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Comparative Cephalometric Evaluation of Tongue and Sagittal Airway Dimension in class I, II

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Abstract

The study was conducted on 30 individuals equally divided into three groups of skeletal class II div 1, skeletal class II div 2 and skeletal class I normal occlusion. The study was conducted on two lateral cephalograms for each subject, one taken at rest and one in centric occlusion. On evaluation of tongue posture, statistically significant difference was observed at the middle portion of the tongue in class II div 1 malocclusion, and at the postero-medial portion of dorsum of the tongue in class II div 2 skeletal malocclusions as the tongue moved from rest to centric occlusion. While statistically significant differences were found between class II div 2 malocclusion and class I normal occlusion, no statistically significant differences were observed between class II div 1 and class II div 2 malocclusions. Tongue position is seen to be the same in both class II div 1 and class II div 2 malocclusions with no statistically significant differences.

Keywords: Abnormalities, Malocclusions, ANOVA.

Introduction

The concept of equilibrium of labio-lingual muscular forces along with the role of muscles in maintaining tooth position and arch stability has been gaining immense popularity amongst orthodontists. The tongue is an agile, versatile, active and extremely sensitive organ performing on a complex muscle background. Various studies have emphasised the role of tongue posture and size in the development of different skeletal malocclusions.

Based on previous studies of lip and tongue pressure, it has been suggested that pressures created at rest may influence the dental arch form and tooth position. Graber believed muscle posture to be more important than muscle function in moulding the hard tissues. For the majority of the time, the tongue is in rest position and thus influencing the dentoskeletal deformity. Forces from unintentional and habitual behaviour, regarded as abnormal posture can often lead to jaw deformity and

malocclusion.[1] As abnormalities in either function or position of the tongue can lead to changes in the surrounding dentoalveolar structures, having a thorough knowledge of the tongue posture is advantageous to better diagnose the aetiology of malocclusion and plan an appropriate treatment plan, alongside preventing the chances of a relapse.

Thus, this study aimed to evaluate and compare the tongue position in rest, in centric occlusion and the changes seen in tongue posture as it moves from rest to centric occlusion in subjects of skeletal class II div 1 malocclusion, skeletal class II div 2 malocclusion, and skeletal class I normal occlusion.

Materials And Methods

This was a prospective cephalometric study performed on 30 individuals having class II div 1, class II div 2 and class I malocclusions. As tongue formation in most individuals is completed by about 16 years of age and age is seen to have an important bearing on the position of the tongue, 18-25 years was selected as the age range for this study.

The 30 individuals were divided equally into 3 groups of the skeletal malocclusion based on the clinical evaluation and the following inclusion criteria.

Inclusion Criteria

1. Skeletal class I normal occlusion comprised of 10 individuals with skeletal class 1 normal occlusion.
2. skeletal class II div 1 malocclusion - comprised of 10 individuals with a Class II molar relationship on both the sides and an overjet of more than 5 mm.
3. The sides and Overjet less than 2mm and an overbite more than 2mm.

Exclusion Criteria

1. Patients with any oral and parafunctional habits.
2. Facial deformity or craniofacial syndrome.
3. Patients having undergone orthodontic treatment in the past were also excluded from the study.

Evaluation of tongue position

The position of the tongue was evaluated based on the tongue analysis method using a template described by Rakosi (1982) and further by Graber *et.al.*in 1997. The landmarks selected and marked on the lateral cephalogram are described in Table 1 and can be seen below in Fig 1.

Figure 1: Lateral cephalogram showing tongue in rest position after being coated with Barium sulphate solution.

The template on the lateral cephalogram was constructed by joining the tip of the lower incisors (ii) and cervical, distal-most point on the 2nd erupted molar (Mc), extending posteriorly till the most caudal point of the soft palate or uvula or its projection on the reference line (U). Taking (O) as the mid-point of the reference plane ii-U, the tongue was equally divided into 7 parts by constructing angles at 30^0, 60^0, 90^0, 120^0 and 150^0. Apart from these 7 parameters, labelled as Tg1- Tg7, as described by Rakosi (1982), the tongue height (Tgh), tongue length (Tgl), based on reference lines given by Lowe et. al. and distance of the tongue from the pharyngeal wall (Pt-Pw), were also evaluated and compared. The 10 parameters assessed are described in Table 1 and marked in Fig 2. When you submit your final version, after your paper has been accepted, prepare it in two-column format, including figures and tables.

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Figure 2: Lateral cephalogram showing tongue in centric occlusion after being coated with barium sulphate solution.

Statistical Analysis

The statistical software namely SPSS version 20.0 was used to calculate descriptive data. Paired t-test was performed to evaluate the change from rest to centric occlusion in all 3 groups of malocclusions. The ANOVA with post-hoc Tukey test was done to compare the obtained data in all 3 groups of skeletal malocclusions.

Discussion

The tongue being an agile, versatile appendage of the oral cavity, has long been considered to have a direct impact on the Dento-skeletal structures. Any abnormality in the function and position of the tongue is seen to have a direct influence on the jaw bases, especially the mandible. While various studies in the past have reported a direct correlation between a lowered tongue posture and class III malocclusion and a retracted tongue posture and class II div 1 malocclusion,

little is known about the tongue position in class II div 2 malocclusions, characterized by skeletal class II jaw bases, with upright/retracted incisors.

Thus, the study aimed to evaluate and compare the tongue position at rest and centric occlusion in subjects with skeletal class II div 1 malocclusion, skeletal class II div 2 malocclusion and skeletal class I normal occlusion. As various authors have emphasized the importance of resting tongue posture as a critical feature in dentoskeletal growth and development, both the tongue position, at rest and in centric occlusion were investigated and compared in the study.

Subjects in the age range of 18-25 years were selected for the study as previous reports have suggested that the dorsal tongue height in children is higher than that in adults and the tongue growth in females is essentially completed by 18 years of age.

Clinical examination was used to segregate the patients into the 3 groups of malocclusions based on the inclusion and exclusion criteria. As lateral cephalograms are a routine diagnostic aid required by the patients undergoing orthodontic treatment at institutions, are economical, easy to use and provide definitive and quantitative information about the soft tissues, they were the preferred choice of method for this study. With only a limited number of methods for tongue analysis on the radiograph, the analysis given by Graber et.al. (1997) was used to assess the tongue posture in this study. Guay et. al. has suggested that to better visualise the soft tissue structures on the radiographs, they must be coated with a radio-opaque solution that is adhesive and retains its integrity for at least 2 swallows. Thus, in this study, the tongue of each subject was coated with barium sulphate solution before shooting the lateral cephalograms. Barium sulphate solution was chosen as it was easy to use, light-medium, palatable and did not interfere with the movements of the tongue.

Dependent Variable	(I) Groups	(J) Groups	Mean Difference (I-J)	p value
Tg4	Group 1	Group 2	1.25000	.712
		Group 3	-4.25000	.006
	Group 2	Group 1	-1.25000	.701
		Group 3	-5.50000*	.023*
	Group 3	Group 1	4.25000	.070
		Group 2	5.50000*	.028*

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Table 1: Pairwise multiple Intergroup comparison of the significant parameters between 3 groups at Rest position. *- (p-value <0.05) statistically significant difference.

The outcomes of the study showed that in Group 1, the maximum thickness of the tongue at rest position was seen in the anterior tip region of the tongue (Tg1) while the least thickness was observed in the middle region of the dorsum (Tg5). However, in centric occlusion, the maximum thickness of the tongue was observed in the root portion (Tg7) while the least thickness in the middle portion of the dorsum (Tg4). The Tongue when it moved from rest to centric occlusion, it showed statistically significant increases at the levels of Tg3, Tg4, Tg5, Tg6, Tg7 and Tgl. This suggests that the tongue moved antero-superiorly in the posterior and root end regions, and superiorly in the middle region of the dorsum by a significant amount. These results coincide with the explanation given by Peat *et.al*. that in normal occlusion, there are 2 positions of the tongue, first, that shows contact of the dorsum with the soft palate, to maintain the posterior oral seal and the second is the contact of the tip of the tongue to maintain the anterior oral seal. Both are produced at the expense of contact with the hard palate.

In Group 2, while the rest position showed a maximum thickness at the tip of the tongue (Tg7), the centric occlusion showed maximum thickness at the posterior root level (Tg1). Thus, suggesting that the tongue moved superior-posteriorly while the mandible moved from rest to centric occlusion. These results are similar to those of Rakosi et. al., who pointed out that as the tip of the tongue in class II malocclusion is retracted, the position of the tip of the tongue does not change much from rest to centric occlusion, however, he also concluded that the posterior portion of the tongue moved anteriorly from rest to centric occlusion. The least values at the rest and centric occlusion were obtained in the middle portion of the dorsum (Tg4, Tg5). A statistically significant increase (p-value <0.05) was observed in the middle portion of the dorsum of the tongue (Tg4) as it moved from rest to centric occlusion. These results coincide with those of Verma*et. al.* wherein the tongue in class II div 1 malocclusion was observed to significantly move posterior-superiorly in the posterior-medial region of the tongue.

In Group 3, the highest values were observed at the tip of the tongue for both rest and centric occlusion positions, while the lowest values were observed at the middle portion of the dorsum of the tongue (Tg4, Tg5). A statistically significant increase was noted in the medial-posterior region of the tongue (Tg2), suggesting that the tongue moved posterior-superiorly from rest to centric occlusion.

On comparison between the 3 groups at the centric position, statistically significant differences (p-value<0.05) were noted at the anterior regions of the tongue and the tongue tip (Tg7, Tg6, Tg5) along with the total length of the tongue (Tgl). On pairwise comparison of the 3 groups, significant differences were seen between groups 1 and 2 at the middle portion of the tongue (Tg5) and anterior body of the tongue (Tg6), suggesting that the anterior part of the tongue was more superiorly and anteriorly placed in class I occlusion compared to skeletal class II division 1 malocclusion. Significant differences were observed between groups 1 and 3 at the tip of the tongue and the total tongue length. Thus, suggesting that the total length of the tongue was smaller in class II division 2 malocclusion compared to class I.

Also, the tip of the tongue was retracted and more posteriorly placed in class I compared to Class II division 2 malocclusion. Significant differences between

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groups 2 and 3 were only found at rest position, at the middle portion of the dorsum of the tongue. This suggests that the tongue in skeletal class II division 2 malocclusion is more highly placed, closer to the palate as compared to the position of the tongue in Class II division 1 malocclusion. This is seen to have a clinical implication, as a class II division 2 malocclusion is characterized by a broader arch form, while class II division 1 malocclusion is normally found with constricted arches.

These differences were mainly observed in the middle portion of the dorsum of the tongue, as well as at the tongue height, which suggests that change in tongue posture from rest to centric occlusion is significantly much lesser in class II division 2 malocclusion compared to class I normal occlusion, particularly in the middle portion of the tongue.

Conclusions

The tongue position in class I is more anteriorly and superiorly placed in centric occlusion, when compared to class II division 1 malocclusion, which was seen to have a more retracted tongue posture. On moving from rest to centric occlusion, the tongue in all 3 groups moved in a posterior and superior direction. Within the limitations of this study, the following conclusions can be drawn from the study – The tongue posture in class II division 2 malocclusion is more retracted compared to that in class I normal relation. The length of the tongue is also significantly smaller compared to class I normal occlusion. In comparison to class II division 1 malocclusion the middle portion of the dorsum of the tongue in class II division 2 is more highly placed, when at rest position.

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