Original Article

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Quick Response Code:

Website: www.jorthodsci.org

DOI: 10.4103/jos.jos_174_21

Factors that affect lip changes following incisor retraction in Vietnamese adults with a convex facial profile

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Abstract:

OBJECTIVE: This study aimed to evaluate the factors that influence lip change through the results of tooth anterior retraction by fixed orthodontic treatment in Vietnamese adult patients with a convex facial profile.

MATERIALS AND METHODS: This prospective study included 32 Vietnamese adults who have convex facial profiles. Digital software measurements according to Arnett's analysis and the superimposition method were performed to evaluate the changes in dentoskeletal structures, and soft tissue variables included lip change. A multiple logistic regression model was applied with various explanatory variables to analyze the correlation.

RESULTS: The study revealed a strong correlation of lip change at the site of the cervical point and incisal edge of the upper incisors, and the cervical position demonstrated a stronger correlation. The ratio between lip change and incisor retraction in patients is approximately 1:2.3 at the incisal edge and 1:1.3 at the cervical point.

CONCLUSION: Lip change was associated with incisor retraction at the cervical and incisal edge, but it did not correlate with the rotation axis of the upper incisors.

Keywords:

Convex profile, incisor retraction, lip changes

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Submitted: 10-Sep-2021
Revised: 07-May-2022
Accepted: 23-May-2022
Published: 24-Aug-2022

Introduction

In the facial profile esthetic, three patterns of facial profiles are defined in orthodontics, namely, the straight profile, convex profile, and concave profile.[1] In some populations such as Asian, African, or Hispanic Americans, the convex profile is very common,[2-4] and these patients seek orthodontic treatment to improve their facial profiles, and they expect a straight profile. The orthodontists help patients improve their appearance by changing the position of lip support structures such as the teeth and alveolar bone, particularly retracting incisors, which will reduce the protrusion of the lips. However, many cases with lip protrusion are not reduced in response to incisor retraction. The question of whether there is a correlation between lip changes with the retraction of the incisors and the ratio between those is also an important issue among clinicians.

Numerous studies have evaluated the correlation between the retraction of the incisors and lip changes.[5-7] In addition, many studies have found a correlation between incisor retraction and lip changes and the predictability of lip changes.[8-10] However, other studies have concluded that the predictability of lip changes when retracting the incisors was very weak.[11,12]

How to cite this article: Le T, Tran P, Tran V. Factors that affect lip changes following incisor retraction in Vietnamese adults with a convex facial profile. J Orthodont Sci 2022;11:40.

Thus, the issue is still controversial because many factors can influence lip changes when retracting the incisors in patients with a convex profile.[5,13-15]

In the Vietnamese population, most people exhibited a convex profile during the actual treatment. The proportion of Angle class I malocclusion in the total number of patients visiting and receiving treatment at Hanoi Central Facial Dental Hospital from 2004 to 2008 is 69.2%, in which patients with overjet accounted for the highest rate, with 21.33%.[16] In this study, we aimed to assess the relationship between lip retraction with incisor retraction at the incisor tip and cervical point of the upper incisors and compare the difference in terms of correlation.

Materials and Methods

Sample selection

The study was approved by the Ethical Committee (XXX) on May 30, 2017. Consent forms and an outline of the proposed research were distributed to all identified participants using participant information sheets. Participants were selected from a pool of patients referred for orthodontic treatment at the Department of Orthodontics, HCMC Odonto Stomatology Hospital, Ho Chi Minh City, Vietnam, during the period from 2017 to 2019. The clinical criteria for sample selection were as follows: Patients with a convex profile and diagnosis of class I or class II malocclusion according to Angle's classification of malocclusion. The exclusion criteria were as follows: Any type of systemic disease and history of congenital deformities in a maxillofacial region, maxillofacial surgery, or orthodontic treatment.

A total of 32 volunteer patients, including 23 women and 9 men (aged 22.0 ± 3.6 years), who met the criteria above were recruited into the study. All patients were treated with straight-wire appliances. Eighteen patients had four premolar extractions, 2 were treated with three premolar extractions due to tooth loss, and 12 patients with two maxillary premolar extraction. Pretreatment cephalometric data of the patients and the index of harmonic face in Vietnamese[17] are presented in Table 1.

Table 1: Pretreatment cephalometric data (*n*=32)

Measurement	Mean	SD	Min	Max	Index of the harmonic face in Vietnamese[17]	
					Mean	SD
SNA (°)	82.84	3.08	76.5	89.8	83.2	4.2
SNB (°)	79.05	2.74	74.1	85.5	80.8	4.3
ANB (°)	3.83	1.93	−0.2	9	2.4	2.9
FMA (°)	29.48	4.72	19.4	40.6	27.0	5.7
Upper incisor to maxillary plane (°)	121.71	6.09	109	134	117.1	6.2
IMPA (°)	99.04	7.81	81.8	123.9	95.8	7.7
Interincisal angle (°)	108.64	7.68	95	126	120.1	10.7
Overbite (mm)	1.65	2.22	−3	5	2.0	1.8
Overjet (mm)	6.38	3.01	0.5	14.5	2.9	1.9

Cephalometric analysis

All digital lateral cephalometric radiographs of the selected patients were retrieved for the cephalometric analysis. These cephalometric radiographs were measured and analyzed using Dolphin software (Dolphin Imaging and Management Solutions, Los Angeles, CA, USA). In this study, the true vertical line (TVL) identified as a straight line perpendicular to the natural horizontal head position passing through the subnasale was established.[18] Important hard and soft tissue landmarks were placed on the cephalogram as described in Figure 1. The structures represented positive value (+) for the right TVL and negative value (−) for the left TVL. Fourteen cephalometric measurements according to Arnett's analysis[19] and other common cephalometric measurement variables were also recorded before and after treatment. Maxillary superimposition-based cephalometric measurements using the palatal plane registered at the anterior nasal spine as a landmark were performed to evaluate the change in incisor retraction at the incisal edge and cervical point.

Reliability

A method of quantifying measurement error was performed using the Dahlberg formula (22) for calculating the size of the measurement error. The Dahlberg error achieved over 0.8 was considered reliable in the evaluation of the measurement error. In this study, 10 cephalometric radiographs and 10 mounted models were measured twice by the same author (XXX) at 2 weeks apart. The Dahlberg error of cephalometric measurement (D = 0.93) and mounted models (D = 0.95) were detected. The results indicated that data collected from the cephalometric and mounted model measurements in this study are highly reliable.

Statistical analysis

Data were expressed as the mean and standard deviation (SD). The Wilcoxon signed-rank test was used to compare pretreatment and post-treatment data. The relationship between lip change and incisor retraction with multiple explanatory variables as the change of the inclination of incisors and characteristics of lip morphology were evaluated using multiple logistic regression analysis. Statistical analysis was performed by using R software (Nokia Bell Labs, Murray Hill, NJ, USA). A *P* value of less than 0.05 is defined as significant.

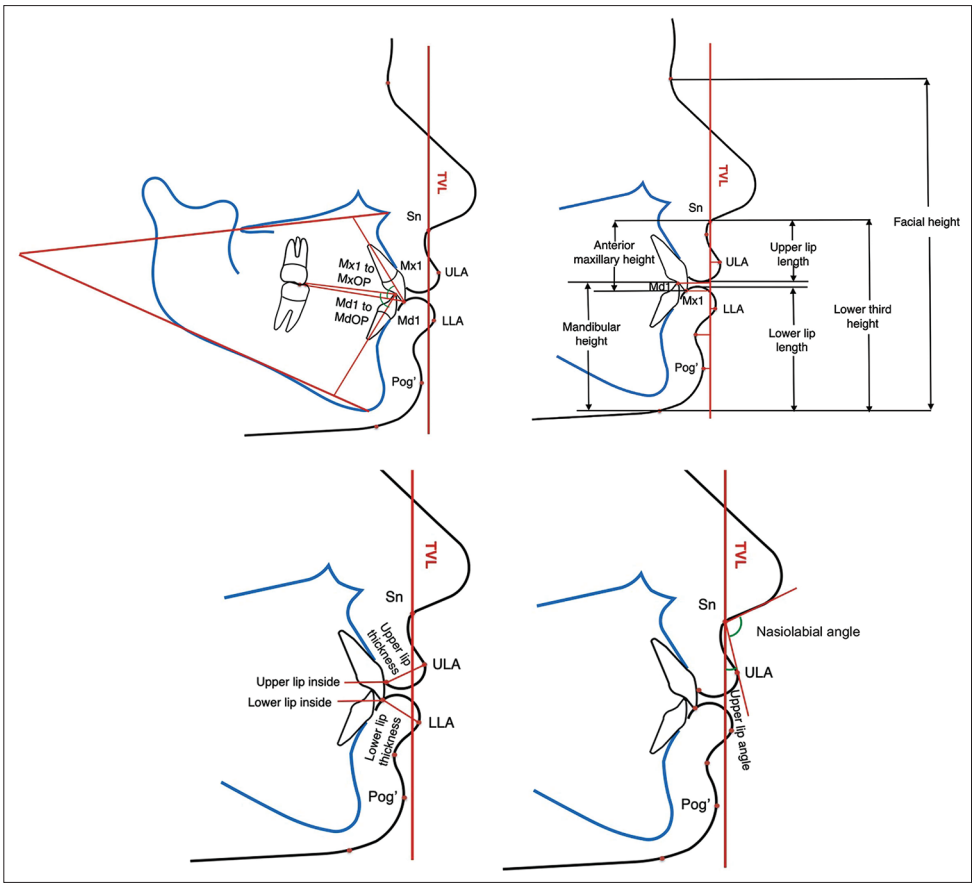

Figure 1: Hard tissue and soft tissue measurement on cephalometric analysis. Abbreviation: Mx1, maxillary incisor tip; Md1, mandibular incisor tip; MxOP, maxillary occlusal plane; MdOP, mandibular occlusal plane

Results

Changes in the incisal positions

The protrusion of the incisors decreased, whereas the upper incisors were 1.8 times more retracted than the lower incisors on average. Particularly, the maximum retraction of the upper and lower incisors was up to 7.5 mm and 6 mm, respectively. The change in the cervical point of the upper incisors was also measured using the superimposition-based cephalometric method. The mean and SD of retraction at the cervical point of the incisor were 2.58 and 0.66, respectively. A decrease in the angle of the upper incisors to the maxillary plane and incisor mandibular plane angle indicated an inner inclination uptrend. On average, the upper incisor inclination change was twice more than the lower incisor inclination change. The interincisal angle declined on average [Table 2].

Changes in lip morphology

Lip protrusion decreased significantly after treatment [Figure 2b]. A decrease in lip prominence was also expressed through other values of change, which included an increase in the nasolabial angle, a decrease in the upper lip angle [Figure 2a], lengthening of the upper lip, and a decrease of the interlabial gap [Figure 2c]. On the contrary, the upper and lower lip thickness increased, but no significant change was found in the lower lip thickness ($P = 0.095$, Figure 2d).

To evaluate the trend in lip changes after incisor retraction, we evaluated the thickness of the lip change, in which change <0.5 mm was considered an unchanged status. The pattern of lip thickness change was unpredictable [Figure 2e]. After orthodontic treatment, the upper lip thickness demonstrated an increasing trend (56.3% of cases observed), whereas the lower lip tended to maintain the thickness (50% of the cases). The lip thinning status was identified in 4/32 (12.5%) and 5/32 (15.6%) cases of the upper and lower lips, respectively. Interestingly, the absolute minimum and maximum thickness changes in lower lip thickness were both higher than those in the upper lip, despite the low average change in lower lip thickness [Table 2]. A negative correlation between upper lip thickness change and upper lip thickness [Figure 2f] and a positive correlation between upper lip thickness change and upper incisor retraction [Figure 2g] were also noted.

Table 2: Cephalometric data pretreatment and post-treatment

Variables	Pretreatment		Post-treatment		Change			
	Mean	SD	Mean	SD	Mean	SD	Min	Max
Measurements of the hard tissues								
Upper incisor protrusion (mm)	−1.03	3.05	−5.53	2.93	4.5	1.21	2	7.5
Lower incisor protrusion (mm)	−7.53	4.75	−10.07	3.6	2.53	1.83	−4	6
Upper incisor inclination (°)	48.93	4.78	57.29	4.8	8.35	5.51	−6.6	19.5
Lower incisor inclination (°)	57.92	5.79	62.08	6.56	4.16	6.3	−7.6	13.8
Upper incisor to maxillary plane (°)	121.71	6.09	111.17	6.79	10.54	7.52	−6	28.3
IMPA (°)	99.04	7.81	92.64	5.78	6.4	6.11	−4.3	22.2
Interincisal angle (°)	108.64	7.68	123.37	7.71	14.73	9	−2.5	36.8
Overbite (mm)	1.65	2.22	2.87	0.39	1.22	2.18	−2	6.1
Overjet (mm)	6.38	3.01	3.4	0.53	−2.98	2.83	−9.8	2.5
SNA (°)	82.84	3.08	80.72	3.09	−2.12	1.62	−6.4	0.4
SNB (°)	79.05	2.74	78.12	2.86	−0.93	1.59	−7.2	2.5
ANB (°)	3.83	1.93	2.59	1.78	−1.25	1.28	−3.9	0.9
Measurements of the soft tissues								
Nasolabial angle (°)	90.12	8.83	100.21	5.38	10.09	7.99	0.8	29.6
Upper lip angle (°)	28.41	5.05	21.91	6.97	−6.5	7.56	−18	9.8
Upper lip protrusion (mm)	8.78	1.55	6.81	1.61	1.97	0.76	0	3.5
Lower lip protrusion (mm)	3.04	3.77	1.13	3.77	1.91	0.87	0	3
Upper lip length (mm)	8.94	1.52	7	1.84	−1.94	2.09	−8.5	1.5
Interlabial gap (mm)	6.93	1.99	3.02	1.1	−3.91	2.4	−10	−0.2
Lower lip length (mm)	20.74	2.32	22.07	2.16	1.32	0.78	−0.1	2.7
Upper lip thickness (mm)	11.73	1.61	12.38	1.67	0.66	0.93	−1.3	2.1
Lower lip thickness (mm)	13.28	1.63	13.53	1.36	0.25	1.08	−3.2	2.4

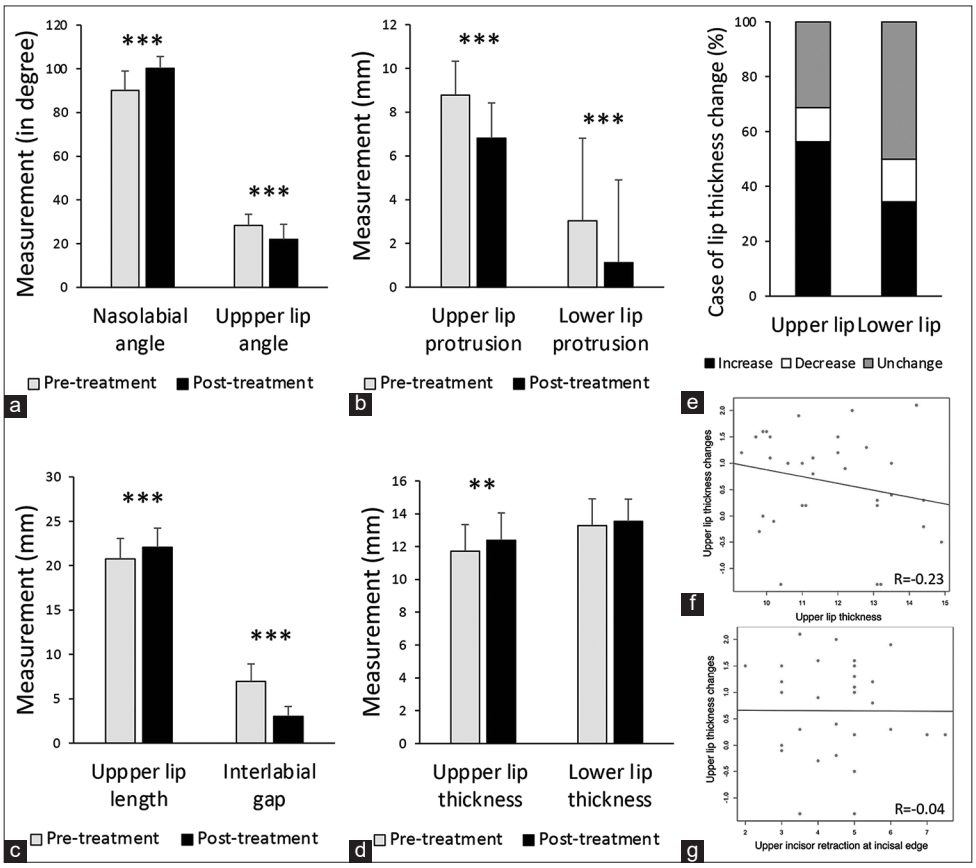

Figure 2: Changes in lip morphology. (a–g) Statistical analysis of the change of soft tissue variables before and after treatment. Data are presented as mean ± SD; **P* < 0.05, ***P* < 0.001, ****P* < 0.0001 indicates significant change after treatment

Relationship of lip changes and influential factors

The multiple logistic regression analysis demonstrated a positive correlation between upper lip retraction and incisor retraction [Figure 3]. Particularly, the correlation coefficient of 0.81, which presented a very strong correlation with upper lip retraction, was identified at the cervical point of the incisors, whereas the incisal edge presented a moderate correlation (R = 0.57). The remaining factors demonstrated a weak association with each other, except for the correlation between the incisal edge and cervical point (R = 0.72, Figure 3), and a correlation between lower lip retraction and lower incisor retraction [Figure 4]. The ratio of the upper lip retraction to the upper incisor retraction was 1:2.3 at the incisal edge and 1:1.3 at the cervical point. Furthermore, the ratio of the lower lip retraction to the lower incisor retraction at the incisal edge was 1:1.3, and the upper lip increased the length with a ratio of 1:1.5 compared with upper lip retraction [Table 2].

Discussion

Because the change in incisor position plays an influencing role in the prediction of lip change, many variables involving the incisors were evaluated in this study. The results of the cephalometric measurement indicated a decrease in incisor protrusion and interincisal angle. However, our results were different from the findings in the study conducted on Vietnamese patients, in which the upper and lower incisors retracted by 5.4 mm and 4.8 mm, respectively.[16] Meanwhile, some studies have reported 6.7 mm incisor retraction,[20] which might increase up to 7.79 mm.[9] The retraction of the mandibular incisors in the present study was also less than what was reported in previous studies.[16,21] On the contrary, the cervical position of the upper lip presents potential as a reference point in the incisors. The change at a cervical point was less than that at the incisal edge because the retracting movement of the incisors always combines with rotation. However, most studies have only investigated incisor retraction at the incisal edge.[16,20] In the present study, the retraction at the cervical point was 2.3 mm, which was not quite similar to previous studies on incisor retraction at the incisal edge and cervical point.[9,21,22] Nevertheless, incisor retraction relied on the treatment plan to ensure the re-establishment of functional occlusion and improvement of esthetics.

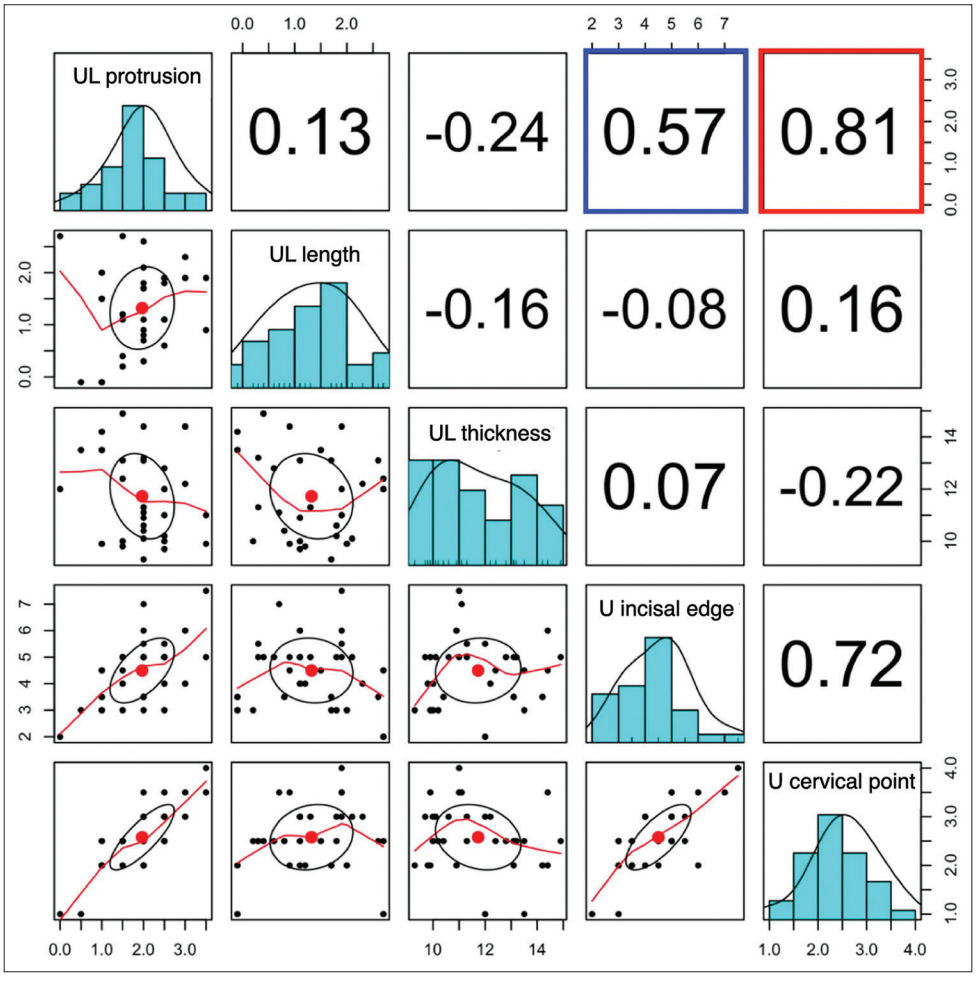

Figure 3: Multiple logistic regression analysis of the correlation between upper lip change and influential factors

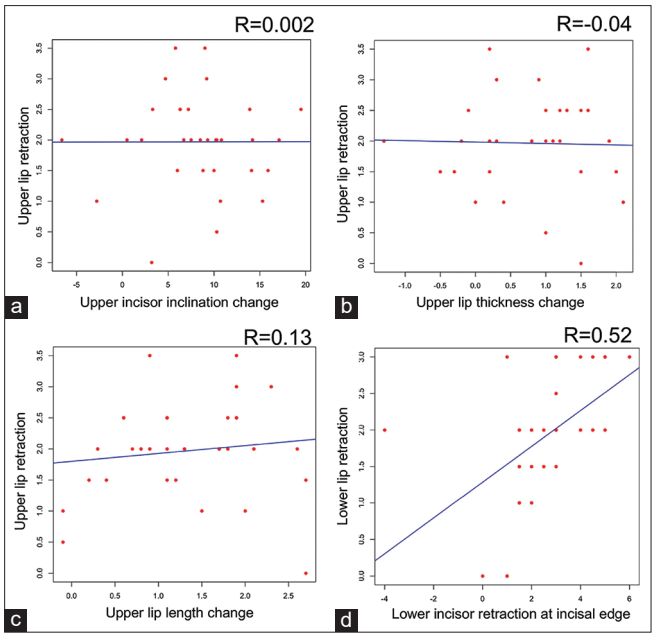

Figure 4: Correlation between lip retraction and incisor retraction after treatment. (a–c) A correlation between upper lip retraction and other factors. (d) A correlation between lower lip retraction and lower incisor retraction

Therefore, the difference in varying incisor retractions among studies was probably less significant.

The most important factor that affects the lip morphology in response to incisor retraction is lip protrusion, which has gained great interest of researchers and clinicians. The lip morphological changes in our study were different from those in other studies. A small change in upper lip retraction was observed in the present study when compared with those reported in most previous studies,[16,20,21] whereas Talass *et al*.[20] reported the maximum retraction of the upper lip with a change of 4.3 mm on average.[20] Among most studies, the lower lip usually retracted more than the upper lip. This might be due to the overjet relation. The overjet of patients in our study was quite severe, with an average of 6.75 mm and a maximum of 14.5 mm. Thus, this allowed the maxillary incisors to predominately retract more than the mandibular incisors in orthodontic treatment.

The ratio of the upper incisor retraction to the upper lip retraction varied among studies.[6,16,20,21] In the present study, the ratio of maxillary incisor retraction to upper lip retraction was 2.3:1, which was consistent with the ratio of 2.38:1 in a previous study[22]; however, this finding was different from that in a recent study.[16] Meanwhile, the correlation between lower incisor retraction and lower lip change was quite comparable among studies. In the present study, the ratio of lower incisor retraction compared with lower lip retraction was 1.3:1. This ratio was consistent with many studies on Asians, Americans, and other ethnicities.[6,21]

Many studies have also examined the change in lip thickness.[9,15,20] According to Lai *et al*.[15] the thickness of the upper lip increased, whereas it decreased in the lower lip as a response to the incisor retraction, and a participant had an increasing upper lip thickness up to 8.1 mm. On the contrary, Hayashida *et al*.[9] demonstrated a 0.52 mm decrease in the average upper lip thickness and a 2.02 mm increase in the average lower lip thickness. According to Talass *et al*.[20] the thickness of the lower lip remained almost unchanged; however, the upper lip thickness increased by a mean of 2.3 mm. Consequently, these findings indicated that the thickness change did not follow a dominant rule and was difficult to predict. The correlation test used in the present study also indicated negative correlations between the upper lip thickness and all influential factors, such as upper lip thickness, upper incisor retraction, and upper lip retraction. However, their weak correlation coefficient ($0.4 > R > -0.4$) proved that the relationship might not exist. Thus, further studies are needed to investigate the rule of lip thickness change.

On the contrary, upper lip retraction demonstrated a positive correlation with incisor retraction. In this model, the correlation coefficient was lower than the result of Nguyen[16] and Kusnoto *et al*.[23] but higher than those of some authors.[6,20] The correlation between upper lip retraction and incisor retraction at the cervical point was very strong, suggesting that the cervical point of the incisors should be used to predict lip retraction. Moreover, these findings revealed the benefits of bodily tooth movement to decrease lip protrusion. However, the correlation between lip retraction and incisor retraction at the cervical point varied among studies.[9,21] This variation might be due to the difference in the type of tooth movement, which was not mentioned in the studies.

The analysis result in the present study revealed a strong retracting relationship between the lower lip and lower incisors, in agreement with the findings of many previous studies.[16,20,24] However, the correlation reported by Yasutomi *et al*.[21] and Hayashida *et al*.[9] was deemed weak. The retraction of the lower lip change does not affect the facial esthetic as upper lip change, and this issue is less mentioned. Similarly, the relationship between lip retraction and lip morphological change was also less observed. In the present study, a negative correlation was found between upper lip retraction and lip thickness change, and a positive correlation between upper lip retraction and lip length change indicated that the more the lip retraction, the longer the lip, although the lesser the lip thickness change. However, the very weak correlation coefficients between them presented that the relationship between these factors was not reliable. This might be the reason why fewer authors referred to these factors.

Conclusions

Based on the results of this study, we obtained the following conclusions:

- The protrusion of the upper incisors changed more than lower incisor protrusion, and the upper and lower incisor inclinations improved after treatment.
- Upper and lower lip protrusions decreased after orthodontic treatment. However, the change in lip thickness was unpredictable.
- Lip change was associated with incisor retraction at the cervical and incisal edges but did not correlate with the rotation axis of the upper incisors.

The findings of this study might offer a broad view of factors that affect lip change, thus optimizing orthodontic treatment plans and improving the effectiveness of orthodontic treatment in patients with a convex facial profile in Vietnam.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1. Downs WB. Variations in facial relationships; their significance in treatment and prognosis. Am J Orthod 1948;34:812-40.
2. Chan EK, Soh J, Petocz P, Darendeliler MA. Esthetic evaluation of Asian-Chinese profiles from a white perspective. Am J Orthod Dentofacial Orthop 2008;133:532-8.
3. Farrow AL, Zarrinnia K, Azizi K. Bimaxillary protrusion in black Americans--An esthetic evaluation and the treatment considerations. Am J Orthod Dentofacial Orthop 1993;104:240-50.
4. Gu Y, McNamara JA Jr., Sigler LM, Baccetti T. Comparison of craniofacial characteristics of typical Chinese and Caucasian young adults. Eur J Orthod 2011;33:205-11.
5. Basciftci FA, Uysal T, Buyukerkmen A, Demir A. The influence of extraction treatment on Holdaway soft-tissue measurements. Angle Orthod 2004;74:167-73.
6. Mirabella D, Bacconi S, Gracco A, Lombardo L, Siciliani G. Upper lip changes correlated with maxillary incisor movement in 65 orthodontically treated adult patients. World J Orthod 2008;9:337-48.
7. Boley JC, Pontier JP, Smith S, Fulbright M. Facial changes in extraction and nonextraction patients. Angle Orthod 1998;68:539-46.
8. Sodagar A, Borujeni DG, Amini G. Prediction of soft tissue profile changes following orthodontic retraction of incisors in Iranian girls. World J Orthod 2010;11:262-8.
9. Hayashida H, Ioi H, Nakata S, Takahashi I, Counts AL. Effects of retraction of anterior teeth and initial soft tissue variables on lip changes in Japanese adults. Eur J Orthod 2011;33:419-26.
10. Huang YP, Li WR. Correlation between objective and subjective evaluation of profile in bimaxillary protrusion patients after orthodontic treatment. Angle Orthod 2015;85:690-8.
11. Sayin MO, Turkkahraman H. Cephalometric evaluation of nongrowing females with skeletal and dental class II, division 1 malocclusion. Angle Orthod 2005;75:656-60.
12. Scott Conley R, Jernigan C. Soft tissue changes after upper premolar extraction in class II camouflage therapy. Angle Orthod 2006;76:59-65.
13. Leonardi R, Annunziata A, Licciardello V, Barbato E. Soft tissue changes following the extraction of premolars in nongrowing patients with bimaxillary protrusion. A systematic review. Angle Orthod 2010;80:211-6.
14. Konstantonis D. The impact of extraction vs nonextraction treatment on soft tissue changes in class I borderline malocclusions. Angle Orthod 2012;82:209-17.
15. Lai J, Ghosh J, Nanda RS. Effect of orthodontic therapy on the facial profile in long and short vertical facial patterns. Am J Orthod Dentofacial Orthop 2000;118:505-13.
16. Nguyen TB. To evaluate the morphological change of hard and soft tissue of the face after orthodontic treatment on twenty eight bimaxillary protrusion patients with four bicuspid extraction [dissertation]. Ha Noi: Hanoi Medical University; 2015. Vietnamese.
17. Duong TH, Tran NQ. Morphological characteristics of dentofacial and soft tissue in adult Vietnameses. J Pract Med 2020;1135:140-4.
18. Spradley FL, Jacobs JD, Crowe DP. Assessment of the anteroposterior soft-tissue contour of the lower facial third in the ideal young adult. Am J Orthod 1981;79:316-25.
19. Arnett GW, Jelic JS, Kim J, Cummings DR, Beress A, Worley CM Jr., *et al*. Soft tissue cephalometric analysis: Diagnosis and treatment planning of dentofacial deformity. Am J Orthod Dentofacial Orthop 1999;116:239-53.
20. Talass MF, Talass L, Baker RC. Soft-tissue profile changes resulting from retraction of maxillary incisors. Am J Orthod Dentofacial Orthop 1987;91:385-94.
21. Yasutomi H, Ioi H, Nakata S, Nakasima A, Counts AL. Effects of retraction of anterior teeth on horizontal and vertical lip positions in Japanese adults with the bimaxillary dentoalveolar protrusion. Orthod Waves 2006;65:141-7.
22. Kasai K. Soft tissue adaptability to hard tissues in facial profiles. Am J Orthod Dentofacial Orthop 1998;113:674-84.
23. Kusnoto J, Kusnoto H. The effect of anterior tooth retraction on lip position of orthodontically treated adult Indonesians. Am J Orthod Dentofacial Orthop 2001;120:304-7.
24. Caplan MJ, Shivapuja PK. The effect of premolar extractions on the soft-tissue profile in adult African American females. Angle Orthod 1997;67:129-36.