show minor functional impairment and little impact on Health-Related Quality Of Life (HRQOL). In India, occurrence of LBP is also alarming; nearly 60% of the people have significant back pain at some time or the other in the lives.[5] A variety of strategies have been proposed by Snook and White (1994), to prevent LBP, considering its prevalence, cost and substantial impact on work disability. Mechanical LBP is the most common cause of work-related disability in persons younger than 45 years in the United States. In India, back pain is the second most common reason for visits to office based physicians. For individuals older than 45 years, mechanical LBP is the 3rd most common cause of disability and is generally associated with a work related injury.[6]

It is often referred to as clinical spinal instability. Instability could be the result of

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tissue damage, making the segment more difficult to stabilize. Insufficient muscle strength or endurance or poor muscle control, and instability are unusually a combination of all three components. When the neuromuscular control system is affected there is increased body sway which has been found in patients with low back pain indicating a less efficient muscle control system with decreased ability to provide the needed spinal stability.[7,8]. Lumbar spinal instability may be caused by degenerative disease, postoperative status, trauma to the spine or its surrounding structures, developmental disorders, like scoliosis and other congenital spine lesions, infection, and tumors. Studies have shown that there is dysfunction of transverse abdominis and multifidus in low back pain subjects.[9] Treatment of low back pain is one of the most controversial subjects in clinical medicine at the present time, yet it comprises of most interesting paradox. There is now considerable evidence documenting the efficacy of exercises in the conservative treatment of low back pain. Exercises can be relatively inexpensive, easily administered treatment method, which proves to be the most effective solution for the patients whose pain appears to be resistant to other treatment options. However the choice of exercise therapy is also fraught with difficulty for the clinician because aerobic exercises, strengthening exercises, coordination exercises, and specific stability exercises have all shown to be effective in the treatment of this condition.[10]

Research has developed specific exercises for transverse abdominis with the help of pressure biofeedback unit and concluded that this specific type of therapeutic exercise with pressure biofeedback provides effective pain relief for chronic and recurrent back pain sufferers through enhanced segmental stability.[9] The present study was designed to find out the efficacy of stability around the lumbar spine in patients with mechanical low back pain by providing stabilization exercises with pressure biofeedback.

Methods and Materials

A total of 30 young adult patients with mechanical low back pain were selected from the hospitals of New Delhi and NCR between the age of 20-45 years. Patients with any history of neurological involvement, surgery and any congenital bony anomaly were excluded. Prior to the intervention, all the subjects were given proper instructions, task familiarization and their informed consent to participate in the study was taken, as per the ethical guidelines of Indian Council of Medical Research.[11]

Study design

Pretest-Post test experimental study design was used.

Outcome measures

VAS (visual analogue scale) was used to assess the intensity of pain before the treatment and after the treatment and Modified Oswestry disability low back pain Questionnaire was used to give a score that indicates each patient's level of functional disability.

Intervention

A total of 30 patients was divided in 2 groups, each group having 15 patients of which 2 patients dropped out from group 2 in the second week of the 3 week intervention protocol. The first group was given lumbar stabilization exercises with pressure biofeedback Pressure Biofeedback Unit (Stabilizer TM, Chattanooga Group, INC., Chattanooga, TN) and other group was given stabilization exercises without pressure biofeedback. Both the groups underwent 3 week treatment program. Subjects were given lumbar stabilization exercises with and without the pressure biofeedback unit. Patients were made to hold the tuck in

maneuver of tummy for 10 secs and repeat each exercise ten times. Hot fomentation was given to patients in crook lying position and general stretching was given to the patient prior to exercise.

Data analysis

The data were analyzed using SPSS 16. Descriptive analysis was used for demographic data. Dependent variables were analyzed using paired students t- test. Pearson's chi square test applied to study gender based group differences. The significance value was set at P d"0. 05.

Results

The mean age of the sample was 30.4±7.6 years and BMI 19.8±2.6 kg/m^2. Pearson's chi square test revealed a resultant p value of 0.93(≥0.05) signifies no gender disparity between the two groups. The Student t-test analysis for pre-test of the outcome measures disability index and VAS reported no significant difference between the two groups mentioned in table 1 and table 2. In contrast, post test analysis for disability index and VAS showed a significant difference (p≤ 0.05) with a p-value of 0.02, indicating significant improvements in Group 1 than Group 2

Discussion

The aim of this study was to find out the efficacy of lumbar stabilization exercises using pressure biofeedback and without pressure biofeedback for pain and functional disability in patients with mechanical low back pain. Everett C Hills *et al* (2006) reported that mechanical low back pain is common in individuals less than 45 years of age and also a common cause of disability[6] that form the basis for which similar group of patients was incorporated in the present study. The reasons for this could be the occupation, genetics or the personal behavior. Occupations that increase the risk for low back pain are those that involve more of lifting, twisting, bending and reaching.

According to the researches present in the literature, both males and females either have an equal propensity to develop low back pain or females are more prone to it. Our result is supported by work done by --- Peter M Kent *et al* (2005) who conducted a study on epidemiology of low back pain in primary care and found that there was a small gender differences in the frequency of general medical consultation for low back pain (mean 7.0% for females and 5.5% for males), but it is unclear whether real gender differences exist or reflect the sampling error as the statistical significance of this difference was not reported.[12]

Disability relates to the patient's perception of how their particular problem is affecting their activities of daily living and their quality of life.[13] The disability questionnaire is the key to determine the response to treatment as it provide information about a wide range of functional status.[14] The questionnaire is a reliable predictor of disability with ICC 0.83-0.94.[15] The results from a post intervention

Table 1: Pretest –Posttest comparison of Disability Index between groups

Disability index	Group (n=15)	Group 2 (n=13)	p- value
Pre- test	33.8±11.55	31.54±17.53	p ≥ 0.05
Post- test	18.27±5.76	27.61±15.38	P< 0.05

Note: NS=Non Significant; *=significant (p valued"0.05)

Table 2: Pretest–Posttest comparison of VAS between groups

VAS	Group 1 (n=15)	Group 2 (n=13)	p-value
Pre- test	5.47±1.12	5.15±1.14	0.87 ^{NS}
Post- test	2.2±0.77	4.3±1.31	0.02*

Note: NS=Non Significant; *=significant (p valued"0.05)

of 3 weeks the inter group comparison of the present study revealed that the Disability index score was statistically significant in group A (with pressure biofeedback) as compared to group B (without pressure biofeedback). Lumbar stabilization causes co-contraction of transversus abdominis, posterior fibers of internal oblique and lumbar multifidus that increases the intra abdominal pressure and the tension of the thoracolumbar fascia.. These muscles are segmental muscles which directly attach to the lumbar vertebra hence are most responsible for segmental stabilization.[9,16] Consequently, stabilization of the spine is maintained by the intra abdominal pressure in the abdominal cavity and the stiffness of the lumbar spine.[16] Pressure biofeedback is a type of Knowledge of performance (KP) which is given during and after the performance of a task and is related how the task is performed. The therapist provides the information through the apparatus and by attending to the information the patient forms a close loop. Our results are also supported by the work done by Fábio Renovato França et *al*, (2010). They concluded that Segmental stabilization and strengthening exercises effectively reduce pain and functional disability in individuals with chronic low back pain.

Conclusion

Biofeedback techniques are used to augment the patients sensory feedback mechanisms through precise information about body processes that might otherwise be inaccessible.[19] The findings of this study provide evidence to support previous research, which indicates that a difference exists in the deep abdominal function of patients with and without low back pain. Additionally it is suggested that the pressure biofeedback unit may be considered as a useful tool to act as an indicator of deep abdominal function. Lumbar stabilization exercises using pressure biofeedback are more beneficial than lumbar stabilization exercises alone in mechanical low back pain patients.

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Original Article

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Preliminary Report on Common Complaints of Pandharpur Pilgramage - The Insite..

Abhijeet Diwate*, Sunil N. Mhaske, Pawan Suryawanshi*****

Abstract

The PANDHARPUR WARI is distinct from all other forms of pilgrimages like the 'yatra' in a variety of ways. To begin with, it is a collective form of BHAKTI (worship) often undertaken as an extension of family tradition. It has a predetermined scheduled and route and has no purpose other than sheer worship. The 'yatra' on the under hand is undertaken by individuals at their convenience to a variety of deities for personal reasons. Participating in the WARI is its own reward and Panduranga the lone object of worship. The WARI is a microcosm of the vast sects, sub-sects, castes and trades that go into the making of the state of Maharastra – as men, women, young and old people from all walks of life, age and socio-economic status walk alongside each other, never for a moment being aware of their differences or status. Most unconventional is the belief that the Lord Vithhal awaits this meeting with his devotees (bhaktas). The eagerness to meet Lord Vitthal and the repetitive chanting of RAM-KRISHNA-HARI refrain during the walk are unifying bonds among different peoples all termed WARKARIS. No other rituals dot the WARIKARI horizon unlike in the 'yatra' where host of rites and rituals are prescribed and have to be adhered to. In short, WARI is synonymous with annual pilgrimage on foot to PANDHARPUR and the WARKARI refers to the ardent devotee of Lord Vitthal.[1]

Keywords: Pandharpur; Warkari; Worship; Social aspect; Complaints.

Introduction

The Pandharpur yatra is held on Aashadi Ekadashi (June- July). One of the most famous pilgrimages in Maharashtra, Pandharpur Ashadhi Ekadashi Wari has been taking place for more than 700 years. This is a religious padyatra is comprised of over 1 million pilgrims traveling for 21 days to Vithoba temple by foot. Numerous palkhis (processions) from various towns and villages join the main palkhi that starts from Sant Tukaram Temple at Dehu in Pune district. The yatra culminates at the Vithoba temple on Ashadi Ekadasi at Pandharpur. The annual Pandharpur Yatra to the famous Vithoba Temple at Pandarpur in Maharashtra is an unparalleled pilgrimage that breaks the barriers of caste, creed, rich and poor. The main rituals are performed in the early morning (0300hrs).[1]

There is no definite information available on the origins of this "wari" tradition, which is a pilgrimage on foot to Pandharpur. However, there are some references about Vitthalpant, Saint Dnyaneshwar's father joining the Wari to visit Pandharpur in the month of Aashaad & Kartik (October / November). So it can be inferred that the state of Maharashtra has seen this tradition being followed since the last 800 years.The pilgrims known as "warkaris" started the main pilgrimage on 23rd of June from Dehu in Pune district on foot, carrying the palkhi (palanquin) of Saint Tukaram, a renowned devotee of Lord Vitthala, a form of lord Vishnu. This main procession was joined by other palkhis from other towns and villages like the famous Saint Dnyaneshwar palkhi from Alandi. On their way, the pilgrims

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played musical instruments like veenas, mridungas, dholkis and chiplis. The pilgrims also played the traditional folk dance "fugdi" with their infectious enthusiasm and energy. With the saffron coloured triangular 'paatakas' (flags) in hands and tulsi leaves on their heads the pilgrims presented a perfect picture of the Bhakti tradition of Maharshtra. These devout pilgrims got the reward for their long journey when they witnessed the "maha puja" of Lord Vitthala and his concert Rukhmini in Pandharpur on the Ashadi Ekadashi day. The maha puja was performed by Maharashtra chief minister Prithviraj Chavan and his wife Satyashila, as is the custom. Speaking to reporters after the puja, the chief minister said that that he prayed to lord Vitthala for good rains across the state for farmers' prosperity, and the state's development in all fronts.[2]

One of the most famous pilgrimages in India, Pandharpur Ashadhi Ekadashi Wari has been taking place for more than 700 years. The annual Pandharpur Yatra to the famous Vithoba Temple at Pandarpur in Maharashtra is an unparalleled phenomenon that breaks the barriers of caste, creed, rich and poor; which are so deeply rooted in the soceity. More than 40 'Palkhis' (palanquins) form a major part of the procession during the pilgrimage. The pilgrims follow the tradition of carrying the paduka (footwear) of the saints in a palanquin. This annual pilgrimage is a 21-day trek and culminates on the Ekadashi, that is the eleventh day after the full moon in the month Ashadh (June – July) according to the Hindu lunar calendar.The Warkaris, as the pilgrims are called, walk their way to Pandharpur and spend their nights in the camps set up in different villages en route. The local people from these villages make arrangements to lodge and feed the Warkaris, a scene of unadulterated humanity.[3,4]

The Warkaris give up all the wordly pleasures and comforts, during their journey to Pandharpur.

They uphold a strict vegetarian diet throughout and observe fasts during the pilgrimage. During this journey the Warkaris always address each other as 'Mauli' (mother like) and never use their real names. Most of the saints are fondly called as Mauli, thus breaking the wall between God and a human being. It is a belief that these saints still travel as a part of the Wari, through the Every year pilgrims from all over the Maharashtra gather together in Alandi-Dewachi and Dehu to do wari from alandi to souls of the other Warkaris.[5]

Materials and Methods

The study was undertaken by PDVVP's Medical college, Ahmednagar during period of July 07, 2013 to July 12, 2013(6 days) so as to include all pilgrims passing from Manmad – Shirdi highway during this period.

Total 963 pilgrims were included in study and all pilgrims were classified according to their complaints so as to include:

Inclusion criterion

- All pilgrims passing from Manmad – Shirdi Highway during period of July 07,

2013 to July 12, 2013(6 days).

Exclusion criterion

- pilgrims less than 10 years of age and more than 90 years of age
- pilgrims having chronic illness interefering with common complaints.

Observations

Total number of patients were 963 of which 592 (61.47%) were males and 371 (38.52%) were females (Table 1). Five hundred (51.92%) pilgrims were farmer, 126 (13.08%) were servant(Govt. and private sector), 49 were businessmans, 288 (29.90%) were from non specific group.

The most common complaints of pilgrims was muscular pain. 524 (54.41%) out of 963 pilgrims had muscular pain (Table 2).

Joint pain is second common complaint amongst pilgrims with 368 (38.21%) out of 963 had joint pain distribution as per Table 3.

Remaining 575 (59.70%) out of total 963 pilgrims had other complaints as per table 4

All pilgrims were screened according to their complaints and tables are made so as to highlight common complaint.

Table 1: Agewise Distribution of total pilgrims. (n=963)

Age in years	No of cases		
	Male	Female	Total
10-20	07	04	11
21-30	27	21	48
31-40	100	70	170
41-50	190	106	296
51-60	160	109	269
61-70	98	56	154
71-80	07	05	12
81-90	03	00	03
TOTAL	592	371	963

Table 2: Distribution of pilgrims according to muscular pain involvement

Part involved	No of cases		
	Male	Female	Total
Upper limb	145	59	204
Lower limb	200	110	310
Chest	07	03	10
TOTAL	352	172	524

Table 3: Distribution of pilgrims according to joint involvement

Joint involved	No of cases		
	Male	Female	Total
Spine	66	54	120
Hip	05	02	07
Knee and Ankle	95	110	205
Shoulder	08	07	15
Elbow and wrist	15	06	21
TOTAL	189	179	368

Table 4: Distribution of pilgrims according to Common Complaints

	No of cases		
	Male	Female	Total
Non specific pain	05	05	10
Respiratory tract infection	132	53	185
Mouth ulcer	08	07	15
Gasritis(Hyperacidity)	44	56	100
Skin Allergies	28	12	40
Leg ulcers	12	08	20
Loose motion	23	32	55
Headache	44	16	60
Fever	20	15	35
Nausea Vommiting	05	15	20
Tingling , Numbness	08	02	10
breathlessness	17	08	25
TOTAL	346	229	575

Discussion

Every year Warkaris walk hundreds of miles to the holy town of Pandharpur, gathering there on *ekadashi* (the 11th day) of the Hindu lunar calendar month of Aashaadha (which falls sometime between late June to July in the Gregorian Calendar). Warkaris making the pilgrimage to Pandharpur carry the *palkhis* (palanquins) of the Saints from their places of *Samadhi*. According to historians, Vitthal devotees were holding pilgrimages prior to the 13th century.

In the present times , many devotees, come from all over Maharashtra to Pandharpur. All age group male –females irrespective of caste –religion, economic, social status come to Pandharpur by walking. In this study we have tried to get a preliminary report regarding their complaints. It was surprising report that in our study we have seen both the age group of

persons walking to Pandharpur in wari. In pediatric age group total 11 children were participated where as 170 senior citizens was walking in wari esp. 3 Warkaris were in the age group of 81-90 yrs. Many of them were farmers also few from government retired person and businessman. Major complaints we got from this study of only musclie/joint pain. Irrespective of distance not single warkari had cardiac or breathing difficulties in any age group. By analgesics and physiotherapy they got the relief of muscle and joint complaints.

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7. Adapted from Sri Jnanadeva's Bhavartha Dipika, 671.

Original Article

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Effectiveness of Cervicothoracic Mobilisation on Grip Strength in Subjects with Impingement Syndrome

Pallavi Chugh*, Lipy Bhat, Abhishek Sharma**, Ravinder Narwal****

Abstract

Aim and Objective: Shoulder joint is the most common joint to be effected by the degenerative process of the body. As it offers more mobility than stability, overuse injuries not only affect the shoulder joint but also exert their effect to distal segments of the limb. Due to the anatomical linkage with the spine, any abnormality at the shoulder is thereby suspected to affect the spinal biomechanics and the associated nervous system functioning. Researchers have postulated hand muscle weakness to be an associated finding in subjects with shoulder joint pathologies and thus the following study was aimed at determining the effectiveness cervicothoracic mobilization and hand grip exercise on grip strength in subjects with impingement syndrome. **Method:** 20 subjects with history of impingement syndrome for at least 4 weeks and positive Neers and Hawkins Kennedy test were randomly assigned into two groups of 10 subjects each. Group A underwent cervicothoracic mobilization and group B received hand grip strengthening protocol for 1 month, thrice a week and once a day. Readings for grip strength were taken by a hand held dynamometer before starting and after the intervention i.e. after one month. **Data Analysis:** Statistics were performed using Graph pad. Intra group and inter group analysis was done and Mann Whitney test was used to analyze and compare the intervention scores. Significance level was set at p d" 0.05. **Results:** Though both the groups improved significantly, group A, cervicothoracic mobilization group resulted in more significant hand grip strength improvement when compared with group B, the hand grip exercise group. **Discussion and Conclusion:** results conclude that apart from the standard hand grip exercises, cervicothoracic mobilization can be effectively used to enhance the grip strength in subjects with impingement syndrome.

Keywords: Cervicothoracic junction; Hand grip; Supraspinatus tendinitis; Impingement syndrome.

Introduction

Neck pain and shoulder pain are one of the most controversial topics in medicine. The disorder involving both physical and psychological disturbances remains a poorly understood and challenging clinical entity. Generalized shoulder pain and neck pain are common problems that are difficult to treat and are frequently recurrent. Researchers have shown that long-term shoulder pain can lead to a considerable restriction of work and leisure activities.[1]

Rotator cuff tear, periarthritis, bursitis and impingement syndromes are few of the most commonly occurring shoulder pathologies and being one of the most vulnerable joints to be affected by the degenerative and overuse injuries, rotator cuff tendinitis or supraspinatus tendonitis at the shoulder has been estimated to be the cause of shoulder pain in about 7% to 25% of the general population with an incidence at 10 per 1,000 per year, peaking at 25 per 1,000 per year among those 42 to 46 years of age.[2]

Impingement syndrome refers to a pathological condition in which there is irritation and inflammation of the supraspinatus tendon secondary to abrasion against the under surface of the anterior one

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third of the acromion. It is commonly seen in overhead athletes.[3]

Sobel *et al* (1997) found that restricted mobility in the cervicothoracic spine in patients with shoulder pain did not seem to recover significantly even after 26 weeks. In another study it was found that the reduced relative mobility at levels C7-T1 and T1-T2 significantly predicted neck-shoulder pain and the symptomatic weakness in the hands and it was estimated that 14% of neck-shoulder pain and 15% of weakness in the hands was due to reduced mobility.[4]

Cervical spine manipulation and rib raising techniques have been widely used to treat the hand muscle weakness but due to the risk involved in the cervical spine manipulation and difficulty in mastering the technique by general population, investigators suggested the use of cervicothoracic spine mobilization as an intervention in management of patients with shoulder pain. Therefore the following was done to determine the effectiveness of cervicothoracic spine mobilization on grip strength and to compare its effectiveness with the hand grip exercises.

Methodology

All the subjects were divided randomly into two groups A and B on the basis of inclusion and exclusion criteria. Each group have 10 subjects and their consent was taken after complete explanation of the procedure and its outcomes. Initial readings of grip strength were recorded by a hand held jamar dynamometer at the same time.

To record the grip strength the subject was seated in a chair with forearm supported and the upper limb positioned according to the recommendations of the American Hand Society of Hand Therapists *i.e.* shoulder adducted and neutrally rotated, elbow 90° flexed, forearm in neutral position, and wrist slightly extended (0-30°).

The subject was told to squeeze the handles of the dynamometer together with as much force as possible and make a total of three attempts in the above mentioned position, thereafter the mean of these readings was recorded in kgs. To control for fatigue, the subject was asked to take a rest period of 30 sec between each attempt.

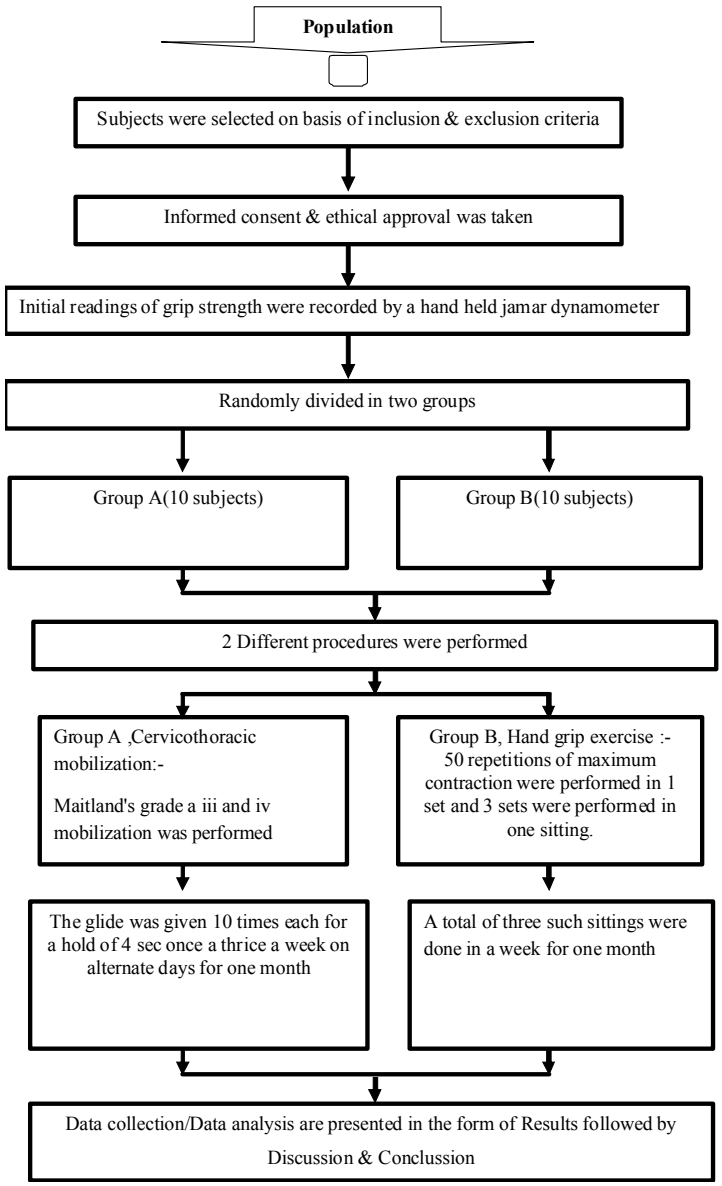
The subject of group A *i.e.* cervicothoracic mobilisation group was made to lie prone on a couch with hands under the forehead and region of cervical and upper thoracic spine exposed. Next C5, C6, C7, T1, spinous processes were palpated. The palpation was done in a cranio caudal direction, with the therapist standing at the head end and first palpating the occipital protuberance, dip of C2 and further removing the slack, palpating the spinous processes and descending down. The shoulder and elbow of the therapist was aligned 90° to the subjects spine. The spinous processes were palpated using the thumb of the therapist and were marked with a permanent marker.

Next, Maitland's grade a iii and iv mobilization was performed (under the supervision of the guide) in postero- anterior direction 10 times each for a hold of 4 sec once a thrice a week on alternate days for 1 month. Subsequently lateral glide of grade iii and iv (on the day, spinous process) was given opposite to the affected side with subjects lying in prone, hands by the side and therapist standing on the affected side with arms perpendicular to the level of the spine of the subject that is to be mobilised. The glide was given 10 times each for a hold of 4 sec once a thrice a week on alternate days for 1 month.[5]

Data collection

The mean reading for hand grip was taken at the end of four weeks by a hand held

Flow Chart



hydraulic Jamar dynamometer.

For group B *i.e.* hand grip exercise group, subject was asked to follow the following hand grip strengthening protocol with a hand grip exerciser. 50 repetitions of maximum contraction were performed in 1 set and 3 sets were performed in one sitting. A total of three such sittings were done in a week for one month.

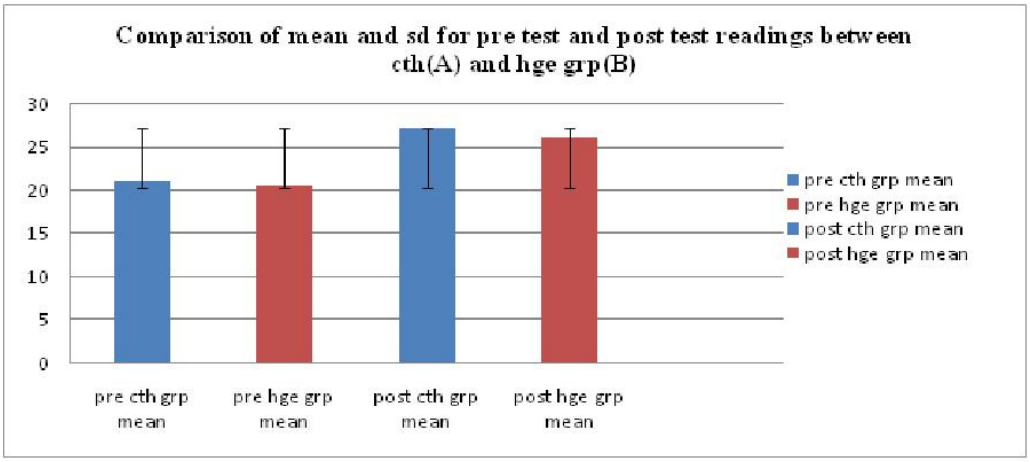
To use the exerciser, subjects were seated in a chair with forearm supported and shoulder adducted, elbow 90° flexed, wrist 20° in extension and 5° ulnar deviation and, were instructed to squeeze the springs together.

The fingers should be squeezed as tightly as possible, to get the greatest possible benefit. The subjects were made to exercise with only three springs for the first week, four springs for the second week, five springs for the third week and six springs for the fourth week. The mean readings for grip strength were taken after four weeks by a hand held jamar dynamometer. At the end of one month, pre test and post test hand grip strength scores obtained were used for the data analysis.[6]

Table 1

Variables	Pre treatment Mean ± St. Deviation	Post treatment Mean±St. deviation	Between Group p value
Cervicothoracic mobilization(A)	21.06 ±0.56	28.32 ± 1.37	= 0.05
Hand grip exercise(B)	20.46 ± 1.33	26.06 ± 0.97	
Within Group p value	= 0.05	= 0.05	

Fig 1: Comparison of mean and standard deviation for pre test and post test readings for cervicothoracic and hand grip exercise group



Data analysis

Statistics were performed using Graph pad. Intra group and inter group analysis was done and Mann Whitney test was used to analyze and compare the intervention scores. Significance level was set at p d" 0.05.

Results

Table1:Comparison of mean, standard deviation, and p value for pre treatment and post treatment values of cervicothoracic mobilization group (group A) and hand grip exerciser group (group B).

Discussion

The present study was done on 20 individuals, divided into 2 groups of 10 subjects each according to the inclusion criteria. The end result was formulated on the basis of changes in grip strength values measured by a hand dynamometer in the two groups i.e Group A and Group B.

Most impotent finding of this study reveals that both the gost roups were found to be significantly improved in hand grip scores however, groupA (cervicothoracic mobilization group) improved more significantly than group B (hand grip exercise group).

The possible explanation for improvement in group A *i.e.* cervicothoracic mobilization group can be attributed to the reversal of the abnormal anatomical, physiological or biomechanical dynamics of the contiguous vertebrae that adversely affect function of the nervous system. According to Pickar biomechanical changes caused by spinal mobilization are thought to have physiological consequences by means of their effects on the inflow of sensory information to the central nervous system. Muscle spindle afferents and Golgi tendon organ afferents get stimulated which can lead to increased muscle recruitment and thereby increased muscle strength.[7]

As the rotator cuff is innervated by nerves arising from the mid and lower cervical spine, it is theorized that dysfunction of the spinal

joints adversely affects nerve endings, causing inhibition of nerve function and affecting the rotator cuff. This is congruent with research which describes how there could be a decrease in muscular activity due to interference with the nerve supply of a muscle by means of a spinal joint fixation. In light of this, one could hypothesize that removal of a cervical joint dysfunction by manipulation, could increase motor unit recruitment and muscular activity of the muscles supplied by that cervical level and therefore possibly strengthen the muscles involved. This supports the improvement in strength of gripping muscles after the mobilization of C5-T1 cervical spines because the forearm and hand muscles are mainly supplied by the C5- C8 cervical segments.[8]

The improvement in group B *i.e.* hand grip exercise group can be attributed to the neural and muscular adaptations taking place in the contractile structure of the muscle. Although it takes 8 weeks for full strengthening to take place but neural adaptations have been shown to take place in initial 2 weeks of the strengthening program followed by the muscular adaptations. (Richard Lieber Skeletal muscle structure, function and plasticity).[9]

The reason for a more significant improvement in group A *i.e.* cervicothoracic mobilization group over group B *i.e.* hand grip exercise group can be due to the direct concentration of the muscle inhibiting mechanism at the spinal level rather than its peripheral component. The correction of the hypo mobility or the biomechanical alterations in the cervical and thoracic spine caused by the impingement syndrome at the shoulder might be responsible for the increased mobility of the originating nerve roots from the specific spinal levels, thereby increasing the nerve conduction velocity and further improving the muscle unit recruitment of the hand gripping muscles.[10,11]

More significant effects of mobilization can also be explained with the support of studies inferring the physiological and biomechanical changes brought by manipulation of the spinal segments. In a literature review on updates on manipulation and exercise by Malik in 2009 it is stated that from a purely logical perspective, it makes sense that spinal manipulation will add a substantial benefit to exercise. Manipulation by improving range of motion, overcoming abnormal restrictive barriers, increasing and normalizing mechanoreceptive input from articular and periarticular structures, and restoring normal motor programs may allow a joint to derive more benefit from exercise training while minimizing the risk of injury. The study also proposes that spinal manipulation is a superior treatment over the exercises alone but best results are seen when both are used as a synergistic treatment.[12,13]

Clinical relevance

Although hand grip strengthening exercises are known to increase the grip strength, the effectiveness of an intervention concentrating on the spinal control of the grip strength was questionable. The following study demonstrated the effectiveness of cervicothoracic mobilization in increasing the hand grip strength in impingement syndrome subjects and so should be included in the therapy regimen.

Future research & Limitations

The study was done on a small sample size. Mobility of the specific spinal segments was not checked before administering the mobilization and resistance of the springs used in hand grip exerciser was not evaluated.Future research is necessary with a comparatively large sample size to determine the carryover of the improvement after the treatment session terminates. The influence of age, sex and dominance on hand grip strength may also be evaluated along with specific grip style testing. The variation in grip strength after each week of intervention can also be recorded for further evaluation.

Conflict of interest & Ethical approval

There was no conflict of interest was reported among all authors. This research

work is approved by ethical committee of HIPMS, HIHT University (UK) India.

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Review Article

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Short Term Effects on Peak Extensor Torque of Muscle by Multi Modal Method of Stretching: A Review

Saurabh Sharma

Abstract

Stretching is traditionally used as part of a warm-up to increase flexibility or pain-free range of motion (ROM) about a joint in an attempt to promote better performances and/or reduce the risk of injury. Physiotherapist also recommend that their athletes or patients stretch before performing strengthening exercises or strength assessment tests. However, authors of recent systematic reviews have suggested that pre-exercise stretching may temporarily compromise a muscle's ability to produce force and power output. This ''stretching-induced force deficit'' has been reported to affect isometric force , Power, concentric isokinetic peak torque , dynamic constant external resistance (DCER) force , vertical jumping performance and balance different types of PNF techniques have been suggested like static, dynamic , Hold Relax and Contract–Relax, Agonist Contraction and Hold–Relax with Agonist Contraction . Effects of stretching on strength / torque and performance is still in inconclusive with studies showing both increase and decrease in both the variables. There is dearth of evidence related to the subject of peak torque after modal variants of stretching, hence in future there is need for randomized controlled trial on athletes and various patient populations.

Keywords: Stretching; PNF; Torque; Performance.

Introduction

Stretching prior to participation in sports activities is standard protocol for all levels of sports, competitive or recreational.[1] Stretching is traditionally used as part of a warm-up to increase flexibility or pain-free range of motion (ROM) about a joint in an attempt to promote better performances and/or reduce the risk of injury.[2] Rehearsal of the skill about to be performed is incorporated into the warm-up regime at incremental intensities so that the specific muscle fibers and neural pathways are recruited for optimum performance.[3]

Physiotherapist also recommend that their athletes or patients stretch before performing strengthening exercises or strength assessment tests. However, authors of recent systematic reviews have suggested that pre-exercise stretching may temporarily compromise a muscle's ability to produce force and power output. It may be possible that this short-term effect of stretching on muscle force and power production may have negative effect on performance of various rehabilitation exercises.[2]

This ''stretching-induced force deficit'' has been reported to affect isometric force , Power, concentric isokinetic peak torque , dynamic constant external resistance (DCER) force , vertical jumping performance and balance.[4]

Two main assumptions have been put forward to rationalize the stretching-induced force deficit: (a) mechanical factors, such as decrement in musculotendinous stiffness that may affect the muscle's length – tension relationship and/or sarcomere shortening velocity and (b) neural factors, that may reduce peripheral muscle activation, reduced muscle firing frequency, and/or altered reflex sensitivity. Fowles *et al* (2000) suggested that

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stretching-induced decreases in neural drive could only account for a percentage of the force deficit, and thus mechanical as well as neural factors may contribute to the stretching induced force deficit.[4]

Number of researches have examined the effects of static and dynamic stretching preceding strength training, jumping, running and power performance. Static stretching, as the name implies, involves stretching a muscle and holding the stretch with minimal or no movement for a given duration. Many research studies suggest that static stretching before strength training or jumping may result in decrease performances. Static stretching may reduce the nervous system's ability to recruit muscles or it may reduce the ability of the muscle to produce force and power directly.[5] Consequently, a reduction in maximal torque and power output post stretching might be related to a change in neural or mechanical status.[6]

It has also become clear that static stretching may negatively affect immediate physical performance[7] and the "active" component has been shown to benefit performance by increasing core temperature, blood flow, and preparing the body for Exercises[3], Because of this, dynamic stretching has been recommended as an alternative to static stretching for warm-up, as evidence suggests that dynamic stretching positively impacts on immediate physical performance[9]

There has been little research investigating the acute effects of static stretching of the antagonist on the expression of strength and power. Previous research has investigated the effects of stretching on the muscle primarily involved in the movement. Only one published research has attempted to determine the effects of static antagonist stretching of muscle for a given movement. But no known research has attempted to examine and compare the effects of static and dynamic stretching of the antagonist muscle for a given movement. Antagonist muscles provide a braking force to the movement of their opposing muscles, stretching the antagonist muscle could reduce this braking force. This could potentially enhance strength and power following antagonist stretching. Gains in strength may be accompanied with an increase in neural activity of the agonist and neurological inhibition of the antagonist.[10] Stretching the agonists prior to a given movement may decrease the agonist muscle strength and power, perhaps through decreased neural drive.[11] Conversely, stretching the antagonists may result in their inhibition and reciprocally facilitate increased activity of the agonists, with subsequent improvements in strength and power related performance.[5]

Types of stretching

There are three types of stretching: Static, Dynamic, and Proprioceptive neuromuscular facilitation (PNF).

Static stretching

The most common type is static stretching, where the muscle is held to a point of a stretching sensation and repeated. This can be executed passively by a clinician, or actively by the patient or client. Static stretching is frequently used to increase flexibility due to safety and ease of use. This technique is effective in enhancing range of motion. The clinical pearls for effective static stretching are maximum control, little or no movement, and minimal to no velocity of movement.[12]

Dynamic stretching

There are 2 types of dynamic stretching: active and ballistic stretching. Active stretching involves moving an extremity through its full range of motion to the end ranges and repeating several times. Ballistic stretching involves rapid, alternating movements or 'bouncing' at end-range of motion; but because of increased risk for injury, ballistic stretching is no more advised.

Unlike ballistic stretching, active stretching does not increase the risk of injury and the joint of the limb is stretched with a movement that resembles part of a sport skill. Dynamic

stretching is considered to elevate core body and deep muscle tissue temperatures, increase post-activation potentiation, and probably reduces the risk of injury. This may increase force and power development and vertical jump performance.[12]

Proprioceptive neuromuscular facilitation (PNF)

Proprioceptive neuromuscular facilitation techniques used for stretching (PNF stretching), also referred to as active stretching or facilitative stretching, accumulate active muscle contractions into stretching maneuvers to facilitate or inhibit muscle activation and to increase the chance that the muscle to be lengthened remains as relaxed as possible as it is stretched. It is believed that when muscle fibers are reflexively inhibited through autogenic or reciprocal inhibition, there is less resistance to elongation by the contractile elements of the muscle. However, inhibition techniques are designed to relax only the contractile structures of muscle, not the connective tissue in and around shortened muscles.[12]

Types of PNF stretching

There are several types of PNF stretching procedures. They include: Hold–relax (HR) or contract–relax (CR) , Agonist contraction (AC) and Hold–relax with agonist contraction (HR-AC).

Hold–relax and Contract–relax

With the hold–relax (HR) procedure, the muscle is first lengthened to the point of limitation or to the extent that is comfortable for the patient. The patient then performs a prestretch, end-range, isometric contraction (for 5 to 10 seconds) followed by voluntary relaxation of the tight muscle. The limb is then passively moved into the new range as the range-limiting muscle is elongated.

Agonist contraction

Another PNF stretching technique is the agonist contraction (AC) procedure. The "agonist" refers to the muscle opposite the range-limiting muscle. "Antagonist," therefore, refers to the range-limiting muscle. As the short muscle (the antagonist) preventing the full movement of the prime mover (the agonist). Dynamic range of motion (DROM) and active stretching are terms that have been used to describe the AC procedure.

To perform the AC procedure the patient concentrically contracts (shortens) the muscle opposite the range limiting muscle and then holds the end-range position for at least several seconds. The movement of the limb is independently controlled by the patient and is deliberate and slow, not ballistic. In most instances the shortening contraction is performed without the addition of resistance.

Hold–relax with agonist contraction

The HR-AC stretching technique combines the HR and AC procedures. The HR-AC technique is also referred to as the slow reversal hold–relax technique. To perform the HR-AC procedure, move the limb to the point that tissue resistance is felt in the tight (range-limiting) muscle; then have the patient perform a resisted, prestretch isometric contraction of the range-limiting muscle followed by relaxation of that muscle and an immediate concentric contraction of the muscle opposite the tight muscle. For example, to stretch knee flexors, extend the patient's knee to a comfortable position and then have the patient perform an isometric contraction of the knee flexors against resistance for 5 to 10 seconds. Tell the patient to relax the knee flexors and then actively extend the knee as far as possible, holding the newly gained range for several Seconds.[13]

Effects of stretching on strength and performance

The majority of studies show that static stretching has either no effect or decreases performance whereas dynamic stretching has either no effect or improved performance. These findings indicate that sports relying on high lower-body power output may benefit from dynamic stretching instead of static stretching prior to activity.

Both neural and mechanical factors have been proposed for stretching-induced decreases. Many different peripheral mechanisms have been put forward to explain reduced muscle activation after stretching. These encompass the autogenic inhibition of the Golgi tendon reflex, mechanoreceptor and nociceptor afferent inhibition, fatigue-induced inhibition, joint pressure feedback inhibition due to excessive ranges of motion during stretching, and stretch reflex inhibition originating from the muscle spindles. A central nervous system mechanism, such as "supraspinal fatigue", has also been suggested as a mechanism. The mechanical factors involve the viscoelastic properties which affect the muscle's length tension[14] and decreasing the amount of elastic energy that can be stored in the musculotendinous unit. However, some studies have found that dynamic stretching has the opposite effect of enhancing performance. This phenomenon has been linked to the rehearsal of specific movement patterns, helping proprioception and preactivation, and allowing an optimum switch from the eccentric to concentric muscle contraction required to generate high running speeds.[15] In one of the repeated measures study of fifty-one moderately to very active subjects, no significant difference was found between the three treatments of static or dynamic stretching and no stretching in 1 repetition maximum for bench and leg presses. The study came to result that if the stretching routine is not intense and long, then pretesting stretching probably will not adversely affect strength tests. In this study, three sets of fifteen seconds were performed for the static stretching and 15 repetitions were performed for the dynamic stretch protocol.[17] Belm *et al* found impairments in balance, reaction time and movement time post-stretch when they used a static stretching protocol involving the quadriceps, hamstrings, and plantar flexion at three sets of forty-five second stretches each.[16] Egan, *et al* measured the peak torque and mean power output of maximal concentric isokinetic leg extensions at 60° and 300° after a bout of static stretching of eleven NCAA DI Women's Basketball players.[17] Four leg extensor stretches were performed four times and held for thirty seconds. This stretch protocol was the same used in studies that found a strength deficit from pre-exercise static stretching, but the results showed that isokinetic peak torque and mean power were not reduced. Egan *et al* concluded that strength in these trained athletes may not be affected by an intense static stretching protocol.[17] Little & Williams evaluated how different stretching protocols during warm-ups effect high speed motor capacities in professional soccer players.[18] Eighteen professional soccer players were examined for countermovement vertical jump, stationary 10-m sprint, flying 20-m sprint and agility performance after each stretch protocol. The three regimes of static, dynamic and no stretch were executed on three nonconsecutive days. Four different static stretches were performed with a 30 second hold and twenty seconds of rest between stretches. Dynamic stretches were performed on alternating legs for 60 seconds with approximately one stretch cycle every 2 seconds or unilaterally for thirty seconds with approximately one stretch cycle every second. The total time spent on stretching was 6 minutes and 20 seconds. All tests were performed in the same order for each protocol with twenty seconds between each test. There was no significant difference among the different stretch protocols for the vertical jump. Both static and dynamic led to better performance than no stretch in the 20m Max speed, but only dynamic was significantly faster than no stretch in the 10 m acceleration. Dynamic was much faster than the static and no stretch regimes in the zig-zag agility. In

summary, dynamic stretching produced better performance than static in 1 of the two tests used (agility) and showed a tendency for having more efficacy in 2 of the three other tests. From these results, the authors suggested that the decrements that other studies have seen following static stretching may have been avoided in this study due to the shorter stretch duration. The authors came to a result that dynamic stretching, as opposed to static stretching or no stretching, is probably most effective at preparation for the high-speed performances required in sports such as soccer and that, if static stretching is used, it should be limited to short durations and be followed by further activity to minimize decrements to power-based performance.[18]

Siatras *et al* evaluated vaulting speed in gymnasts after static and dynamic stretching.[19] Eleven healthy prepubescent boys participated in the study. On nonconsecutive days, the athletes performed a general warm-up only, a general warm-up and static stretching exercises, and a general warm-up and dynamic stretching exercises. Two 30 second stretches were performed with each stretch protocol. The static stretches were each held for 30 seconds and the dynamic stretch motions were performed as quickly as possible for 30 seconds. Vault speed was significantly slower in the static stretching and warm-up compared to warm-up only ($P<0.01$). No significant differences were found between the dynamic and static or the dynamic and warm-up protocol. The study suggests that, though stretching is necessary for flexibility, it is not advisable to perform static stretching prior to activities like vaulting.[19] Zakas, *et al* used a Cybex NORM dynamometer at angular velocities of 60, 90, 150, 210 and 270°/seconds to evaluate the peak torque of fourteen semiprofessional soccer players after static stretching sessions.[19] Each player had to complete each of the three sessions within a week of the previous. Static stretching of the quadriceps muscle group was done in all three regimes with the difference being in the number of stretches: 1 x 30 seconds, 10 x 30 seconds and 16 x 30 seconds. All three stretch protocols significantly increased knee flexion from pre to post stretch. There was no clinically significant difference in between group range of motion. Isokinetic peak torque was also measured pre and post stretch with no significant difference was found after the single 30 second stretch protocol, but significant decreases in peak torque were found after the 10 x 30 second and 16 x 30 second protocols. The first four velocities (60, 90, 150, 210°) in the 10 x 30 second and the first two of the 16 x 30 second had a P value of < 0.01 while the 270° for the 10 x 30s and the last four speeds of the 16 x 30 seconds had a P value < 0.001. The authors could not pinpoint a specific mechanism explaining the results, but the neural inhibition and tissue damage could probably explain the decrease caused by the prolonged static stretching.[20]

Marek, *et al* compared the acute effects of static and proprioceptive neuromuscular facilitation stretching on muscle strength, mean power output, active range of motion, passive range of motion, electromyography amplitude of the vastus lateralis and rectus femorus muscles during concentric isokinetic leg extensions at 60 and 300°/ second.[21] Four repetitions of each stretching exercise were held for 30 seconds with a 20 second rest between each stretch. PNF and static protocols were performed in two different visits. Both regimes increased active and passive range of motion and caused similar decrement in strength, power output, and muscle activation at both velocities. The study concluded that effect sizes for these changes were small and that practitioners need to consider a risk-to-benefit ratio when incorporating static or PNF stretching.[22]

Cramer *et al* used a Cybex 6000 dynamometer to evaluate the acute effects of static stretching on leg extensor peak torque at 60 and 240°/second. The authors concluded that these finding support the theory that a central nervous system mechanism, such as "supraspinal fatigue", may be responsible for the decreases in force following an acute bout of static stretching.[13]

John B. Sandberg studied the effects of static stretching of the antagonist muscles on a

variants of strength and power measures.[5] Sixteen active males were tested for vertical jump height and isokinetic torque production in a slow knee extension (KES) at 60°/s and a fast knee extension (KEF) at 300°/s. Electromyography was taken during knee extension tests for the vastus lateralis and the biceps femoris muscles. Subjects executed these tests in a randomized counterbalanced order with and without prior antagonist stretching .Paired samples t tests revealed a significant ($p = .034$) difference between stretch KEF and non-stretch KEF conditions. There was no significant ($p > .05$) difference between KES stretch and non-stretch conditions. Vertical jump power was also higher in the stretch versus the non-stretch condition .These results suggest that stretching the antagonist hamstrings prior to high speed isokinetic knee extension increases torque production. It also demonstrated that stretching the hip flexors and dorsi flexors may enhance jump height and power. Practitioners may use this information to acutely enhance strength and power performances.[5]

Considering the review of the evidence related to the above said topic of generation of peak torque after the static and dynamic stretching , it seems that still there is dearth of evidence related to the subject of peak torque after modal variants of stretching, hence in future there is need for randomized controlled trial on athletes and various patient populations.

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