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Original Research Paper

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THE EFFECT OF VERTICAL FACIAL HEIGHT CHANGES IN POSITION AND ANGULATION OF CONDYLES FOR CLASS I MALOCCLUSION AFTER ORTHODONTIC TREATMENT

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ABSTRACT **Introduction:** Ortodontic treatment in Class I malocclusion can change the position of molar, occusal plane and mandibular rotation that can lead to the change in vertical facial height. The changes in vertical facial height may have an effect to the changes in condyles position and its angulation. However, the changes in vertical facial height after orthodontic treatment often trigger controversies. The objective of this study is to understand if the change in vertical facial height can affect the position and the angulation of condyle. Methods: this research used a cross sectional methods with 30 sampel from a cephalometry radiograph before and after treatment with and without extraction. Changes in vertical height measured from MP-SN angle, position of condyles measured from distance Co-TC and distance Co-T vertikal. Angulation of condyles measured from Co-T-Tvertikal angle. Result and Discussion : Significant changes were found in vertical facial height without extraction sample ($p<0.05$). however, there were no significant changes found in vertical facial height with extraction sample ($p>0.05$) . No significant changes were found in position and angulation of condyle with or without extraction ($p>0.05$). there were no significant correlation found between the changes in vertical facial height and changes in position and angulation of condyle with or without extraction ($r<0.5$). Conclusion : Changes in vertical facial height will not give any significant effect in the changes of position and angulation of condyles in Class I malocclusion.

KEYWORDS : skeletal Class I malocclusion,vertical facial height, condyle position, TMJ.

INTRODUCTION

Orthodontic treatment has been used to correct various malocclusion problem in patients such as crowded, protuding teeth, diastema and other cases. Dental malocclusion has been categorized based on Angle Classification published in 1980's where Angle divides the malocclusion into Class I, II and III. The main goal of orthodontic treatment is to achieve better occlusion in terms of function and aesthetics.[1,2,3]

In orthodontic treatment with Class I malocclusion, usually there are changes in vertical facial height. It consist of changes in occlusal plane, position of molar and its rotation. For example in a case which requires a transversal expansion, usually molar teeth tipped to the buccal side in which the palatal cusp move downward and contact with its antagonist teeth, so that it will stimulate clockwise rotation of the mandible resulting in vertical facial height changes. [1,2,3,4]

If there is a case where molar distalization is required, an open bite will occur due to premature contact so that in a low angle patient, mandible rotation is needed to correct the patient's profile by increasing the height of the lower face. However in high angle patients, clockwise rotation will only aggravate the facial profile and open bite can occur. In addition, the correction of Class I malocclusion cases type 2 where protrusion of the maxillary incisors is in contact, it will affect the changes in facial height.[1,2,4]

Extrusion of the posterior teeth gives a downward and backward rotation of the mandible which can result in vertical facial dimensions changes so that facial height will also change. [2,4], ` The occlusal plane of the tooth will also change as the position of the tooth change, so that it will result in changes of mandibular rotation and vertical facial height.[4]

Khatoon et al's research showed that in fixed orthodontic treatment, changes will occur in the sagittal, transverse and vertical planes where changes in the vertical plane such as changes in vertical facial height will be different in each patient so that sometimes it will be very beneficial in certain cases.5 Moreover, Earson and Garlington (Cit Sivakumar et al.) said that orthodontic treatment with extraction and without extraction give significant difference in the changes of vertical facial height.6 In the contrary, Hosseinzadeh-Nik et al found that the extraction of four premolars did not have a significant changes in vertical facial height.[7]

Temporomandibular joint is a complex joint that move around in three dimensions such as horizontal, vertical, sagittal and the translation movement. Normal TMJ movements occur when the condyle is in the central area (intermediate zone) of the disc. If there is a change in the position, it can cause interference with the temporomandibular joint (TMJ). [2,4,8,9,10]

Bjork concluded that changes in vertical facial height correlate very closely with the changes in the angle of the mandibular plane. Keeling et al also said in their study that in case of deep bite patients, the clicking on TMJ will increase. Research by Ari-Demirkaya et al concluded that patients with deep bite cases tends to have a flat condyle. [11,12,13]

Based on this background, the authors are encouraged to know and evaluate the effect of vertical facial height changes in position and angulation of condyles before and after orthodontic treatment.

Methods

The design of this study is analytic with a cross sectional approach using 30 sample of Class I malocclusion lateral cephalometric pre and post orthodontic treatment radiographs at the Orthodontic Clinic of the Dental and Oral Hospital of FKG USU (RSGM FKG USU) who were treated with extractions or non-extractions.

Preparation of research samples by identifying 30 cephalometric radiographic samples of patients with the sample criteria, namely male and female patients aged 20-40 years with pre and post treatment cephalometric radiographs of class I malocclusions. The cephalometric radiographs were good and clear with no history of craniofacial syndrome, or

trauma around TMJ and chin. Each sample will be radiographically analyzed before and after orthodontic treatment by determining the points MP, SN, T, C, T vertical and Co Bjork methods showed that the position of condyle can be measured first from point Co to the vertical line T and second from point Co to line TC, while the angle of condyle can be measured from point Co to point T and to vertical line T. [6,7,9]

The position of the condyle (Co) can be measured by two reference lines of the X axis and Y axis according to the Cartesian coordination system. The 'X' axis is formed by the TC (Cranial base line) line determined by the point T (tubercle), which is the anterosuperior point of the anterior wall of the tursica, to point C (cribiform) which is the most anterior point of the cribiform plate at the junction with the nasal bone. The TC line is used as a reference line in this study because according to Viazis (2001) the TC line is a stable line and does not change after the age of 5 years. The axis 'Y' is formed by a vertical T line that is perpendicular to the X axis and passes through the point T. The linear measurements used to determine the position of the condyle are first, distance from Condylion (Co) to the Vertical T (Vert-T) line and second, distance from Condylion (Co) to the TC line and. The angle of condyle can be measured from point Co-T-Tvertical line (Figure 1). So there are three measurements that are used to determine the position and the angulation of condyle as shown in Figure 1. This study compared each measurement of the sample group pre and post orthodontic treatment with extraction or non-extraction. [6,7,9,14,15]

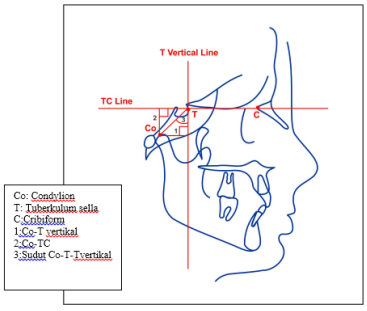

Figure 1. Measurement of position and angulation of the condyle.6,14,15

Many parametric can be used to determine the changes in facial vertical height in orthodontic treatment. The SN cranial base line can be used as a reference line because this line does not change after growth is completed. The SN line is a reference line to determine the inclination of the mandibular plain (MP) (Figure 2). As explained before, if the inclination of the mandibular plane changes either clockwise or counterclockwise, the vertical facial height will also change. Nasby et al. said that the increased molar diameter and the length of the arch of the maxilla and mandible caused a decrease in the angle of the mandibular plane resulting in changes of vertical facial height.1,3 Therefore in this study, MP-SN angle is used as a measurement to determine the changes in facial vertical height.

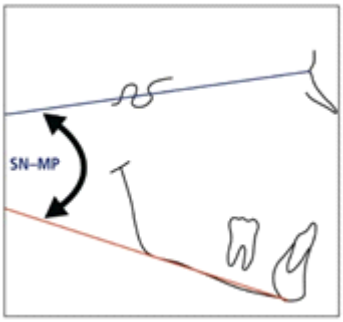

Figure 2 : MP-SN Angle 1,3

After analyzing all the required measurement, then data processing can be taken place. Analysis of variables pre and post treatment used paired T test, to find out the mean difference pre and post orthodontic treatment and then the Smearson correlation test will be used to determine the relationship of changes in facial height to the position and angulation of the mandibular condyle. If the data are not normally distributed then Spearman analysis is used.

RESULT

The sample group was divided into groups with extraction and non-extraction. Shapiro Wilk data normality test is used in both groups of study samples because the number of samples is less than 50 samples. In both groups of patients normality tests were performed to find out that all data had been normally distributed with a result of $p > 0.05$

Paired T-test was used to analyze changes in MP-SN, position and angulation of the condyle before and after treatment.

Table 1. Mean Value of Vertical Face Height, Position and Angulation of Condyle Pre and Post Treatment in the Non-extraction group

Variable	Mean±SD Pre Tx	Mean±SD Post Tx	P Value
MP-SN Angle	30,00±5,24	30,64±5,60	0,029
Co-TC distance	21,00±3,99	21,36±4,03	0,521
Co-Tvertikal distance	19,44±3,30	19,47±2,70	0,928
Co-T-Tvertikal Angle	42,19±7,97	41,69±7,23	0,456

In table 1 it can be seen that the p-value at the MP-SN angle ($p = 0.029$), if $p < 0.05$, the statistical results show that the change in the MP-SN angle between pre and post orthodontic treatment in a non-extraction sample is significant. Where the values for the Co-TC distance ($p = 0.521$), the Co-Tvertical distance (p-0.928) and the Co-T-Tvertical vertical angle ($p = 0.456$) are greater than 0.05. So based on statistical results the mean values between pre and post treatment do not indicate a significant change.

To see the effect of vertical facial height changes in the position and angulation of condyles, the Pearson correlation test was performed between pre and post orthodontic treatment.

Table 2 Correlation Value of the changes in vertical facial height (MP-SN) to the changes in the distance of the Co-TC, Co-T-vertical condyle and Co-T-Vertical angle in Non-extraction group

Variable	Mean±SD	P value	r
MP-SN Angle	0,63±1,13	0,518	0,163
Co-TC Distance	0,36±2,37		
MP-SN Angle	0,63±1,13	0,539	0,155
Co-Tvertikal distance	0,02±1,27		
MP-SN Angle	0,63±1,13	0,333	0,242
Co-T-Tvertikal distance	0,500±2,78		

From the data analysis that can be shown in table 2, the value of the relationship strength (r) on each variable is less than 0.5 according to DA De Vaus that there is no relationship or less significant change in vertical facial height (MP-SN) to the distance of the condyle (Co-TC and Co-Tvertical) and condyle angle (Co-T-Tvertical) in Class I malocclusions in the non-extraction group after orthodontic treatment.

In the sample group of extraction, there were no significant changes ($p > 0.05$) in the MP-SN angle between pre and post treatment (Table 3). So in conclusion the correlation between the effect of changes in MP-SN to changes in angulation and position of the mandible condyle is also not significant.

Table 3. Mean Value of Vertical Face Height, Condylus Position and Angulation Pre and Post Treatment in the sample group with extraction

Variable	Mean±SD Before	Mean±SD After	P Value
MP-SN Angle	35.54±4,99	35,8±5,45	0,627
Co-TC Distance	19,33±3,33	19,75±2,41	0,563
Co-Tvertical Distance	19,44±3,30	19,47±2,70	0,928
Co-T-Tvertical distance	40,71±9,64	41,08±6,30	0,834

DISCUSSION

In this study, value of MP-SN angle that are used to see the changes in vertical facial height have been analysed by paired t-test and it showed a significant result in the Non-extraction group sample (p=0,029) (table 1), whereas the changes in MP-SN angle in extraction group sample (p=0,627) (table 3) did not show a significant result. The results of this study are supported by previous study by Dougherty, Edward, Klapper et al, Chua et al, Cusimano et al, Stagger et al, Sarac dan Cura, Bishara et al, Kocadereli et al, Hayasaki et al, Kim et al showed that orthodontic treatment with extraction did not give notable effect on changes in vertical facial height.[16,17,18]

In Table 1, the p-value of the Co-TC distance (p = 0.521), the Co-Tvertical distance (p = 0.928) and the Co-T-Tvertical angle (p = 0.456) did not show any significant difference in results between pre and post orthodontic treatment which means that there is no big changes in condyle's distance and angle between pre and post orthodontic treatment in sample group class 1 malocclusion without extraction. The results of this study are the same as Richteret et al and Kinzinger et al who found that the position of the condyle is generally unchanged after treatment in Class I malocclusion patients, if any, then the changes that occur are also not significant. This study also showed that the correlation value (r) of the changes in vertical facial height (MP-SN) to the Co-TC distance is 0.163, the correlation value (r) of the changes in vertical facial height (MP-SN) to the Co-Tvertical is 0.155 and the correlation value (r) of the changes in vertical facial height (MP-SN) to the Co-T-Tvertical angle is 0.242 in extraction group sample (table 2). Which means that there are no notable correlation between the changes in vertical facial height (MP-SN) with changes in distance and angle of condyle after orthodontic treatment. The normal position of the condyle will give balance to the mastication system and can also reduce the risk factors for TMD in future.[19,20,21,22]

According to Gunn et al and Goymen et al there is no relationship between vertical malocclusion and TMJ. Rebibo et al also said that changes in incisor bite height of 1mm will result in condyle rotation of 1 °, which is the same as condyle-discus shifting of 0.1mm so that with healthy TMJ, these dimensional vertical changes do not significantly affect the temporomandibular joint.[3,20,23]

The results of this study reported that there were significant changes in facial height between pre and post orthodontic treatment in cases of Class I malocclusion without extraction, but in the contrary orthodontic treatment with extraction shown there were no significant differences in facial height between pre and post orthodontic treatment. (Table 1 and Table 3). This may be influenced by the type of bracket used and the variation of techniques that are used such as the use of elastic in the orthodontic treatment.

CONCLUSION

Based on the results of this study, it can be concluded that there were no significant changes in the condyle position and angulation for patients with Class I skeletal malocclusion after orthodontic treatment with extraction nor without extraction. Changes between facial heights do not have a strong effect on the condyle position and angulation in patients with Class I skeletal malocclusion after orthodontic treatment in cases of extraction or non-extraction.

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