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CONTENTS

EFFECT OF DEEP CERVICAL FLEXOR MUSCLES TRAINING USING PRESSURE BIOFEEDBACK ON PAIN AND DISABILITY IN BIKE RIDERS WITH NECK PAIN

Tanbir Ahamed[1], Nishat Quddus*[2], Sohrab A. khan[3], Suraj Kumar[4]

ABSTRACT

Introduction: Bike riders often complain of neck pain due to their busy scheduled and most of the time spent on the bike which causes neck pain by different precipitating factor. There are lots of study available on the neck pain and study have already done on different groups of people concerning the neck pain but there are limited study available rather than a little study is only available on the neck pain among bike riders. Thus this study is undertaken to compare the effectiveness deep cervical neck flexor muscles training using pressure biofeedback and conventional exercise among bike riders. **Methodology**: Group A were given deep cervical neck flexor muscles training using pressure biofeedback and conventional exercise, Group B were given only conventional exercise for 4 weeks. Pain on NPRS scale and Disability score on NDI were measured. **Results:** The data analysis revealed that there was a significant improvement in pain and disability in both the groups but results in experimental group were better than the control group. **Conclusion:** The result of the present study shows that there is significant improvement in the pain and disability after 4 weeks of deep cervical flexor training in bike riders with neck pain when training is done by using pressure biofeedback and conventional exercise both. When compared this training with the control group it is found to be superior to the training done by only conventional exercises. But within the both group it is found that both treatment is effective in decreasing neck pain.

Key words – Neck pain score, Neck Disability index, Deep Cervical flexor muscles, Pressure biofeedback, bike riders.

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Introduction : Now a day's neck pain is the most chronic problem after low back ache. Day by day its prevalence is increasing. From corporate sector to housewives, from old aged person to school children, every one suffers from these diseases at any stage of their lives. In the introduction to the report of the "Bone and Joint Decade 2000–2010 Task Force on Neck Pain and Its Associated Disorders," Haldeman et al [1] state that "most people can expect to experience some degree of neck pain in their lifetime."it becomes the most discussed health related problem now a days. This disorder can affect both men and women. In general neck pain is more common among women than the men and symptoms become more prevalent with increasing the age. The review of existing literature on neck pain suggests that neck pain is experienced by people of all age group including children and adolescents. Therefore it occurs irrespective of age. Age as a risk factor for incident of neck pain is equivocal. However, as other musculoskeletal conditions the prevalence of neck pain increase with older age peaking in the middle age and declined in later age. Neck pain depends upon its determinants which are usually causative factor for neck pain. These determinants consider as the burden or risk factors of neck pain. There are variety of risk factors and associated risk factors which have been considered as predisposing factor for neck pain. Among them accident, collision work place, health factor, social factor, personal behavioral factor psychological factor is very common. In work place and health behavior factor it is found in literature that motor cycle rider has an increased risk factor for developing neck pain. In work place, the computer users also have an increased risk for the neck pain development. Personnel behavior like smoking, affluent life style, etc. also put stress on neck.

With the increase prevalence of neck pain, literature also produces support on the treatment and management of neck pain to get rid of it. Study conducted by Jull et al., was designed to determine the effectiveness of six week low load cranio-cervical flexor exercise program in cervicogenic headache patients. The results showed that the treatment did significant reduction in the pain associated with neck movements.

Deep cervical flexor training as a treatment for neck pain and resulting disability is based on rational that deep cervical flexor the longus coli muscle, which have a major role in postural function to support the cervical lordosis especially in functional mid range of cervical spine, lose their endurance capacity in patients with neck pain. Therefore, it is attributed that pressure bio-feedback specially target deep neck flexor muscles and decrease neck pain which occur due to its impairments.

Research recommends that training which emphasizes the correct use of the deep cervical flexor muscles before introducing strengthening of the global cervical spine musculature has been shown to be more affective in the rehabilitation of the cervical spine. Retraining the deep cervical flexor muscles has shown to decrease neck symptoms. Neck muscle training also improves the disability score and significantly reduces self reported neck pain but both endurance strength training and referent exercise intervention involving low load retraining of the craniocervical flexor (CCF) muscle reported a reduced average intensity of neck pain and reduced neck disability index (NDI) score. Hence, cranio-cervical muscle training is recommended clinically for the management of neck pain.

With the above point of view, this study was designed to determine the effect of deep cervical muscle training using pressure bio-feedback on neck pain and disability in bike riders with neck pain. As literature support, motor cycle riding is a causative factor for neck pain; this study was undertaken.

Methods

The study was conducted at H. A. H Centenary Hospital and E.S.I. Hospital (Okhla) using pretest-posttest group design. The subjects were randomly selected into experimental and control group. The experimental group received deep cervical flexor muscles training using pressure biofeedback and conventional exercise where as the control group received deep cervical flexor muscles training using conventional exercise only. All the subjects were recruited from different hospital in New Delhi on the basis of inclusion and exclusion criteria.

- Hakeem Abdul Hamid Centenary Hospital (physiotherapy department)
- E.S.I. Hospital Okhla .

The subjects will be matched according to the following criteria and then will be randomly assign.

Protocol:

In the above mentioned hospital in physiotherapy department the patient is first identified and they were screened first according to the inclusion and exclusion criteria. The entire subject who met the inclusion and exclusion criteria was included in the study. They were informed about nature, procedure and application of the study, its aim and objectives were made clear to the patients and if he agreed to participate in the study then only Informed consent was taken and he was included in the study. After signing the consent form subjects were then randomly allocated into two groups. All the doubts from the participants were cleared.

Group A- Experimental Group

Subject in this group received the treatment for neck pain in terms of neck flexor muscle training using pressure biofeedback and conventional exercise simultaneously.

Group B – Control Group

Subject in this group received only conventional exercise program for the purpose treatment.

CCF test using pressure biofeedback-

Performed with the patient lying in supine position with inflated pressure biofeedback unit placed under the occiput set at 24mm Hg, and performing a gentle head nodding Action of CCF (indicating yes) for 5 incremental stages of increasing difficulty (20-30mm Hg). Each stage is held for 10 seconds. Inability to sustain target pressure levels of 24 mmHg or greater for a period of 10 seconds is poor performance on the clinical craniocervical flexion test.

Conventional Exercise was done ensuring that the craniocervical spine was maintained in neutral position while head was lifted off the supporting surface. Participants were initially tested on their 12 repetition maximum. If the participant could perform 12 repetitions lifting head weight, with fatigue experienced at the completion of repetitions, they were instructed to begin lifting head weight only. If they were unable to perform 12 repetitions with head weight only, they were put in progressively inclined position to reduce the effects of gravity until 12 repetitions could be performed. Conversely, if 12 repetitions were performed easily, 0.5 kgs weights were incrementally added to the forehead until the 12-repetition maximum was found.

Over the first 2 weeks the patients performed an initial conditioning program of the 12 repetition maximum repetitions, slowly building up to 3 sets of 15 repetitions.

Over the final 2 weeks 15 repetitions maximum was determiner and practiced until 3 sets of 20 repetitions s could be performed.

Procedure:

Measures of dependent variable of Neck disability Index (NDI) and NPRS score were taken to indicate the level of pain and functional disability. Baseline information of dependent variables was taken at the beginning of study on day zero (PO, DO), before commencement of training protocol.

Then experimental group was given deep cervical flexors muscles training using pressure biofeedback as well as conventional exercises for 4 weeks and 3session in a week.

Control group was given deep cervical flexors muscles training using only conventional exercises for 4 weeks. Exercise regime was conducted over 4 week's period 3days in week under my supervision. Subjects were asked not to receive any other specific intervention for neck pain. All measurements were repeated at the end of 2 weeks that is after 6 session (P14, D14) and at the end of 4 weeks after 12session (P28, D28).

Following the program the obtained data was analyzed to find the results of this study.

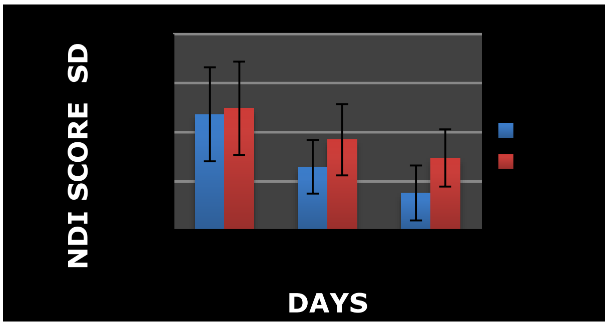
Result:

30 male subjects participated in this study. Subjects had mean age of (29.93.± 3.936) in group A and (29.73±4.728) in group B. Required statistical test were performed to find out the effect of experiment on the dependent variables, these findings are mentioned below. Baseline characteristics' of subjects Age, pain and disability levels were not different between the two intervention groups. (all $p>0.05$)

NDI

On comparing the value between the baseline (D0), after 2 weeks (D14), 4 weeks (D28), in between group a significant improvement was noted in groups A ($p<0.05$) . Mean reduction in NDI scores in group A was 12.00±2.993 at p= 0.000 and mean reduction in Group B was 7.6±2.778 at p= 0.000 .

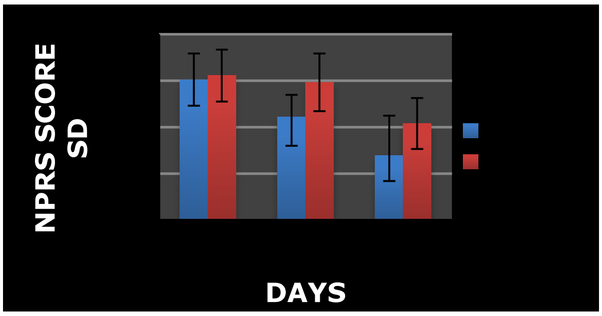
On comparing the difference between D0 and D14 for both the group A and Group B it showed significant difference ($p<0.05$). On comparing between D14 and D28 in both groups a significant difference was noted. Thus there is also a significant difference in both groups in D28 D 0 comparison.



NPRS

Comparing the values between the baseline (P0), after 2 weeks and After 4 weeks (P28) significant improvement was noted in Group A ($P<0.05$). Mean reduction in NPRS scores in group A was (3.67±.657 in group B was (2.33±0.02).

On comparing difference between P0- P14 for both the groups A and B it showed significant difference in Group A but it is insignificant in Group B. On comparing the difference between P14 and P28 it showed significant difference in both the groups. And while comparison is done between P0-P28 for both the groups it showed there is significant improvement in Group.



Discussion

The study shows that the level of pain decreases in both the group is significant. In experimental group, the decrease of level of pain between the baseline measurement and after two weeks measurement shows significant improvement ($p<0.05$). And also in comparing the two weeks measurement with four weeks measurement, it comes significant. Thus, it shows that pain improves in experimental group in both readings while in control group it shows that there is improvement of pain only when comparing the results between two weeks and four weeks measurements and it is significant in reducing pain. But the result in baseline measurement and two weeks measurement shows that there isn't any significant amount of pain improvement.

This can be explained by research on mechanism of pain reduction by exercise. The exercise increase Endorphin that occurs after training. A better neuro-muscular control may decrease this pain. Literature supports that the muscle strengthening improvement takes about four weeks to improve in significant amount to gain its control. Thus the decrease of pain by mechanism of muscle strengthening requires at least four weeks. But from the result it is apparent that in control group between four weeks and baseline measurements, there isn't any significant amount of pain reduction. But in experimental group, there is a significant amount of pain reduction which does not support the existing literature.

The reason may be attributed to the fact that the pain improvement does not occur in this study due to the buildup of muscles but it might be due to a placebo effect of treatment protocol with the pressure biofeedback which has a psychological effect on patients. Mental stress variation also could be a factor behind this which may have a significant role in pain reduction. Moreover due to the less number of subjects, there might be a difference in results.

When pain is compared between the groups and as well as within the groups, it shows that there is significant amount of pain reduction more in the experimental group compared to the control group after two weeks and four weeks. Thus our results are supporting the initial hypothesis, are in agreement with those obtained by randomized controlled trail conducted by Jull et al to determine the effectiveness of 6 weeks low load cranio cervical flexion exercise program in cervicogenic headache patients.

The neck disability index shows in our study significant change in both the groups. In between groups, it is apparent from the result that the NDI score is significantly improve in experimental group in both two weeks and also in four weeks compared to the control groups. Thus it may be assumed that the pressure biofeedback has a superior role in reduction of disability over the conventional exercises.

When the comparisons of the results within the group is done, it shows that the experimental group NDI score significantly improve within two weeks and it also improve more after four weeks. While in control group it how that the improvement of disability also significant from baseline to two weeks and from two weeks to four weeks.

These results could be explain form the reduction in the pain intensity which can bring improvement in the disability. Harman et al, also supported that the relationship between pain and neck disability index is quiet strong as pain intensity is one of the ten areas addressed on NDI.

But it is followed that in within group comparisons of the control, pain has not been reduces significantly while the disability improves significantly which means disability improvement occurs without the improvement of pain level. It may be attributed to the effect of other component of NDI scale which has been assessed on the scale (i.e. concentration and headache).

Conclusion:

The result of the present study shows that there is significant improvement in the pain and disability after 4 weeks of deep cervical flexor training in bike riders with neck pain when training is done by using pressure biofeedback and conventional exercise both. When the experimental group, given training with pressure biofeedback and conventional exercise is compared with the control group, which is given only conventional exercise it is found that the improvement in experimental group was superior than the controlled group. But within group it is found that in both group treatments is effective in decreasing neck pain among bike riders. Therefore our initial hypothesis is accepted.

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EFFICACY OF LATERAL GLIDE IN THE MANAGEMENT CHRONIC LATERAL EPICONDYLITIS.

Iftikhar Hussain[1], Amal al Jaziri[2], Ammar Merabet[3]

Abstract
Introduction: This preliminary study indicates the proportions of patients with lateral epicondylalgia demonstrate a beneficial effect of manual therapy protocol in comparison conventional therapy protocol. **Methodology:** Total thirty subjects with lateral epecondylalgia participated in a quasi-experimental design, we measured i) pain ii) pain free grips strength iii) pressure pain threshold iv) global measure of improvement for two weeks intervention of manual therapy protocol and conventional therapy protocol. **Results:** Significant differences were found between the groups treated with manual therapy and group treated conventional therapy in terms of pain reduction and improvement score. While as less significant difference by found in pain free grips strength and pressure pain threshold between the groups. **Conclusion:** It can be concluded that manual therapy is a promising intervention for the treatment of chronic lateral Epicondylitis compared to conventional therapy. Further research is warranted to investigate the long-term effectiveness of manual therapy protocol.
Key words: Chronic Lateral Epicondylitis, MWM, Ultrasound, Stretching, Friction Massage, and Strengthening.

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Introduction: Chronic lateral Epicondylitis is defined as lateral Epicondylitis symptoms that last for more than three months[1,2,3]. Pain over the lateral humeral epicondyle which manifests during activities involving the hand in gripping or manipulating an object, such as that required when lifting a tea cup, shaking hands, dressing and desk or house work, will to most musculoskeletal health car practitioners signal the provisional diagnosis of “Tennis Elbow’’ or more correctly lateral epicondylalgia (LE). The cardinal physical signs of Lateral epicondylalgia are pain to direct palpation over the lateral epicondyle and reproduction of pain and weakness during grip strength testing commonly, resisted contractions of the extensor muscles of the forearm, particularly the Extensor Carpi Radiallis Brevis (ECRB) are also painful. No diagnostic imaging is usually required to confirm the diagnosis, although diagnostic imaging technology such as radiographs or CAT scan can be used to exclude other conditions and injury of the underlying bone[4].

Lateral epicondylalgia (LE)[5,6] is a condition with complex etiological and pathophysiological factors. LE is characterized by pain at the lateral aspect of the elbow, marked functional impairments, mechano hyperalgesia, motor control deficits, and muscle strength changes

Commonly associated with resisted wrist finger extension and gripping activities. LE[6,7,8,9,10,11,12] is also known as Lateral Epicondylitis, tennis elbow or tendonitis of the affected forearm extensor muscle. The preferred nomenclature is LE as the suffix “algia” denotes pain. The pathophysiology of the condition is less commonly inflammation or degeneration than it is predominantly hyperalgesia and pain.

Epidemiological evidence[4,13,14,15] indicates that le is reasonably prevalent in the broad community (3% of general population) accounting for 5-7 in every thousand general medical practitioners visit.

The annual incidence of the disorder is between 1% and 3% in the general population. The average duration of a typical episode of lateral epicondylitis is reported to be between 6 months and 2 years16. Many sufferers of this condition who present to clinics for treatment do not play tennis, making the term ‘’tennis elbow’’ inappropriate for them. At risk populations such as tennis players, fish processing workers, and those in industries requiring repetitive manual tasks, express the condition in higher proportions, some found to be as high as 15%, mostly the evidence present in epicondylitis is improper or excessive use of elbow. There were no difference in incident in between men and women or association between lateral epicondylitis and dominant hand[19].

The etiology18 of lateral epicondylitis is not fully understood and although many treatments have been advocated none are supported by high-level evidence. Humeral epicondylitis[20] is caused by many factors, the etiology and the pathophysiology vary, but the main symptom is the same in all cases- pain in humeral epicondyle. An occupational factor is often mentioned as one of the most common causes of the disease.

Mostly the evidence[18] present in epicondylitis is improper on excessive use of elbow. It appears to be multifactorial in origin where as the clinical picture is fairly uniform. Recent studies have also sited a number of additional factors that may cause lateral epicondylitis symptoms including un accustomed strenuous activity that involves repetitive wrist movements, decreased reaction time and speed of movement in patients arms, an eccentric contraction. Lateral epicondylitis in young tennis players develops as a result of incorrect production of the single arm backhand stroke[19]. In some evidences periostitis resulting from a partial tear of the origin of Extensor Carpi Radiallis Brevis (ECRB) has been advocated as the etiology. The primary pathology[20] of epicondyle is a degenerative process with repetitive stress producing either micro or macro tears, subsequent fibrosis with hyaline degeneration and neo vasculature. Histopathology[22] fails to reveal an acute inflammation reaction or inflammatory cells, but rather reveals one of a degenerative nature with fibrous tissue supporting the concept of tendinosis rather than tendinitis as a pathologic process.

Studies4 concluded on biopsy material taken at the time of surgical treatment for Lateral Epicondylitis have identified a lack of inflammatory markers instead, degenerative changes in connective tissue have been reported, and degenerative changes have also been shown in other chronic tendinopathies. In the chronic stages[18] of lateral epicondylitis however, there is conclusive histological, pathological & imaging evidence to suggest that degenerative changes occur in the common wrist extensor origins of chronic lateral epicondylitis patients & not inflammatory changes. This may be why approaches such as corticosteroids injections, rest & anti-inflammatory medication have demonstrated little success when used in the management of chronicle lateral epicondylitis.

Typical pathological & histological changes that have been observed in extensor tendons with chronic lateral epicondylitis include fibrosis, altered blood vessel changes, fibro cartilaginous transformation, glycosaminoglycan infiltration & calcification

LE[4] is an intriguing condition because while it presents with a reasonably uncomplicated clinical picture its underlying etiology is not readily understood .it is also regarded as an overuse injury that is difficult to treat, prone to recurrent bouts and may last for 48 months.[15]

Much of the manual therapy to date has focused on treating spinal motion segments. There is a dearth of information or manipulative therapy techniques need to be investigated because condition of the peripheral musculoskeletal system is as important as those of spine. Tennis elbow represents a challenge to the clinicians because many of the commonly used treatments are unsupported by research17. Also, there is very less research done on comparison of protocols. Hence we have designed two treatment protocols to study their independent effects in treating chronic lateral epicondylitis.

Aims and objectives

1. To study the efficacy of manual therapy and conventional therapy in treating chronic lateral epicondylitis.
2. To study the early return of normal functional activity.

Methods: A convenience sample of 30 subjects was solicited from the out patient department and physical therapists, of AIIMS who attended a preliminary session for screening using the inclusion and exclusion criteria's followed by the principle of simple randomization. All the subjects signed a written consent form after fulfilling the eligibility criteria.

Inclusion criteria

- Any person complaining of local pain and tenderness over lateral humeral epicondyle from last three months,
- A positive resisted wrist or finger extension test,
- Unilateral involvement and
- Within the age group of 20-50 yrs.

Exclusion criteria

- Exclusion criteria included
- Persons with bilateral involvement,
- Cervical spine or upper limb problems,
- Referred pain,
- Radial tunnel syndrome,
- Posterior interosseous nerve syndrome,
- Polyarthritis,
- Radio humeral bursitis,
- Painful shoulder,
- Neurological impairments,
- Osteoporosis,
- Malignancies,
- Diabetes,
- Cardiovascular diseases
- Aversion to manual contact and previous therapy for elbow joint.
- Previous experience of manipulative therapy to the elbow joint (to reduce bias from subject's expectation),
- Concurrent use of certain medications such as analgesic or anti-inflammatory drugs

Design

It was an experimental design. Subjects were randomly assigned into two groups viz A and B. group A subjects were treated with manual therapy protocol while as group B subjects were treated with conventional therapy protocol. Both the groups were treated for two weeks.

Measurement tools and material

Pain free grip strength: Pain free grip strength is a measure of the grip force required to produce the onset of pain. Pain free grip strength has been reported to be the most sensitive outcome measure of physical impairment in tracking changes in lateral Epicondylitis. Pain free grip strength (pfgs) was measured using a hand held jamar dynamometer (hydraulic hand held dynamometer) with the upper limb in a standardized position of elbow in extension and forearm pronated/supinated. The upper limb was completely supported by a table. The dynamometer was checked at the commencement of each experiment session.

Pain free grip strength was measured over three repetitions with 30-second rest intervals. Stratford et al have conducted studies of the intra tester reliability and validity of data obtained and also construct validity of data along with the sensitivity to detect change over time in the participant condition

Pressure pain threshold (PPT): Pressure pain threshold was measured over the most sensitive area of the elbow by an electronic digital algometer. The first instance that the sensation of pressure became one of the pain. This measure is somewhat akin to the manual palpation often performed by physical therapist in that it measures the amount of pressure required to cause pain. This is done by applying the algometer probe tip over the most sensitive point of the lateral epicondyle. Pressure pain threshold was measured three times with a rest interval of approximately 30 seconds between measurements. Although pressure pain threshold has been used in evaluating outcomes in a number of studies of lateral epicondylitis . The conditioning protocol that would be utilized are typically three sets of 8-12 repetitions

An electronic algometer (Electronics Engineering corporation, Chennai) was used to measure pressure-pain threshold over the tenderest area of the lateral epicondyle. The algometer consist of a 1-cm2 rubber tipped plunger mounted on a force transducer. The pressure was applied at a rate of 40 kPa/sec. The test was terminated at the subject's perception of the first onset of pain. Pressure-pain threshold was measured 3 times with an approximately 30 seconds rest period between each measurement.

Pain: Pain was primarily measured by a standard horizontally oriented VAS for pain, which was anchored at one end by "no pain" and at the other end by "worst pain". The VAS was used to measure the patient's worst level of pain over the previous 24 hrs.

Global Measure of improvement scale: It is six point scale to measure the overall improvement during the treatment where 1="completely recovered", 2 = "much improved", 3="slightly improved", 4="not changed", 5="slightly worse", and 6 much worse". A successful outcome was defined as much improved or completely recovered. This method of dichotomizing the measurements was choosen before the study and was based on previous studies

Mobilization belt

Mobilization belt or mulligan belt was used to apply and sustain the lateral glide technique at the elbow.

Theraband band

Thera bands were used to provide resistance to perform the strengthening exercises of the wrist extensors.

Procedure

Following the principle of simple

randomization the subjects were allocated into two groups A & B. All subjects signed a consent form to participate in the study. Group A received the manual therapy protocol which included Mulligans movement with mobilization (MWM), deep friction massage followed by strengthening of wrist extensor's for four sessions in a week for two weeks. Group B received the conventional therapy protocol which included ultrasound therapy, stretching of wrist extensor's followed by strengthening of wrist extensor's for four sessions in a week for two weeks.

Group A subjects were instructed to lie supine on a treatment table. The physiotherapist established with the patients that active motion reproduced the patient's elbow pain. This was considered to be the "comparable sign". The comparable sign was one of the following, making a fist, gripping a rolled elastic bandage of 5 cm diameter, wrist extension unresisted, wrist extension resisted, or third finger extension unresisted. Or third finger extension resisted. The first of the above motions to be reported as painful was designated the comparable sign, and no further motions were assessed. Mulligan's movement with mobilization involves the therapist using one hand to glide the proximal forearm laterally while the other hand fixates the distal end of the humerus. The glide was applied and sustained for approximately for 5-10 seconds while the patient performed the pain free gripping actions. Six repetitions of the technique were performed and the period of time between each repetition was no longer than 60 seconds. The gliding pressure was then maintained until the participants completely released the grip. The fundamental rule that the technique should not provoke pain was followed. This was followed by deep friction massage, with the pad of the index finger; middle finger or thumb is placed directly over the involved site. With the patients seated comfortably and the involved elbow rested on a treatment table the therapist applies with light pressure and moves the skin over the site of the lesion back and forth in a direction perpendicular to the normal orientation of the fibres of the involved part for 1-2 minutes. As tenderness subsided after 1-2 minutes. The pressure was increased somewhat and continued for 2 more minutes. During the final 2 minutes of deep friction massage the therapist applied deep pressure so that the depth of the friction massage is sufficient to affect the involved structure.

Group B received the conventional protocol treatment. The patients were positioned in sitting with elbow rested on the table in semi-flexed position. Every session included a 7½ minute pulsed ultrasound treatment around the lateral humeral epicondyle (Phyaction 190, Unify, Germany) given in contact using electrolyte coupling medium with a preset parameters of., 1 MHz, 1wcm¬-2, 1:4, followed by stretching of the wrist extensors with the elbow extended fully and forearm pronated. The therapist stabilized the fore arm with one hand and with the other hand grasp the patient at the dorsal aspect of the hand applies a stretch force in the direction of wrist flexion. The stretch is maintained for minimum of 15 seconds for 5 repetitions with a rest interval of 10 seconds for approximately 10 minutes by the physical therapist. When pain subsided, subjects were instructed in muscle strengthening exercises by the physical therapist and were told to perform the exercises at home twice daily. These exercises consisted of movements against resistance, rotational exercises, and occupational exercises. These exercises were intensified in 4 steps, with increasing resistance

Progressive isometric strengthening exercises of the wrist extensor muscles were given in various pain free positions. When there is no pain through the range of motion, progress to concentric resistance at an appropriate dosage. Progressive resistance exercises (PREs) using a hand held weight was used for flexion, extension, pronation, and supination. Elastic resistance was used for wrist flexion and extension by placing a loop of elastic material under the foot and holding the other end in the hand: the arm is held or supported in a horizontal position. When the forearm is pronated, resistance is against the wrist extensors: when supinated, the resistance is against the wrist flexors.

Subjects were informed that the study was investigating the effects of manual therapy and conventional therapy on performance on the pain, grip strength, pressure pain threshold, and functional improvement.

Results:

Intergroup Analysis: On comparison between Group A & B, Pain shows no significance (P.0.05) at base line and one week post intervention but became significant at second week of intervention (P=0.05). Pain free grip strength shows significance at base line (P<0.05) but after one week and second week post intervention pain free grip strength became highly insignificant (P>0.05). On comparison of pressure pain threshold at base line the values show a level of high insignificance (P>0.05) but on first week post intervention the results are significant (P=0.02) and on second week post intervention the values show again insignificance (P>0.05). Similarly on comparing the global measure of improvement there is no significance (P>0.05) on base line measurement and first week of post intervention but on second week post intervention the results show a good significance (P=0.01)

Within Group A Analysis

Group A

1.VAS: The mean ± S.D of VAS Score was calculated for each week. The graph (fig 5.1) illustrates that there is a linear decrease in pain from pre intervention to second week post intervention. (P=0.0001)

2. Pain free grip strength: The mean ± S.D of Pain free grip strength was calculated for each week. The graph (fig 5.3) illustrates that there is a significant increase from base line values to one week and second week respectively. (P=0.0001)

3.Pressure pain threshold: The mean ± S.D of Pressure pain threshold was calculated for each week. The graph (fig 5.5) illustrates that there is a significant increase from base line values to second week post intervention (p=0.0001)

4.Improvement scale: The mean ± S.D of Improvement scale was calculated for each week. The graph (fig 5.7). A marked improvement was noted at first and second week post intervention

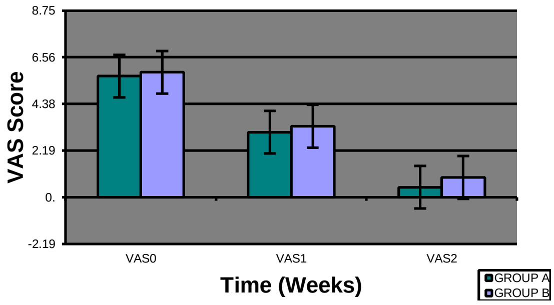
Group B

1.VAS: The mean ± S.D of VAS Score was calculated for each week. The graph (fig 5.2) shows a linear reduction in pain from base line measurements to the end of the second week follow up. (P=0.0001)

2.Pain free grip strength: The mean ± S.D of Pain free grip strength was calculated for each week. The graph (fig 5.4) shows a good significance level (P=0.0001) as the patient completed the two week follow up.

3.Pressure pain threshold: The mean ± S.D of Pressure pain threshold was calculated for each week. The values show a significant result at the end of second week of follow up, but the results were not that much significant at the second week of follow up (p=0.035) (fig. 5.6)

4.Improvement scale: The mean ± S.D of Improvement scale was calculated for each week. The data shows a significant improvement through out the follow up (p=0.0001) graph (fig 5.8).



5.1:Comparison Of The Mean Values Of The Pain (VAS) scores On Week 0 To Week 2 Between The Groups Along With The Standard Deviations

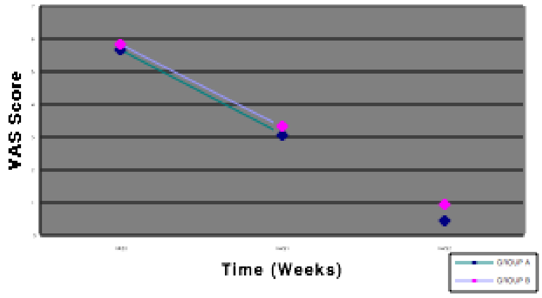


Figure 5.2: Comparison Of The Mean Values Of The Pain (VAS) Scores On Week 0 To Week 2 Between The Groups

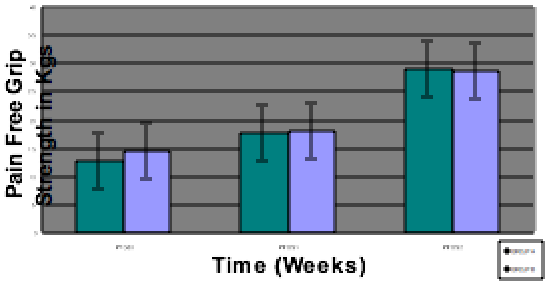


Fig. 5.3 Comparison Of The Mean Values Of The Pain Free Grip Strength On Week 0 To Week 2 Between The Groups Along With The Standard Deviation

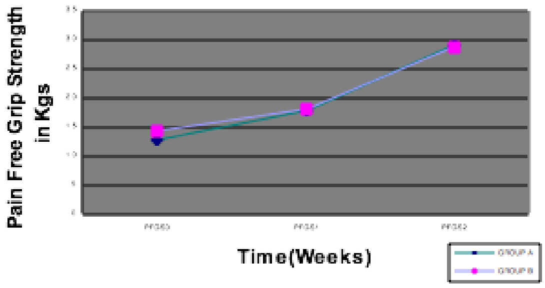


Figure 5.4: Comparison Of The Mean Values Of The Pain Free Grip Strength From Week 0 To Week 2 Between The Groups

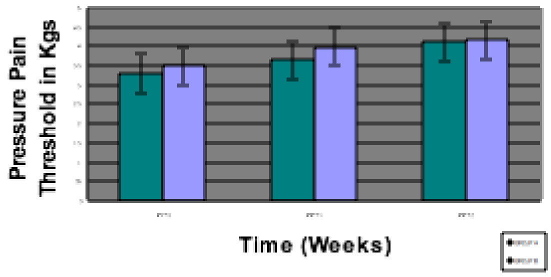


Figure 5.5: Comparison Of The Mean Values Of The Pressure Pain Threshold From Week 0 To Week 2 Between The Groups Along With The Standard Deviation

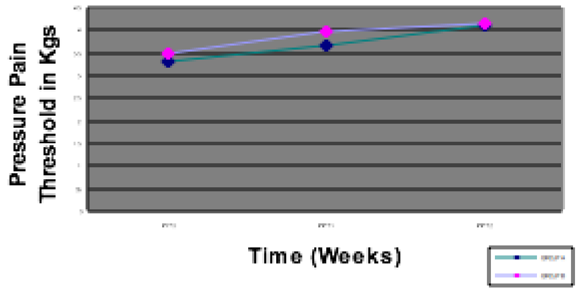


Figure 5.6: Comparison of the Mean Values Of The Pressure Pain Threshold From Week 0 To Week 2 Between The Groups.

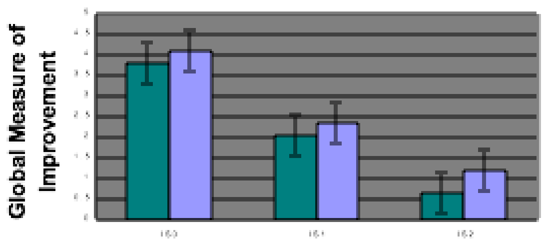


Figure 5.7 : Comparison Of The Mean Values Of The Improvement Scale From Week 0 To Week 2 Between The Groups Along With The Standard Deviation

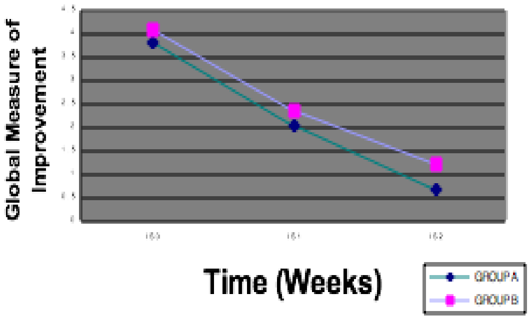


Figure 5.8: Comparison Of The Mean Values Of The Improvement Scale From Week 0 To Week 2 Between The Groups.

Discussion: This study has demonstrated the role of applying a novel manual therapy protocol and conventional therapy protocol on the pain and dysfunction that is classically associated with tennis elbow or LE. The manual therapy protocol based on the principles advocated by Mulligan[21], Cyriax[30], Pienimaki[31] produced immediate improvements in pain, Pain-Free Grip Strength (PFGS), Pressure Pain Threshold (PPT) and Global Measure of improvement (IS) with nearly similar effects by the conventional therapy protocol.

Both the groups showed significant reduction in pain but was more enhanced in group receiving manual therapy protocol as were assessed prior to the intervention. The significantly greater effect following a manual therapy treatment technique applied to a peripheral joint corroborates the findings of previous studies of manual physical therapy treatments of the spine 32. Vicenzino and Wright conducted a single-case study report using this technique, which involves a physiotherapist gliding the proximal forearm laterally while stabilizing the distal portion of the humerus, as designed by Mulligan[21]. This technique produced a significant reduction in pain and increase in function although the authors acknowledged the lack of statistical power with this study.

Pain free grips strength has been proved to be most reliable and sensitive measure in the treatment of lateral epicondylitis[33]. Pain free grips strength provide an objective index of the functional integrity of the upper extremity. This improvement in grip strength was correlated with improvements in function and decrease in pain as measured by their respective VASs. The results were supported by the improvement in all of the pain producing activities assessed prior to the intervention.

The manual therapy protocol produced an improvement in pain-free grip strength during treatment of 128% as compared to reduction in conventional therapy protocol of 98.54% . This effect profile contrasts to that of the lateral glide technique of the cervical spine, a spinal manipulative therapy technique for lateral epicondylalgia that has been previously investigated. The lateral glide of the cervical spine produced an improvement in pain-free grip strength of the order of 12% to 30% and an improvement in pressure-pain threshold of approximately 25 to 30% immediately following treatment. This difference may be due to the different body regions being manipulated (i.e. elbow versus cervical spine) because previous studies of manual therapy have shown that the area of body being treated influences the outcome[34,35] Another possible reason for different effect profiles between the mobilization-with-movement treatment technique of the elbow and the cervical spine lateral-glide techni¬que is the frequency profile of the techniques.

The frequency profile of a physical treatment protocol has been shown to influence the outcomes it produces ¬

The parameters for ultrasound in this study reporting enhanced recovery coincides with earlier study by Binder et al. Were 1 MHz; 5-10 minutes, 1:4, 1-2w/cm2 the procedure used in these two studies were similar to those of in our study, 1 MHz, 1:4, 7.5 minutes 1w/cm2 the result in the present study supports the finding of Binder et al. which shows a significant therapeutic effect of ultrasound as against placebo ultrasound ($p < 0.01$, n = 76). The study scored 44% as compared with that of Lundeburg, Abrahamsson and Haker, which scored 38% and showed no significant difference between the ultrasound and the placebo, although it did demonstrate superiority of ultrasound over rest only ($p < 0.01$, n = 99). These results suggest that there is a significant placebo effect with ultrasound treatment. Unfortunately, neither of the studies includes a power analysis, which could estimate the possibility of a type 2 error, i.e., missing an existing difference when comparing ultrasound and placebo. A well control study by Lunderberg T. 1988. Concluded that ultrasound may be better than placebo in alleviating pain. In a study of Hashish et al. it was shown that ultrasound at an intensity of 0.1 and 0.5 Wcm-2 might have an anti-inflammatory activity

Whereas the physiologic effects36 of ultrasound have been discussed in detail, it should also be mentioned that ultrasound can have significant therapeutic psychological effects. A number of studies have demonstrated a placebo effect in patients receiving sham ultrasound. One excellent study, by Stratford et al 37, with a score of 73%, showed no significant difference between ultrasound with phonophoresis and placebo ultrasound, or between phonophoresis with or without friction massage in 40 subjects.

Pulsed and continuous[37,38] ultrasound therapy appeared to be used commonly by the physiotherapists although its overall efficiency for musculoskeletal disorders is still in debate.

In chronic inflammatory conditions ultrasound seems to effective in increasing blood flow for healing, and for pain reduction through heating. It is possible that the local gentle massage due the movement of the transducer over the skin has some direct beneficial effect, which is appoint noted by Schlapbach[39].

Tissues heated[40] by ultrasound loses its heat at a fairly rapid rate; therefore, stretching, friction massage, or joint mobilization should be performed immediately post ultrasound. To increase the duration of the stretching window, it is recommended that stretching be done during and immediately after ultrasound application. It appears that ultrasound and stretching increases range of motion more than stretching alone immediately following treatment. However there is no significant difference between the two techniques over the long term.

These finding conform that ultrasound enhances recovery in patients with lateral epicondylitis. When comparing ultrasound with rest there was a significant difference in pain alleviation, including that treatment enhances recovery the patients who had less severe symptoms generally responded better to treatment. We found, as did Binder et al. a definite discrepancy between the subjective and objective assessments.

Drechsler et al[41] stated that standard treatment for lateral epicondylitis involve stretching, strengthening, deep transverse friction and ultrasound.

Deep transverse frictions[42] were used always or frequently by physical therapists. Verhaar and colleagues[43] investigated deep transverse frictions in combination with the Cyriax (Mills) manipulation when compared to Corticosteroid injections and found them to be less effective in terms of 'mean group strength' and subjective accounts in 103 chronic lateral epicondylitis patients after six weeks. Deep transverse frictions were also found to be no better than ultrasound in treating lateral epicondylitis. Therefore, despite widespread clinical use there is currently limited evidence to endorse or refute the effects of deep transverse frictions for chronic lateral epicondylitis. In another study by Vasseljen[44] found that Friction massage may be more effective than laser treatment of lateral epicondylitis.

Furthermore, the mechanical hyperalgesia (reduced pressure pain threshold), which was present at the beginning of the experiment, was reduced.

Pressure-pain threshold data demonstrated in increase of approximately 26.44% following application of the manual therapyprotocol , which was greater than the 17.81% reduction in pressure-pain threshold in conventional therapy protocol. Global measure of improvement imply that the treatment protocol employed is suitable to aid the restoration of pain-free function in those afflicted by tennis elbow.

Thomas et al. in the study of Plancher et al.[45] stated that rehabilitation protocols involving stretching and strengthening supervised by physiotherapist are helpful in returning the individual to the pre disease state. It appears that stretching the exercised muscles following exercise may offer advantages in the conditioning process and aid in the desensitization of the painful soft tissues even though stretches do not appear to have a role in the prevention of injury[46]. Early mobilization is reported to have good effects on the tensile strength of connective tissue scars in muscles injury. Exercises are usually prescribed in the rehabilitation of soft tissue disorders such as tennis elbow. Often the exercises that are prescribed are those, which aggravate the pain. Subsequently the patient may exercise with pain or avoid exercises.

Progressive stepwise exercises program can promote healing without traumatisation. The damaged epicondylar attachment area is an osteochondral region with the properties of inflamed and atrophied tendon prolonged cases, bony atrophy too.

There was a strong correlation between pain reduction and increase in function. This correlation implies that the reduction of the pain was critical to the success of the treatment. The reduction of pain and increase in function that followed this protocol allowed the patients in this study to resume their pre injury levels of manual work. Progressive stretching and strengthening were identified as popular treatments for chromic lateral epicondylitis patients in terms of pain levels[47] and maximum group strength, sleep disturbance, subjective ability to work and isokinetic torque of wrist flexion,

A well executed study by Pienemaki et al. has supported and found enhanced recovery in management of lateral epicondylitis treated consecutively by progressive strengthening and stretching exercises or with local pulsed ultrasound to compare the effects of active treatment and the traditionally used local passive treatment. The result showed that exercises were superior to pulsed ultrasound. Having good effect on pain at rest and under strain, a good effect on working ability with beneficial effect on the muscles performance. Furthermore, exercise for chronic lateral epicondylitis patients is a 'hands-off' approach and this strategy has been recommended for chronic pain patients.

Another shortcoming of our study was that only short-term effects were investigated. Although often patients are mainly interested in a fast recovery effects over the long term might be less distinctive. In a recent study by Halle et al. comparing corticosteroids injections with non steroidal anti inflammatory drugs, the initial advantage of injections subsided at long term follow up. Strengthening regimen[48]. In some cases of chronic LE the deconditioning of the muscle is so severe that one set per exercise session per day should be performed slowly. The fact that both pain and function were strongly correlated and that pain improved more rapidly than function implies that the reduction of pain was critical to the success of the treatment.

All the outcome measures showed no differences between groups. This finding was most likely due to the small number of subjects included, resulting in a low power. The small sample size and resulting low power of the study implies that cautions most be used in drawing definitive conclusions about the relative effectiveness of the two interventions used in one study. From result of our study, we believe no definitive conclusions about the relative effectiveness of the interventions can be drawn.

Future Research:

Future research is important with the inclusion of more number of subjects drawn with the manual therapy protocol being given for longer sessions and with relatively larger sample size. Further investigation of these pain relieving effects will improve our understanding of the pain control mechanism activated by manipulative therapy and improve non surgical management of LE.

Conclusion:

In the present study there was little significant difference between the manual therapy protocol and conventional therapy protocol in treating chronic lateral epicondylitis. The manual therapy protocol has been little more beneficial than the conventional therapy protocol. There is significant difference in eliminating pain of a previously painful active movement and the overall improvement in the condition while as little significance was seen in pain free grips strength and pressure pain threshold, thus proving the hypothesis. Additionally, there were no adverse effects reported in the short-term, implying that the treatments are both safe and effective.

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THE RELATION BETWEEN LOWER EXTREMITY INJURIES AND HAMSTRING LENGTH AMONG MAJMAAH UNIVERSITY STUDENTS

Radhakrishnan.U*, Chandrasekar.L; Mohammed SM Alhudib*****

Abstract

Introduction: Football is the most popular game in Saudi Arabia. The Majmaah university students also shows a keen interest towards the Football game with their participation in football matches as a sport and recreation activity and are more prone to Lower limb injuries. Studies from the professional leagues in Union of European Football Associations [UEFA]) agree that injuries to the lower extremities constitute the major problem. The sophisticated life style of the students suggests a prevalence of reduced physical activity and decreased flexibility in musculature. The study was conducted to understand the relation between Lower extremity injuries and Hamstring length among Majmaah University students. **Methodology:** A total of 49 Male students under the age group of 18- 22 years who has history of non-contact Lower extremity injuries acquired during Football play were selected for the study. A informed consent was obtained from each student. Hamstring muscle length was assessed by straight leg raise (SLR) using goniometry. The Lower extremity injuries were assessed using the valid questionnaires, the Foot and Ankle Outcome Score (FAOS) and Knee Osteoarthritis Outcome Score (KOOS) score, Hip and Groin outcome score(HAGOS).The respective values were documented and statistically analyzed.**Results:** The mean values of FAOS, KOOS & HAGOS were78.13, 73.6 & 80.2 respectively. The mean value of Hamstring muscle length (SLR) for Right limb was 78 degrees and for Left limb was 76 degrees. No significant correlation was observed between hamstring flexibility (right & left) with mean scores of FAOS, KOOS & HAGOS ($p<0.05$). **Conclusion:** The findings of the present study did not show a significant correlation between Lower extremity injuries and hamstring length. The subjects with injuries should be clinically assessed with Special test by relating with the mechanism of injuries. However it is important to provide injury prevention strategies that focus on education about mechanism of injuries, training on warming up and cooling down exercises to avoid injuries and Fitness programmes. The study should be conducted with large sample size and requires further correlation with other risk factors for lower extremity injuries.

Key words: Straight leg raise, Goniometry, Knee osteoarthritis outcome score

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Introduction

Football is recognized as the most popular sport around the world[13]. Football is the most popular modern sport in Saudi Arabia. Saudis of all ages have taken the game to heart, from children kicking on playgrounds to international matches in spectacular modern stadiums. The strong economy of the country supports the sporting facilities of which the youth of the country is utilizing to the fullest. The Majmaah university students also shows a keen interest towards the Football game with their participation in football matches as a sport and Recreation activity and are more prone to Lower limb injuries The incidence of injuries among adult male soccer players on the elite level has been checked and documented to range between 25 and 35 per 1000 game-hours.[3] Thus, the injury risk is considerable and high compared with other team sport. Studies from the professional leagues in Europe (Norway, Sweden, Iceland, Britain, Federation International de Football Association [FIFA], and Union of European Football Associations [UEFA]) agrees that injuries to the lower extremities constitute the biggest problem.[11] (Hawkins RD). The 4 dominating injury types in soccer are sprains to the ankle and knee and strains to the hamstring and groin. These account for more than 50% of all injuries. The sophisticated life style of the students suggests a high prevalence of physical inactivity. The research data shows prevalence of around (43.3%-99.5%) of physical inactivity among Saudi Arabian children and adults[12]. This may lead them to musculoskeletal problems like reduced Flexibility of muscles of Lower limb. Hamstring injuries are common in Saudi Arabia. Hamstring Flexibility had been proved to be a modifiable risk factor for sport injuries. The soccer players with an increased tightness of the hamstring muscles have a statistically higher risk for a subsequent musculoskeletal lesion.[10].

In football game the occurrence of lower extremity injuries are considerably high. The student population of Majmaah university students are involved in Football game and are under the chances of Lower limb injuries. The sedentary life style of students and use of car as a mode of transport due to low prices of petrol, lead them to lack of physical exercise among them. This may lead to tightness in Lower limb muscles. Muscular tightness is considered as an intrinsic risk factor for the development of a muscle injury. However, very little prospective data exist to prove this. It is of great importance to identify the Lower limb injuries among the student and their Muscular flexibility to study their relation for appropriate prevention and training. The identification enables us to prevent the student from further injury or to refer the injured student to appropriate treatment measures. This study helps prevent injuries among the students and to stress the importance of Exercise training for a healthy wellbeing.

Methodology:

A total of 49 Male students under the age group of 18- 22 years from College of Applied Medical Sciences, Majmaah University, who have the problems of non-contact Lower extremity acute injuries and pain with duration up to 7 days or a week old , acquired during Football play were selected for the study. The students with history of contact injuries, bleeding injuries and deformed limbs were excluded. The informed consent was obtained from each student who is willing to participate in the study. The students were asked to fill out a questionnaire given in English. The first section of questionnaire consisted of general information (Name, Date of birth, Age, professional or recreational player. If professional player then, team, field position, and player experience were recorded. In case of Recreational player the frequency of game, Duration of game and history of injuries were recorded. The following next sheet included the Questionnaires used to assess injuries and function , the Foot and Ankle Outcome Score (FAOS) and Knee Osteoarthritis Outcome Score (KOOS) score, For the Hip and Groin outcome score(HAGOS). The functional scales consists of subscales; Pain, other Symptoms, Function in daily living (ADL), Function in sport and recreation (Sport/Recreation) and knee related Quality of life QOL. Standardized answer options were given (5 Likert boxes) and each question gets a score from 0 to 4.The mean scores for all five subscales were taken which gives values such as 0 indicates extreme problems and 100 indicate no problems.[19] Roos E, Roos H. These Functional scales were Valid, reliable and responsive Patient-Reported Outcome (PRO) questionnaires for young to middle-aged, physically active individuals[16]. KOOS has high test-retest reproducibility (ICC >0.75). The FAOS is considered to be valid scale to record injuries and function[20] (Rooos EM). Based on the results of the questionnaire, the students will be identified for their risk of injuries.[5] and their overall functional score were recorded.The Hamstring muscle length of Right and left lower limb were assessed by straight leg raise (SLR) using goniometry. Subjects were positioned in supine Lying with legs extended and lower back and sacrum flat on the treatment table. If the lower back did not go flat due to hip flexor shortness, place a pillow under the contra lateral leg to flex the hips to flatten the back. In this manner the starting position was always standardised to have the lower back flat on the plinth. To maintain the lower back and sacral position the contra lateral leg was held firmly down against the plinth by use of a belt across the upper and lower thigh. The opposite leg was then passively flexed at the hip joint while maintaining knee extension with the foot in a relaxed position[14]. The angle of hip flexion was measured to the nearest degree, using a universal goniometer. The universal goniometer was centred on the greater trochanter of the femur with stationary arm aligned along the mid axillary line and movable arm aligned along the shaft of the femur. The end point was determined when either the subject reported slight tension within their hamstring or the tester felt resistance[14]. The goniometric scores were repeated three times and average score was recorded. The assessment procedures were conducted in Therapeutic Exercise Lab at College of Applied Medical sciences, Majmaah University. The respective values were documented and statistically analysed.

The data were entered and analysed using SPSS 20.0. Mean + S.D were given for quantitative variables. Frequencies and percentages were given for qualitative variables. Pearson correlation was applied to observe correlations between Lower extremity injuries and Hamstring length. A p-value of <0.05 will be considered as statistically significant. The study was approved by the local ethical committee.

Results:

The TABLE 1 shows the maximum and minimum mean value recorded for each scales. The mean value of FAOS was 78.13 with S.D (12.6) and KOOS mean value was 73.6 and S.D value (8.8). The mean value of HAGOS was 80.2, S.D (7.4). The correlation was observed between these scales for injuries and function. No significant correlation was observed between mean scores of foot & ankle and KOOS knee (p=0.141, r=0.211), between mean scores of foot & ankle and hip & groin (p==0.663, r= -0.065) and between KOOS knee and hip & groin (p=0.46, =0.139).The table 2 shows the mean value of Hamstring muscle length measured by (SLR) method using Goniometer for both lower limbs. The mean value of Right Lower limb was 78 degrees and for Left Lower limb was 76 degrees.

Fig. 1: Universal Goniometer

Fig.2: Starting position for measurement

Table: 1 Mean values of the Scales FAOS, KOOS & HAGOS

scales	N	Mean	SD
FAOS	49	73.6	12.6
KOOS	49	73.6	8.8
HAGOS	48	80.2	7.4

Table: 2 Mean value of Hamstring Muscle length

Leg	N	Mean	SD
RIGHT	49	78.00	9.0
LEFT	49	76.00	9.3

No significant correlation was observed between hamstring flexibility (right & left) with mean scores of FAOS, KOOS & HAGOS ($p<0.05$).

Discussion:

Hamstring is a long muscle located at the back of thigh; it is of group of three muscles, namely the semi-membranous, semi-tendinous and biceps femoris. These muscles get attachment to the lower part of the pelvis in ischial tuberosity and the lower leg bones tibia and fibula below the knee joint. There are studies suggesting that hamstring tightness increases in apparently healthy people from childhood up to age 40-49 years and it is higher in males than females[1].The major factors in hamstring tightness are low levels of fitness and poor flexibility. Children seldom acquire hamstring injuries, probably because they are flexible. Hamstring muscle fatigue and not warming up properly can contribute to hamstring injuries. The literature supports that improving hamstring flexibility will lower the risk of lower extremity injuries[8].These information created interest to check the lower extremity injuries among Majmaah University students and to evaluate the students for any hamstring tightness , to predict that reduced hamstring flexibility may be the cause for their non –contact sports injuries.

The study conducted among the Majmaah university students shows no significant correlation between the Lower extremity injuries and Hamstring length. The results are similar with the study done by which supports that a Flexibility of a joint is determined by the geometry of the articular surfaces and by muscle, tendon, ligament, and joint capsule laxity. Conventional wisdom asserts that there is a relation between increased flexibility and decreased incidence of injury. There are literatures which explain that Muscular tightness is frequently postulated as an intrinsic risk factor for the development of a muscle injury, very little prospective data exist to prove this. A lack of strength and flexibility are among the leading causes of knee injuries. Tight or weak muscles offer less support for knee because they don't absorb enough of the stress exerted on the joint. Though the literature are giving information about the relation between the muscle length and risk of injuries, the current study conducted among Majmaah university students will add strength to the rational that there is no relation between hamstring flexibility and lower limb injuries. The reasons for the result in this study may be due to many factors such as imbalances in the strength of different leg muscles,the hamstring muscles of one leg may be much stronger than the other leg, or the quadriceps muscles on the front of the thigh may overpower the hamstrings.

The Lower extremity injuries among the students were identified using the Functional scales such as FAOS, KOOS & HAGOS. These valid scales have strong evidence to administer Anders H. Engebretsen.et.al[5] documented that the players with a significantly increased risk of injury were able to be identified by using a questionnaire, their study implies that, the KOOS questionnaire has been validated for several orthopaedic conditions. The questionnaires helped to identify the Lower extremity injuries, the Mean scores of the study for FAOS; KOOS & HAGOS were 78.13, 73.6 & 80.2 this shows that there were injuries in the joints of lower limb which reduced their activities and quality of life. The mean value of Hamstring muscle length (SLR) for Right limb was 78 degrees and for Left was 76 degrees which too proves for hamstring tightness when compared with scores of standard studies[4]. The two variables when compared for correlation shows no significant correlation ($p<0.05$). The procedure to evaluate the hamstring length was performed by following a single method. The alternative methods of evaluation of hamstring length such as, AKE (active knee extension test), PKE passive knee extension test, SKE (sitting active knee extension test) and the mean score of these values will give a better understanding about the length of hamstring muscles. The alternative reasons for this result might be the type of sample selection as the samples shows only moderate injuries and loss of function it was 70%-80%. The samples contained mixed population of students who do regular gym exercises which has influence in the flexibility. The study may be continued in future by selecting the students only with a low Functional score of 50% and below and then evaluated for hamstring length. As major group of studies correlates the flexibility with Knee pain[24]. Smith AD.et al, an intensified study should be carried out for correlation between Knee injuries and hamstring length. The statistical analysis should be expanded with the relationship to the subscales Pain, other Symptoms, Function in daily living (ADL), Function in sport and recreation (Sport/Recreation) and knee related Quality of life QOL. The documented results do not show any significant change in their Function and Quality of life of the students. Though the results are not significant it is important to monitor the Hamstring length. Prevention of injury remains an important goal for clinicians and researchers. However, to prevent lower extremity injury, a structured programme of warm-up exercises, stretching exercise and neuromuscular training program[26] to lower limb should be encouraged to avoid injuries. It is also important to value the minor lower limb injuries, it should be evaluated by the specialist and appropriate treatment measures should be followed, as these injuries may lead to major disability.

Conclusion:

The findings of the present study did not show a significant correlation between Lower extremity injuries and hamstring length .The subjects with injuries may be clinically assessed with Special test by relating with the mechanism of injuries. However it is important to provide injury prevention strategies that focus on education about mechanism of injuries, training on warming up and cooling down exercises to avoid injuries and Fitness programmes. The study should be conducted with large sample size and requires further correlation with other risk factors for lower extremity injuries.

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COMPARATIVE STUDY ON THE EFFECT OF WARM UP AND COOL DOWN ON DELAYED ONSET MUSCLE SORENESS

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Abstract

Introduction: Delayed onset muscle soreness (DOMS) is a frequent problem after unaccustomed exercise. No universally accepted treatment exists. Warm up and Cool Down is often recommended for this condition but uncertainty exists about its effectiveness. To determine the effects of warm up and cool down on DOMS. **Methodology:** Physically active male and female subjects (n=32) in age group of 18-25 were included after they met inclusion criteria. Participants were randomly to one of group warm up, cool down, both and control. The soreness, Pain, Range of Motion and Strength measure d in all 4 groups. Main outcome measures: Soreness, Pain, ROM, Strength. **Results:** Within Group analysis most of value shows an in significant difference at all time intervals. But Between Group analysis shows warm groups has significant effect on soreness and pain as compared to other groups. **Conclusion:** In conclusion, warm-up performed immediately prior to unaccustomed eccentric exercise produces small reductions in delayed-onset muscle soreness, but cool-down performed after intense exercise does not.

Key Words: Soreness, Pain, Strength, Range of Motion, Warm up.

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Introduction

Delayed onset muscle soreness refers to the skeletal muscle pain1when individual engage in exercise to which they are unaccustomed[1]. It is associated with connective and contractile tissue micro trauma, resulting from high-tension generated during the eccentric phase of a movement[2].The intensity of soreness increases during the first 24hr, peaks at 24-48hr and subsides within 5-7days post exercise. The cardinal sign and symptoms of DOMS are; loss of movement (due to muscle shortening or pain), swelling, decreased muscular performance and pain, which becomes particularly apparent during movement or palpation[3-5]. The exact mechanism responsible for DOMS is not completely understood. A number of theories have been proposed in attempt to explain the underlying mechanism responsible for DOMS. These theories include the following: Lactic acid, muscle spasm, connective tissue and muscle damage[6], enzyme efflux and inflammation1although loss of intracellular Ca++ homeostasis could play a primary role[7].

There is controversy concerning the presence of sex differences in the response of muscle to damage inducing exercise. In contrast to the animal literature which clearly show that females experience less damage than males, research using human studies suggest that there is either

no difference between man and women or that women are more prone to exercise induced muscle damage than men[8].There is some evidence indicating that fast twitch fibers are more susceptible to eccentric contraction induced damage. This may be due to inherent weakness in these fibers or selective recruitment of fast twitch motor unit for eccentric exercise. The severity of damage and the time course of the subsequent symptoms are dependent on both the specific condition of the exercise bout and the intrinsic factors related to the individual. The structural abnormalities predominate in the fast twitch glycolytic fibres[9]. In recent review; Lieber & Friden[6] proposed that the larger amount of fiber injury in fast-glycolytic fibers after eccentric exercise was a result of the increased strain and injury due to their short fibers length.

Eccentric exercise results in injury to the cell membrane, setting off an inflammatory response that leads to prostaglandin [prostaglandin E2 (PGE2)] and leukotriene synthesis. Prostaglandin

E2 directly causes the sensation of pain by sensitizing type III & IV pain afferents to the effects of chemical stimuli; whereas leukotriene increase vascular permeability and attract neutrophils to the site of damage. The "respiratory burst' 'of the neutrophils generates free radicals, which can exacerbate damage to the cell membrane. Swelling results from the movement of cells and fluid from the blood stream into the interstitial space with inflammation and can contribute to the sensation of pain[10].

Because the precise pathology of DOMS is unknown, determining an appropriate course of treatment is difficult. No intervention strategies currently exist for prevention of DOMS, the only alternative is to treat the sign and symptoms after they occur[11]. Numerous investigators have attempted to identify treatment for DOMS but none of the study reviewed addressed all sign and symptoms; the majority only assessed muscle soreness[12].

Despite limited scientific evidence supporting their effectiveness, warm up routines prior to exercise are a well accepted practice. The majority of the effects of warm up have been attributed to temperature- related mechanisms (e.g. decreased stiffness, increased nerve-conduction rate, altered force-velocity relationship, Increased anaerobic energy provision and increased thermoregulatory strain), although non-temperature related mechanisms have also been proposed (e.g. Effects of academia, elevation of baseline oxygen consumption (vo2) and increased post activation potentiation).It has also been hypothesized that warm up may have number of psychological effects (e.g. increased preparedness).

Warm up techniques can be broadly classified into two major categories: Passive warm up and Active warm up. Passive warm up involves raising muscle or core temperature by some external means, while active warm up utilizes exercises. Passive heating allows one to obtain the increase in muscle or core temperature achieved by active warm up without depleting energy substrates. Passive warm up, although not practical for most athletes, also allows one to test the hypothesis That many of the performance changes associated with active warm up can be largely attributed to temperature-related mechanisms[13].

Cool Down: Lowering down the intensity of the work out/ Training session/ Competition by performing limbering and stretching exercises followed by deep breathing relaxation exercises is called cooling down or limbering down. When we exercise there is a lot of blood flow in our muscles if we stop suddenly there may be pooling of blood in the extremities and cause giddiness and sometime collapse. Cooling down exercise release the extremity blood into circulation and make the exchange easier. Cooling down exercises prevent the post exercise soreness and stiffness. Cooling down is essential for recovering to pre-exercise/work out state and for readjusting various function i.e. .physical, physiological, biochemical. Cooling down is also essential to avoid pulling down of blood in veins, which causes fatigue[14]. Every endurance exercise session should conclude with a cool-down period. Cool down is best accomplished by slowly reducing the intensity of the endurance activity during the last several minutes of your work out.

Methodology: A sample of 32 healthy student's volunteers (male and female) n: 32 of age 18-25 years participated in the study. All the subjects were informed about the nature, purpose, and possible risk involved in the study and an informed written consent was taken from them prior to participation. Subjects were randomly assigned into 4 experimental groups A, B, C and D on the basis of inclusion and exclusion criteria. All subjects were taken from the Hamdard University and Prakash Institute of Physiotherapy (students of physiotherapy and occupational therapy stream) having delayed onset muscle soreness. The participants were excluded if they don't consider themselves capable of performing the treadmill exercise for 30 minutes or had any congenital abnormalities. Patients under medication (muscle relaxants) were also excluded in the study.

Treatment Protocol: On the first day subject was explained about the nature and procedure of study and was given demonstration of procedure. They were told about any possible threats to training and also the method of overcoming harmful possibilities that ensure their safety. The willing participants were required to sign informed consent form. The assessment was done and the suitable participant on the basis of inclusion and exclusion criteria was included in the study. Healthy adults were allocated randomly to one of the four groups: A-warm up and cool down group, B- only warm up group, C-only cool down group and D-control group

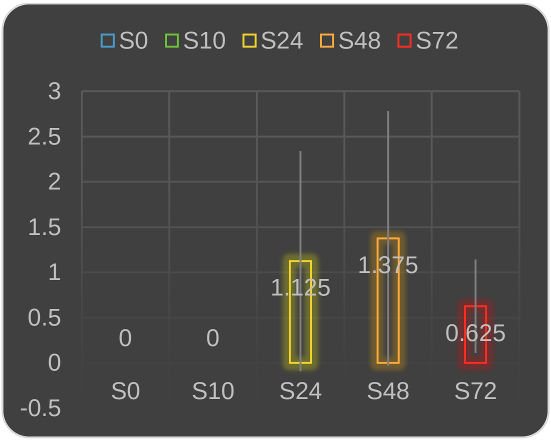
Initially, all participants rested in a seated position for 10 minutes. Subsequently, participant in Group A and Group B performed 10 minute warm up. Participants in the Group C and D remained resting for a further 10 minutes. Then all participants performed 30 minutes of eccentric exercise to induce muscle soreness. Immediately after the exercise, participants in the two Group C and D performed the 10 minute cool down. Participants in the two groups A and B rested in sitting for a further 10 minutes. Participants were instructed to refrain from strenuous physical activities for three days after the exercise in this study. Muscle soreness in the gastronomies muscle of the right leg was assessed 10 minutes after the exercise, and then at 24 hr intervals over the three days following the exercise.

The exercise was designed to induce muscle soreness in the gastronomies muscle of the right leg and involved walking backwards downhill on a treadmill inclined at 13 degree and the speed was 2.2km per hr, for 30 minutes at 35 steps per minutes, leading with right leg. Participants were instructed to take large backward steps with the right leg and to strike the treadmill with the toe of the right foot and with the right knee extended. This protocol induces muscle soreness in most of the participants.

Both warm up and cool down exercise consist of walking forward uphill on a gentle inclined treadmill (3 degree inclination) for 10 minutes at 4.5to5km/hr walking at this speed and on average rate of approximately 3.1to3.4 metabolic equivalent.

Results: Using SPSS (version 15) software system. Anova was used to find differences in Demographic data of subjects. Between group analysis of variables was done by Post Hoc test. Within Group analysis of variables was done by Mauchly's test of Sphericity. The prior alpha level P= < 0.05 was set as significance for all comparison.

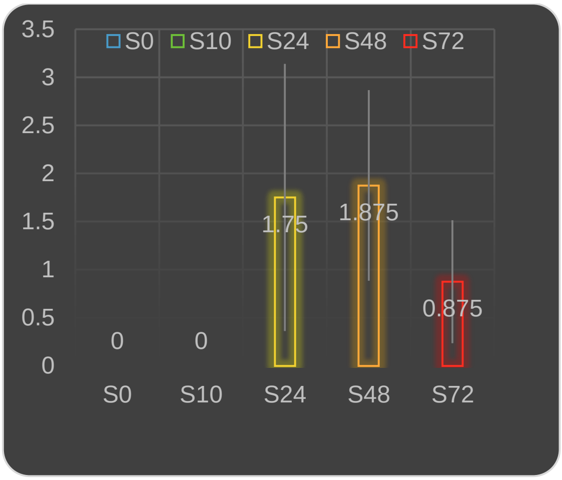
Within Group Analysis of Soreness in Warm up group revealed that the soreness compared with in warm up group at different time intervals S0, S10, S24, S48 and S72 were statically insignificant (P value >.005).



Graph 5.1 within group analysis of soreness in warm up group

Soreness in cool down group: The analyses revealed that the some soreness values compared with in cool down group at different time intervals S0, S10, S24, S48 and S72 were statically insignificant (P value >.005). Comparison of S0-S48, p value 0.01(P value<0.05) and S10-S48, p value 0.01(P value<0.05) were statically significant.

The aim of this study was to determine the effects of warm up and cool-down on muscle soreness following eccentric exercise. 32 players volunteered to participate in study among which 8 were in warm up group with mean age (23.37 ±1.30), 8 were in cool down group with mean age (221.62 ±1.59), 8 were in warm and cool down group with mean age (22.37 ±1.18), and 8 were in control group with mean age (23.25±1.58). The outcome variables taken for this purpose were Soreness and Pain.



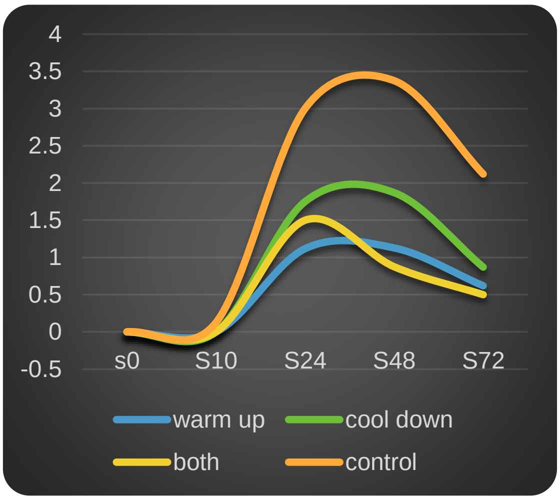
Graph 5.2 within group analysis of soreness in cool down

Within group analysis revealed that soreness values at different time intervals S0, S10, S24, 48, S72 in warm up and warm up and cool down group were stastically insignificant.(P value>0.05). But in cool down group when soreness compared at S0-S48 and S10- S48 were stastically significant. (P value<0.05). In control group comparison of soreness were stastically significant. (P value<0.05).

The analysis conform the induction of DOMS in the selected muscle group. The increased discomfort, decreased ROM of DF indicates that DOMS was successfully induced. Eccentric exercise successfully produced the symptoms of delayed onset muscle soreness. One of the possible causes the muscle damage may be due to disruption of the z-band. Clarkson and Sayers in 1999 in their study stated that during the eccentric muscle contractions there are fewer motor units, thus fewer muscle fibres, activated. This may lead to an increase in tension taken through the cross bridges of the muscle fibre resulting in disruption of the z-band causing streaming.

Another previous study by Clarkson and Kazunori[37] reveals that soreness appears 24 hours after exercise and peaks at 2-3 days of post exercise. Soreness slowly dissipates and does not fully subside until 8-10 days of exercise. The probable reason could be this of my result. In this present study pain values at different time intervals P0-24, P0-P48, P10-P24,P24-P48,P24-P72 and P48-P72 in warm up, cool down, warm up and cool down and control group were stastically significant.(P value<0.05).

Previous study by Newham[30] stated that when subjects perform eccentric exercise they are aware of muscle fatigue but are completely pain free for approximately 8h. The first discomfort is usually a feeling on movement which increases over the following one or two days. The affected muscle often feel swollen, are tender to palpation and, in severe cases there may be an arching, pain at rest. All discomfort has usually disappeared by four or five days.The study results have significant difference only after 10min reading because pain present at least after 8 hour.



Graph 5.21 Comparison of Soreness between Groups

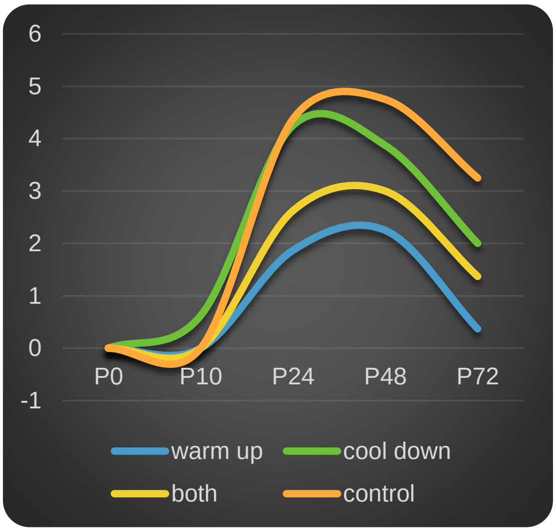
The analyses revealed that the soreness values compared with in warm up, cool down, warm up and cool down and control group at different time intervals S0, S10, S24, S48 and S72 were stastically insignificant (P value >.005). Comparison of S48 and S72 p value .001(P value<0.05) were stastically significant.

Discussion: In present study, the soreness was compared in warm up, cool down, warm up and cool down and control group, there were a significant difference between groups. As we compare warm up group with cool down, statically soreness was less significantly produced in warm group that was most apparent at 24, 48 and 72 hours.

Previously study by Maarteen F. Bobert stated that 10 mins warm up produced small reduction in muscle soreness, however a longer warm up duration could provide greater protection against muscle damage and may result in greater reduction in muscle soreness.

Previously many studies stated that cool-down after exercise because they believe that cool-down will reduce delayed-onset muscle soreness. This study demonstrated that cool-down performed immediately following eccentric exercise does not reduce delayed-onset muscle soreness. Cool-down is performed after the events that initiate eccentric exercise-induced muscle damage. Thus the only way that cool-down could reduce muscle soreness is by interfering with the cascade of events that follow the initial damage. The present study demonstrates that cool-down has no appreciable effect on muscle soreness, and it suggests that cool-down has little effect on soreness-inducing events that follow the initial damage.

Comparison of Pain between Groups revealed that the Pain values compared with in warm up, cool down, warm up and cool down and control group at different time intervals P0, P10, P24, P48 and P72 were stastically insignificant (P value >.005). Comparison of P24, P48 and P72 p value .01(P value<0.05) was stastically significant.



Graph 5.22 Between Group Analysis of Pain in all groups

In this present study pain compared in warm up, cool down, warm up and cool down and control group, there were a significant difference between groups. As we compare warm up group with cool down, both and control group, pain statically less significantly produced in warm group that was most apparent at 24, 48 and 72 hours. There was no relevant literature found that relates pain in all these groups.

Conclusion: It can be concluded that there is a strong significant difference between soreness, pain, range of motion and strength at all time intervals. The results of study have important implication of using a warm up procedure to reduce Pain and Soreness. Warm-up performed immediately prior to unaccustomed eccentric exercise produces small reductions in delayed-onset muscle soreness, while cool-down performed after intense exercise does not.

Limitations

1. Small number of populations as large sample size would have brought in more clarity in observed trends.
2. Blinding was not done during study.

Future Scope

1. Generalized of results can be increase by comparison with female subjects.
2. Study can be be done on a large sample size for better credibility of results.

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EFFECTIVENESS OF ERGONOMICS AWARENESS TRAINING PROGRAMME IN MINIMIZING WORK-RELATED MUSCULOSKELETAL DISORDERS AMONG DENTAL SURGEONS

Abdul Rahim Shaik *

Abstract

Introduction: The postures assumed by the dental surgeons during their professional work have a huge impact on their body and carry a high risk of work-related musculoskeletal disorders. To determine the effectiveness of ergonomics awareness training programme in minimizing the work-related musculoskeletal disorders in dental surgeons. **Methodology:** The study was conducted on 130 dental surgeons who were experiencing lower back pain between moderate to severe on 0-10 Numeric Pain Rating Scale using non-probability convenience sampling technique among dental students, faculty and practitioners with more than one year of work experience in and around Mangalore, India. A six week of ergonomics awareness training programme was developed and imparted. The effectiveness of ergonomics awareness training programme was determined by a pre-tested structured musculoskeletal disorder rating scale. **Results.** The frequency of pain, mean difference of right hand ($p = 0.003$) and left knee ($p = 0.002$) was found to be significant and mean difference of the remaining body parts was found to be highly significant ($p < 0.001$). Mean differences of all the body parts were found to be highly significant ($p < 0.001$) in intensity of pain and frequency of stiffness**. Conclusions:** High incidences of work-related musculoskeletal disorders were as a result of wrong postures adopted by the dental surgeons. Lack of awareness regarding key ergonomic postures and positioning strategies resulted in loss of work efficiency and the prevalence and severity of these disorders, which were minimized by adopting ergonomics awareness training programme.

Key Words: Dentistry, Posture, Pain, Stiffness, Ergonomic intervention.

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Introduction: Musculoskeletal disorders are the health problems of locomotor apparatus, i.e., muscles, tendons, the skeleton, cartilage, the vascular system, ligaments and nerves. Work-related Musculoskeletal Disorders (WMSDs) include all Musculoskeletal Disorders (MSDs) that are induced or aggravated by work and the circumstances of its performance[1].

Most of the dental surgeons today perform their work in the sitting position, while treating the patients in the supine position. Invariably the dental surgeons often have to perform their professional work in prolonged static postures[2]. Even in optimal seated postures more than one half of the muscles of the body are contracted statically and there is little movement of the vertebral joints. These result in physiological changes that can lead to back, neck or shoulder pain or WMSDs. If regularly occurring pain or discomfort is ignored, the cumulative physiological damage can lead to an injury (macro change) or a career ending disability[3]. In dentistry, repetitive tasks - such as scaling, root planning and uncomfortable physical postures contribute greatly to WMSDs and loss of productivity. To perform efficiently and effectively, the dental surgeons shall always like to attain a position that allows them to achieve optimum access, visibility, comfort and control at all times[4].

Basic operating posture is considered to be an important occupational health issue for dental surgeons. It is generally agreed that the physical posture of the dental surgeon should be such that all the muscles are in a relaxed, well – balanced and neutral position. Postures other than this neutral position are likely to cause musculoskeletal discomfort. Dental surgeons are prone to unique muscle imbalances and require special exercises and ergonomic interventions to maintain optimal health during the course of their career[5].

A poor ergonomically designed workplace may not show immediate ill health effect, because the human body has capacity for adapting to a poorly designed workplace or structured job. However, the compounding effect of job and workplace deficiencies will surpass the body's coping mechanisms causing WMSDs. The successful application of ergonomics assures high productivity, avoidance of illnesses and injuries and increased satisfaction among workers. Unsuccessful application of ergonomics, on the other hand, can result in WMSDs[6].

While it may be impossible to completely eliminate all ergonomic exposures in dentistry, the detrimental effects of these hazards can be minimized through engineering controls such as workstation design/adjustment and through administrative controls such as creative scheduling and rest breaks. The variety of tasks performed by dental surgeon provides the opportunity for "musculoskeletal relief" offered by alternating task assignments. Dental surgeons and other allied healthcare professionals trained in ergonomics awareness training programmes are able to recognize early signs of discomfort or WMSDs. Training also increases awareness of ergonomic risk factors, body mechanics and helps them develop possible solutions to ergonomic concerns. Early reporting of symptoms gives the employer the opportunity to respond quickly, address concerns and to head-off or alleviate potential WMSDs problems.

Despite the evidence of WMSDs in dentistry, research conducted in the area is very scanty. However a few studies conducted in the western countries have not attempted to incorporate interventions and studying their effects in general. Keeping in view the status of research carried out to minimize the WMSDs in dentistry and by studying the effect of corrective measure(s) explained and adopted by the dental surgeons after subjecting them to a short competency based training programme, it is believed that introduction of an effective and result oriented training shall go a long way to minimize the WMSDs in the dental surgeons by creating awareness in them to adopt healthy working practices.

The purpose of the current study is to develop and implement a comprehensive approach and to evaluate the effectiveness of Ergonomics Awareness Training Programme (EATP) in minimizing the WMSDs among dental surgeons. The underlying hypotheses for the study are that: 1) The mean post-test scores of frequency of pain in selected body parts of dental surgeons will be significantly lower than that of their mean pre-test scores, 2) The mean post-test scores of intensity of pain in selected body parts of dental surgeons will be significantly lower than that of their mean pre-test scores, and 3) The mean post-test scores of frequency of stiffness in selected body parts of dental surgeons will be significantly lower than that of their mean pre-test scores.

Methodology: Group pre-test post-test study design was used to evaluate the effectiveness of EATP for the WMSDs among dental surgeons. A pre-test was administered by means of Musculoskeletal Disorders Rating Scale (MDRS) and EATP was given. A post-test was conducted using the same MDRS. The study was conducted in two dental colleges namely: Yenepoya Dental College and AB Shetty Memorial Institute of Dental sciences, Mangalore and 20 private dental clinics in and around Mangalore city, Southern Karnataka District, India from May 2011 to January 2012 by using non-probability convenience sampling technique. All dental surgeons who were present during the data collection period in selected dental colleges and private dental clinics and who fulfilled the sampling criteria were selected as the subjects for the study. The reasons for selecting these dental colleges and private dental clinics were: availability of subjects for the study, economy of time, familiarity with setting and to facilitate the access and administrative approval from the dental colleges and private dental clinics.

The study was conducted on 130 practicing dental surgeons having work experience of more than one year and having lower back pain between moderate to severe on 0-10 Numeric Pain Rating Scale were selected as the subjects for the study. They were basically post graduate dental students (66.1%), faculty members of dental colleges (21.6%) and private dental practitioners (12.3%).

The dependent variable in the study was WMSDs in terms of perception of pain and stiffness and this was measured by the MDRS which consisted of socio demographic proforma and pain and stiffness scale. In order to find the perception of pain and stiffness experienced by the dental surgeons a pain and stiffness scale was administered to the selected dental surgeons under study. Pain and stiffness scale (51 items) was developed on the basis of survey to quantify the perception of pain and stiffness experienced by working dental surgeons in the past six months of their body parts. This scale has three components such as frequency of pain, intensity of pain and frequency of stiffness. In turn, frequency of pain and stiffness has three variables like 'always', 'some times' and 'never'. If the question was answered 'always' one point was given on the pain and stiffness scale, similarly two points for 'sometimes' and three points for 'never'. In order to find out the intensity of pain, the researcher used 0-10 Numeric Pain Rating Scale which consisted 0: no pain, 1-3: mild pain, 4-6: moderate pain and 7-10: severe pain. The dental surgeons were asked to mention the appropriate number corresponding to their body parts.

The independent variable was the EATP for dental surgeons. EATP to minimize WMSDs among dental surgeons was developed on the basis of public domain NIOSH publication and USAF Dental Evaluation and Consultation Service, Washington D.C, USA[3,7-11]. EATP is for providing people with the skills, knowledge, abilities and tools to accomplish their designated responsibilities. Interventions or prevention strategies require an awareness of how to fit the job to the worker and not the worker to the job. Applying ergonomics to the practice of dentistry not only could provide safety benefits but a practice might also improve performance objectives through greater productivity. A six week of EATP for selected working dental surgeons was developed to provide training. It included lecture-discussion session with the dental surgeons under study to impart awareness about types of WMSDs, signs and symptoms of WMSDs, risk factors of WMSDs, ergonomics and physical exercises. Demonstration sessions were arranged by the researcher with the dental surgeons under study on one to one basis to make the EATP effective and purposeful. The demonstration consisted of good postures and positions and chair side directional stretching exercises to be adapted as a practice during mini breaks while working.

To make the EATP effective, an ergonomics awareness training manual was prepared and used during the training. After imparting the EATP, the researcher visited each dental surgeon every two weeks for a period of six weeks to find out any difficulties regarding the application of interventions demonstrated during the training period. Any help or explanation required by the dental surgeons was provided on the spot by the researcher to facilitate use of interventions by the dental surgeons under study. After six weeks of training, a MDRS (pain and stiffness scale) was administered to the dental surgeons to find out the effectiveness of EATP in the reduction of perception of pain and stiffness among the dental surgeons.

A structured MDRS was developed by the researcher to find out the perception of pain and stiffness experienced by the dental surgeons on their body parts while performing their professional work. The scale consisting of 51 items and these were validated and pre-tested. Reliability of MDRS (pain and stiffness scale) was done on 20 dental surgeons in Yenepoya Dental College, Mangalore by using internal consistency reliability. The reliability coefficient was calculated by using Cronbach's alpha (or coefficient alpha) and it was found 0.793 in frequency of pain, 0.660 in intensity of pain and 0.728 in frequency of stiffness. This indicates that the tool was reliable.

Ethical clearance to conduct the study was obtained from Yenepoya University Ethical Committee. After explaining the purpose of the study a written consent was obtained from the participants on voluntary basis and the questionnaire was handed over to the dental surgeons to fill their responses. Data were analyzed using SPSS version 17.0 software. Data for pre-test and post-test scores were analysed by applying Student's paired t-test to test the significance of difference between the pre-test and post-test mean scores and statistical significance was accepted for $p < 0.05$.

Results

The frequency and percentage distribution of dental surgeons on selected sample characteristics presented in Table 1 show that both male and female dental surgeons were equally distributed (50.0%). Majority (86.2%) of these were in the age group of 20-35 years. With regard to the field of dental practice 17.7% were practicing Conservative dentistry and 2.3% were practicing Community dentistry. 46.9% were having 1-5 years of experience and none (0.0%) of these were having ≥ 26 years of experience in their profession.

Majority (50.8%) of these were working 4-6 hours per day and 2.3% of these were working 1-3 hours per day. Majority (85.4%) of dental surgeons were working 5-6 days per week and 2.3% of these were working 1-4 and 4-5 days per week. Majority (61.5%) of these were treating 1-5 patients per day and 9.3% of these were treating ≥ 16 patients per day. With regard to the height and weight of the dental surgeons, 48.5% were between 166-180 centimetres and 6.1% were ≥ 180 centimetre of height. 30.8% were 65-74 kilograms and 4.6% were ≥ 85 kilograms of weight.

The frequency and percentage distribution of frequency of pain on selected body parts of dental surgeons in pre-test and post-test are presented in Table 2 which show that in pre-test, 8.5% of dental surgeons always had pain in the lower back and none (0.0%) of these always had pain in the right and left shoulder, right and left elbow, right and left hip/thigh. Majority (87.7%) of these sometimes had pain in the lower back and 11.5% of these sometimes had pain in the left elbow. 88.5% of these never had pain in the left elbow and 3.8% of these never had pain in the lower back. In post-test, 0.8% of dental surgeons had always pain in the lower back and none (0.0%) of these had pain in the remaining body parts. 42.3% of these sometimes had pain in the lower back and 2.3% of these sometimes had pain in the left elbow. Majority (97.7%) of dental surgeons never had pain in the left elbow and 56.9% of these never had pain in the lower back.

The frequency and percentage distribution of intensity of pain on selected body parts of dental surgeons in pre-test and post-test are presented in Table 3 indicate that in pre-test, majority (88.5%) of the dental surgeons had no pain in the left elbow and 3.8% of these had no pain in the lower back. 36.1% of these had mild pain in the neck and 1.5% of these had mild pain in the lower back. 77.0% of these had moderate pain in the lower back and 4.6% of these had moderate pain in the right and left elbow, left wrist and left hip/thigh. 17.7% of dental surgeons had severe pain in the lower back and 0.8% of these had severe pain in the left elbow and left hip/thigh. In post-test, majority (99.2%) of dental surgeons had no pain in the left wrist and left hand and 56.9% of these had no pain in the lower back. 26.9% of these had mild pain in the neck and 43.1% of these had mild pain in the lower back. None (0.0%) of the dental surgeons had moderate and severe pain in all the body parts.

Table 5 Area wise distribution of pre-test and post-test scores of frequency of pain in selected body parts of dental surgeons **(***n=130*)

Sl. no	Body parts	Frequency of pain Pre-test Mean+SD	Post-test Mean+SD	Difference Mean+SD	t value	p value
1.	Neck	2.73+0.45	2.18+0.45	0.55+0.50	12.459	< 0.001**
2.	Upper back	2.85+0.36	2.52+0.56	0.33+0.52	7.264	< 0.001**
3.	Lower back	2.56+0.51	1.95+0.35	0.61+0.56	12.291	< 0.001**
4.	Right shoulder	2.82+0.38	2.59+0.49	0.23+0.44	5.968	< 0.001**
5.	Left shoulder	2.92+0.28	2.59+0.49	0.32+0.47	7.847	< 0.001**
6.	Right elbow	2.95+0.21	2.81+0.40	0.15+0.36	4.699	< 0.001**
7.	Left elbow	2.98+0.15	2.89+0.32	0.09+0.29	3.622	< 0.001**
8.	Right wrist	2.94+0.24	2.69+0.50	0.25+0.43	6.490	< 0.001**
9.	Left wrist	2.99+0.09	2.85+0.38	0.14+0.37	4.285	< 0.001**
10.	Right hand	2.95+0.23	2.85+0.36	0.10+0.37	3.078	0.003*
11.	Left hand	2.99+0.09	2.85+0.36	0.14+0.35	4.553	< 0.001**
12.	Right hip/thigh	2.98+0.15	2.86+0.35	0.12+0.39	3.404	< 0.001**
13.	Left hip/thigh	2.98+0.12	2.86+0.35	0.12+0.37	3.753	< 0.001**
14.	Right knee	2.92+0.27	2.81+0.40	0.12+0.37	2.596	< 0.001**
15.	Left knee	2.94+0.24	2.85+0.36	0.09+0.34	3.098	0.002*
16.	Right ankle	2.96+0.19	2.82+0.42	0.14+0.39	4.060	< 0.001**
17.	Left ankle	2.97+0.17	2.85+0.38	0.12+0.34	3.824	< 0.001**

*SD: Standard Deviation t: Student's paired t-test p: Probability ** Highly significant*
** Significant*

Frequency of Stiffness

The frequency and percentage distribution of frequency of stiffness on selected body parts of dental surgeons in pre-test and post-test are presented in Table 4 indicate that in pre-test, 4.6% of dental surgeons always had stiffness in the lower back and none (0.0%) of these always had stiffness in the remaining body parts except right ankle (1.5%) and left ankle (0.8%).Majority (54.6%) of these sometimes had stiffness in the neck and 11.5% of these sometimes had stiffness in the left elbow. 88.7% of dental surgeons never had stiffness in the left wrist and 42.3% of these never had stiffness in the lower back. In post-test, 0.8% of dental surgeons always had stiffness in the lower back and none (0.0%) of these had stiffness in the remaining body parts except in the left ankle (0.8%). 18.4% of these sometimes had stiffness in the lower back and none (0.0%) of these had some times stiffness in the left elbow, left wrist, right and left hand, right and left hip/thigh. Majority (100%) of dental surgeons never had stiffness in the left elbow, left wrist, right and left hand, right and left hip/thigh and 80.8% of these never had stiffness in the lower back.

Effectiveness of the Ergonomics Awareness Training Programme: Comparison and Difference of Pre-test and Post-test Scores of Frequency of Pain in Selected Body Parts of Dental Surgeons

The data in Table 5 indicate that the mean post-test scores of frequency of pain in the neck (2.18), upper back (2.52), lower back (1.95), right shoulder (2.59), left shoulder (2.59), right elbow (2.81), left elbow (2.89), right wrist (2.69), left wrist (2.85), right hand (2.85), left hand (2.85), right hip/thigh (2.86), left hip/thigh (2.86), right knee (2.81), left knee (2.85), right ankle (2.82) and left ankle (2.85) were lower than the mean pre-test scores i.e., 2.73, 2.85, 2.56, 2.82, 2.92, 2.95, 2.98, 2.94, 2.99, 2.95, 2.99, 2.98, 2.98, 2.92, 2.94, 2.96 and 2.97 respectively. Mean difference of right hand ($p = 0.003$) and left knee ($p = 0.002$) were found to be significant and mean difference of the remaining body parts were found to be highly significant ($p < 0.001$).

Comparison and Difference of Pre-test and Post-test Scores of Intensity of Pain in Selected Body Parts of Dental Surgeons

The mean post-test scores of intensity of pain in the neck (0.63), upper back (0.28), lower back (1.12), right shoulder (0.22), left shoulder (0.11), right elbow (0.08), left elbow (0.04), right wrist (0.11), left wrist (0.02), right hand (0.08), left hand (0.02), right hip/thigh (0.04), left hip/thigh (0.01), right knee (0.15), left knee (0.12), right ankle (0.06) and left ankle (0.06) were lower than the mean pre-test scores i.e., 3.39, 1.99, 5.35, 1.48, 1.34, 0.87, 0.62, 1.10, 0.69, 1.09, 0.77, 0.96, 0.81, 1.51, 1.34, 0.99 and 0.96 respectively. Mean difference of all the body parts were found to be highly significant ($p < 0.001$) as indicated in the Table 6.

Comparison and Difference of Pre-test and Post-test Scores of Frequency of Stiffness in Selected Body Parts of Dental Surgeons

The data in Table 7 show that the mean post-test scores of frequency of stiffness in the neck (2.45), upper back (2.70), lower back (2.38),right shoulder (2.77), left shoulder (2.79), right elbow (2.87), left elbow (2.89), right wrist (2.85), left wrist (2.88), right hand (2.85), left hand (2.85), right hip/thigh (2.86), left hip/thigh (2.86),

Table 6 Area wise distribution of pre-test and post-test scores of intensity of pain in selected body parts of dental surgeons (*n=130*)

Sl. no	Body parts	Intensity of pain Pre-test Mean±SD	Post-test Mean±SD	Difference Mean±SD	t value	p value
1.	Neck	3.39±2.31	0.63±1.08	2.75±1.93	16.28	<0.001**
2.	Upper back	1.99±2.50	0.28±0.69	1.72±2.16	9.05	<0.001**
3.	Lower back	5.35±1.17	1.12±1.29	4.24±1.23	39.48	<0.001**
4.	Right shoulder	1.48±2.16	0.22±0.53	1.25±1.87	7.649	<0.001**
5.	Left shoulder	1.34±2.11	0.11±0.38	1.23±1.98	7.106	<0.001**
6.	Right elbow	0.87±2.03	0.08±0.42	0.79±1.89	4.787	<0.001**
7.	Left elbow	0.62±1.66	0.04±0.23	0.59±1.62	4.121	<0.001**
8.	Right wrist	1.10±2.03	0.11±0.42	0.99±1.97	5.753	< 0.001**
9.	Left wrist	0.69±1.74	0.02±0.15	0.66±1.75	4.321	< 0.001**
10.	Right hand	1.09±2.01	0.08±0.37	1.02±1.90	6.091	< 0.001**
11.	Left hand	0.77±1.76	0.02±0.18	0.75±1.74	4.930	< 0.001**
12.	Right hip/thigh	0.96±1.86	0.04±0.32	0.92±1.78	5.924	< 0.001**
13.	Left hip/thigh	0.81±1.79	0.01±0.09	0.80±1.78	5.124	< 0.001**
14.	Right knee	1.51± 2.29	0.15±0.59	1.36±2.07	7.491	< 0.001**
15.	Left knee	1.34±2.27	0.12±0.56	1.22±2.06	6.724	< 0.001**
16.	Right ankle	0.99±2.05	0.06±0.37	0.93±1.91	0.651	< 0.001**
17.	Left ankle	0.96±2.06	0.06±0.37	0.90±1.91	0.359	< 0.001**

*SD: Standard Deviation t: Student's paired t-test p: Probability ** Highly significant*

right knee (2.81), left knee (2.85), right ankle (2.82) and left ankle (2.85) were lower than the mean pre-test scores i.e., 2.86,2.96, 2.80, 2.99, 2.99, 2.99, 3.00, 2.99, 3.00, 3.00, 3.00, 3.00, 3.00, 2.99, 2.99, 2.99 and 2.97 respectively. Mean difference of all the body parts were found to be highly significant ($p < 0.001$).

Table 7 Area wise distribution of pre-test and post-test scores of frequency of stiffness in selected body parts of dental surgeons (*n=130*)

Sl. no	Body parts	Frequency of stiffness Pre-test Mean±SD	Post-test Mean±SD	Difference Mean±SD	t value	p value
1.	Neck	2.86±0.35	2.45±0.50	0.41±0.49	9.423	< 0.001**
2.	Upper back	2.96±0.19	2.70±0.46	0.26±0.44	6.759	< 0.001**
3.	Lower back	2.80±0.42	2.38±0.57	0.42±0.60	8.102	< 0.001**
4.	Right shoulder	2.99±0.12	2.77±0.42	0.22±0.41	5.951	< 0.001**
5.	Left shoulder	2.99±0.12	2.79±0.41	0.20±0.40	5.679	< 0.001**
6.	Right elbow	2.99±0.09	2.87±0.34	0.12±0.24	4.255	< 0.001**
7.	Left elbow	3.00±0.00	2.89±0.32	0.16±0.32	4.120	< 0.001**
8.	Right wrist	2.99±0.09	2.85±1.36	0.14±0.35	4.553	< 0.001**
9.	Left wrist	3.00±0.00	2.88±0.33	0.12±0.33	4.255	< 0.001**
10.	Right hand	3.00±0.00	2.85±0.36	0.15±0.36	4.843	< 0.001**
11.	Left hand	3.00±0.00	2.85±0.36	0.15±0.36	4.699	< 0.001**
12.	Right hip/thigh	3.00±0.00	2.86±0.35	0.14±0.25	4.553	< 0.001**
13.	Left hip/thigh	3.00±0.00	2.86±0.35	0.14±0.25	4.553	< 0.001**
14.	Right knee	2.99±0.09	2.81±0.40	0.19±0.39	5.404	< 0.001**
15.	Left knee	2.99±0.09	2.85±0.36	0.15±0.36	4.699	< 0.001**
16.	Right ankle	2.99±0.09	2.82±0.42	0.17±0.40	4.867	< 0.001**
17.	Left ankle	2.97±0.28	2.85±0.28	0.12± 0.44	2.972	<0.001**

*SD: Standard Deviation t: Student's paired t-test p: Probability ** Highly significant*

Discussion

Work-related Musculoskeletal Disorders Experienced by the Dental Surgeons

During the study the researcher observed that WMSDs such as pain and stiffness experienced by majority of dental surgeons are due to bad postures and repetitive movements adopted by them while performing their professional work. Further the WMSDs observed are as a result of inappropriate physical positioning of the patients as well.

Similar studies [12, 13] conducted have reported that symptoms are products of many risk factors including prolonged static postures, repetitive movements and poor positioning. Musculoskeletal pain occurrence among dental surgeons is the result of frequent assumption of static postures, which usually require more than 50% of the body muscles to contract to hold the body motion less while resisting gravity. The static forces resulting from these postures have been shown to be much more tasking than dynamic forces. Repeated prolonged static postures are thought to initiate series of events that could account for pain, injuries or career ending problems seen in WMSDs among dental surgeons.

The findings of the current study are also supported by studies [14, 15] which indicate that dental surgeons are normally included within the group of professionals at risk of suffering MSDs due to prolonged awkward or forced postures at work and failure to adopt preventive measures. High frequency of MSDs probably reflects the specific work load in dentistry with its high demands on vision, precision, fine manipulative hand movements and work with unsupported elevated arms. The symptoms might impair work capacity and the future possibility to continue in the profession.

The present study showed prevalence of WMSDs between 33.0% and 65.3% and it was observed that the most common body parts affected are lower back, neck and upper back. The findings are supported by other studies as well. The most common areas of complaints are the neck, shoulders and lower back where studies indicate prevalence between 63.0% and 93.0% [16, 17].

The study [18] reported that among dental surgeons in New South Wales, Australia, 82.0% of respondents reported experiencing one or more musculoskeletal symptoms during the previous month. 64.0% of respondents reported suffering pain (the majority reported back pain) and 58% headaches. The most severe symptoms reported were pain (39.0%) and headaches (25.0%). The current study revealed that the lower back pain was the most common complaint of the dental surgeons under study. Similar results were observed in study conducted at Athens, Greece [19]. Most of the studies consistently reported that lower back pain is the most common musculoskeletal complaint among the dental surgeons [20-23].

In the current study it was observed that majority of dental surgeons had WMSDs due to prolonged awkward postures adopted while performing their professional work. 69.0% of dental surgeons experienced lower back pain since six months. Among these 24.7% had mild pain, 36.6% had moderate pain and only 7.7% had severe pain. 63.7% of these had neck pain and among those having neck pain, 30.0% had mild pain, 28.0% experienced moderate and 5.7% experienced severe pain. 40.4% of these reported upper back pain. Among these mild and moderate pain was experienced by 23.0% and 14.7% respectively and only 2.7% had severe pain.

Similar study conducted in Nepal [24] showed that 73.5% of the dental surgeons felt that their musculoskeletal complaints were significantly contributed by their professional work. 79.4% of these had at least one episode of back pain in the last one year. Among these 55.9% had mild pain, 19.4% had moderate pain and only 3.0% had severe pain. 58.8% of dental surgeons experienced at least one episode of neck pain during the last one year. Among these 42.6% had mild pain, 11.8% had moderate and 5.9% had severe pain. Shoulder pain was less common. 47.1% had at least one episode of shoulder pain in the last one year. Among those who had shoulder pain, 39.7% reported mild pain, 5.9% and 6.0% had moderate and severe pain respectively.

Similar studies [13, 25] also observed that most of the dental surgeons reported some kind of musculoskeletal pain in the last six months. The region most commonly affected by pain was the neck, followed by lumbar zone. Majority of the respondents had mild symptoms and only a small percentage experienced moderate to severe pain.

Effectiveness of Ergonomics Awareness Training Programme

In most of the studies [26] the dental surgeons are reported to be relatively inactive and a limited number of them use one or other form of physical exercises and ergonomic advices to benefit from the same. Thus there is a scope for further decreasing the prevalence and severity of WMSDs by adopting ergonomic advices and performing regular specific exercises [24, 27].

An ergonomic systems approach to interventions, focusing on the worker and also on factors within the work organization, appears to be most effective to reduce WMSDs [28]. According to some studies, improvement in the ergonomics of the dental equipment has not served to reduce the incidence of MSDs [29]. The aetiology of musculoskeletal disease is multifactorial, with the involvement of biomechanical, individual and psychosocial factors related to work.

Consequently, the preventive strategy must be multifactorial and should focus on ergonomics, breaks at work, general health and physical exercise [3, 5, 30].

The findings of the study showed that mean post-test scores of frequency of pain on selected body parts of dental surgeons were lower than the mean pre-test scores. Mean difference of right hand ($p = 0.003$) and left knee ($p = 0.002$) were found to be significant and mean difference of remaining all the body parts were found to be highly significant ($p < 0.001$). Mean post-test scores of intensity of pain and frequency of stiffness on selected body parts of dental surgeons were lower than the mean pre-test scores. Mean difference of all the body parts were found to be highly significant ($p < 0.001$). The findings of the study indicated that the EATP was effective in minimizing the WMSDs in terms of perception of pain and stiffness.

The findings of current study are supported by other study findings [31-33] which showed that arm support, ergonomics training and workplace adjustments, new chairs and rest breaks help employees with MSDs and, combined with physical exercise, they may reduce symptoms of the neck and upper limbs. Strenuous physical exercise during leisure time may also reduce the risk of future psychological complaints, poor general health and long-term sickness among working dental surgeons. A systematic review study conducted in Toronto, Canada [34] showed that work-style interventions focusing on body posture and workplace adjustment could reduce work disability duration and associated costs.

The results of another study [35] also indicate that dental teams need functionally-designed dental equipment and proper training in ergonomic methods. With the professional aim of delivering the highest quality of care for a reasonable profit, the practice of ergonomics becomes the centre of focus in determining how best to achieve success with patients without stress [4].

Another study [36] suggests that every aspect of practice implies ergonomic considerations and it is necessary that dental ergonomics involves all aspects of practice organization, management, methods of working and organization of treatment. Prevention or reduction of symptoms in the musculoskeletal system can be successful in terms of more efficient use of body and dental equipment and implementation of a daily self-care programme and cognitive-behavioural modifications.

General health is another aspect to be taken into account for the effective prevention of WMSDs. It is essential to dedicate the necessary time to lei¬sure activities and to implement other measures for the control of mental stress. The preventive role of physical exercise is also a key element to be taken into account. Dental surgeons should learn to avoid the various risk factors – the ultimate objective being the definition of personalized rehabilitation exercises, stretching and regular aerobic activity. Aerobic exercise has been shown to prevent or improve general pain, facilitate weight loss and strengthen the torso. The stretching of the muscle and tendon structures in turn appears to be helpful in reliev¬ing back pain [3, 5, 30, 37].

Practical Implications and Further Research

The implications of the study findings are that the successful application of EATP ensures high productivity, avoidance of illnesses and injuries and helps to utilize their services more effectively. It is expected to minimize the WMSDs and thereby increases the efficiency and satisfaction among the dental surgeons. Therefore not only those engaged in dentistry will benefit from a reduction of the chronic trauma often associated with the profession, but society as a whole will also reap benefits in terms of efficiency and reliability of dental surgeons and their practices. Further the findings suggest that similar research can be conducted to find awareness of ergonomic interventions among dental students while performing dental procedures. The findings also suggest that working environment of dental surgeons needs to be designed and organized in accordance with the principles of ergonomics in order to minimize WMSDs among dental surgeons.

Strengths and Limitations

The study examined most of the dental surgeons who are actively involved in the clinical practice of dentistry in and around Mangalore city. All the dental surgeons (100%) were undergone EATP implemented by the researcher. The analysis was adequately powered to find the comparison and difference between the pre-test and post-test scores. However the study did not use randomization for selection of the samples and thus limits the generalization of the study findings. The study also did not use control group. The researcher had no control over the events that took place between pre-test and post-test. Interventions were limited to six weeks and the follow up was done every two weeks. However more frequent visits like twice a week may be required since changing old routines take longer period and require follow up.

Conclusions

The study concluded that high incidences of WMSDs are as a result of wrong postures adopted by the working dental surgeons and they were not practising many key ergonomic postures and positioning strategies. WMSDs result in loss of work efficiency among dental surgeons and the prevalence and severity of these disorders were minimized by adopting ergonomic interventions such as activity mini breaks, good postures and positions, organizational changes, creative use of part-time or rotating work, chair side directional stretching exercises, strengthening and aerobic exercises. Thus it is drawn conclusion that EATP helped dental surgeons in minimizing work-related pain and stiffness and work for longer periods along with improvement in their quality of life.

Conflict of Interest: Authors, Abdul Rahim Shaik, B. H. Sripathi Rao, Akhter Husain declare that no conflict of Interest.

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