Original Research Article

Effects of Bite Opening on Masseter and Geniohyoid Muscles : A Randomised Clinical Trial

Abstract

Objective: To evaluate the effects of anterior bite plane on the masseter and geniohyoid muscle thickness.

Materials and Methods: 14 subjects who needed bite opening were allocated as a single group with mean age of 17.4± 3.4 years and mean overbite of 5.3±0.2 was treated with a fixed anterior bite plane (ABT) . The pre-treatment (T1) and post-treatment results (T2) was compared to study the effect of Bite opening. The ultrasonographic imaging was used to evaluate masseter muscle thickness (clenched and relaxed) and geniohyoid muscle thickness.

Results: The study showed , the right masseter muscle thickness(RMT) in (R) at T1 was 8.68 ± 1.13 mm, T2 was 7.68 ± 1.14 mm and in (C) 0.72 ± 1.39 mm and 9.86 ± 1.35 mm respectively While left muscle thickness(LMT) was at 8.54 ± 1.3 mm and 7.68 ± 1.3 mm respectively. The mean geniohyoid muscle thickness before treatment was 6.58 ±0.69 mm and after treatment was 7.40 ± 0.69 mm with an increase in thickness of 0.8 ±0.04 mm

Conclusion: Bite opening procedure influence the muscles thickness , with reduction of masseter muscle thickness and increase in geniohyoid muscle thickness .

Keywords: Anterior Bite Plane, Geniohyoid Muscle, Masseter Muscle.

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Introduction

Deep overbite is considered to be a common malocclusion which refers to the increased overlap of maxillary anteriors over mandibular anteriors beyond 30– 40%.[1] In orthodontics, different techniques are used for deep bite correction. Treatment must be carefully planned for each patient, based on the etiology of malocclusion . Relapse occurs when no accurate identification of the etiologic factors is performed .[2]

Management of deepbite becomes more difficult with the existence of, or the increased severity of, an underlying skeletal discrepancy. Nonsurgical correction of a deep bite includes molar extrusion, incisor intrusion, or a combination of both,[3] with a general understanding that intrusion of teeth is more difficult than extrusion.

Common method used to correct deep bite includes the use of anterior bite plane[4] that may affect the various muscles of the jaw. An increase in the vertical dimension may lead to some changes in the orofacial structures. It is stated that such changes in vertical dimension alter the length of the main jaw elevator muscles and the position of the mandibular head in the fossa temporalis. Thus, they may affect the masticatory function, resulting in the bite force values.[6]

A study by Lindauer et al. stated that the changes in vertical jaw opening affect the relative contributions of masticatory muscles for bite force production. When bite force was consistent, electromyographic activity increased per unit of force production was relatively high at the smaller degrees of jaw opening.[7]

Various methods could be used to study the activity of muscles. One of the methods is the use of ultrasound scanning. This method enables dynamic visualization of the muscles of the head and neck.[8,9] This method is also considered to be the most accurate and rapid method for measuring the thickness of superficial muscles, such as the masseter and temporalis,

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without any known adverse effects when compared to other methods like Computed Tomography and Magnetic Resonance Imaging.[10,11]

So far no studies had been reported in the literature which evaluated the effect of bite opening using anterior bite plane , on the thickness of masseter and geniohyoid muscles.

Hence this prospective clinical study was taken up to investigate the the outcomes of anterior bite plane on masseter and geniohyoid muscle thickness.

Materials and Methods

The study was initiated after attaining Institutional ethical approval (27/2018/ISRRC) at Sri Hasanamba Dental College and Hospital, Karnataka, India. Data were collected from subjects who underwent fixed orthodontic treatment based on the inclusion criteria such as subjects in the age group of 16-24 years with a minimum of 50 percent of anterior deep bite. All subjects should be either horizontal to average skeletal pattern and also patients who required bite opening by extrusion of posteriors will be indicated as a part of their treatment plan.

14 subjects were allocated as a single group who were traated with fixed anterior bite plane(ABT)

Ultrasonographic Method- Patients were examined by using an Ultrasound scanner (Esaote MyLab Seven, Genova, Italy).

a. Masseter muscle area: The measurement was done at the thickest part of the masseter, close to the level of the occlusal plane, approximately in the middle of the mediolateral distance of the ramus. Imaging and measurements were performed bilaterally with the subjects in a supine position under two different conditions, when the teeth ooccludegently with the muscle in a relaxed position and during maximal clenching, with the masseter

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muscle contracted. The thickness of the masseter muscle was evaluated before and after deep bite correction.[14,15] (Figure 1)

b.Geniohyoid muscle area: The ultrasound transducer was held in alignment with the midline of the floor of the mouth and perpendicular to the lower chin surface of the patient. The fascial boundary of the geniohyoid muscle was identified and measurement was done at the thickest part for evaluating thickness.[16,17] The thickness of the geniohyoid muscle was evaluated before and after deep bite correction. (Figure 2)

Statistical analysis

Inferential statistics included Paired t-test to check pre-operative and post-operative values. . IBM SPSS-20 (IBM Company, Palo Alto, California, US) was used for the analyses of data at a significance level of $P<0.05$.

RESULTS

Table 1, Table 2 shows the effect of anterior bite plane (ABT) on masseter and geniohyoid muscle thickness.

When the overall change in the muscle thickness before and after treatment in the relaxed position was compared, the mean right masseter muscle thickness at T1 was 8.39 ± 0.85 mm and at T2 was 7.75 ± 0.81 mm which was statistically significant with a P-value of 0.000. (Graph 1)

When the overall change in the muscle thickness before and after treatment in relaxed position was compared, the mean left masseter muscle thickness at T1 was 8.57 ± 1.04 mm and at T2 was 8.00 ± 1.16 mm which was statistically significant with a P-value of 0.000. Between the groups, with more reduction in Group 1. (Graph 2)

When the overall change in the muscle thickness before and after treatment in clenched

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position was compared, the mean right masseter muscle thickness before treatment was 10.74 ± 1.15 mm and after treatment was 10.17± 1.18 mm which was statistically significant wia th P-value of 0.000. Between the groups, more reduction in Group 1. (Graph 3)

When the overall change in the muscle thickness before and after treatment in clenched position was compared, the mean left masseter muscle thickness before treatment was 10.86± 1.36 mm and after treatment was 10.25 ± 1.51 mm which was statistically significant with a P-value of 0.000. Between the groups, more reduction in Group 1. (Graph 4)

When the overall change in geniohyoid muscle thickness before and after treatment, mean geniohyoid muscle thickness before treatment was 6.67 ± 0.64 mm and after treatment was 7.21 ± 0.64 mm which was statistically significant with a P-value of 0.000. Between the groups, with more increment in Group 1. (Graph 5)

DISCUSSION

The purpose of the present study was to evaluate the effect of anterior bite plane and and its influence on masseter and geniohyoid muscle thickness.

Masseter muscle thickness was found to be reduced in both the groups with the anterior bite plane group showing more reduction in the thickness of muscle in relaxed and clenched positions. The higher values obtained during contraction of the muscle compared to relaxation in this study is in agreement with those of previous studies by Kubota et al.,[21] Satiroglu et al.,[22] This disparity between the values in masseter muscle thickness during relaxation and during maximal clenching can be explained by the fact that during the contraction phase, the mandible will be elevated. This cause enlargement and thickening of the muscle fibres which may account for the observed higher thickness in the clenched state.

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The right masseter muscle was thicker than that of the left in both the groups, during relaxation and contraction in all the participants. This finding is in line with the findings of Chan et al.,[23] and Satiroglu et al,[22] who reported that the right masseter muscle was much thicker than the left.

A possible explanation could be that most of the participants in this study masticated on the right side of their mouth. Exercising the muscle has been known to increase its thickness and the bite force, and a significant positive correlation has been found between bite force magnitude and the thickness of the masseter muscle. This is also supported by the previous study of He et al.[24] who reported that reduced activity of the masseter muscle resulted in thin muscle fibres. However, a previous study by Raadsheer et al.[25] reported greater thickness on the left side, whereas Marquezin et al.[26] found no side differences in the thickness of the muscle in subjects with normal occlusion.

Individuals with reduced overbite tend to have thinner masseter muscle because the superficial masseter muscle is anteriorly inclined and obliquely oriented relative to the occlusal plane and has a superior positioning of its insertion on the mandible compared to deep overbite individuals who have vertically oriented masseter muscle.[27]

The reduction in masseter muscle thickness after bite opening is in agreement with the results of previous studies by Weijs and Hillen,[28] Satıroglu F et al.,[22] which showed that the masseter muscle is thicker in individuals with a short face who tend to have a deep overbite, and thinner in those with a long face who tend to have reduced overbite or an anterior open bite. The results of this study clearly indicated that the masseter muscle thickness reduced after bite opening.

Geniohyoid muscles play an important role during hyoid bone elevation. There was a positive correlation between geniohyoid muscle thickness and jaw-opening strength.[29] A correlation

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between geniohyoid muscle thickness and the movement of hyoid bone was found and results suggested that the geniohyoid muscle is a key muscle involved in the anterior movement of the hyoid bone.[30]

The present study showed a statistically significant increase in the geniohyoid muscle thickness after bite opening. This could be due to the forward movement of the hyoid bone after bite opening. The results of this study clearly indicated that the geniohyoid muscle thickness increased after bite opening.

CONCLUSION

Within the limitations of the present study, it can be concluded that,

1. Masseter muscle thickness reduced with the studied bite opening procedures and reduction was more pronounced with the anterior bite plane.
2. Geniohyoid muscle thickness increased with bite opening. The increase in muscle thickness was more in the samples treated with the maxillary anterior bite plane.

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COMPETING INTERESTS DISCLAIMER:

Authors have declared that no competing interests exist. The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was

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Figure 1: Ultrasonography of masseter muscle

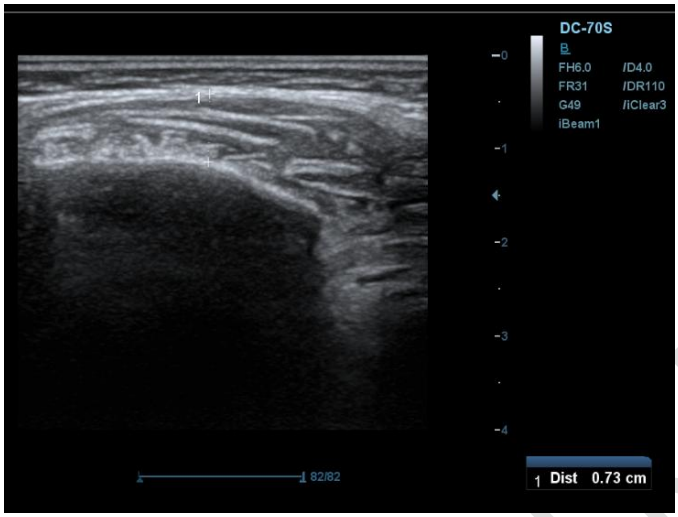

Figure 2: Ultrasonography of geniohyoid muscle

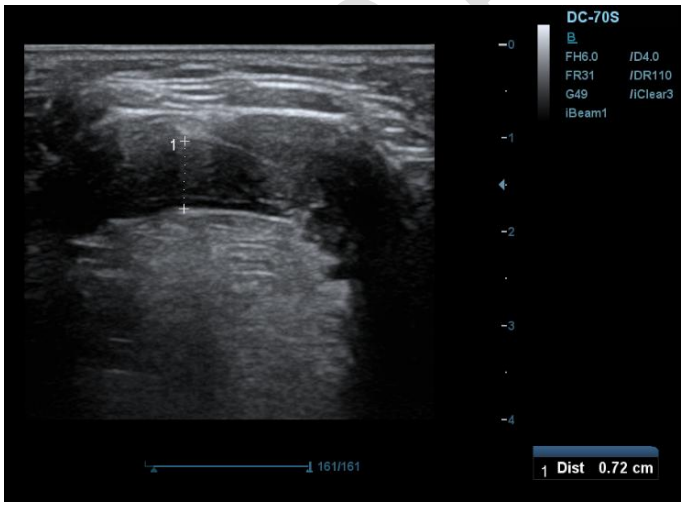

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Table 1: Pre and Post Values of All Parameters

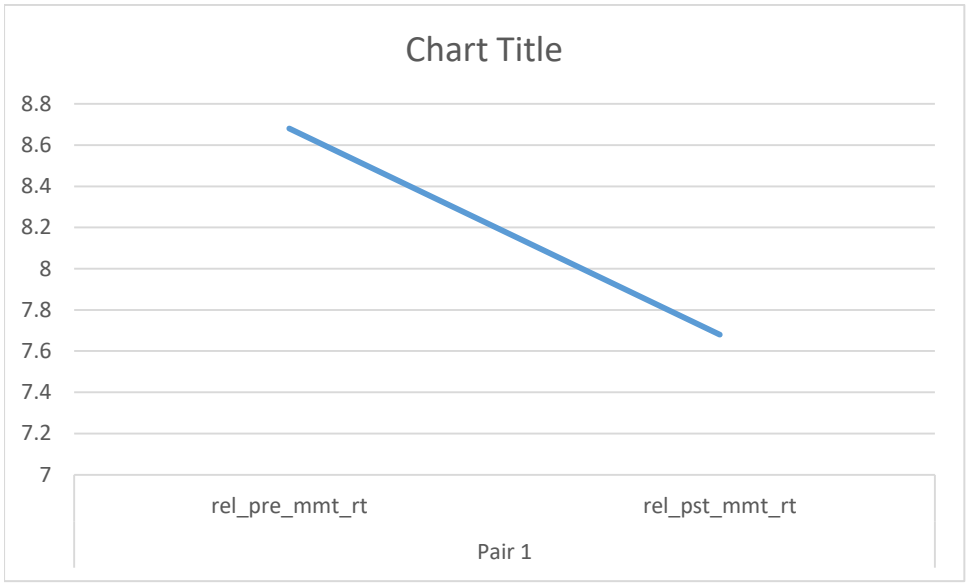
		Mean	Std. Deviation	Std. Error Mean
Pair 1	rel_pre_mmt_rt	8.68	1.137	.508
	rel_pst_mmt_rt	7.68	1.145	.512
Pair 2	rel_pre_mmt_lt	8.54	1.372	.614
	rel_pst_mmt_lt	7.64	1.372	.614
Pair 3	clen_pre_mmt_rt	10.72	1.399	.626
	clen_pst_mmt_rt	9.86	1.350	.604
Pair 4	clen_pre_mmt_lt	10.32	1.529	.684
	clen_pst_mmt_lt	9.40	1.488	.666
Pair 5	GMT_pre	6.58	.698	.312
	GMT_POST	7.40	.693	.310

Table 2: Difference Between Pre And Post Treatment Values and Their Significance

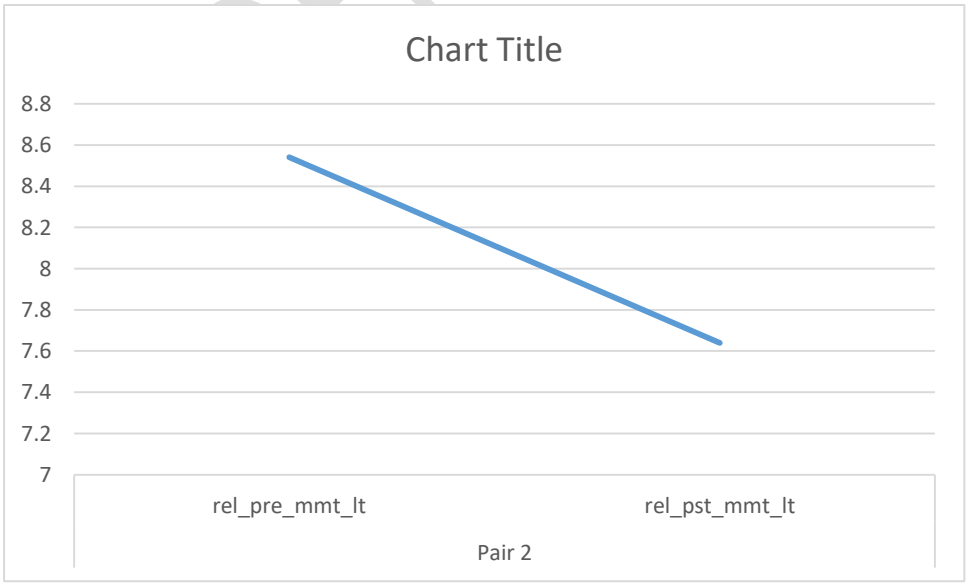
		Paired Differences		t	df	Sig. (2-tailed)
		Mean	Std. Deviation			
Pair 1	rel_pre_mmt_rt - rel_pst_mmt_rt	-1.000	.100	22.361	4	.000
Pair 2	rel_pre_mmt_lt - rel_pst_mmt_lt	-0.850	.100	19.650	4	.000
Pair 3	clen_pre_mmt_rt - clen_pst_mmt_rt	-0.860	.152	12.680	4	.000
Pair 4	clen_pre_mmt_lt - clen_pst_mmt_lt	-0.920	.045	46.000	4	.000

Pair 5	GMT_pre - GMT_POST	0.820	.045	-41.000	4	.000

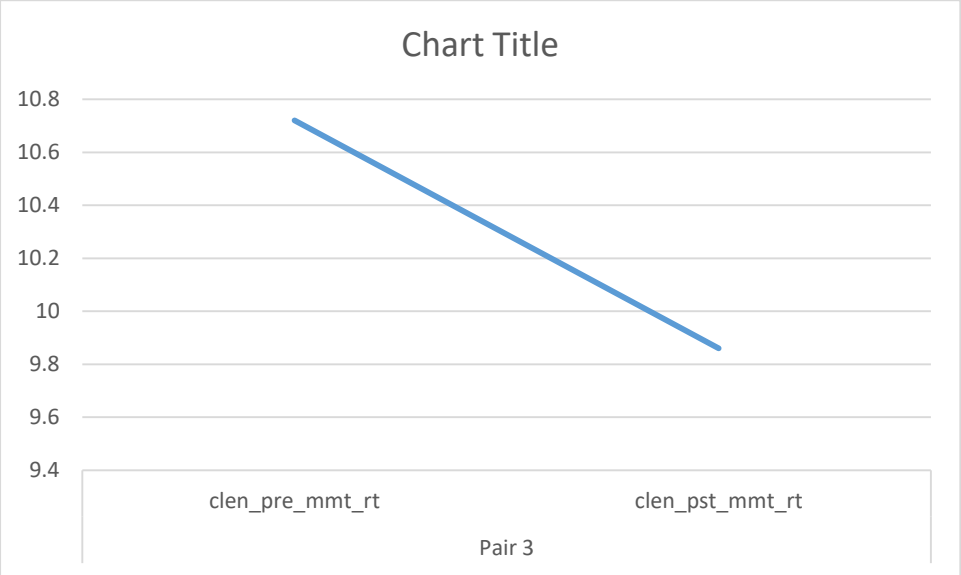
Graph 1: Graph indicating changes in right masseter muscle thickness in a relaxed position



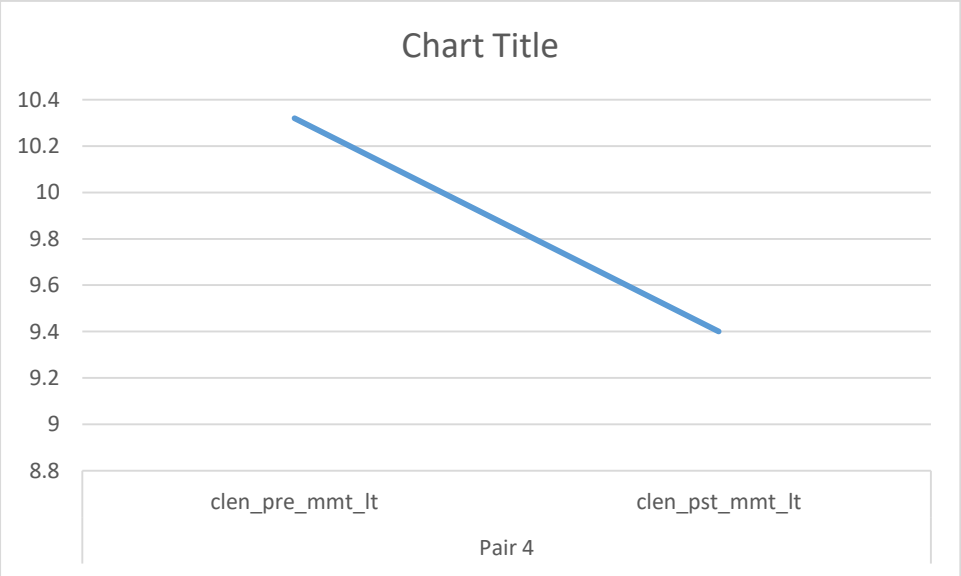
Graph 2: Graph indicating changes in left masseter muscle thickness in relaxed position



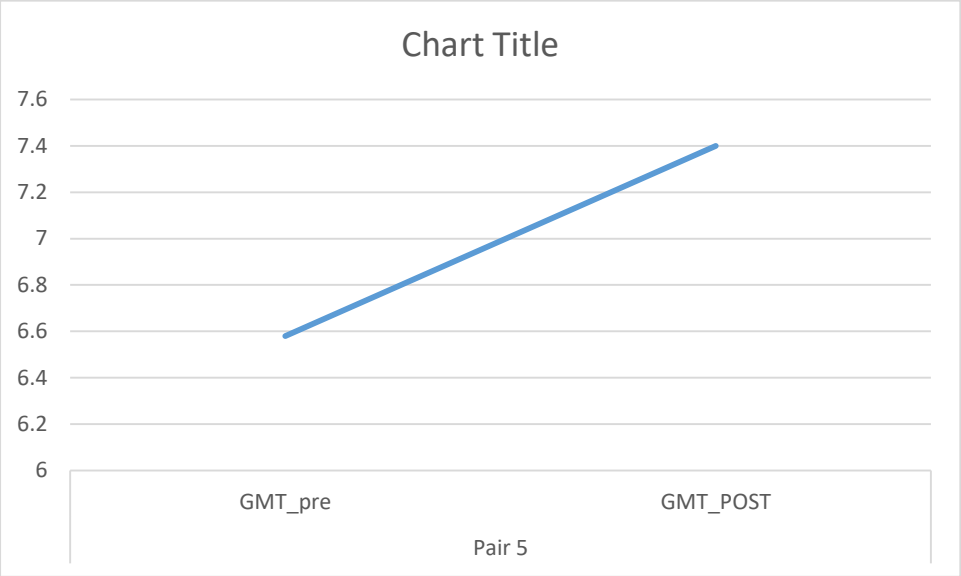
Graph 3: Graph indicating changes in right masseter muscle thickness in clenched position



Graph 4: Graph indicating changes in left masseter muscle thickness in clenched position



Graph 5: Graph indicating changes in geniohyoid muscle thickness



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