

# Changes in soft tissue facial profile of class II skeletal malocclusion patients with retrognathic mandible treated with twin block appliance

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## ABSTRACT

**Introduction:** The soft tissue aspect in orthodontics treatment has gained attention in the last few years. The soft tissue profile is said to reflect the underlying skeletal profile, which causes a convex profile in patients with class II skeletal malocclusion. This research was aimed to determine the changes in the soft tissue facial profile of class II skeletal malocclusion patients with retrognathic mandible after twin block treatment. **Methods:** The type of research used in this study was retrospective descriptive research with paired t-test. The population was children aged 10-13 years old with class II skeletal malocclusion that were treated with twin block appliance in the Faculty of Dentistry Universitas Padjadjaran, Indonesia. The results of soft tissue changes before and after twin block treatment were compared. **Results:** There was an insignificant increase in soft tissue profile angle and Holdaway's soft tissue angle after twin block treatment ( $p > 0.05$ ). Whereas, Holdaway's H-angle was decreasing and Merrifield's Z-angle was increasing after twin block treatment, with statistically significant difference ( $p < 0.05$ ). **Conclusion:** There was a decrease of H-angle, indicates a reduction in facial convexity and improvement of the facial profile after twin block treatment, but no difference in soft tissue profile angle and Holdaway's soft tissue angle after twin block treatment.

**Keywords:** Facial soft tissue profile, class II skeletal malocclusion, retrognathic mandible, twin block appliance

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## INTRODUCTION

In recent years, the basic fundamental concept of orthodontics is undergoing a paradigm shift. Greater attention is paid to the soft tissue aspects without neglecting the dental and skeletal components.<sup>1</sup> According to McNamara mandibular

skeletal retrusion is the most common single characteristic of Class II malocclusion.<sup>2</sup> Soft tissue facial profile is closely related to the underlying skeletal profile. This character often causes patient with Class II malocclusion to have a convex profile.<sup>3</sup> Male facial profiles with bi-maxillary protrusion and a female profile with retruded

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mandible were considered the least attractive. Whereas, straight facial profile was perceived to be highly attractive by both expert and non-expert groups.<sup>4</sup>

A study carried out in Jakarta, Indonesia has found that the prevalence of malocclusion in children aged 12-14 is 83.3% and the percentage of Class II malocclusion patients is 31.6%. The same study also found that 77.4% of the Class II patients required orthodontic treatment.<sup>5</sup>

There are many treatment options for Class II malocclusion and the usual option in treating Class II skeletal problems is growth modification. There are three types of orthodontic appliances used for growth modification of Class II skeletal problems namely extraoral force appliance, functional appliance and interarch elastic traction. The ideal indication of skeletal Class II malocclusion with retrognathic mandible is the functional appliances.<sup>6</sup>

The Twin Block is a kind of functional appliance and is often regarded as the most "patient friendly" due to its comfortable, efficient and aesthetic design. A very unique feature of the Twin Block is that this appliance is constructed into two separate upper and lower appliances. Just like any other functional appliance, the twin block is designed to position the mandible downward and forward to stimulate mandibular growth. The best time to wear the twin block appliance is during active growth period.<sup>7</sup>

Many researchers have reported the effect of Twin Block on skeletal structure. However, there is scant number of study on the soft tissue changes after Twin Block treatment especially in Bandung, Indonesia. Therefore, this research was aimed to determine the changes in the soft tissue facial profile of class II skeletal malocclusion patients with retrognathic mandible after twin block treatment.

## **METHODS**

The type of research was retrospective descriptive research with paired t-test whereby the measurements of the same variable at two different points were compared. In this study, the collected data were the cephalometrics before and after Twin Block treatment and the angular

value of the soft tissue facial profile before and after treatment.

The sampling method was total sampling whereby all patients who fulfilled the inclusion criteria of the population will be selected as the sample. The sample consisted of 6 subjects who had undergone Twin Block treatment at the Department of Orthodontics, Faculty of Dentistry, Universitas Padjadjaran, Bandung, Indonesia. Ethical approval for the study was obtained from the Ethical Committee of the Faculty of Medicine Universitas Padjadjaran. The inclusion criteria applied for this study were male and female, class II skeletal relationship ( $anb > 4^\circ$ ), retrognathic mandible ( $snb < 78^\circ$ ), class II skeletal relationship with normal maxilla ( $sna = 82^\circ \pm 2^\circ$ ), convex facial profile.

There were a total number of six samples that fulfilled the criteria. Cephalometric radiographs of the selected samples were traced manually. Seven landmarks used in this study namely Po (Porion), Or (Orbitale), n (soft tissue nasion), sn (subnasale), ls (labrale superius), li (labrale inferius) and pg (soft tissue pogonion) as shown in Figure 1.

Seven reference lines constructed were as follows: (1) H line, (2) Z line, (3) soft tissue facial line, (4) Frankfort plane, (6) n-sn line and (7) sn-pog line. The H line is a tangent to the chin point (pog) and upper lip (ls), whereas the soft tissue plane is a line drawn from the skin nasion (n) to the skin pogonion (pg). The intersection of these two lines will form an acute angle which is known as the H angle.

The Z line is the tangent to the soft tissue pogonion and lips whereas the Frankfort plane is a line that connects the lowest point of the orbit and the upper margin of the bony auditory meatus. The intersection of these two lines will form an acute angle, which is known as the Z angle.

The n-sn line and sn-pog line are constructed. The intersection of these two lines will form an obtuse angle, which is known as the Soft Tissue Profile angle. Lastly, the Soft Tissue angle is an angle formed between Frankfort plane and the soft tissue facial plane.

All the four angles mentioned above were measured and recorded in angular measurements. The measurements were tabulated and analysed

using the SPSS software. A paired t-test was used to compare the changes before and after the treatment.

To evaluate the method error, three randomly selected cephalometrics from the samples collected were traced manually. After tracing, the Soft Tissue angle, Z angle, H angle and Soft Tissue Profile angle were measured and the values were recorded. The same cephalometrics are retraced after one week and the same angles as mentioned above were measured again and the values were recorded. Paired t-test was conducted to compare the values of the first tracing and the second tracing, with significance level of 0.05. The results showed no significant differences, indicating no random error.

## RESULTS

There were a total of 6 patients who fulfilled the inclusion criteria. There were 3 males and 3 females aged 10-13 years. These patients were treated with Twin Block appliance for phase I treatment before proceeding to phase II treatment. According to Table 1, the difference of the Z angle before and after Twin Block treatment is significant. The mean value of the Z angle before

the treatment is 55.58 degrees whereas the mean value of the Z angle after the treatment is 62.08 degrees. This shows that the soft tissue chin has moved forward after Twin Block treatment.

Based on Table 1, the difference of H angle before and after Twin Block treatment is significant. The mean value of H angle before treatment is 28.58 whereas the mean value after treatment is 24.83 degrees. The H angle is closely related to facial convexity. Holdaway stated that as skeletal convexity increases, the H angle must also increase. This result showed that the facial convexity of the patients decreased after Twin Block treatment.

The difference of the soft tissue angle before and after Twin Block treatment is not significant. The mean value of the soft tissue angle before treatment is 86.67 degrees, which means that the entire sample has a slightly retrusive mandible. After Twin Block treatment, the mean value of the soft tissue angle is 87.33 degrees. Just as expected, the soft tissue angle increases after treatment because of the forward growth of the mandible. However, the difference that occurred is very small and is not significant statistically.

The difference of Soft Tissue Profile angle before and after treatment is not significant. The mean values of soft tissue profile angle before and after treatment are 157.83 degrees and 159.75 degrees respectively. The angle increased after Twin Block treatment due to the decrease of facial convexity. However, the difference that occurred is very little and is not significant in statistical point of view.

## DISCUSSION

Class II skeletal malocclusion is often related to mandibular retrognathism, which results in larger facial convexity and convex facial profile is often regarded as less aesthetic when compared to other classes.<sup>8</sup> In this current research, all six patients had a convex facial profile and Class II skeletal relationship with retrognathic mandible before orthodontic treatment. Patients with retrognathic mandible are determined by value of SNB angle. The patients in this study all have a SNB angle of less than 78 degrees.

Contemporary orthodontic treatment philosophies not only aimed to produce ideal

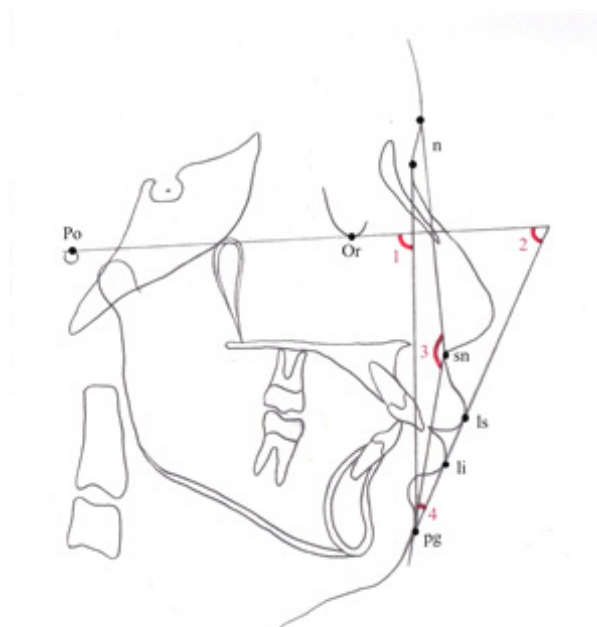


Figure 1. Landmarks used in the study: Po= Porion, Or= Orbitale, n= soft tissue nasion, sn= subnasale, ls= labrale superius, li= labrale inferius, pg= soft tissue pogonion. Soft tissue angular measurements: (1) Soft Tissue angle, (2) Z angle, (3) Soft Tissue Profile angle, (4) H angle<sup>23</sup>

Table 1. Descriptive statistics for the soft tissue facial profile variable before and after twin block treatment

Angular measurement	Before		After		P-value	Significance
	Mean	SD	Mean	SD		
Z angle	55.58	4.32	62.08	5.77	0.017	s
H angle	28.58	4.34	24.83	5.34	0.046	s
Soft tissue angle	86.67	3.06	87.33	1.54	0.516	ns
Soft tissue profile angle	157.83	7.50	159.75	7.55	0.169	ns

Notes: s, significant; ns, non significant

occlusion and functional improvement, but also to optimize dental and facial aesthetic.<sup>9</sup> Forward growth of the maxilla is slightly lesser in patients wearing functional appliance because the functional appliance positioned the mandibular forward which will create a reciprocal force acted distally on the maxilla and restricted its growth. In this current study, the patients had small reduction in the SNA angle after the treatment. However, many researchers reported no restraint in the maxilla forward growth therefore it is not a major factor in functional appliance therapy.<sup>10</sup>

A significant lengthening of the mandible can be achieved when a functional appliance therapy is performed at pubertal or immediately postpubertal periods of skeletal development. Recent study reported that functional appliance therapy indicated at pubertal spurt followed by fixed appliance is very successful in treating patients with unfavorable Class II malocclusion. Besides that, this timing for growth modification was reported to produce a long-term lengthening of the mandible. Moreover, a greater increase in mandibular length and ramus was reported when treatment is indicated during pubertal peak when compared to treatment before puberty begins.<sup>11</sup>

The goal of functional appliance treatment is to stimulate or redirect the growth of the mandible in a favorable direction. The main differences in the effect of various functional appliances are associated with the technique of fabrication, bites construction and duration of wear. Of all the removable and fixed functional appliances, the Twin Block and Herbst appliance are the most effective in correcting Class II malocclusions. According to a research carried out in North India, Twin Block appliance was found to be more effective in increasing the extra mandibular length. Besides that, Twin Block appliance can also restrict the forward movement of maxillary molars, produce mesial movement of

the mandibular molar, retroclined the maxillary incisors and proclined the mandibular incisors.

Twin Block appliance has greater skeletal effect in molar correction and overjet reduction in comparison to Mandibular Protraction Appliance-IV (MPA-IV).<sup>10</sup> The Twin Block appliance has gained popularity in the United Kingdom. It consists of upper and lower separable acrylic blocks trimmed to an angle of 70 degrees. This less bulky appearance and freedom in movement of the mandibular increase the patient's acceptance compared to other functional appliance such as monoblock.<sup>12</sup>

The Z angle measures the position of the lower lips in relation to the upper lips. Further mandibular growth could add thickness to the total chin and change the relationship to upper lip. Increase in total chin thickness will increase the Z angle value.<sup>13</sup> The Twin Block is a functional appliance that positioned the mandible forward and this action creates a reciprocal force acted distally on the maxilla. This reciprocal force will cause retraction of the maxillary central incisors and changes the relation of the lower lips to the upper lips.<sup>10</sup> Khoja et al. reported that Z angle increased when compared between treatment and control group and the results are significant.<sup>21</sup> Similar results were reported in Turkey, whereby the Z angle showed significant difference before and after Twin Block treatment.<sup>14</sup> However, Janardhanan et al. reported non significant changes in Z angle.<sup>20</sup>

The H angle is closely related to the upper lip position.<sup>15</sup> According to a study in Turkey, profile changes can happen after an orthodontic treatment because of the retraction of upper incisors.<sup>16</sup> The Twin Block is usually designed with a labial bow in the upper arch of the appliance and this will create a maxillary dental retraction. This effect of treatment will decrease the prominence of the upper lip in relation to the overall soft

tissue profile.<sup>21</sup> According to the analysis proposed by Holdaway, the results of the current study showed that the samples had a decrease in soft tissue facial convexity. Although the values had decreased, however the post-treatment values did not fall within the ideal range as stated by Holdaway. Baysal and Uysal reported similar changes whereby the H angle was decreased after Twin Block therapy.<sup>17</sup> Khoja et al. also reported similar results and their changes are statistically significant.<sup>21</sup> In contrast, another study on the soft tissue changes after twin block treatment by Janardhanan et al. showed that the changes in H angle was not significant.<sup>20</sup>

The soft-tissue facial angle measures the position of the lower jaw in relation to the upper jaw. Holdaway ideally preferred this angle to range between 90 to 92 degree. Value lesser than 91 degree shows retrusive mandible. However, Holdaway recognized a wide range of acceptable value, as high as  $\pm$  seven degrees for some cases.<sup>16</sup> However, the Twin block is an appliance that increases the length of the mandible, at the same time also increases the lower anterior face height. Every increase of one-millimeter of the anterior facial height will hide one-millimeter increase of the mandible length and causes the chin point to rotate downward and backward.<sup>18</sup> This explains why the increment of the soft tissue angle is so small and is not significant statistically.

Hard tissue profile tends to become straighter with age however the soft tissue profile shows fewer tendencies to straighten with age. This is due to the differences in growth of soft tissue thickness covering the underlying hard tissue. Findings have shown that there is a greater increase in the thickness of soft tissue covering the maxilla than in the mandibular symphysis. Even though the soft tissue profile follows closely to the skeletal chin growth, however this extra soft tissue thickness growth around the maxilla has compensate the differences.<sup>19</sup> The forward growth of the mandible had increased the soft tissue profile angle. However, at the same time the extra growth of soft tissue covering the maxilla has compensated the mandible growth. Therefore, the difference that occurred is very little and is not significant in statistical point of view. In contrast, Baysal and Uysal reported similar changes, where the soft tissue convexity measurements increased

after Twin Block treatment but their results are significant.<sup>17</sup> Similar results were reported by Chaudhary et al. whereby the soft tissue profile angle increased significantly after treatment.<sup>22</sup>

One of the benefits of this research is to guide the thinking and practice of orthodontists and to aid in explaining the outcome of the treatment to the patient. Besides, the results from this research may also contribute information on the changes of soft tissue facial profile using Twin Block appliance and as a base data for future research in orthodontics. However, there are also limitations in this research. Khoja et al mentioned about the importance of having control group in order to assess the influence of normal growth that would have occurred without using functional appliances<sup>21</sup>, which was not applied in this research due to the lack of data in the Faculty of Dentistry Universitas Padjadjaran.

## CONCLUSION

There was a decrease of H-angle, indicates a reduction in facial convexity and improvement of the facial profile after twin block treatment, but no difference in soft tissue profile angle and Holdaway's soft tissue angle after twin block treatment.

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