# Soft Tissue Adaptation in the Treatment of Class II Division 1 Malocclusion with Four Premolar Extractions

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**ABSTRACT**

***Objectives:*** This study aimed to evaluate soft tissue adaptation in Class II Division 1 malocclusion patients treated with four premolar extractions and fixed appliances, focusing on the correlation between anterior teeth retraction and soft tissue changes. ***Materials and Methods:*** Thirty-one patients (19 with micro-implant anchorage, 12 with conventional anchorage) were treated at Hanoi Central Odonto-Stomatology Hospital. Lateral cephalograms, taken pre- and post-treatment, assessed changes in soft tissue landmarks relative to Rickett's E-line and the Sn-Pog' line. Statistical analyses included paired t-tests and Mann-Whitney U tests. ***Results:*** Pre-treatment measurements showed no significant differences in Pn-Sn-Ls and Ls-SnPog', indicating comparable initial soft tissue profiles. However, lip protrusion relative to Rickett's E-line was significantly higher in the MI group, with upper lip (Ls-E) measurements of 3.4 ± 2.0 mm compared to 2.1 ± 2.5 mm in the conventional group ($p = 0.008$) and lower lip (Li-E) measurements of 6.3 ± 2.5 mm versus 4.2 ± 2.4 mm ($p < 0.001$). Post-treatment adaptations revealed that the MI group experienced a greater reduction in lower lip protrusion relative to the E-line (-2.9 ± 1.7 mm) compared to the conventional group (-1.2 ± 2.6 mm, $p = 0.034$). Other variables, including Ls-SnPog' and Li-SnPog', showed no significant differences between the groups. ***Conclusions:*** Orthodontic treatment with premolar extraction significantly improved facial aesthetics by reducing lip protrusion. Micro-implant anchorage demonstrated superior control over soft tissue adaptation compared to conventional anchorage, underscoring its efficacy in enhancing treatment outcomes.

***Keywords:*** *Soft tissue, Class II Division 1, premolar extraction, cephalometrics, micro-implant anchorage*

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## INTRODUCTION

Class II Division 1 malocclusion1 is a common orthodontic condition characterized by a retrusive mandible, proclined maxillary incisors, and an increased overjet. This malocclusion not only affects dental alignment and occlusion but also significantly impacts facial aesthetics and soft tissue profile. The management of Class II Division 1 malocclusion often requires a comprehensive treatment approach that balances dental correction with the enhancement of facial harmony. One widely accepted method for addressing this malocclusion involves the extraction of four premolars to create space for the retraction of anterior teeth and the alignment of dental arches2. This strategy aims to correct the protrusion of the maxillary incisors, improve overjet, and achieve a more

balanced occlusal relationship. However, while the skeletal and dental corrections are well-documented, the adaptation of soft tissues in response to these changes warrants further exploration. Soft tissue adaptation plays a crucial role in the overall treatment outcome, influencing facial profile, lip posture, and aesthetic perception. Understanding the relationship between hard tissue movement and soft tissue response is essential for predicting treatment results and enhancing patient satisfaction. This manuscript aims to investigate the patterns of soft tissue adaptation following the extraction of four premolars in the treatment of Class II Division 1 malocclusion. By analyzing these changes, we seek to provide insights into optimizing treatment plans that not only achieve functional occlusion but also improve facial aesthetics. Through a comprehensive review of clinical outcomes and soft tissue responses, this study will contribute to the existing body of knowledge, guiding clinicians in achieving balanced and aesthetically pleasing results in patients undergoing orthodontic treatment for Class II Division 1 malocclusion with premolar extractions.

## MATERIALS AND METHODS

### Study design and subjects

The study was a descriptive follow-up study. The subjects were patients diagnosed with Angle Class II division 1 malocclusion, all of whom were treated with fixed edgewise mechanics and four premolars extraction at the School of Dentistry and Hanoi Central Odonto-Stomatology Hospital from November 2020 to June 2021. They were divided into 2 groups of different types of anchorage depending on crowding severity and the extent of retraction of maxillary anterior teeth. Group 1 (n = 19) received maximum anchorage with micro- implant, group 2 (n = 12) received conventional anchorage preparation with a transpalatal arch, Nance appliance or the second molars bands.

*Inclusion criteria*

- Patients have Vietnamese parents.
- Permanent dentition, pre-treatment Class II division 1 malocclusion according to Angle's classification:

+ Class II molar and canine relationship.

+ Pre-treatment overjet of more than 3 mm.

+ Fixed edgewise mechanics with four premolars extraction was indicated

+ Their records contained pre-treatment (T1) and post-treatment (T2) cephalograms.

+ The informed consent of the patient was obtained.

*Exclusion criteria*

- Congenital malformations.
- Tooth agenesis, tooth loss caused by any reason (except the third molar).
- Dentofacial trauma.
- Orthognathic surgery was indicated
- Those lacked any of the inclusion criteria.

### Procedures

The cephalograms were taken by Orthoralix Cephalometric radiographs 9200 (Care Stream, USA) at the Hanoi Central Odonto- Stomatology Hospital and Orthophos XG5 (Sirona, Germany) at the School of Dentistry.

Landmarks and reference lines on cephalometric radiographs were manually traced by hand on matte acetate tracing papers of Ormco company (USA). They are, then, measured by orthodontists using 0.5mm mechanical pencils. In particular, the angular and distant cephalometric variables were measured by cephalometric orthodontic protractor (Ormco, USA).

**Data analysis**

Statistical analysis with the paired-sample t-test or Wilcoxon signed rank test was performed to assess the changes between two points in time and Mann-Whitney U test to compare the medians between the MI and the conventional group The software used was SPSS 20.0 (IBM, USA).

## RESULTS

The orthodontic treatment group using micro-implants saw more lip protrusion regarding the E line than the traditional anchorage group ($p < 0.05$).

***Table 1***. *Soft tissue measurements on pre-treatment cephalogram in MI anchorage and conventional anchorage groups*

| Groups / Variable | Microimplant (n= 19) $\overline{X} \pm SD$ | Conventional anchorage (n= 12) | p |
|---|---|---|---|
| Pn-Sn-Ls ($^0$) | 93.6 ± 12.1 | 93.8 ± 11.3 | 0.959 |
| Ls- SnPog' (mm) | 9.1 ± 1.7 | 8.3 ± 2.0 | 0.206 |
| Li- SnPog' (mm) | 9.4 ± 3.0 | 8.3 ± 2.3 | 0.490 |
| Ls-E (mm) | 3.4 ± 2.0 | 2.1 ± 2.5 | 0.008 |
| Li-E (mm) | 6.3 ± 2.5 | 4.2 ± 2.4 | 0.000 |

A remarkable difference was only observed in the distance from the lower lip to the E line (Li-E). The MI anchorage experienced a larger decrease than the conventional one ($p < 0.05$).

***Table 2.*** *Soft tissue adaptation in MI anchorage and conventional anchorage groups*

| Group / Variable | MI anchorage n=19 $\overline{X} \pm SD$ | Conventional anchorage n=12 | p |
|---|---|---|---|
| Ps-Sn-Ls ($^0$) | 3.3 ± 7.6 | 1.0 ± 6.0 | 0.397 |
| Ls-SnPog' (mm) | -1.8 ± 1.8 | -1.2 ± 1.4 | 0.316 |
| Li-SnPog' (mm) | -2.7 ± 2.2 | -2.4 ± 2.2 | 0.663 |
| Ls-E (mm) | -1.9 ± 1.3 | -1.4 ± 1.8 | 0.363 |
| Li-E (mm) | -2.9 ± 1.7 | -1.2 ± 2.6 | 0.034 |

## DISCUSSIONS

The adaptation of soft tissue is of great significance in the treatment process because it directly affects facial aesthetics3,4. Any structural changes in the bone can alter the structure of the overlying tissue. However, soft tissue response varies with age, ethnicity, and severity of malocclusion5. Since Rickett's E line goes from the most prominent point of the nose to the most prominent point of the chin and the Vietnamese has lower nose bridge than the Caucasian does6, comparing the position of the lips with this plane may lead to incorrect conclusions. Thus, in this study, we used the reference line SnPog' associatively to assess the position of the lips. Facial attractiveness is not only influenced by either the distance from the upper and lower lip to the E line or the nose and chin, but also by the harmony of both the maxillary and mandibular in anteroposterior

dimension. Therefore, it is necessary to evaluate the position of the most prominent points of the upper and lower lips to the SnPog' line by the name of Ls-SnPog', Li-SnPog', which is introduced by Burston. This is also the diagnostic measurements for lips protrusion7. Besides, to reduce the errors that may be encountered due to the growth process of young patients, the SnPog' line is a more accurate reference line because it does not depend on growth, especially the nose8.

In our study, the micro-implant anchorage group experienced a more remarkable decrease in the lower lip protrusion in relation to the E line (Li-E) than the anchorage group by the conventional method ($p < 0.05$). The results of our research correspond with Upadhyay's perception that the utilization of micro-implants boosts the effectiveness of lip retraction9. Our results showed that the retraction of the upper and lower lips is closely related to the retrusion of both the upper and the lower incisors. These results are consistent with the conclusions of Hayashida and Ramos10,11. However, Yasutomi's study on Japanese found that only the upper lip had the strongest horizontal correlation with the change in the position of the upper incisors12. After the treatment, the nasolabial angle increased; it is more obtuse than the initial state, indicating the reduction in the labial inclination of the incisors. However, the increase in the nasolabial angle is not proportional to the treatment efficacy but because the study subjects are of different ethnic, the degree of protrusion diverges considerably; moreover, the degree of protrusion also varies among individuals of the same race. Therefore, the treatment goal for increasing the nasolabial angle is also different. The research demonstrates an increase in the nasolabial angle at a significant level, but it should be a cautious decision to apply clinically. For example, increasing the nasolabial angle by 100 would be desirable for patients with a pre-treatment nasolabial angle of 850 but it would be too much and affect the aesthetics of patients with the that of 900. Our research results coincide with the conclusions of Weyrich, Bishara, Kocadereli13-16 that the change in nasolabial angle occurs independently of orthodontic treatment with premolars extraction. Furthermore, the variation in study results may be explained by ethnic differences in soft tissue morphology. Suhatcha assessed the factors affecting soft tissue after orthodontic treatment in 104 Thai patients aged 8 - 16 years, showing that when teeth are brought forward, the lips are also stretched and pushed forward17. According to Zierhut, it is necessary to accurately evaluate the impact of lip tension on lip indices in all studies18. Mini implant anchorage support the treatment with better anchorage19. Lip tension varies among individuals and changes over time. In the lateral cephalometric radiography, the patient must relax the facial muscles completely, thereby eliminating the possibility of muscle hypertension. If the patient tries to close the lips while taking the cephalometric radiograph or has not really relaxed, causing increased muscle tension, which may lead to the error.

## CONCLUSIONS

The post-treatment protrusion of the upper and lower lips relative to the E line and the Sn- Pog' line decreased significantly, and the facial profile aesthetics was improved. After the treatment, the maximum anchorage group with MI experienced a larger decrease in the degree of protrusion of the upper and lower lips than the conventional anchorage group.

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