

Evaluation of orthodontic results of Angle Class I malocclusion with first premolar extraction

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Summary

Objective: To evaluate the change of hard tissue and soft tissue after treatment of dental and skeletal bimaxillary protrusion in Angle Class I malocclusion patient by extraction of 4 premolars. **Subject and method:** The uncontrolled clinical trial of 45 patients with skeletal bimaxillary protrusion at Dental Department - 108 Military Central Hospital, from January of 2015 to May of 2018. **Result and conclusion:** Changes in hard tissue and soft tissue after treatment: Pre-treatment PAR index of malocclusion was 17.2 points, uneven anterior teeth has the highest index of 11.5; then uneven posterior teeth was 3.5. After treatment: Uneven anterior teeth, uneven posterior teeth, posterior teeth bite and overjet change were statistically significantly reduced ($p < 0.001$), 88.2% of patients with PAR index decreased ($> 70\%$); no patients with PAR changes $< 40\%$. The protrusion of patient's profile improved significantly after treatment. Angle of convexity changed $-2.7 \pm 1.46^\circ$ with $p < 0.001$ so that the surface reduced convexity. Reduce the protrusion of the upper and lower lip compared to the horizontal plane, respectively, those was $2.6 \pm 2.41\text{mm}$ and $3.2 \pm 2.81\text{mm}$ ($p < 0.001$). The protrusion of the upper and lower lips compared to the esthetic line E after treatment was $0.8 \pm 1.29\text{mm}$ and $3.0 \pm 1.83\text{mm}$, respectively, $2.3 \pm 1.26\text{mm}$ and 3.2 ± 1.72 with $p < 0.001$. The protrusion of upper lip and lower lip compared with SnPog' plane after treatment was $7.4 \pm 1.64\text{mm}$ and $7.0 \pm 2.11\text{mm}$ respectively, decreased 2.0 ± 1.38 and $3.0 \pm 1.89\text{mm}$ respectively. VAS score was 7.0 ± 1.05 points.

Keywords: Angle Class I malocclusion, dental and skeletal bimaxillary protrusion.

1. Background

In Vietnam as well as in the world, malocclusion Class I is the most common bite [1], [2]. Patients come to the orthodontic examination with malocclusion, dental and skeletal protrusion. In National Hospital of Odonto-stomatology from 2010 to 2014 the rate of Angle Class I malocclusion was 69.2%, the highest rate (21.33%) was dental and skeletal bimaxillary protrusion. Angle Class I malocclusion with bimaxillary protrusion is characterized by severe buccal tipping of incisors,

which causes upper and lower lip protrusion. It affects esthetic and psychology of the patient. In the orthodontic clinic, first premolars extraction is recommended to reduce facial convexity as a result of anterior teeth retraction, which keeps canines and first molars in key to occlusion. This is a very difficult problem because it depends on the prognosis of the doctor and the space closure phase needs to be carried, out with overbite and incisors torque control. So, we made this study with purpose: *Evaluation of changes in hard tissue and soft tissue after orthodontic treatment of dental and skeletal bimaxillary protrusion in Angle Class I malocclusion with first premolars extraction.*

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2. Subject and method

2.1. Subject

Patients were examined and treated at Dental Department - 108 Military Central Hospital with the selection criteria:

Patient is Vietnamese, Kinh people.

Facial type: Convex $Gla-Sn-Pog' < 180^\circ$, the distance from the upper lip to $SnPog' \geq 6mm$, the distance from the lower lip to $SnPog' \leq 5mm$.

Permanent teeth, Angle Class I malocclusion.

Angle of incisors $< 121^\circ$.

First premolars extraction is recommended.

Patients agree to participate in the study.

Exclusion criteria:

Deformity of the face, permanent teeth missing for any reason (not to mention the third molar).

Patients with orthognathic surgery.

Patients haven't the selection criteria.

2.2. Method

Research design: This is a non-controlled clinical intervention study with patients whom were diagnosed dental and skeletal bimaxillary protrusion in Angle Class I malocclusion and indicated four premolars extraction.

Time and place of study from January 2015 to May 2018, at Dental Department - 108 Military Central Hospital.

2.3. Steps to proceed

Diagnosis and treatment planning.

Treatment steps:

Pre-orthodontic treatment.

Pathologies of hard tissue and periodontitis will be treated before orthodontic therapy.

First premolars was extracted on the dental chair with local anesthesia.

Set chun split interdental.

Orthodontic treatment:

We use self-ligating braces and 3M (USA) wires with Slot 822 for easy to correct, control tooth axis and close remaining extraction spaces.

Stages:

Aligning teeth stage: The teeth are aligned on both arches and flattened the curve of Spee. Niti 012 wire $\rightarrow$ Niti 014 $\rightarrow$ Niti 016 $\rightarrow$ Niti 016*022 $\rightarrow$ Niti 017*25 $\rightarrow$ Niti 019*25 $\rightarrow$ SS 19*25. Patient is checked and replace new wire every 4 - 6 weeks (only change wire when the wire is passively located in the brace.)

Closed stage: Close remaining extraction spaces. Retracting back incisors (2 methods).

First, pull the canines, then 4 anterior teeth.

Pull the front teeth to the back.

Finishing stage: Detail correct to have a perfect bite. According to the American Orthodontic Association, the goal of occlusal management is:

The alignment of teeth.

The leading edge of the both arches teeth are aligned.

The buccal and lingual slopes of the teeth must be closed.

The occlusal contact must achieve the posterior zone cage bite.

The correlation of occlusion in the antero-posterior direction of the molars, premolars, canines by classification of Angle.

Overjet.

Side contact.

Tooth roots are parallel to each other and far away.

When the teeth moved to right position, they are fixed by lingual wire 0.008mm or 0.010mm in 3 - 6 months.

Last stage: The patient wears the fixed plastic retainer in the next 1 year.

In the first 3 months, the patient wears continuously 24/7, except when eating or oral hygiene. 6 months later, only the night; the next 3 months, two days one night.

2.4. Model analysis, PAR (Peer Rate Assessment) evaluation

PAR classification.

$PAR \leq 10$: Normal occlusion.

$10 < PAR \leq 20$: Low malocclusion.

$20 < PAR \leq 30$: Average malocclusion.

PAR > 30: High malocclusion.

2.5. Evaluation of treatment results

Evaluate PAR results:

Degree of change: = PAR before treatment - PAR after treatment

Percent of improvement: To reflects the change after treatment versus before treatment. Good result is > 70%, bad result is < 40%, 40 - 70% is average result.

% improvement = (PAR before treatment - PAR after treatment) / PAR before treatment × 100%

Hard and soft tissue changes:

The change in bone and soft tissue is the change in the value of the lateral cephalogram indexes before and after treatment. Then, compare two means with Pair - T-test.

Facial aesthetics evaluation: Facial aesthetics are evaluated based on VAS with a score of 0 - 10.

Evaluation based on 2 criteria.

1. After treatment: Patient's face is more beautiful or worse.

2. The degree of change of the lateral cephalogram after treatment.

0 - 1 points: No change.

1.1 - 3 points: Little change.

3.1 - 6 points: Average change.

6.1 - 10 points: Many changes.

3. Result

3.1. Patient age

The smallest age in the study group was 12 years old and the oldest was 45 years old, the average age of patients (starting treatment) in the study group was 21 years old with the distribution:

Table 1. Age

Age	n	Percent %
< 18 years	16	35.5
> 18 years	29	64.5
Total	45	100

Patients > 18 years were 64.5% higher than patients < 18 years.

3.2. Treatment duration

The average treatment duration was 27.2 ± 8.29 months, the longest was 48 months and the shortest was 12 months.

3.3. Correlation of some factors with treatment duration as a dependent variable

Table 2. Independent variables (n = 45)

Independent variables	Correlation coefficient (r)	p
Starting treatment age	-0.072	0.520
PAR before treatment	-0.061	0.45
PAR Changes	-0.048	0.612
PAR after treatment	-0.52	0.641
Overbite T ₁	0.013	0.721
Overjet T ₁	-0.080	0.504
Middle line T ₁	-0.251	0.100
Posterior teeth bite T ₁	-0.171	0.201
Unven anterior teeth T ₁	-0.015	0.810

Unven posterior teeth T_1	-0.054	0.620
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Significant with $p < 0.05$, T_1 before treatment.

Comment: No correlation with statistical significance between the treatment time with predictive factors, such as age, level of malocclusion.

3.4. Deviation of teeth and bite

Table 3. PAR Index (T_1 before treatment, $n = 45$)

Variables (point)	$\bar{X}$	SD	Max	Min
Uneven anterior teeth	11.5	4.02	1.0	19.8
Uneven posterior teeth	3.5	3.24	0.0	12.0
Posterior teeth bite	1.2	1.66	0.0	8.0
Overjet	1.2	1.02	0.0	6.0
Overbite	0.4	0.80	0.0	3.0
Middle line	0.2	0.42	0.0	0.8
Total (PAR)	17.2	7.66	4.8	36.0

Comment: The first was uneven anterior teeth with the highest points (11.5) and high vibration amplitude (from 1 to 19.8 points), the second was uneven posterior teeth with 3.5 points. The middle line had the least points (0.2) and had the lowest vibration amplitude (0 - 0.8 points). Pre-treatment PAR (T_1) was 17.2 points, the amplitude (4.8 - 36 points).

3.5. Changes in PAR (W) after treatment

Table 4. Changes in PAR (W) after treatment ($n = 45$)

Variables	Before treatment (T_1)	After treatment (T_2)	Changes ($T_1 - T_2$)	p
	$\bar{X} \pm SD$	$\bar{X} \pm SD$	$\bar{X} \pm SD$	
Uneven anterior teeth	11.5 $\pm$ 4.02	0.3 $\pm$ 0.61	11.02 $\pm$ 4.01	0.000
Uneven posterior teeth	3.5 $\pm$ 3.24	0.7 $\pm$ 0.64	2.8 $\pm$ 3.33	0.000
Posterior teeth bite	1.2 $\pm$ 1.66	0.3 $\pm$ 0.47	0.9 $\pm$ 2.03	0.005
Overjet	1.2 $\pm$ 1.02	0.4 $\pm$ 0.86	0.8 $\pm$ 6.5	0.000
Overbite	0.4 $\pm$ 0.80	0.2 $\pm$ 1.02	0.2 $\pm$ 1.21	0.048
Middle line	0.2 $\pm$ 0.42	0.2 $\pm$ 1.36	0.2 $\pm$ 2.07	0.133

Comment: The changes of uneven anterior teeth, uneven posterior teeth, posterior teeth bite, overjet were statistically significant reduced ($p < 0.001$). Overbite changed little (0.2 $\pm$ 1.21) but it was statistically significant ($p < 0.05$). Middle line was also little changed (0.1 $\pm$ 2.07). There was no statistically significant difference between before and after treatment of middle line ($p > 0.05$).

3.6. Soft tissue-indexes after treatment

Table 5. Soft tissue-indexes after treatment ($n = 45$)

Variables	$\bar{X} \pm SD$	Max	Max	Normal limits ($\bar{X} \pm SD$)	p
ULth (mm)	13.6 $\pm$ 2.25	9.0	18.0	15.0 $\pm$ 1.5	0.326

LLth (mm)	16.6 ± 2.07	10	2.0	16.3 ± 1.2	0.41
Ls-y (mm)	84.2 ± 5.12	74.2	9.8		
Li-y (mm)	82.4 ± 6.5	70	94		

Table 5. Soft tissue- indexes after treatment (n = 45) (Next)

Variables	$\bar{X} \pm SD$	Max	Max	Normal limits ($\bar{X} \pm SD$)	p
Pog'-y (mm)	70.4 ± 7.4	56	87.0		
Nasolabial angle (°)	96.2 ± 9.37	68.0	110.0	95.0 ± 3	0.425
Z (°)	64.4 ± 5.82	6.0	80.0	71.9 ± 6.6	0.000
LsE (mm)	0.8 ± 1.29	-1.0	4.8	0.2 ± 1.7	0.001
LiE (mm)	3.0 ± 1.83	0.0	6.8	1.09 ± 1.59	0.000
Ls Sn Pog' (mm)	7.4 ± 1.62	5.0	10.0	4.68 ± 1.06	0.000
Li Sn Pog' (mm)	7.0 ± 2.11	3.0	12.0	5.05 ± 1.77	0.000
Gla - Sn - Pog'	169.2 ± 4.25	160.0	179.0	166.7 ± 3.68	0.025

Comment: Upper and lower lip thickness was in normal limits ($p > 0.05$). After treatment, nasolabial angle was in normal limits, which indicated that the patient's protrusion was reduced, but no statistically significant ($p > 0.05$). The protrusion of the upper and lower lip compare to the E line and Sn Pog' line were both larger than the mean, so the lip was still little protrusive ($p > 0.05$). The angle of convexity (Gla - Sn - Pog') was significantly higher than that index of Asian. However, it was less than European. So that, the convexity of the surface was statistically significant reduced ($p < 0.05$).

3.7. Changes soft tissue- indexes after treatment

Table 6. Changes soft tissue- indexes after treatment (n = 45)

	Before treatment (T ₁)	After treatment (T ₂)	Changes (T ₁ - T ₂)	p
ULth (mm)	$\bar{X} \pm SD$	$\bar{X} \pm SD$	$\bar{X} \pm SD$	0.321
	13.2 ± 1.73	13.6 ± 2.25	-0.3 ± 1.8	0.604
LLth (mm)	16.4 ± 1.72	16.6 ± 2.07	-0.1 ± 1.7	0.000
Ls-y (mm)	86.9 ± 5.04	84.2 ± 5.12	2.6 ± 2.41	0.000
Li-y (mm)	85.2 ± 6.08	82.4 ± 6.5	3.2 ± 2.81	0.125
Pog'-y (mm)	71.1 ± 7.09	70.4 ± 7.5	0.6 ± 2.06	0.000
Nasolabial angle (°)	86.0 ± 8.04	96.2 ± 9.37	-8.3 ± 7.05	0.000
Z (°)	56.9 ± 6.05	64.4 ± 5.82	-7.2 ± 5.09	0.000
LsE (mm)	3.3 ± 1.59	0.8 ± 1.29	2.3 ± 1.26	0.000
LiE (mm)	6.5 ± 2.03	3.0 ± 1.83	3.2 ± 1.72	0.000
Ls Sn Pog' (mm)	9.5 ± 1.41	7.4 ± 1.62	2.0 ± 1.38	0.000
Li Sn Pog' (mm)	10.0 ± 2.09	7.0 ± 2.11	3.0 ± 1.89	0.000
Gla - Sn - Pog'	166.0 ± 4.08	169.2 ± 4.25	-2.7 ± 1.46	0.000

3.8. Aesthetic results

The mean VAS score (T_1) was 7.0 ± 1.05 , the lowest score was 4.0 and the highest score was 9.3. All patients were evaluated that the aesthetics improved in the positive way.

3.9. Common treatment results

Table 7. Results (n = 45)

	PAR changes	Aesthetics	Percent %
Good	> 70%	Beautiful	88.2
Average	< 70%	Beautiful	11.8
Bad	< 70%	No change	0

Comment: Good results was 88.2%. Average results was 11.8%. No bad results.

4. Discussion

4.1. Age

The youngest age in the study group was 12, the oldest age was 45, the average age of patients starting treatment in the research was 21 years old. The 18-group was 35.5% and the 18+group was 64.51%, this age needs made beauty. This age is also the age in the study of many authors [7], [8]. To eliminate the growth factors that affect the outcome of treatment, we selected patients who have been growth, so the youngest age was 12. However, to correct the errors that may be encountered due to the growth increase, we evaluated the movement of lips compared to Sn Pog, this index does not depend on the growth, especially nose [6].

4.2. Treatment duration

The average treatment duration was 27.2 ± 8.29 months. The longest time was 48 months and the shortest was 12 months. Our results were longer than Alrnett [7] 31.7 ± 8.0 . Many authors believed that the treatment time depends on the degree of finishing of the occlusion, such as the final position of the tooth is a factor influencing the treatment time, especially tipping of incisors based on the lips - palate/tongue point. Our results in Table 3 as well as 2 authors about age, treatment time. The duration of treatment was influenced by malocclusion factors, the cooperation of the patient, the individual's biological response to the force, the

level of chewing or oral hygiene. There was no correlation between treatment duration and patient age. In our study, there was no correlation between the age of the patients who started treatment and the duration of treatment or the degree of malocclusion (Table 2). Therefore, it is difficult to predict the duration of treatment based on known factors such as degree of deviation, type of deviation or age of the patient. The fact that some elderly patients felt satisfied with the results of treatment, did not want to extend the time, so they need to end the treatment earlier than expected, but young patients have not pressure about time. Another factor affecting the speed of movement was that adults plan to move their teeth slowly but they are conscious of cooperating with the doctor in the process of treatment, good oral hygiene, braces sprung less, so it did not take treatment time. This may also be an important factor that affects the duration of treatment and falsifies the correlation between treatment duration and starting treatment age.

After removing the braces, we have a strong commitment to patients who wear wears the fixed plastic retainer in the next 1 year. In the first 3 months, the patient wears continuously 24/7, except when eating or oral hygiene. 6 months later, only the night; the next 3 months, two days one night to maintain the results. If the patient fails to comply, it may recur, patients must take responsibility and we have excluded these patients from the study: The

time to evaluate the far results, we would like to do in the next study.

4.3. Characteristics of malocclusion

In this study, for the PAR index (no include the coefficient of difficulty), including uneven anterior teeth and uneven posterior teeth had the highest points, then in turn posterior teeth bite, Overjet, Overbite (Table 3). The lowest was middle line. The distribution of the PAR components proved regular teeth wasn't the necessary and sufficient condition for harmonious soft tissue and aesthetics. Therefore, the diagnosis and treatment planning should be based on soft tissue rather than malocclusion. Although the PAR index is the sum of the component indices; in our study, uneven anterior teeth, uneven posterior teeth, posterior teeth bite, overjet were mainly, so they were the most common characteristic in patients with Angle Class I malocclusion, dental and skeletal bimaxillary protrusion. Overbite not statistically significant in the diversity of the initial PAR index, so this was also a favorable factor for treatment.

4.4. Relationship between soft tissue and hard tissue transduction after treatment

Changing angle of convexity ($-2.7^{\circ} \pm 1.46^{\circ}$ with $p < 0.001$), it mean that facial angle reduced convexity.

Changes in the upper and lower lips: The Frankfort plane was once considered a horizontal reference plane in lateral cephalogram analysis. But according to a study by Verma SK (2012) [8], this is a hard plane determined, because the under eye point and the highest point of the outer ear canal are two points that are difficult to determine accurately on the film. Thus our study uses the X horizontal reference plane as the plane created by SN1 at angle 7° in Na, from there comparing the position of the lip and the incisors after treatment with the Y plane that is perpendicular to this plane at S point. In addition, the X, Y plane like this plane will reduce the error in analysis.

Compared with the E line: Before treatment, the upper lip and lower lip protrudes before the normal index. After treatment, the lips' protrusion was

significantly reduced by $0.2 \pm 1.7\text{mm}$ and $1.09 \pm 1.59\text{mm}$. This result was similar to Arnett [7], Young TM et al, 0.4mm and 1.10mm [6]. The mean value after treatment was greater than the normal value.

Compared with Sn Pog' line: Before treatment the upper lip and lower lip protrudes before compared to normal 5.02mm and 7.15mm. After treatment, the lips' protrusion was significantly reduced by 7.4 ± 1.62 and 7.0 ± 2.11 and the mean value after treatment is 169.0 ± 4.25 , in the normal limit value. If evaluating the position of the skull with the E aesthetic plane after treatment is still slightly protrusion when compared to the average of patients with beautiful Asian faces but if based on the correlation with the Sn Pog' plane, the two lips are within normal limits, the lip position is harmonious with the face of the Vietnamese, the plane is the plane provides a reliable value when evaluating protrusion of the lips. This plane is also meant to be unaffected by the growth of the nose.

Holdaway RA (1983) [5] has over the years analyzed and observed clinically that hard tissue analysis in lateral cephalogram film is not sufficient to plan treatment but should be based on soft tissue analysis. According to the author when moving, point A will also be moved, but not soft tissue will also shift to the same degree that it depends on the taper of the lips. If the taper are average, the rate of displacement of the lips and teeth is 1 : 1, if the lips are tended to be due to teeth, the thickness of the lips will increase immediately after the upper incisors move back.

4.5. Facial aesthetics

Facial aesthetics is the result of a complete picture of the components of the incisors, the protrusion of the lips, the exposing of the incisors against the upper lip, the harmony of the chin-lips. VAS scores (7.0 ± 1.05) gives a very good aesthetic result. As the Vietnamese patients in addition to the protrusion, the degree of deviation a lot, so patients with more deviation is often less level of change of the inclination of the face compared to patients with relatively regular teeth. That is also the reason to

explain our VAS scores lower than the results of research Lim HJ [4] and Bowman SJ [3].

The PAR index before treatment or the degree of deviation of the group improved much lower than the PAR index of the less improvement group. It is also important that the PAR index after treatment of the group has a much improved incline surface more than that of the less improvement group. Therefore, if you rely solely on the bite, sample to plan treatment and rely on it to evaluate the result is a serious shortcoming. Thus, the four premolars to pull back the upper and lower incisors are very effective treatment of teeth and bimaxillary protrusion. In our study we achieved a good 88.2%, on average only 11.8%, with no bad results. Not only improve the occlusion but also decrease the convex of the face so improved aesthetics.

Except for the upper lip, the lower lip thickness and the cheek muscles changed but not statistically significant; the soft tissue dependency ratios were greatly altered ($p < 0.001$).

The lower lip (Li - y) moved back more than the horizontal plane X 3.2 ± 2.81 (mm) resulting in an increase in the angle $7.2 \pm 5.09^\circ$ makes the patient's profile after treatment $8.3 \pm 7.05^\circ$. therefore, it has reduced the protrusion of teeth an alveolar bone.

The upper lip is moved behind the horizontal plane of 2.6 ± 2.41 .

5. Conclusion

Through studying 45 patients who meet the selection criteria from January 2015 to May 2018 at

the Dental Department of 108 Military Central Hospital, there are Angle Class I malocclusion with four premolars extraction, had the following results:

About changes in hard tissue and soft tissue after treatment

Before treatment: PAR index was 17.2; uneven anterior teeth has the highest index of 11.5; then uneven posterior teeth was 3.5.

After treatment: Uneven anterior teeth, uneven posterior teeth, posterior teeth bite and overjet change were statistically significantly reduced ($p < 0.001$). 88.2% of patients with PAR index decreased ($> 70\%$); no patients with PAR changes $< 40\%$.

The protrusion of patient's profile improved significantly after treatment.

Angle of convexity changed $-2.7 \pm 1.46^\circ$ with $p < 0.001$ so that the surface reduced convexity.

Reduce the protrusion of the upper and lower lip compared to the horizontal plane, respectively, those was 2.6 ± 2.41 mm and 3.2 ± 2.81 mm ($p < 0.001$).

The protrusion of the upper and lower lips compared to the esthetic line E after treatment was 0.8 ± 1.29 mm and 3.0 ± 1.83 mm, respectively, 2.3 ± 1.26 mm and 3.2 ± 1.72 with $p < 0.001$.

The protrusion of upper lip and lower lip compared with SnPog' plane after treatment was 7.4 ± 1.64 mm and 7.0 ± 2.11 mm respectively, decreased 2.0 ± 1.38 and 3.0 ± 1.89 mm respectively.

VAS score was 7.0 ± 1.05 points.



Figure 1. Initial intraoral photographs



Figure 2. Final intraoral photographs



Figure 3. Initial and final lateral cephalograms

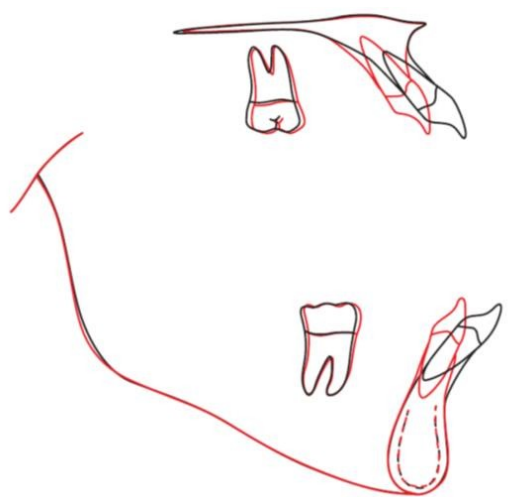


Figure 4. Initial (black) and final (red) cephalometric tracing

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