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EVALUATION OF PRESSURE PAIN THRESHOLD AND ACTIVE RANGE OF MOTION OF TMJ AND NECK IN STRESSED AND NON STRESSED STUDENTS

Peeyoosha Gurudut[*1], Esha Bhadauria[2], Manjula Almeida[3]

[*1]**M.P.T**, Assistant Professor, Department of Orthopaedic Physiotherapy, KLE University's Institute of Physiotherapy, City: Belagavi State: Karnataka Country: India

[2]**B.P.T.** KLE University's Institute of Physiotherapy, City: Belagavi State: Karnataka Country: India

[3]**B.P.T.** KLE University's Institute of Physiotherapy, City: Belagavi State: Karnataka Country: India

Abstract:

Objectives: *- To compare the influence of naturally occurring stress in stressed and non stressed undergraduate physiotherapy students.*

Method: *- Before the examination 222 undergraduate Physiotherapy students were screened for stress using a questionnaire, out of which 45 showed to be stressed. 37 students who were not giving the examination served as controls. These participants were assessed for PPT and AROM for Temporomandibular and cervical joints. The stressed students were assessed before examination and a week after examination. The control group was assessed only once.*

Results: *- The values for stress were significantly high in the stressed group before exams when compared to non stressed group. The values significantly reduced in the stressed group when comparisons were made between before and after the examinations. When comparison was made after examination of the stressed group and non stressed group, the scores became insignificant.*

Conclusion: *- The results justify direct relation between stress and muscle functions affection. Examination proved to be a natural stressor for students. However, these stress related effects are temporary and self limiting.*

Keywords: *- **Students, Natural stress, Muscle function, Trigger Points, Neck, Jaw.***

INTRODUCTION

Stress is defined as an organism's total response to environmental demands or pressures[1]. Stress is also defined as state of mental or emotional strain or tension resulting from adverse or demanding circumstances.[2] Health and stress are inversely proportional. Stress arises when individuals perceive that they cannot adequately cope with the demands being made on them or with threats to their well-being.[3]

Hans Selye in 1930s coined the term "stressors" that is known to be a stimulus that causes stress. Hans Selye defined stressor as "physical, mental, or emotional strain or tension" or "a condition or feeling experienced when a person perceives that demands exceed the personal and social resources the individual is able to mobilize"[4]. The common stressors are intense workload, depression, death, divorce, loss of job, starting a new job, getting married, moving, chronic illness, interpersonal conflict, finances, taking care of elderly, anxiety, and academic work, social and health-related factors.[5]

In today's world, college students also experience the stress and strains of living. They constantly face new situations where the outcome is often uncertain. Stress in students may be due to exams, work stress, emotional reasons, faulty posture, using computers in awkward position, carrying heavy bags, long standing activities etc.[6] A cross-sectional study was conducted among 1,224 students of medical, dental and engineering colleges from the urban area of Sangli district, Maharashtra, India.

Results showed that 229 (24.4%) students experienced stress. Out of 229, 115 (38.5%), 102 (34.1%) and 82 (27.2%) were dental, medical and engineering students, respectively. Stress was observed more in females than males.[7] The estimated prevalence of stress and emotional disturbance found in several studies on medical students was higher than that in the general population.[8,9]Physiotherapy education is changing, and educators are increasingly concerned about the levels of stress observed in students. Considerable research has investigated stressors in medical, physiotherapy and nursing students.[10] A study was conducted to determine the sources of stress, perceived course difficulty, and hours of paid employment in

Corresponding Author: Peeyoosha Nitsure, *Department of Orthopaedic Physiotherapy, KLE University's Institute of Physiotherapy, City: Belagavi State: Karnataka Country: India*

undergraduate physiotherapy students in Western Australia (WA) and the United Kingdom (UK); (n=249 WA; 161 UK) and a Master of Physiotherapy (graduate entry) program (n=24 WA) with an overall response rate of 70%. Academic concerns were rated highest for all students, especially in terms of learning, time demands of the course, and clashing with other co-curriculum activities. The course was perceived to be more difficult than expected by 71% of students[11].

Stress has been associated with affection of muscle functions. It has shown to produce physical symptoms like headache, teeth grinding, neck and shoulder tighten up/ache, trigger points in muscle. It has been hypothesized that the feeling of general tension represents a physiological activation response that may or may not include muscle fiber activation.[12] TMJ-related symptoms and painful conditions seem to be more associated with work-related psychosocial factors than with type of work itself.[13]

Psychological stress has been implicated in several aspects of Temporomandibular disorders[14]. Temporomandibular pain and dysfunction syndrome, is described by Costen, as the pain is felt in the TMJ region slightly ahead of ear and is associated with uncomfortable and painful symptoms upon mastication: opening, biting, grinding and lateral rotatory movements of the TMJ.[15]

Literature search revealed a study which was done to assess stress in dental students before, during and after examination using a pressure pain threshold for the TMJ muscles by comparing with non stressed Achilles tendon. The PPT of the TMJ muscles was lowered before and during examination[13]. However, there is dearth in the literature that includes assessment of stress by assessing neck muscles through PPT and assessment of ROM. Further, there is lack of literature where stress in exam going physiotherapy students has been assessed.

Therefore, the current study was conducted with primary aim to compare the influence of naturally occurring stress (examination) in stressed undergraduate physiotherapy students (before and after examination) and secondary aim was to know association between stress and Pain Threshold and Active Range of Motion in TMJ and neck.

METHODOLOGY

After obtaining the approval from KLE institutional ethical review committee, students were recruited in the Study after fulfilling the Inclusion Criteria of under-graduate physiotherapy students between age of 18-25 years writing internal assessment exams and the students who had highest score were further taken as stressed/experimental group. Students were excluded if they had any orthodontic device (braces) or undergone any dental surgery (tooth extraction) or Students with preexisting nonspecific neck pain , chronic neck pain and cervical complaints, any neuropathy or bone disorders. Purpose of the study was explained and a written informed consent was taken from all the students willing to participate in the study. 222 undergraduate students were screened for stress using STAI questionnaire 185 Physiotherapy students who were appearing internal assessment exam were found to be stressed as had higher score on STAI questionnaire The Non-stressed group /control group consisted of 37 students who were not answering exams and were doing their internship were found to be non-stressed as had lower score on STAI questionnaire.

In stressed students and non-stressed students, stress was assessed for Pressure Pain Threshold for TMJ and neck muscles, Active ROM for TMJ opening and cervical lateral flexion and rotation and STAI questionnaire. The stressed group were assessed twice i.e. before exams and one week after the completion of exams. The non-stressed group was assessed once during the course of the study as had minimal score on STAI questionnaire, Active ROM and Pressure Pain threshold.

Stress assessment procedure:

STAI Questionnaire: - Students were assessed for current stress level with Spielbergers's State – Trait Anxiety Inventory (STAI). State-score (S-scores) states how person feels right now about exams, Trait scores (T-scores) states how person feels bout exams throughout. This consists of questionnaire of 20 statements, with raw scores ranging from 20 to 80. The interpretation was that higher the score the more is the amount of stress. For S score more than 55 and for T score more than 50 was considered as being stressed.

Active range of motion (AROM): - AROM was measured for TMJ opening and cervical lateral flexion and rotations.

1) TMJ opening: TMJ opening was measured using was 30 inch rigid transparent plastic scale and readings were measured in centimetres from tip of upper incision to tip of lower incision.
2) Cervical joint – Digital Goniometer was used to assess the right and left lateral flexion and rotations. The readings were measured in degrees. (Refer Fig 1).

For right and left lateral flexion, fulcrum was placed at C_7, stationary arm was placed along the spine and movable arm where participant was commanded to try to touch ear to shoulder on either sides.

For right and left cervical rotation, fulcrum was placed at the vertex of the head and stationary arm parallel to head and movable arm where participant was commanded to rotate head on either sides. A pen/pencil was used as a reference point for movable arm which was placed in the subject's mouth.

Corresponding Author: Peeyoosha Nitsure, *Department of Orthopaedic Physiotherapy, KLE University's Institute of Physiotherapy, City: Belagavi State: Karnataka Country: India*

Pain pressure threshold: - PPT was assessed using a push pull force gauge Pressure Algometer. The following muscles were assessed: Masseter, Sub-Occipital, Levator Scapulae and anterior fibres of upper Trapezius. These muscles were assessed for right and left sides. The PPTs were recorded with a 5sec interval between each site. 3 PPT measurements were recorded and mean was considered for analysis. For all the muscles the tender points were determined by palpation method and the point at which the subject sensed a change of feeling of pressure to a feeling of pain were marked with the marker. PPTs were measured in pounds. (Refer Fig 1)

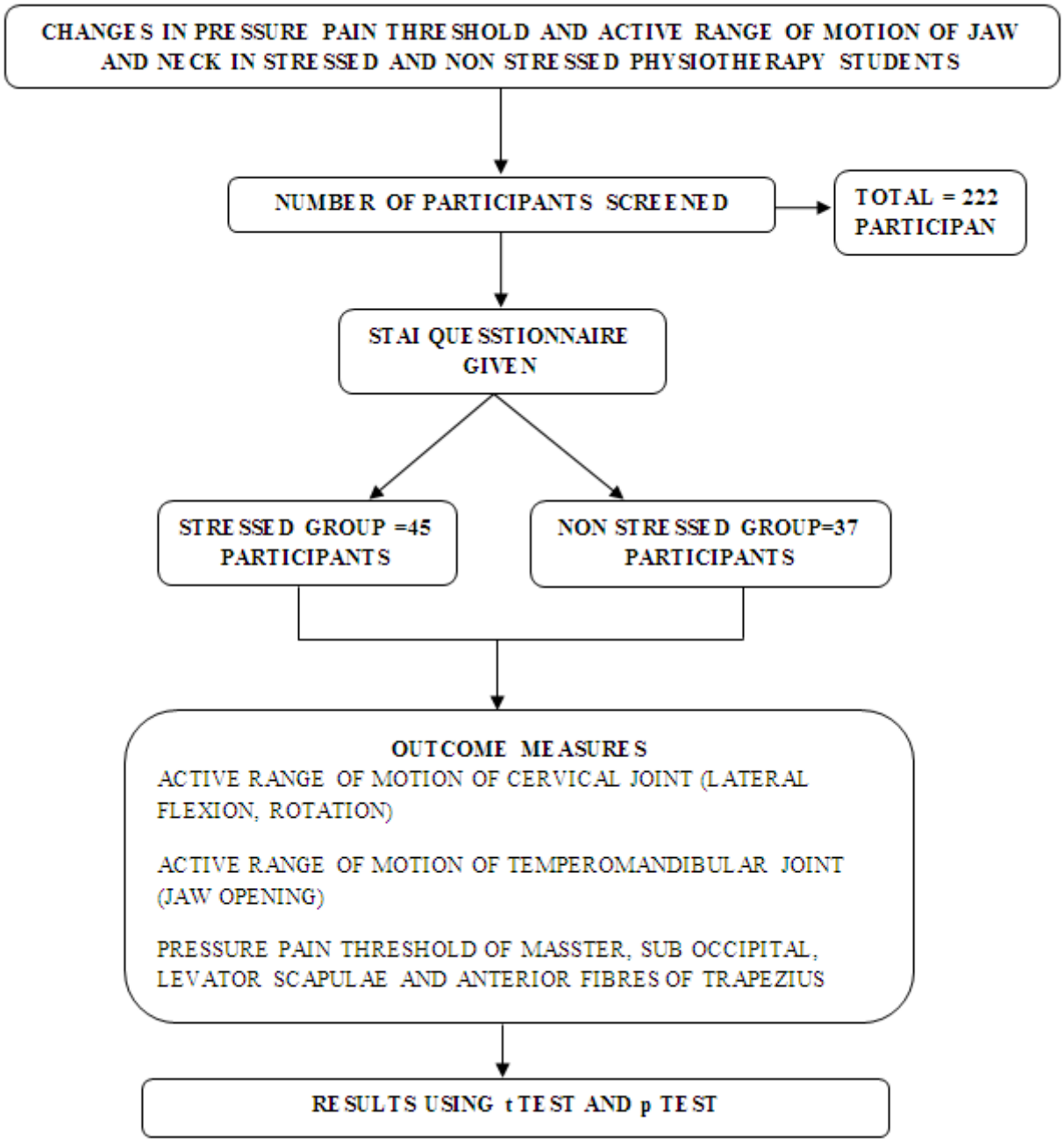

Fig 1:- Flow Chart

To ensure precise relocation of these sites, a transparent laminating paper was used. For Masseter, the upper border was placed in horizontal alignment to the ear lobe, Naso labial folds and to the eyes and markings were made. For Sub-occipital muscle, C7 was marked as landmark and the sheet was placed vertically. For anterior fibres of Trapezius, edge of the upper border of the paper was kept parallel to the clavicle and perpendicular to the ear lobe. For Levator Scapulae, the paper was kept vertically between medial border of scapulae and C_7 Spinous process.

STATISTICAL ANALYSIS

Data was computed and analyzed using Statistical Package of Social Sciences (SPSS) software version 16. Nominal data from subject's demographic data i.e. age, pre and post values of range of motion for TMJ and cervical lateral flexion and rotation were analysed using Paired t-test and p

Corresponding Author: Peeyoosha Nitsure, *Department of Orthopaedic Physiotherapy, KLE University's Institute of Physiotherapy, City: Belagavi State: Karnataka Country: India*

value was calculated. Probability values less than 0.05 was considered statistically significant and probability values less than 0.001 were considered highly statistically significant.

RESULTS

Mean age group for the study is 19.3+_1.63; mean age for non-stressed group is 22_+1.47.

STAI scores, PPT and Active ROM of TMJ and neck were significantly high in the stressed group when compared to non stressed group. The values were significantly reduced in the stressed group when comparisons were made between before and after the examinations. The values were not significant when comparisons were made between after examination values of the stressed group and non-stressed group (Tables 1, 2 &3).

Table 1: COMPARISON BETWEEN BEFORE EXAMS AND AFTER EXAMS IN STRESSED GROUP

PARAMETER	BEFORE EXAM	AFTER EXAM	DIFFERENCE	T value	p value
STAI SCORE					
S Score	63.4±7.98	34.3±9.47	↑29.1±12.10	68.168	<0.001*
T Score	55.3±9.81	36.8±10.67	↑18.5±14.46	8.607	<0.001*
RANGE OF MOTION(CMS,DEGRESS)					
JAW OPENING (cms)	3.8±0.81	4.7±0.52	↑0.8±0.54	10.510	<0.001*
Rt LATERAL FLEXION (degree)	24.1±0.14	40.2±3.62	↑16.1±6.59	16.372	<0.001*
Lt LATERAL FLEXION (degree)	26.8±6.66	40.2±4.16	↑13.4±6.42	14.001	<0.001*
Rt ROTATION (degree)	33.9±6.88	42.4±3.11	↑8.5±6.39	8.990	<0.001*
Lt ROTATION (degree)	34.9±6.17	42.7±2.99	↑7.8±5.54	9.468	<0.001*
PRESSURE PAIN THRESHOLD(lbs)					
Rt MASSETER	0.26±0.75	2.01±0.69	↑1.7±0.72	16.209	<0.001*
Lt MASSETER	0.24±0.64	2.08±0.64	↑1.8±0.89	16.256	<0.001*
Rt SUB OCCIPITAL	0.96±1.31	2.96±1.12	↑2±1.27	10.497	<0.001*
Lt SUB OCCIPITAL	1.07±1.47	2.97±1.11	↑1.9±1.34	9.476	<0.001*
Rt UPPER FIBRE OF TRAPEZIUS	1.56±1.71	5.76±1.67	↑4.2±2.09	13.484	<0.001*
Lt UPPER FIBRE OF TRAPEZIUS	1.52±1.78	5.78±1.73	↑4.2±2.15	13.272	<0.001*
Rt LEVATOR	2.9±1.67	4.7±1.33	↑1.8±1.63	7.380	<0.001*
Lt LEVATOR	2.8±1.94	4.7±1.30	↑1.9±1.79	7.337	<0.001*

***SS**

Table 2: COMPARISON BETWEEN BEFORE EXAMS OF STRESSED GROUP WITH NON STRESSED GROUP

PARAMETER	STRESSED GROUP (before exam)	NOT STRESSED GROUP	t value	p value
STAI SCORE				
S Score	63.4±7.98	39.1±10.49	11.774	<0.001*
T Score	55.3±9.81	40.3±9.17	6.984	<0.001*
ACTIVE RANGE OF MOTION (CMS, DEGREES)				
JAW OPENING (cms)	3.8±0.81	4.5±0.67	3.690	<0.001*
Rt LATERAL FLEXION (degree)	24.1±6.16	41.3±4.68	14.226	<0.001*
Lt LATERAL FLEXION (degree)	26.8±6.66	41.8±3.32	13.184	<0.001*
Rt ROTATION (degree)	33.9±6.88	43.2±2.99	8.155	<0.001*

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Lt ROTATION (degree)	34.9±6.17	43.7±2.15	8.859	<0.001*
PRESSURE PAIN THRESHOLD (lbs)				
Rt MASSETER	0.27±0.75	2.68±1.02	11.730	<0.001*
Lt MASSETER	0.24±0.64	2.82±0.82	15.129	<0.001*
Rt SUB OCCIPITAL	0.96±1.31	3.89±1.52	9.242	<0.001*
Lt SUB OCCIPITAL	1.07±1.47	3.87±1.32	8.794	<0.001*
Rt UPPER FIBRE OF TRAPEZIUS	2.91±1.67	7.85±12.15	2.705	<0.001*
Lt UPPER FIBRE OF TRAPEZIUS	2.78±1.94	5.82±2.16	6.604	<0.001*
Rt LEVATOR	1.56±1.71	7.58±3.17	10.140	0.008*
Lt LEVATOR	1.52±1.78	7.64±3.22	10.115	<0.001*

*SS

TABLE 3: COMPARISON BETWEEN AFTER EXAMINATION OF STRESSED GROUP WITH NON STRESSED GROUP

PARAMETER	STRESSED GROUP (after exam)	NOT STRESSED GROUP	t value	p value
STAI Questionnnaire score				
S Score	34.3±9.47	37.7±12.14	1.430	0.157
T Score	36.8±10.67	40.3±9.47	1.564	0.122
Range of Motion (cm/degrees)				
JAW OPENING (cms)	4.7±0.53	4.5±0.66	1.694	0.094
Rt LATERAL FLEXION (degree)	40.2±3.62	41.3±4.68	1.249	0.215
Lt LATERAL FLEXION (degree)	40.2±4.16	41.8±3.32	1.88	0.063
Rt ROTATION (degree)	42.5±3.11	43.1±3.01	0.900	0.371
Lt ROTATION (degree)	42.7±2.99	43.6±2.14	1.605	0.113
Pressure Pain Threshold (lbs)				
Rt MASSETER	2.01±0.69	2.6±1.03	3.171	0.002*
Lt MASSETER	2±0.64	2.8±0.87	4.401	0.001*
Rt SUB OCCIPITAL	2.9±1.12	3.89±1.51	3.171	0.004*
Lt SUB OCCIPITAL	2.9±1.11	3.8±1.31	3.300	0.001*
Rt UPPER FIBRE OF TRAPEZIUS	5.7±1.67	7.6±3.16	3.069	0.004*
Lt UPPER FIBRE OF TRAPEZIUS	5.7±1.73	7.6±3.21	3.086	0.003*
Rt LEVATOR	4.7±1.33	5.89±2.16	2.827	0.007*
Lt LEVATOR	4.7±1.30	5.8±2.16	2.594	0.12

***SS**

(1) STAI Questionnaire:

When comparisons were made for S and T scores, before and after examination in stressed group statistically significant differences were noted (p<0.001).when comparison was made between before exams of stressed group with non-stressed group statistically difference was found (p<0.001). However, when comparisons was made between after exams of stressed group and non-stressed group (S Score p=0.157, T Score p=0.122).

(2) Active Range of Motion:

For TMJ opening, when comparisons were made between before and after examination in stressed group statistically significant differences were noted (p<0.001). when comparison was made for TMJ opening between before exams of stressed group with non-stressed group statistical difference was seen (p<0.001).However, when TMJ opening

Corresponding Author: Peeyoosha Nitsure, *Department of Orthopaedic Physiotherapy, KLE University's Institute of Physiotherapy, City: Belagavi State: Karnataka Country: India*

was compared after exams in stressed group with non-stressed group,(p=0.094).

In cervical joint, the ROM values for the right and left lateral flexion and rotations, were noted to be statistically significant (p<0.001) when comparisons were made between before and after examination in stressed group. When comparison was made between before exams of stressed group with non-stressed group statistical difference (p<0.001) was seen. However when comparison was done between after exam of stressed group with non-stressed group before exam of stressed group with non-stressed group p value (Rt Lateral flexion=0.215, Lt Lateral flexion=0.063, Rt rotation=0.371, Lt rotation=0.113)

(3) Pressure Pain Threshold:

In TMJ for right and left Masseter muscles, the PPT scores were statistically significant (p<0.001) when comparisons were made before and after examination in stressed group. When comparison was done between before exam of stressed group with non-stressed group statistical difference was seen (p<0.001). However, when comparison was made between after exam of stressed group with non-stressed group there was statistical difference seen (p<0.002 for Rt masseter and p<0.001 for Lt masseter).

In cervical muscles, for left and right anterior fibers of upper Trapezius, Levator Scapulae and Sub-Occipital muscles the PPT scores were shown to be statistically significant (p<0.001) when comparisons were made before and after examination in stressed group. When comparison was made between before exam of stressed group with non-stressed group statistical difference was seen (p<0.001). However, when comparison was made between after exam of stressed group with non-stressed group, sub occipital there was statistical difference seen (p=0.004, p=0.001 for Rt and Lt sub occipital). For Rt trapezius (p=0.004) and Lt trapezius (p=0.003) was found statistically significant. For Rt levator scapulae (p=0.007) and Lt levator scapulae (p=0.12) was statistically significant on right side only.

DISCUSSION

Stress has shown to affect muscle functions, the relation between stress and muscle function has been explained in the study where it was revealed that source of stress related neck pain lies in the brain.[6] There is release of cortisol, adrenaline and other hormones that makes muscle tense up, irritate nerves and cause muscle aches and stiffness. The blood supply to the muscle decreases causing pain and tightness/spasm.[16]Another explanation to prove the relation is Perceptual Disruption theory. [17]According to this, stress and anxiety contribute to alterations in pain perception by disinhibiting central nervous system structures involved in the regulation of attention (eg. Ascending reticular activating system). The disruption may result in amplification of nociceptive stimuli. Thus, it could be hypothesized that this amplification would occur in students undergoing academic examination which is a stressful condition[17]. Stress leads to spasm /tightness of muscles which further leads to formation of trigger points in the muscles.

The findings of the present study showed direct relation between examination and stress. It revealed that examination acts as natural stressor for students. Physiotherapy students are no different in getting stressed. As all health sciences, undergraduate physiotherapy students are also vulnerable to stressful conditions. This relation has previously been studied which indicated that students describe their undergraduate education as demanding and academic requirements as stressful[11]. The stress inherent in the paramedical and medical profession has numerous deleterious consequences for students' psychological well-being as well as their professional effectiveness[18].

A large number of physiologic responses involving the central and peripheral nervous system are activated during stress. Stress and anxiety increase sympathetic activity and the release of epinephrine at the sympathetic terminals, which may directly activate nociceptors. Stress and anxiety may also activate hypothalamic – pituitary – adrenocortical system and the release of endogeneous opioids. Although a "standard " laboratory stimulus is relatively robust for inducing a predictable acute stress, psychologic and physiologic responses to stress occur suddenly and begin to fade away immediately after the cessation of the stimuli.[19]

Study concluded that, performance of a stressful task could induce abnormal contractions and prolonged hyperactivity in TMJ muscles of healthy subjects specifically affecting TMJ and neck muscle[14]. Further, another investigatory study conducted in health care workers proved that perceived work stress is related to trapezius muscle hyper-activity.In humans, findings of muscle cell abnormalities are common in the trapezius muscle, which is also a common location of neck and shoulder pain[20].Another study revealed that mechanical neck pain leads to myofascial trigger points in healthy subjects in upper fibres of Trapezius, Levator Scapulae and Sub Occipital muscles[21.] Also a study conducted for relation of psychological stress and EMG activity of Trapezius proved that mental stress induces muscle tension in Trapezius muscle[20]. Hence, the use of assessment of stress through AROM (cervical lateral flexion and rotation & TMJ opening) and PPTs of TMJ (Masseter) and neck muscles (Levator Scapulae, Sub Occipital and anterior fibres of upper Trapezius) is justifiable in the present study.

Stress in students was assessed using Spielbergers State – Trait Anxiety Inventory (STAI), active Range of Motion

Corresponding Author: Peeyoosha Nitsure, *Department of Orthopaedic Physiotherapy, KLE University's Institute of Physiotherapy, City: Belagavi State: Karnataka Country: India*

(AROM) Of TMJ and Cervical Joint and Pressure Pain Threshold (PPT) of TMJ and neck muscles. The use of STAI Questionnaire to screen for stress is reasonable as it has good validity and reliability to pick up the current state of mental stress[22.] It also has been used by previous studies where Psychometric and self-reported measures were used to evaluate subject's psychologic changes during the study[14]. Previous studies have used STAI in different population like maternal[23] and geriatric populations[24].

The present study showed that stress was high in students before answering examination when compared to non stressed group and after examination values. Similar findings were noted in previous study where in academic examination was considered natural emotional stressor in symptom free dental students. A relationship between psychologic stress and pressure pain sensitivity of the masticatory muscles and non-stressed Achilles tendon, venous blood samples for beta–endorphine measurement were obtained in the examination group immediately after exam and a month later. The PPT was significantly high in masseter muscles as compared to non stressed muscle. Plasma levels of beta-endorphine on day of exam and stress free period did not differ significantly[14]. In the present study the control group was formed by students who were not stressed or not giving exams. Conversely, in the above mentioned study, control group was formed by non stressed muscle Achilles tendon.

The values of AROM and STAI questionnaire reduced in the stressed students when compared between before and after examination values. This proves the fact that after withdrawal of stressor/stimulus, the students got relaxed psychologically[25, 26]. However, although the values did reduce clinically, the PPT values remained statistically significant after 7 days of completion of exams. This can be attributed to the fact that tender points take some time to resolve after withdrawal of stimulus. A previous study had shown complete resolution of symptoms/tender points where follow up was done a month after the examination[14].

LIMITATIONS

Long term effects of stress have not been studied. The more objective method of stress assessment like endorphin and electromyography were not done due to limited resources. The long term follow up was also not done after the exams.

CONCLUSION

The results justify direct relation between stress and muscle functions affection with the TMJ and neck muscles being more vulnerable. Examination proved to be a natural stressor for undergraduate students although the effects were temporary and self limiting. These stress related effects on muscles can be assessed using PPT and AROM.

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Corresponding Author: Peeyoosha Nitsure, *Department of Orthopaedic Physiotherapy, KLE University's Institute of Physiotherapy, City: Belagavi State: Karnataka Country: India*