ORIGINAL ARTICLE

Dentoalveolar and Soft Tissue Compensation in Class III Malocclusion

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ABSTRACT

Objectives: **Compensatory is a mechanism that preserve a proportional and harmonious facial pattern in patients with Class III skeletal pattern. There are two major treatments for this type of patient which are orthodontic surgery and fixed orthodontic appliances. The objective of this study is to assess dentoalveolar and soft tissue compensation in Class III skeletal pattern in relation to normal occlusion.**

Methods: **Pre-operative lateral cephalometric radiograph of 30 patients each from Class I and Class III skeletal pattern were selected for this study. The cephalometric parametric such as sagittal jaw relationship, occlusal plane angulation, chin thickness, distance of lips toward aesthetic line, incisors inclination were measured.**

Results: **The result shows significant difference in DL' (p = 0.019), ANB (p = 0.000), SN-AB (p = 0.004), SN-L1 (p = 0.001), SNB (p = 0.037), L1A (p = 0.000) and DU' (p = 0.001). There are no significant differences in other sagittal jaw relationship, upper incisor proclination, distance of upper lip to aesthetic line and thickness of chin.**

Conclusion: **In summary, the dentoalveolar compensation in Class III skeletal pattern is by retroclination of the lower incisors meanwhile the soft tissue compensation is achieved by the change of the distance of the upper and lower lips towards the aesthetic line, in response to the inclination of the incisors.**

KEY WORDS

class III skeletal pattern, dentoalveolar compensation, soft tissue

INTRODUCTION

Aesthetic is one of the reason patients with malocclusion come to clinic to seek orthodontic treatment[1]. Orthodontic patients were very concern with any treatment that might changes their facial form and facial harmony. The treatment should also not be detrimental to patient's daily life[2]. Since patient seek treatment primary for aesthetic reason, the evaluation and understanding of the factors that affect their decision is very important. Treatment demand can be influence by a psychological profile whereby patient with high self-esteem are prone to seek improvement in facial appearance[3].

There is some variable in the growth of upper and lower arches for some patients. This in turn can cause discrepancy in occlusion if the growths are not in proper sequence. However, this imperfection can be compensated by dentoalveolar and skeletal changes. Dentoalveolar compensatory can be describe as a process of controlled development of dental and alveolar arches to achieved ideal teeth occlusion and their adaptation to basal jaws[4].

The role of dentoalveolar compensation is important to achieved normal occlusion. Malocclusion is result from insufficient dentoalveolar compensation for different facial pattern[5]. Dentofacial complex a compensatory mechanism exists and tries to preserve and harmonious the facial pattern. In Class III malocclusion, there are two major treatments available which are orthognathic to correct skeletal pattern thru surgery and treatment with dentoalveolar compensation without correcting the skeletal pattern for patients who are satisfied their facial appearance[6].

Dentoalveolar compensation is a system that try to maintain normal relationships with upper and lower arches. Skeletal relationship is known to be the main factor in the aetiology of most Class III malocclusion. The soft tissues in Class III malocclusion usually will push the lower and upper incisors to each other. This is known as soft tissue compensation. This in turn will result in the incisor relationship became less severe compare to the skeletal pattern.

Ishikawa H. *et al* (1999), identified that the jaw relationship parameter, the SN-AB angle, and three dental parameters which are SN-U1, SN-L1 and SN-OP as the most appropriate method of describing dental compensation quantitatively. Among the three dental parameters, SN-L1 shows the strongest correlation to SN-AB, where each degree of change in SN-AB results in largest change in SN-L1. This shows that lower incisor inclination was determined by the sagittal jaw relationship. In another study, it is found that there is mild to moderate compensatory incisor inclinations in mild-to-moderate sagittal basal Class III malocclusion, where the maxillary incisors are mildly protruded and the mandibular incisors retruded which is obtained from preoperative cephalograms[7].

Class III malocclusion may arise from different anteroposterior position of the upper and lower arches. When compared, upper incisors are more protrusive and lower incisors are more retroclined in lower jaw prognathism than in upper jaw retrognathism. If compared to the normal sagittal maxilla and mandible, the upper incisors are more protrusive in lower jaw retrognathism while in mandibular prognathism the upper incisors are more protrusive and the lower incisors are more retroclined[8].

Lateral cephalometric tracing is a way to measure facial disharmony and recognizing what causes it. The advantage of this analysis is that it

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Table 1: Statistical analysis with parametric test. *p < 0.05 by independent t-test

Parameter	Skeletal pattern	Mean	Standard Error Mean	p-value
ANB value	Class I	3.13	0.15	0.000*
	Class III	-0.93	0.35	
SN to occlusal plane	Class I	14.77	2.30	0.494
angle (SN-OP)	Class III	13.07	0.90	
SN to AB line angle	Class I	74.50	2.21	0.004*
(SN-AB)	Class III	83.10	1.83	
SN to upper incisor	Class I	114.1	1.04	0.118
angle (SN-U1)	Class III	3	109.7	2.48
SN to lower incisor	Class I	48.00	1.06	0.001*
angle (SN-L1)	Class III	58.37	2.66	
Upper incisor to	Class I	122.00	1.06	0.151
maxillary plane	Class III	0	2.66	
angle (U1A)		119.4		
		3		
Lower incisor to	Class I	97.57	1.18	0.000*
mandibular plane	Class III	90.03	1.20	
angle (L1A)				
Distance of soft tissue	Class I	2.13	0.53	0.019*
lower lip (DL')	Class III	0.50	0.43	

Table 2: Statistical analysis using non-parametric test. *p < 0.05 by Mann Whitney test

No	Parameter	Malocclusion	Median	IQR	p-value
1.	SNA value	Class I	84.00	6.00	0.130
		Class III	81.50	7.00	
2.	SNB value	Class I	81.00	4.00	0.037*
		Class III	83.00	7.00	
3.	Maxillomandibular	Class I	25.50	7.25	0.694
	plane angle	Class III	27.50	7.00	
	(MMPA)				
4.	Distance of soft	Class I	-0.50	3.00	0.001*
	tissue upper lip	Class III	-3.00	3.50	
	(DU')				
5.	Distance of soft	Class I	11.00	3.25	0.940
	tissue pogonion	Class III	11.00	2.25	
	(DPg")				

enables objective measurements of the main structures and their connection. Tracing process is important part of treatment plan because normal facial profile can be improved if the underlying factors can be recognized and treated. In a study done to compare two compensatory approaches taken in skeletal Class III patient, the initial lateral cephalometric radiograph of the soft tissue analysis for both extraction and non-extraction groups shows prognathic appearance. The Holdaway angle in both groups were below the normal range. However, a significant difference can be noted for the esthetic line to the lip position, where in the nonextraction group, the lips are in more retruded positions. Meanwhile the nasiolabial angle value exceeded normal range in both groups (Zimmer B. *et al*, 2016). Position of the teeth usually determined by soft tissue influences. Therefore, the treatment option should focus on changes in tooth position that the treatment could produce[9].

The general aim of this study is to investigate dentoalveolar and soft tissue compensation in Class III patients in relation to the normal occlusion. The specific objective is to compare dentoalveolar compensation between Class I and Class III patients and to compare soft tissue compensation between Class I and Class III patients.

MATERIALS AND METHOD

This research is a retrospective study done in polyclinic Islamic Sciences University of Malaysia (USIM) in Kuala Lumpur, Malaysia. Ethical approval was applied to USIM Research Ethics Committee and approval was given. A total of 60 samples lateral cephalometric radiographs were selected whereby 30 samples were Class I skeletal pattern while the other 30 samples were Class III.

The information regarding Class I and Class III skeletal pattern patients was taken from the orthodontic screening records from Department of Orthodontics USIM. The inclusion criteria for this study were patient aged 18 years and above, ANB less than 3°, Class I or Class III skeletal pattern and no missing teeth. The exclusion criteria were patients with syndromic or cranial malformation, facial asymmetry, posterior crossbite and severe rotation of central incisors.

Lateral Cephalometric tracing analysis was done on the pre-treatment lateral cephalometric radiographs. The cephalometric analysis was based on parameters for soft tissue, skeletal and dentoalveolar. The parameters for the jaw relationship were ANB value, SN-AB angle (the angle formed by S-N and A-B planes) and MMPA (maxillomandibular plane ange). The dentoalveolar parameters were measured to assess incisor inclination and occlusal cant plane using the parameters of upper incisor angle (U1A), lower incisor angle (L1A), SN-U1 (the angle formed by S-N and U1), SN-L1 and SN-OP. The soft tissue parameters used were the distance of upper (DU') and lower lip (DL') to the esthetic line and the thickness of the chin (DPg').

Method errors were calculated using Dahlberg's formula (Dahlberg, 1940). Ten randomly selected lateral cephalometric radiographs were traced and measured between two operators. Method error = $\sqrt{\sum d2/2n}$ where d is the difference between two measurements of a pair and n is the number of subjects. The Dahlberg error is 1.94 for the angular measurement and 0.64 for the linear measurement.

The mean differences in both groups were compared with paired t-test and Mann-Whitney U test. The statistical analysis was performed using Statistical Package for the Social Sciences version 21.0 (SPSS) software.

RESULTS

The mean age of the sample is 22.7 years with 71.7% (n = 42) female and 28.3% (n = 18) male. It consists of Malay race which is 91.7% (n = 55) and Chinese at 8.3% (n = 5).

Table 1 shows the result of the parametric analysis using t-test and Table 2 shows the result of the analysis of Mann Whitney U test. Dentoalveolar component show significant difference on the hard tissue parameters which are SNB value (p = 0.037), ANB value (p = 0.000), SN to AB line angle (p = 0.004), SN to lower incisor angle (p = 0.001) and lower incisor to mandibular plane angle (p = 0.000). Meanwhile other parameters do not show any significant difference between the two group. For the soft tissue component, there is significant difference in terms of distance of soft tissue upper lip (DU and distance of soft tissue lower lip (DL between Class I and Class III skeletal pattern while the difference of thickness of the chin is not significant.

DISCUSSION

This study is aimed to determine the difference of dentoalveolar and soft tissue compensation between Class III and Class I skeletal pattern adults. The prevalence of Class III cases showed difference percentage of prevalence according to where the study was done. Previous study showed that higher rates of Class III malocclusion rate among Asian population[10]. A study by Hardy *et al* (2012) stated that Chinese and Malaysian group showed a much higher mean prevalence rate than other racial group. This is consistent with the findings of this[11].

Although it has been noted that the occurrence of Class III malocclusion is more common in boys compared to girls[12]. This study however portrays a different finding where more than half of the samples are female. This is probably because the number of female seeking treatment is higher compared to male[13].

From the analysis, there is significant difference between Class I and Class III skeletal pattern in terms of jaw relationship, lower incisor

inclination and the distance of upper and lower lip towards the esthetic line. The significant difference of the jaw relationship is reflected on the parameters of ANB, SNB and SN-AB value where the p values are less than 0.05. The significant difference in SNB value may suggest that the skeletal discrepancy in the samples was because of mandibular prognathism. Lower arch prognathism was related to a horizontal growth form, a marked dentoalveolar compensatory mechanism, with protrusive upper incisors and retroclined lower incisors[8].

Retroclination of mandibular incisors was present in this study proven by the significance of the L1A and SN-L1 values, however there is no significant difference in proclination of maxillary incisors between both classes as reflected by the p values of U1A and SN-U1 parameters. The lack of compensatory mechanism of the upper incisors may be the possible explanation of the findings.

Several studies found that in Class III skeletal pattern has hypodivergent pattern[14,15]. However, in this study, there is no significant difference in MMPA value. This shows that there is no increase of vertical facial height due mandibular growth backward in Class III skeletal pattern. The improvement of facial profile is result from the tissue changes. It has been indicated that the changes of skeletal and dental underlying soft tissue will lead to profile changes[16-18].

It appeared that there was no significant difference of thickness of the chin between Class I and Class III samples. This is similar to the findings by Burns *et al*., 2010 that the position of teeth influences the position of the soft tissue[19]. Other than that, lip posture can also be affected by skeletal pattern, size of nose and chin, lip thickness and lip tonicity other than incisor position[5].

CONCLUSION

There is significant difference between Class III and Class I skeletal pattern in terms of the jaw relationship, lower incisor inclination and the distance of upper lip and lower lip towards the aesthetic line.

The dentoalveolar compensation in Class III skeletal pattern is by retroclination of the lower incisors meanwhile the soft tissue compensation is achieved by the change of the distance of the upper and lower lips towards the aesthetic line, in response to the inclination of the incisors.

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CONFLICT OF INTEREST

The authors declare that they have no financial or other conflicts of interest in relation to this research and its publication.

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