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Immediate effect of thoracic manual distraction on pressure pain threshold in dental students

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Abstract
Background: Pressure Pain Threshold is the sensitivity towards pressure which is affected by awkward postures, spinal pathology, muscle hyperalgesia and new methods are researched to detect and measure this via pressure algometer. Dental profession is highly susceptible in developing musculoskeletal disorders with decreased sensitivity to pressure, therefore elicit pain early. Hence, physical therapy interventions along with creating awareness amongst Dentist are essential.
Objective: The aim of the current study is to determine the immediate effect of thoracic distraction on pressure pain threshold between dental first year students and dental interns.
Methodology: A simple random sampling of 40 female dental students, which were divided into two groups with 20 participants in each group. Where group A included dental first year students while group B dental interns. Both the groups were given Thoracic Manual Distraction and PPT was measured before and after the.
Results: Pressure Pain Threshold showed significant increase in group A after the thoracic distortion ('t'= 6.26, 'p'= <0.01) while in group B it was not significant ('t'=0.96, 'p'= >0.05). But the immediate post intervention between two groups was considered significant ('t'=4.87, 'p'= <0.01)
Conclusion: Thoracic manual distraction was extremely significant in both the groups but, the dental first year students showed high PPT as compared to the interns.

Keywords: dental students, pressure pain threshold, thoracic manual distraction

1. Introduction
Dentistry accounts majorly for visual demands therefore adoption of static fixed postures for prolonged periods of time are required. The prevalence of dentists suffering from musculoskeletal disorders (MSD) has been well established. Previous studies in this area discovered that 64 – 93% of dental professionals suffer from general work-related MSD. They are exposed to many burdensome and harmful factors during their work such as acquired irrational postures which involve forward bending and repeated rotation of the head, neck and trunk to one side can lead to discomfort and disorders of the musculoskeletal as well as peripheral nervous system [1, 2].
As posture deviates from neutral, it creates a muscular imbalance between agonists and antagonists muscle groups by either shortening and tightening or elongating and weakening it. However, in dentistry the rate of damage exceeds the rate of repair due to insufficient rest periods, leading to necrosis of the muscles. In order to protect the stressed area for further damage and pain, the body compensates by using another part of the muscle to maintain the posture. This is a self-perpetuating cycle which is known as muscle substitution and can result in the development of a whole range of MSDs [2].
Some evidences also suggest that MSD can develop during education and training. This accounts to the pressure of tertiary study along with the physical burden of clinical training. There are various evidences that conclude about these problems occurring during undergraduate training program. A research was done on dental students and results concluded that no student had the acceptable posture and most required postural changes soon. Up to 85% of dental students suffer from musculoskeletal disorders. This could further result in lower productivity, reduced working hours, early retirements and stress [3, 2].
MSDs can cause a decrease in sensitivity towards pressure, therefore elicit pain early. In a previous study, it was shown that Pressure algometer was used to study the changes in the Pressure Pain Threshold (PPT) on reflex sympathetic dystrophy, headache and root pain [5]. Many studies have focused on the neurobiology of pain perception regarding innervations of the skin, whereas knowledge on deep pain from somatic and visceral structures is debatable [6].
There is a need for creating awareness amongst dental students as well as registered dentist professionals about correct working postures and they must follow the basic health and safety principles. Incorporation of ergonomic work practice also reduces the risk of MSD. A study demonstrated a research on ergonomic in dentistry in 2014 where the article sets forth an important background on ergonomics so that the dental practitioners are well aware of the risk factors as well as the ongoing dialogue about ergonomics [4].
As there are many previous studies conducted on interventional measures to treat MSDs, this study includes the thoracic spinal extension gliding technique with patient in the sitting position proposed by Peter Gibbons and Philip Tehan, on dental first year students and interns and PPT was measured before and after the distraction. This technique was delivered in a soundly crafted book on manipulation of the spine, Thorax and Pelvis. The authors have included eight different techniques for the thoracic spine and also provided

relevant information about vertebral motion and spinal coupling [7].

Thoracic spine manipulation (TSM) is defined as a high-velocity/low-amplitude movement or 'thrust' directed at any segment of the thoracic spine. Much of this recent focus has evaluated the effects of TSM in the regions adjacent to the thoracic spine of the body, such as the shoulder and the neck, rather than the areas of the thoracic spine itself, this is known as regional interdependence. However, why relationships like this exist is questionable and remains a topic of discussion [8].

Pressure pain threshold is the minimum amount of pressure that mechanically elicits pain which is recorded by a simple hand-held device called the pressure algometer. Pressure algometry has good repeatability when expressed by intra class correlation coefficients (ICC) results hence it is recommended for clinical practice [9]. Therefore the reliability dependents not only on the application technique, but also the ability of the participant to provide a consistent verbal indication of the pressure pain threshold level. A study that was conducted regarding inter rater reliability of algometry in measuring pressure pain thresholds in healthy humans, using multiple raters and the ICC depict very high (ICC = 0.91; 95% CI 0.82, 0. 97) for the device [10]. The most commonly used surface area of probes is 0.5 or 1 cm2. Compression should be performed slowly to allow the subject to react when pain is felt. Once it is perceived, application of pressure is ceased. Various studies have compared pressure pain threshold over muscle and bone where they found pain threshold higher over bony regions [9].

As there are previous studies that show significant effect of pressure pain threshold on distal parts of upper and lower extremities but no study was done which showed the effect of pressure pain threshold on thoracic spine. Thus, present study is going to conclude whether there are immediate effects of thoracic manual distraction (which is introduced by Peter Gibbons and Philip Tehan) on either increasing or decreasing the pressure pain threshold by application of pressure over T10 spinous process which mechanically elicits pain in dental students using a pressure algometer.

2. Materials and Methodology

A pre and post experimental comparative study was conducted in Department of Orthopaedic Physiotherapy at Dr. A.P.J. Abdul Kalam college of Physiotherapy, PIMS, Loni and the source of data was collected from the normal healthy dental students of Rural Dental College, PIMS, Loni, Taluka – Rahata, District- Ahemdnagar-413736, Maharashtra, India with the approval of institutional ethical committee during the period of September- October 2018. The study was conducted between the periods of August 2018 to November 2018 while for the interventional period, immediate effect was noted. 40 dental students who gave consent to participate in the study were included.

2.1 Equipments to be used: Pressure algometer

2.2 Selection Criteria

Inclusion Criteria: Healthy young dental students, only females who were willing to participate within the age group of 18-22 years, whose weight was 60 kgs and or below were included in the study.

Exclusion Criteria: Individuals who were not corporative, or with fibromyalgia, tenderness over T10 spinous process and any other musculoskeletal, cardiovascular and neurological conditions were excluded in the study.

Data was collected by the primary investigator by simple random sampling. Data was analysed using the trial version of INSTAT software. Various statistical measures such as mean, standard deviation [S.D.] and test of significance such as Paired and Unpaired 't' test were utilized to analyze the data association between two categorical variables. The results were concluded to be statistically significant with $p<0.05$ and highly significant with $p<0.001$. Paired 't' test was used to compare the difference in scores between the pre-intervention and post-intervention values within a single group.

2.3 Procedure

This study had included 40 dental students out of which 20 participants were first year dental students and were grouped in group A while the remaining 20 participants were from the batch of dental intern and were put in group B.

For both the groups, initially their pressure pain threshold was measured by a trained physiotherapist at T10 spinous process by using a pressure algometer (Wanger FDX-25 device [figure: 1], Greenwich, CT). The device has a 1-cm2 round rubber tip which is placed directly over t10 spinous process as the algometer has a linear response to force application. The PPT of the participants was assessed by the same examiner approaching from the right-hand side of the participant. Subjects were asked to lie-down in prone position with the arms down alongside the body and shoulders relaxed. The subjects were told to immediately state when the pressure sensation was replaced by pain sensation, at that time the pressure was stopped and the score was noted. As the algometer maintained its peak value, the examiner was blinded while applying pressure to displayed the score [11].

Fig 1: Wanger FDX-25 device

After recording the pressure pain threshold the subjects underwent thoracic distraction technique which was suggested by Gibbons and Tehan, thoracic spine extension gliding technique with patient in the sitting position [Figure 2] where :-

Purpose: This technique is used to distract thoracic segments especially T3-T11.

Patient position: sitting on a stool/treatment table with arms crossed across the chest and hands grasping each opposite shoulder girdle a far as the patient can comfortably reach.

Therapist position: The therapist stands in walk-standing

position with slightly bent knees behind the patient and the therapists' chest is placed against the targeted spinal segment with a rolled towel in between.
Hand position: the therapist grasps the patients' elbows in each opposite hand such that the left hand grasps the right elbow and the right hand to the left elbow.
Procedure: The patients arms are pulled into further adduction so that the upper thoracic spine is extended to the targeted spinal level and the therapist will lift and squeeze the patient in a superior and posterior direction for 30 seconds [12].

Fig 2: Thoracic Manual Distraction

Immediately after the thoracic distraction the subject was taken again into prone-lying and Pressure Pain Threshold was measured on the T_{10} spinous process. Only one measurement was recorded for the changes in pressure pain threshold.

3. Data analysis interpretation and result

Statistical analysis was done using the trial version of INSTAT software. Paired't' test was used to compare the difference in scores between the pre-intervention and post-intervention values within a single group. Unpaired't' test was used to compare the difference in scores between the two groups i.e. first year dental students (Group A) and the dental interns (Group B).

3.1 Demographic

A total of fifty-two participants were screened for the study considering the inclusion and exclusion criteria out of which forty subjects who were eligible and willing to participate for the study. As it was an immediate study there was no drop out of any of the participants during the study which were selected. Group A had twenty participants and Group B twenty participants.

Age: The mean age of the participants in Group A was 18 0.56 years and the mean age of the participants in Group B was 22 0.46 years. The difference in mean age of two groups was statistically significant ('t' = 18.18. 'p' = <0.0001).

Gender: There was no gender ratio as all participants chosen were females in both the groups according to the inclusion criteria.

Weight: The mean weight of the participants in Group A was 49.85±4.43kgs and the mean weight of the participants in Group B was 52.05±6.98 kgs. The difference in mean weight of two groups was not statistically significant ('t' = 0.47, 'p' = >0.0005).

Table 1: Demographic profile of both the groups.

Group item	Group A (n=20)	Group B (n=20)	P- value
Age [years]	18±0.56	22±0.56	<0.0001
Weight [kgs]	49.85±4.43	51.05±6.98	>0.0005

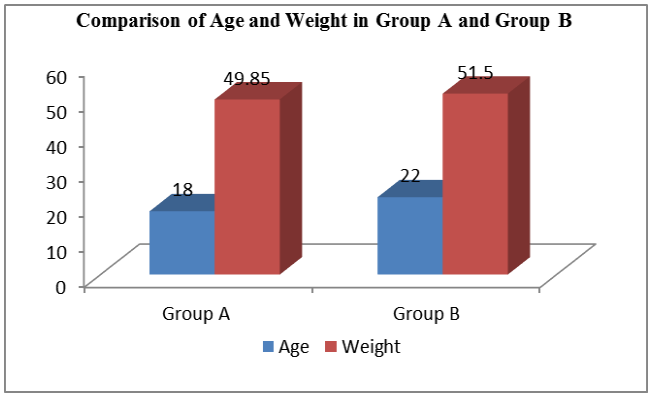

Fig 3: Represents Demographic Profile

3.2 Comparison of outcome measures of pressure pain threshold in Group A

The PPT was measured using the pressure algometer. The pre intervention mean average score and standard deviation for the PPT in dental first years that is Group A was 17.65±6.04. Immediately after measuring the threshold, the invention was conducted and instantly once again the pressure threshold was measured. Hence, the mean average score and standard deviation for these participants was 27.05±7.30. Therefore the mean average difference in the pre and post intervention score as well as standard deviation of PPT was 9.40±1.26. Hence it is considered significant.

Table 2: Pre and post mean values of pressure pain threshold scores in group A

	Pre Mean±SD	Post Mean±SD	Change in scores [post-pre]	'p' value	't' value	Result
Pressure Pain Threshold	17.65±6.04	27.05±7.30	9.40[1.26]	<0.0001	6.29	Considered significant

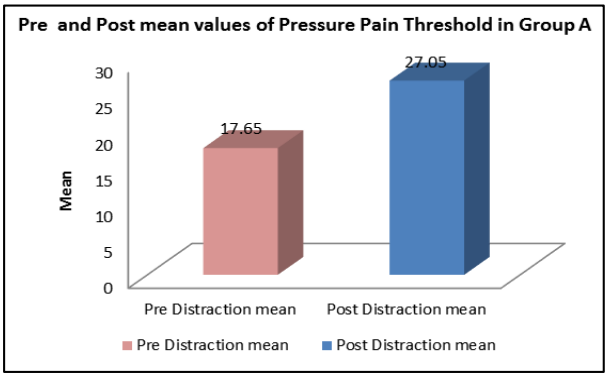

Fig 4: Represents comparison of outcome measures of pressure pain threshold in Group A

3.3 Comparison of outcome measures of pressure pain threshold in Group B

The PPT was measured using the pressure algometer. The pre intervention mean average score and standard deviation for the PPT in dental first years that is Group B was 17.2±4.62. Immediately after measuring the threshold, the invention was conducted and instantly once again the pressure threshold was measured. Hence, the mean average score and standard deviation for these participants was 19.53±5.39. Therefore the mean average difference in the pre and post intervention score as well as standard deviation of PPT was 2.15±0.77. Hence, it is considered not significant

Table 3: Pre and Post Mean values of Pressure Pain Threshold scores in Group B

	Pre Mean±SD	Post Mean±SD	Change in scores [post-pre]	'p' value	't' value	Result
Pressure Pain Threshold	17.20 ±4.62	19.35±5.39	2.15[0.77]	>0.0005	0.96	Considered not significant

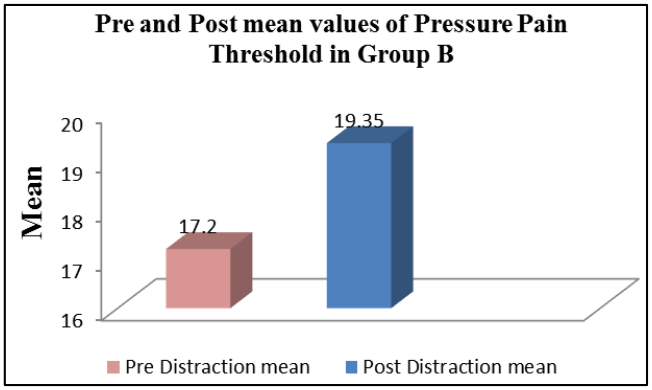

Fig 5: Represents comparison of outcome measures of pressure pain threshold in Group B

3.4 Comparison of outcome measure of post mean values of Pressure Pain Threshold scores in Group A and Group B

There was statistically significant difference in the mean average scores of pressure pain threshold in group A and group B participants treated with thoracic manual distraction which was suggested by Gibbons and Tehan, thoracic spine extension gliding technique with patient in the sitting position ('t' = 4.87, 'p' = <0.0001'). Hence it is considered significant.

Table 4: Post Mean values of Pressure Pain Threshold scores in Group A and Group B

	Post Mean ± SD [Group A]	Post mean ± SD [Group B]	'p' value	't' value	Result
Pressure Pain Threshold	27.05± 7.30	19.35±5.39	<0.0001	4.87	Considered significant

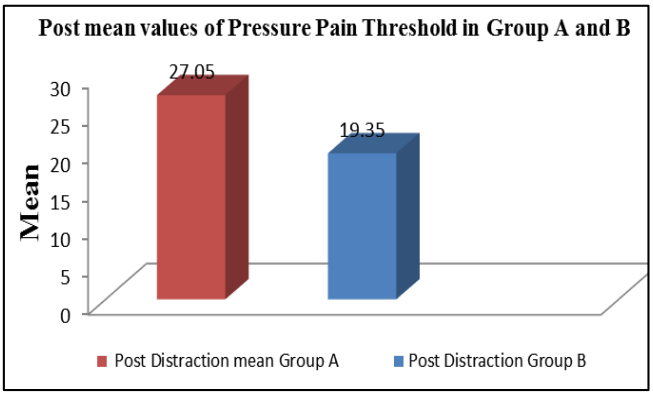

Fig 6: Represents comparison of outcome measures of post Mean values of Pressure Pain Threshold scores in Group A and Group B

4. Discussion

There are many theories that have explained the possible benefits of traction/distraction therapy. Distracting a spinal segment changes the position of the nucleus pulposus which is relative to the posterior annulus fibrosis or it may also change the disc-nerve interface. In addition, it also reduces nucleus pulposus pressure as well as increases interforaminal canal hence, reduces pain. The effect of distraction has a lasting clinical response because it directly works on the mechanobiology of the neural tissues or motion segment.

Manipulation therapies are applied as an intervention for conservative treatment measures. Schliesser *et al.* demonstrated flexion distraction manipulation technique on subject with cervical intervertebral disc herniation and the result was highly effective and patients reported that the

technique significantly decreased pain [13].

There are various studies that have used this technique in:

- Treating joints with hypermobility,
- To restore damaged spinal nerves and surrounding structures ,
- Reducing the stress and internal pressure on the discs through the opening of the spinal facet joints,
- Expansion of intervertebral foramens [14].

The following are contraindications for manipulation of the thoracic spine

- Recent spinal fracture
- Osteoporosis
- Pain during the pre-manipulative hold
- Bilateral or quadrilateral paresthesia
- Constant pain

The current study demonstrated that thoracic manual distraction plays a major role in increasing the pressure pain threshold in dental students without any spinal pathology, pain and other cardiopulmonary complications by using a pressure algometer device. It was found that 95% of all dental students showed an increase in their pressure pain threshold values after the thoracic manual distraction. The first year dental students showed a significant change in their values before and after the distraction while the dental interns did not demonstrate as much change in comparison.

According to the data first year dental students have higher levels of pressure pain thresholds as compared to the interns. As the work profile of the first years is undemanding as comparatively to the dental interns. Their spine is supported for more period of time as they attend more number of theory lectures and have less clinical hours than interns. Hence, the body load is reduced on the thoracic spine as they are sitting for a couple more hours than standing. Dental interns work for hours together in standing and they generally intend in attaining an awkward static posture with less resting intervals between their works.

This also suggests that dental profession is strongly associated with continuous uncomfortable static working posture along with spinal loads. With respect to the new quantitative findings demonstrated by Wunderlinch M *et al*, suggests that static non neutral work posture lead to reduced muscle circulation, as a result metabolites are accumulated within the extracellular space which can lead to chemical imbalance. In addition, it can also damage the spine due to continuous eccentric pressure on the intervertebral disc and can cause cumulative trauma which can further be a cause for MSD.

Therefore interventions should be considered to improve posture and prevent MSD risk factors by involving ergonomics and individual alertness [15]. According to Newell and Kumar, dentists can diminish the risk of developing MSD by being aware about suitable body posture and positions during clinical procedures, integrating regular rest intervals, sustaining general health and carrying out general exercises. They also suggested that regular physical examinations would provide more detailed information and early diagnosis of MSDs [16].

5. Conclusion

After conducting this study it can be concluded that thoracic distraction technique which was suggested by Gibbons and Tehan stated that thoracic spine extension gliding technique with patient in the sitting position for 30 seconds on dental students was effective. It was comparatively more effective in first year dental students than in interns.

According to this study the thoracic manual distraction can be included as an exercise regimen for dental students on a daily basis along with other measures like postural corrective excises, principles of ergonomics followed by dentists and even the universities should have a complete knowledge about building an ergonomically-friendly dental set ups for clinical learning and practising.

It can be stated that the posture is highly affected in the dental profession if regular physical activity and ergonomics are not well aware by the dentists. Hence even the pressure pain threshold is affected.

6. Acknowledgments

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