

## Original Article

# DOES ELECTROMYOGRAPHY BIOFEEDBACK TRAINING REDUCE WORK-RELATED NECK PAIN

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## ABSTRACT

**Purpose:** The purpose of this study is to investigate the use of Electromyography (EMG) biofeedback training in dental professionals to reduce upper trapezius muscle tension and thereby to reduce the work related neck pain. By reducing muscle activity in the neck and shoulder postural stabilizing muscles, EMG biofeedback training would be an effective mode of treatment in dental professionals for the management of work related neck pain.

**Subjects and Methods:** This RCT included a total of 50 dental professionals (29 males and 21 females) aged between 27-44 years (mean age of 36.4). They were randomly allocated equally into either experimental group who received EMG Biofeedback or the control group who received the conventional physiotherapy management. Patients in the control group were given Hot Packs, IFT and neck care advice. In addition to conventional Physiotherapy treatments, patients in the experimental group received an EMG Biofeedback training program for the bilateral trapezius. The treatments were given for 30-45 minutes/ day / 5 days in a week for 2 weeks. The outcome tools used were; Visual Analogue Scale (VAS) and Neck Disability Scale (NDI) and both were measured before starting the treatment and at end of 2 weeks.

**Results & Conclusion:** Adding EMG biofeedback training for the trapezius muscles along with conventional physiotherapy management is found to be an effective method of treatment in the management of chronic non specific neck pain patients.

**KEYWORDS:** EMG Biofeedback, WMSD, Neck pain.

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## INTRODUCTION

Work related musculoskeletal disorders (WMSDs) are syndromes characterized by discomfort, impairment, disability, or persistent pains in joints, muscles, tendons or other soft tissues with or without physical manifestations and caused or aggravated by workplace exposures. Awkward postures, repetitive work

or handling heavy loads and prolonged sitting or standing are amongst the risk factors that may lead to MSDs. Upper limbs (the hand, wrist, elbow and shoulder), the neck and lower back are particularly vulnerable to MSDs. WMSDs are debilitating, activity limiting and currently one of the most common conditions treated by physical therapists. Musculoskeletal pain is

often characterized by loss of function and restricted range of motion (Andersen et al., 2011)<sup>1</sup>. Due to high incidence rates and the incapacitating nature, musculoskeletal disorders are quickly becoming a main concern within the workplace<sup>2</sup>. The past two decades have witnessed a sharp rise in the incidence of work-related musculoskeletal disorders (WMSDs). Prevention of WMSDs are becoming crucial and requires the identification and modification of risk factors. Individual characteristics of the worker such as gender, age, stature, physical condition, strength, etc. may contribute to the occurrence of these musculoskeletal disorders.<sup>3</sup>

In the current study we focused on the Work related neck pain which is most common in the dental professionals. In the dental profession, dentists and dental hygienists spend their work days in an awkward, static position performing extremely precise procedures in a 2"x 2½" workspace- the patient's mouth. As there is no room for error, a steady hand and a steady, awkward posture must be assumed and maintained. Several risk factors were evaluated for each body region (neck, shoulder, elbow, hand/wrist and back) including Awkward postures, Muscle imbalance, Ischemia, Repetition, Force, Vibration, Fatigue, etc or combination of these factors. Repetitive motion in the neck may cause nerve compression, indicative of cervical disorders but more often leads to muscle inflammation.<sup>4</sup>

There are studies stating that dental professional work for around 8 hours a day in the static awkward postures may lead to some sort of musculoskeletal discomfort. The availed data is expected to provide information for preventive measures of WMSDs, modification of risk factors, individual characteristics of workers such as age, gender, experience, department, physical condition etc. to correct unhealthy postures, prevent prolonged repetitive movements, intense work schedules etc<sup>5</sup>. For establishing preventive measures of MSDs, and especially in the neck, the status of WMSDs in the neck has to be investigated. And in further, if any of them have found to be having a WMSDs has to be treated effectively by means of electrophysical agents and work modifications by a physical therapists.

Biofeedback is a new mode of treatment for the management of WMSDs. This mode of treatment uses computers and surface electrodes that are placed on the skin of the person to reveal their internal physiological events, in the form of visual and auditory signals. This is one of the electrotherapeutic modalities in physical therapy, by which a person learns to control physiological processes that are usually involuntary, through auditory and visual stimuli. This modality has been used in the management of temporomandibular joint dysfunctions, patellofemoral pain, hypertension, spasticity and cerebrovascular accidents. Relaxation and facilitation of muscles are some of the main areas of treatment using biofeedback in physical therapy. A few studies have reported, without strict methodological rigor, on biofeedback being used to facilitate and train relaxation in chronic pain. In order to achieve this, biofeedback is targeted to the muscles like trapezius and frontalis. Biofeedback utilizes the principle of hypostimulation (relaxation) of the central nervous system, which increases the endorphins and forms the neuro endocrine basis of biofeedback for control of chronic pain.<sup>6</sup>

Recent research studies have found that biofeedback can be applied to reduce muscular tension in order to treat WMSDs. A few studies have examined the effects of biofeedback interventions to modify muscle activation in office workers and influence their symptoms. There has been little research directly comparing the effects of biofeedback with the effects of traditional physiotherapy approaches such as active exercise and passive treatment modalities. Traditionally, passive physiotherapy involving electric stimulation and/or heat therapy has been commonly used to provide symptomatic relief in patients with neck and/or shoulder pain. When patients are satisfied with temporary symptomatic relief through passive treatment, the problem will often recur if postural or muscle activation habits do not get corrected.<sup>7</sup>

There are many studies stating and proving the involvement of various work related musculoskeletal problems associated with the dental professionals, of which the dentists are more prone for getting work related neck pain. And

for the management for neck pain it was practiced to give only the passive electrophysical agents and exercises by physiotherapists. So the purpose of this study is to test the hypothesis that, the use of Electromyography (EMG) biofeedback training in dental professionals can reduce upper trapezius muscle tension and would be effective in reducing work related neck pain. By reducing muscle activity in the neck and shoulder postural stabilizing muscles, EMG biofeedback training would be an effective mode of treatment in dental professionals for the management of work related neck pain.

## MATERIALS AND METHODOLOGY

The study is a Randomized Controlled Trial with a total of 50 dental professionals (29 males and 21 females) aged between 27-44 years (mean age of 36.4) were selected based on the Nordik Musculoskeletal Questionnaire and then were randomly allocated equally into either experimental group who received EMG Biofeedback or the control group who received the conventional physiotherapy management. Patients in the control group were given Hot Packs, IFT and neck care advice (Group 1). In addition to conventional Physiotherapy treatments, patients in the experimental group received an EMG Biofeedback training program for the bilateral trapezius (Group 2). The treatments were given for 30-45 minutes/ day / 5 days in a week for 2 weeks. The outcome tools used were; Visual Analogue Scale (VAS) and Neck Disability Scale (NDI) and both were measured before starting the treatment and at end of 2 weeks. Informed consent was obtained from each participant. Ethical clearance was obtained from the Central Ethical Committee of the University.

The inclusion criteria for recruiting the subjects were; Dental post graduate students and professionals who diagnosed with non specific work related neck pain, age group between 25 to 45 years, both male & females, at least 1 year of work experience in the current position who still working at least 20 hours per week and neck pain >30 days during past 12 months whereas the exclusion criteria were; hyper mobile joints, cervical joint diseases, subjects undergoing regular flexibility exercise or any other physical

work, severe arthritis or joint disorders, who is taking muscle relaxants, had tumors or inflammatory diseases or reported other complaints in the upper extremities apparently not related to work.

Participants in the biofeedback group were given EMG biofeedback training to relax the both the upper trapezius muscles by using a well calibrated machine – MYOMED 932 manufactured by Enraf Nonius Company, Netherlands. A threshold amplitude was preset by the researcher, and EMG signals above the threshold would trigger an auditory feedback signal, warning the subject to try and reduce the upper trapezius muscle activity, which they are taught to achieve by slightly depressing the shoulders or by sitting quietly with the eyes closed and the shoulders relaxed. A base-test was done without using audio feedback in order to acquire accurate baseline trapezius EMG readings. All participants were given treatment in sitting position with the electrodes placed bilaterally across the upper trapezius in line with the seventh cervical vertebrae (C7) and a ground electrode placed on the ankle.

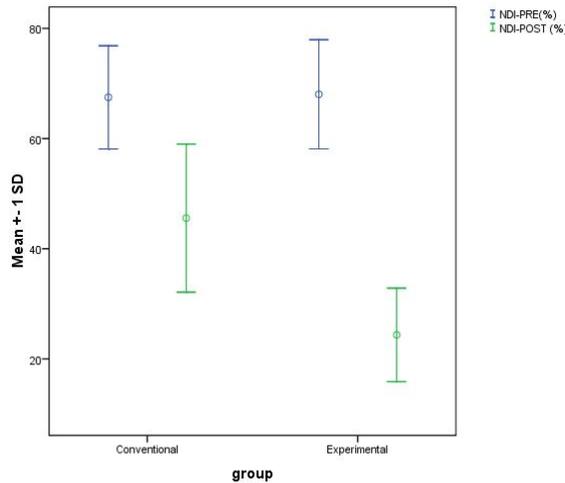
The control group was received interferential therapy (15min) and hot packs which was applied to their neck and shoulder regions for 15 minutes in addition to the neck exercises and advices. The IFT was applied using the Biotech machine and 4 electrodes were applied to the bilateral neck and Upper Trapezius region in a cross-fire pattern. The interferential current with a 4000-Hz carrier frequency and 100-Hz beat frequency, increasing intensity to the maximum tolerable current without muscle contraction was used.

## RESULTS

To find out the statistical results, multiple statistical tests were used with spss package version 16.0. To know the within group and between groups difference for NDI, repeated measures of ANOVA was used. And the result shows that there was a statistical difference within the groups and between the groups. Even though both the groups were showing improvements, the experimental group was showing better improvement.

**Table 1:** Pre- Post comparison of within and between groups for NDI- Repeated measures of ANOVA.

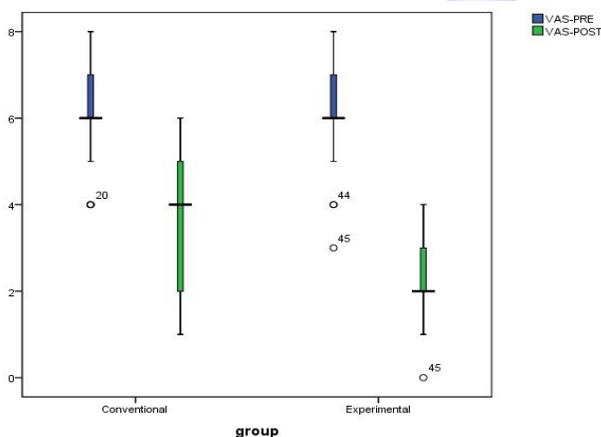
		Mean	S.D	P value	
				Within the group	Between the group
Pre	Conventional	67.49	9.36	p<0.001 F= 887.83	p<0.001 F= 97.64
	Experimental	68.04	9.9		
	Overall	67.77	9.54		
Post	Conventional	45.57	13.45		
	Experimental	24.37	8.49		
	Overall	34.97	15.44		



To know the within group and between groups difference for VAS, Friedmann's test was used. And the result shows that there was a statistical difference within the groups and between the groups. Even though both the groups were showing improvements the experimental group was showing better improvement.

**Table 2:** Pre- Post comparison of within and between groups for VAS- Friedmann's Test.

		Minimum	Maximum	Median	IQ Range	P value	
						Within the group	Between the group
Pre	Conventional	4	8	6	5.5-7.0	p<0.001	p<0.001
	Experimental	3	8	6	5.5-7.0		
Post	Conventional	1	6	4	2.0-5.0		
	Experimental	0	4	2	1.5-3.0		



## DISCUSSION

The purpose of this study was to investigate whether EMG biofeedback training can reduce work related neck pain and for this reason we have selected only one particular group of subjects which are the dental professionals among whom the work related neck pain is found to be very common. The study by Senthil P. Kumar *et al*<sup>8</sup> mentioned that, there was an overall very high prevalence of musculoskeletal (MSK) pain among Dental Professionals. Anna Kierklo *et al*<sup>9</sup> also stated that, it was recognized that limited ergonomics in the work environment of the dentists' results in MSDs, and its prevalence is very high. The study by Khalid Al-Ali & Raghad Hashim<sup>10</sup> indicates that occupationally related musculoskeletal problems are present among dentists and they insisted for further studies to identify the causes of musculoskeletal pain and to identify appropriate interventions that may reduce its prevalence.

The results of the study proves that, EMG Biofeedback training could be an ideal mode of treatment for the management of work related neck pain especially in the dental professionals. The basic principle how the EMG biofeedback works among these subjects are by reducing the upper trapezius muscle tension and this would have reduced the work related neck pain, as the tension in these muscles could have mounted over because of an awkward working posture. The reason why we have recruited only one group of subjects in our study is that, in order to maintain the uniformity of the subjects, even though the work related neck pain is common in other professionals like computer operators as well.

The outcome measurements tools which we had used in our study were the Neck Disability Index (NDI) which is found to be a reliable and valid method of measure to check the disability of the neck, related to any disease or disorders and the other measure was the Visual Analogue Scale (VAS), as this also a commonly used scale to grade the intensity of pain. The results of the NDI score shows that, both the groups were having a significant improvement at the end of two weeks of treatment (p<0.001). And when

the intergroup comparisons were made, the experimental group who received an additional EMG biofeedback training have showed a better improvement than the control group ( $p < 0.001$ ). And in the same way, when the analysis was done for the VAS, the results shows that, even though both the groups were showing improvements, the experimental group was showing a better improvement than the control group ( $p < 0.001$ ).

Oonagh M Giggins *et al*<sup>11</sup> have concluded their study with the statement as EMG biofeedback is by far the most popular form of biofeedback, however newer technologies are been investigated for their potential as biofeedback tools. While the evidence to support the use of biofeedback in rehabilitation appears promising, there is however a lack of systematic reviews including a large number of RCTs examining this subject. Further large RCTs and systematic reviews investigating different biofeedback applications in different clinical populations are warranted. Even though they have suggested the various uses of EMG Biofeedback, not many studies have been conducted to find out the clinical effectiveness of EMG biofeedback so far, in that context, this would be a study to prove its effectiveness in the rehabilitation management.

Abraham Babu *et al*,<sup>6</sup> have stated that, among the vast treatment options of exercises and various alternative therapies, biofeedback is a new modality, which has been investigated in their study for the management of Fibromyalgia Syndrome (FMS). However, this vital technique used in the management of FMS has to be widely used in the clinical scenario to get a healthy outcome. From the results of their study, it is clear that biofeedback is an effective mode of treatment in the management of FMS, especially in decreasing the pain and number of tender points. Even though they have used it in the management of FMS, by the results of our study it can be ascertained that EMG Biofeedback training could help in the management of work related neck pain as well. In future, it is recommended to conduct more studies with latest mode of treatment techniques for the management of work related neck pain and to have studies with more number of subjects.

## CONCLUSION

Even though VAS and NDI score has reduced significantly in both groups when it was compared between pre to post treatment score, the experimental group who received an additional EMG biofeedback training had a significant reduction in the intensity of pain as compared to conventional group. Adding EMG biofeedback training for the trapezius muscles along with conventional physiotherapy management is found to be an effective method of treatment in the management of chronic non specific neck pain patients.

### List of abbreviations:

EMG- Electromyography

WMSDs-Work related Musculo Skeletal Disorders

VAS - Visual Analogue Scale

NDI- Neck Disability Scale

RCT- Randomized Control Trial

FMS- Fibromyalgia Syndrome

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**Conflicts of interest:** None

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