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RESEARCH ARTICLE

Vertical Facial Changes after 6 Months of Fixed Orthodontic Treatment

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ABSTRACT

Background: *The use of fixed orthodontic appliances can change the vertical face due to the movement of the molars. A lateral cephalometric radiograph was used to assess the outcome of the treatment. Analysis of the vertical facial changes was performed by observing the changes in the MP-SN angle.* ***Objective:*** *The purpose of this study was to determine whether there were differences in the vertical face before and after 6 months of fixed orthodontic treatment using the Steiner method.* ***Methods:*** *This study used a case-control design comparing groups before and after 6 months of fixed orthodontic treatment. The sample in this study amounted to 5 people. The vertical measurement of the face is carried out at the MP-SN angle, namely the angle formed by the MP (Mandibular Plane – Go-Gn) line and the SN (Sella-Nasion) line. The data analysis was performed with the program SPSS Version 25.* ***Results:*** *There were no significant changes in the study (p>0.05). The average change is 1.2º. Of the 5 patients, 4 patients (80%) experienced a decrease in the MP-SN angle, while 1 patient (20%) experienced an increase in the MP-SN angle.* ***Conclusion:*** *There was no significant change in facial vertical changes before and after 6 months of fixed orthodontic treatment at RSGM UMY. The decrease in the MP-SN angle is caused by the intrusion of the molars which causes the mandible to rotate counterclockwise. The increase in the MP-SN angle is due to the destabilization of the molars, resulting in a clockwise rotation of the mandible.*

Keywords: *MP-SN, Fixed Orthodontics, Lateral Cephalometry, Steiner Analysis, Facial Vertical*

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INTRODUCTION

Fixed orthodontics is a device that attaches to the oral cavity and can only be removed by the operator. This appliance can handle complex cases of malocclusion such as tipping, rotation, intrusion, and extrusion.[1] Fixed orthodontic appliances are attached to the teeth using chemicals. This allows the doctor to achieve much greater tooth movement than can be achieved with removable orthodontic appliances.[2] Examinations are needed to ensure proper diagnosis and treatment for the patient before orthodontic treatment. Supportive examinations for accurate orthodontic diagnosis can be obtained through several processes, one of which is cephalometric radiography.[3] The radiographic examination that is often used is the lateral cephalometric radiograph. Cephalometric radiography is the standard skull radiograph widely used in orthodontics and maxillofacial surgery.[4] Lateral cephalometry is used to study changes in individual growth in a population. Lateral cephalometry has two purposes: to provide details on skeletal and dental relationships that cannot be observed in other ways and provides a precise evaluation of the response after treatment.[5] Lateral cephalometry can also be used to predict changes caused by orthodontic treatment.[6]

Treatment with fixed orthodontic appliances can cause changes in the MP-SN angle. According to a previous study, this angle change was most significant in patients treated with the Begg technique where the MP-SN angle was increased. This increase was due to the movement of the first molars. Other studies have shown a reduction in the MP-SN angle after fixed orthodontic treatment. This change is due to the presence of molar intrusion and is also the result of mesial-to-molar movement.[7] The changes that occur during orthodontic treatment occur in 3 stages, namely leveling and alignment, working, and finishing. Leveling and alignment is the first phase in orthodontic treatment that occurs in the first 6 months of using fixed orthodontic appliances. Leveling aims to create a gap between the teeth before the teeth can be aligned (alignment).[8] This stage involves simultaneous alignment of all the upper and lower bites, correction of rotated teeth, and elimination of slight class III relationship in the buccal segments.[9] This is the stage of orthodontic treatment that results in changes in the MP-SN angle where there is a movement of the molars that can affect the vertical of the face. Changes in the angle of the MP-SN after the treatment with fixed orthodontics can be caused by molar tooth movement, which results in mandibular rotation.[18,20] Previous studies showed that there was a change in the MP-SN angle in adult women after fixed orthodontic treatment with an average use of 13 months.[10] Another study also showed changes in the MP-SN angle after 9 months of fixed orthodontic treatment.[11] Study by Purwaningsih et al and Wahyuningsih et al mentions a change in the MP-SN angle after performing fixed orthodontic treatment with the Begg technique.[12,13,14]

Based on the description above, the researcher wanted to find out whether there were differences in the vertical face before and after 6 months of fixed orthodontic treatment using the Steiner method.

MATERIALS AND METHODS

This study used a case-control design by comparing two groups, the group before and after 6 months of orthodontic treatment. In this study, total sampling was used, which included all members of the population. The population in this study were orthodontic patients who received lateral cephalometric radiographs at RSGM UMY in March 2021. The inclusion criteria in this study were orthodontic patients who received cephalometric radiographs and received lateral cephalometry before and after 6 months of fixed orthodontic use, while the inclusion criteria of this study were the number of controls is less than 6 times. This research was carried out at the RSGM UMY in March 2021. This research has received permission from the health research ethics committee of the

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Manual cephalometric analysis was performed by tracing on tracing paper and marking the cephalometric landmark. Measurement of the MP-SN angle in this study was carried out by measuring the angle formed from the meeting of the Mandibular Plane (Go-Gn) and the SN line, by Steiner's theory.

Data analysis was performed using SPSS version 25. The normality test was performed using Shapiro Wilk test, and the parametric test was performed using Paired T-Test.

RESULT

The population of this study amounted to 7 people, but during the research period, 2 subjects were not willing to be research subjects so the final number of subjects was 5 people, 4 female and 1 male with the average age of the subjects in the study was 16.6 with the youngest age 14 years old and the oldest 20 years old.

Based on table 1 regarding the normality test, in the Saphiro-Wilk test section (n<50) the significance results (Sig.) were 0.979 Before Treatment and 0.146 After 6 Months. Thus, it can be concluded that the variables are normally distributed (p>0.05) so the parametric test is carried out by using a paired T-test. Paired T-test was used to determine whether there were vertical facial changes before and after 6 months of fixed orthodontic treatment. In table 2 regarding the results of the correlation test, it is known that the correlation coefficient (Correlation) is 0.778 with a significance value (Sig.) of 0.121 (> 0.05), it can be concluded that there is no relationship between before and after 6 months of treatment.

Table 1. Test of Normality

Tests of Normality						
	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Before treatment	.175	5	.200*	.990	5	.979
After 6 month	.262	5	.200*	.833	5	.146
*. This is a lower bound of the true significance. a. Lilliefors Significance Correction						

Based on table 3, it is known the value of Sig. (2-tailed) is 0.535 (> 0.05), then H0 is accepted and H1 is rejected, it can be concluded that there is no significant vertical facial change between before and after 6 months of fixed orthodontic treatment.

Table 2. Paired Samples Correlation

Paired Samples Correlations				
N			Correlation	Sig.
Pair 1	Before and after 6 month	5	.778	.121

Table 3. Paired Sample T-Test

Paired Samples Test								
	Paired Differences					t	df	Sig. (2- tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Pair 1 Before and after 6 months of treatment	1.200	3.962	1.772	-3.720	6.120	.677	4	.535

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DISCUSSION

The MP-SN angle describes the relationship between the mandible and the anterior base of the cranium. A large MP-SN angle (MP-SN 37º) produces vertical face dominance, and a small MP-SN angle (MP-SN 27º) produces horizontal face dominance. Inclination of the anterior cranial base (SN plane) has an important role in assessing vertical relationships. The slope of the SN plane is caused by the vertical and sagittal movements of the nation point. A higher position of the nasion (N) will result in a long face with a normal mandible.[15] The evaluation of facial vertical change after orthodontic treatment was performed to see and compare the treatment's results.

Based on the results of this research, it can be concluded that there is no significant change in the vertical face before and after 6 months of fixed orthodontic treatment at RSGM UMY. This is shown in table 3 with the results of Sig. (2-tailed) 0.535 ($p > 0.05$). The insignificant results may be due to differences in the treatment techniques used by each patient. The results of this study are in line with research conducted by Ding et al which compared skeletal changes between adolescent and adult females. In the hyper divergent malocclusion class II division I after orthodontic treatment in that study, it was found that in adolescent patients, there was a decrease by 0.8º during orthodontic treatment, but there was no significant change.[10]

Another study by Moshiri et al on cephalometric evaluation of patients with anterior open bite with Invisalign treatment also found that there was a decrease in MP-SN angle of 0.9º after orthodontic treatment, but there was no significant change.[16] According to Deng et al and Khlef et al, a decrease in the MP-SN angle can occur as a result of molar intrusion as well as the mesial movement of the molars causing counterclockwise rotation of the mandible.[7,17, 21]

Research conducted by Khlef et al on the comparison of craniofacial growth in females aged 9-18 years found that the largest change in MP-SN occurred at the age of 9-14 years with an average change of 1.98 in class I malocclusion and 2.55 for Class II malocclusion. Female aged 14-20 years experienced a reduction in the mandibular plane by 1.1º.[17] This change is due to a reduction in the mandibular plane and gonial angle.

The results show that one of the subjects has an increase in the MP-SN angle. This is explained in a study by Alkumru et al where the MP-SN angle increased significantly in the distalization group.[4] The increase in the MP-SN angle can be caused by a distal displacement of the maxillary first molar. Research by Abdelhady et al also showed similar results, namely an increase in the MP-SN angle after distalization where distalization of the molars resulted in clockwise mandibular rotation.[18] Darabi and Sadeghi mentioned that the increment of the MP-SN angle might be the result of molar extrusive movement, which occurs concurrently with space closure.[19]

The mandibula is constantly remodeling, resulting in bone apposition in the posterior-inferior part of the body, with or without remodeling at the lower edge of the symphysis. After some time, the gonial angle (Go) decreases, compensating for the increase in the vertical ramus and the direction of growth of the condyles. The angle of the mandibular plane can decrease by 1.1º at the age of 14-20 years due to a tendency to close the rotation of the mandible. This theory is supported by other studies which state that at the age of 9 years, individuals have higher anterior facial height and gonial angles than individuals 18 year of age who has a lower facial height due to counterclockwise rotation of the mandible.[20]

CONCLUSION

Based on the results of the study, it can be concluded that there were no significant differences in vertical facial changes before and after 6 months of fixed orthodontic treatment at RSGM UMY. The decrease in MP-SN angle is due to molar intrusion causing counter clockwise

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mandibular rotation and the increase in MP-SN angle is due to molar distalization causing clockwise mandibular rotation.

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