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Changes in the Soft Tissue Chin Area by Retraction of Mandibular Orthodontic Incisors - A Retrospective Study

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Abstract

Introduction: In the face the lip and the chin area are more noticed. The soft tissue changes following incisor retraction by the cephalograms has been viewed as clinically advantageous and important for orthodontic treatment planning and doctor patient correspondence.To evaluate area and morphology changes of soft tissue chin after orthodontic incisors retraction.

Materials and Methods: One hundred male subjects with bimaxillary protrusion requiring extraction of four premolars were included in the study. Cephalograms before (T0) and after (T1) orthodontic treatment were taken. The soft tissue changes, including the area, thickness and morphology were evaluated. Paired-t tests was done. Pearson correlation analyses and backward multivariate regression analyses are done to recognize the relationship amongst the incisor retraction and soft tissue changes.

Results: A significant increase in the soft tissue thickness, and a significant decrease in the soft tissue thickness of B-B′ were seen. No statistically significant changes in the area of soft tissue chin and lower lip were noted. Pearson coefficient among the thickness changes of B-B′ and the retraction of lower incisors was − 0.376. The multiple correlations between the soft tissue thickness changes and incisor retractions were Y = 1.02–0.42a + 0.42b for L1c-LL, and Y = 0.17–0.31b for B-B′.

Conclusion: The orthodontic incisor retraction could cause soft tissue thickness changes (i.e. an increase in L1c-LL and Pog-Pog' and a decrease in B-B′) without area alterations.

Keywords: Soft tissue change, Orthodontic treatments, Bimaxillary protrusion, Incisor retraction

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Introduction

Face plays a significant role in one's life, social connections, self-respect and mental health [1]. Society usually focuses on the lips and soft tissue chin as opposed to other orofacial structures [2]. The soft tissue chin in patients with class II/ bimaxillary protrusive, is stressed making undermined chin prominence [3]. The orthodontic treatment of bimaxillary protrusive patients normally includes the extraction of premolars and incisors, which brings about increased chin prominence and better facial profiles ex [4]. Recent studies have shown that these progressions of soft tissue chin were mostly because of the rearrangement or reshaping of the soft tissues around the chin following the retraction of incisors [5].

The vast majority of the past investigations utilized cephalometry and explored the proportion between the measure of incisor retraction and soft tissue changes. For instance, a few scientists have announced the predictive ratios for lower lip change alongside the mandibular incisor progression going from 0.26 to 0.85:1, and 1:1 for the difference in soft tissue pogonion to the advancement of hard tissue pogonion [6]. Others have proposed that there were variations for the adjustments in the soft tissue following the extraction treatment in view of many affecting components, like soft tissue thickness, soft tissue areas, the underlying skeletal patterns [7], the soft tissue remodeling during orthodontic treatment and the strain of soft tissue upon the anteriors. In spite of the fact that it is presently conceivable to recreate soft tissue changes for patients with dental extraction and retraction treatment by utilizing some visual treatment objective software, it is as yet hard to precisely foresee the soft tissue changes in the chin region following the orthodontic incisor's removal [8–10].

Albeit the 3-dimensional CBCT has benefits for researching the hard and soft tissues changes following orthodontic therapy, the regular 2-dimensional cephalogram is still of incredible clinical significance and normally utilized in orthodontic determination and treatment planning, because of the constraints of CBCT, for example, significant expense and radiation openness [11]. An exact expectation of soft tissue changes following incisor retraction utilizing cephalograms has been viewed as clinically advantageous and important for orthodontic treatment planning and doctor patient correspondence [12]. In the present study we aim to quantify the area and morphological changes in soft tissues around the chin after orthodontic incisor retraction in patients with bimaxillary dental protrusion, and to explore the connection between these soft tissue changes and the incisor retraction. The hypothesis was that the region around the soft tissue chin would enlarge and reshape following the incisor retraction.

Materials and Methods

We conducted a retrospective observational study. A total of 100 male adult patients (mean age 24.50 ± 2.16 years, range 18–39 years) were considered for the study (Table 1). Only Skeletal Class I, Angle Class I bimaxillary dental protrusive malocclusion and crowding less than 4 mm in both arches with normal overjet and overbite were considered. Those with previous orthodontic treatments and surgical treatments and pathologies were excluded.

Cephalometric analysis

The lateral cephalograms were taken before (T0) and after (T1) orthodontic treatment using a Cephalometer. The primary outcome variables were noted as the changes of soft tissue area and thickness in response to the incisor retraction between pre-treatment and post-treatment. The

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secondary outcome variables are the variations seen in the cephalometric measurements between treatments. Soft tissue thickness was direct distances between the landmarks of L1c to LL, B to B′ and Pog to Pog'. The area of soft tissue chin and lower lip was measured in mm^2 using a digital planimeter on Auto CAD 2016 [16]. Using the appropriate statistical tools th significance was measured keeping the $p \leq 0.05$.

Results

Incisor retractions noted: The distance of upper incisor retraction was 5.350 ± 1.790 mm. The amount of lower incisor retraction was 4.410 ± 1.610 mm. (Table 3).

Soft tissues area changes noted: No statistically significant difference of area change was found in the soft tissue chin or in the lower lip with the incisor retraction (Table 4).

Soft tissue thickness changes noted: A significant increase in the soft tissue thickness of L1c-LL and Pog-Pog' (both $P < 0.05$), and a significant decrease in the soft tissue thickness of B-B′ ($P < 0.01$) (Table 5).

Relationship between the soft tissue thickness change and incisor retraction: A negative correlation between the thickness change of B-B′ and the lower incisor retraction ($P < 0.05$). No statistically significant correlation was found between the incisor retraction and the thickness change of L1c-LL and Pog-Pog' (Table 6).

The multivariate regression analysis revealed that the multiple correlations between the soft tissue thickness changes and incisor retractions were Y = 1.02–0.42a + 0.42b for L1c-LL, and Y = 0.17–0.31b for B-B′ ("Y" was the soft tissue thickness change, "a" and "b" were the retractions of upper incisors and lower incisors, respectively) (Table 7).

Table 1: The weight and age -pre-treatment (T0) and post-treatment (T1)

Measurement	T0		T1		Variance (T1-T0)	
	Mean	SD	Mean	SD	Mean	SD
Age (year)	23.50 (18–39)	2.150	25.70 (20–42)	2.580	2.270	0.570
Weight (kg)	55.680	2.810	55.080	2.600	−0.600	1.380

Table 2: Various Landmarks and their definition

Landmarks
N Nasion: most anterior point of the frontonasal suture where the lines of the glabella profile meet those of the nasal bones
S Sella: Center of bony contour of sella turcica
P Porion: the midpoint of the upper contour of the metal ear rod of the cephalometer (machine porion)
Or Orbitale: the lowest point on the inferior margin of the orbit

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A	Most concave point between anterior nasalspine and superior prosthion
U1	The tip of the maxillary central incisors
U1c	The most anterior point of clinical crown of maxillary central incisors
L1	The tip of the mandibular central incisors
L1c	The most anterior point of clinical crown of mandibular central incisors
B	Most concave point on mandibular symphysis
Pog	Pogonion: the most anterior point on the osseous contour of the chin
Me	Menton: the most inferior midline point on the mandibular symphesis
LL	The most anterior point of the lower lip based on the reference plane
Stmi	Uppermost point on vermilion border of lower lip
B′	The innermost point on the contour of the soft-tissue between the lower lip and the soft tissue chin
Pog’	Soft tissue pogonion: the most prominent point on the chin based on the reference plane
Me’	Soft tissue menton: the lowest point on the contour of the soft tissue chin
Reference planes	
FH	Frankfurt Horizontal plane formed by Portion and Orbitale
MP	Mandibular plane through Me and the lower margin of mandibular angle
VBL	A line passing through the B point and perpendicular to the FH plane serving as the vertical reference for the mandibular evaluations
VNL	A line passing through the N point and perpendicular to the FH plane serving as the vertical reference for the maxillary evaluations
Cephalometrics analysis index	
ANB (°)	The ANB angle shows the difference between the maxilla and mandible
SNA (°)	The SNA angle is used to establish the relationship of the maxilla to the cranial base SNB (°) The SNB angle is used to establish the relationship of the mandible to the cranial base
U1-L1 (°)	Upper and lower central incisors Angle: the intersection Angle of the long axis of the upper and lower central incisors, representing the relative protrusion of the upper and lower central incisors
U1-NA (°)	The intersection Angle between the long axis of the upper central incisor and the NA line, representing the inclination of the upper central incisor
L1-NB (°)	The intersection Angle between the long axis of the lower central incisor and NB line, representing the inclination of the lower central incisor
SN-MP (°)	The Angle between the mandibular plane and the SN plane
FMA (°)	The Angle between the Frankfurt Horizontal plane and the Mandibular plane Stmi-Me’ (mm) Vertical distance between the landmarks of Stmi and Me’
Soft tissue area measurement	
Area 1 (cm2)	The area of soft tissue chin from the border of B-B′ till the border of Me-Me’ Area 2 (cm2) The area of lower lip till the border of B-B′
Soft tissue thickness measurement	
L1c-LL (mm)	Distance between the landmarks of L1c and LL B-B′ (mm) Distance between the landmarks of B and B′
Pog-Pog’ (mm) Distance between the landmarks of Pog and Pog’	

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Table 3: Variations of cephalometric measurement at pre-treatment (T0) & post-treatment (T1)

ANB (°)	4.180	1.400	3.720	1.740	−0.450	1.110	0.020
SNA (°)	83.350	3.370	82.810	3.800	− 0.540	1.480	0.120
SNB (°)	79.170	3.110	79.090	3.740	− 0.080	1.500	0.190
U1-L1 (°)	109.390	7.320	131.770	10.000	22.380	10.870	< 0.01
U1-NA (°)	31.280	5.580	19.680	7.490	−11.600	6.230	< 0.01
L1-NB (°)	35.370	4.150	25.160	5.340	−10.21	7.200	< 0.01
SN-MP (°)	33.200	5.920	34.140	5.330	0.940	2.730	0.050
FMA (°)	27.150	5.410	27.370	5.320	0.220	3.030	0.670
Stmi-Me’ (mm)	44.140	3.030	44.380	2.500	0.2401	1.950	0.470

Table 4: Changes in the soft tissue area between pre-treatment (T0) and post-treatment (T1)

Measurements	T0		T1		T1-T0		*P*-value
	Mean	SD	Mean	SD	Mean	SD	
Area 1 (cm^2)	2.860	0.440	3.010	0.551	0.140	0.500	0.081
Area 2 (cm^2)	2.170	0.571	2.140	0.620	−0.031	0.401	0.690
Area 1 + 2 (cm^2)	5.030	0.831	5.151	0.990	0.120	0.760	0.350

Table 5: Variations in the soft tissue thickness at pre- treatment (T0) and post-treatment (T1)

Measurements	T0		T1		T1-T0		*P*-value
	Mean	SD	Mean	SD	Mean	SD	
L1c-LL (mm)	10.360	1.701	11.001	1.612	0.640	1.671	0.030
B-B′ (mm)	12.090	1.641	10.892	1.551	−1.211	1.340	< 0.010
Pog-Pog’ (mm)	10.441	1.691	10.890	1.640	0.440	1.100	0.020

Table 6: Pearson correlation coefficients among the incisor retraction, ANB, SN-MP and soft tissue thickness change.

Soft tissue thickness	Upper incisor retraction	Lower incisor retraction	ANB	SN-MP

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change	Correlation coefficient	P-value	Correlation coefficient	P-value	Correlation coefficient	P-value	Correlation coefficient	P-value
L1c-LL (mm)	−0.220	*P* = 0.190	0.160	*P* = 0.340	0.2301	*P* = 0.171	0.1260	*P* = 0.460
B-B′ (mm)	0.260	P = 0.120	− 0.380	P < 0.051	.0800	P = 0.640	0.2000	P = 0.231
Pog-Pog’ (mm)	−0.050	P = 0.791	−0.040	P = 0.831	.2731	P = 0.101	0.1220	P = 0.471

Table 7: Multivariate regression analysis for incisor retraction and soft tissue thickness change

Soft tissue thickness change	R2	P-value	Constant	a	b
L1c-LL	0.1640	0.0471	1.020	− 0.420	0.421
B-B′	0.1420	0.0220	0.170	–	−0.310

Discussion

The exactness of predictive values in the changes of the soft tissue chin region after orthodontic therapy utilizing cephalogram is still ineffectively comprehended. The connection between incisor movements and soft tissue change is as yet disputable. This might be on the grounds that

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the soft tissue changes can be influenced by incisor movements as well as numerous different components, for example, dentofacial morphology, ages, gender, ethnics, soft tissue thickness and pressure, and the methods utilized for assessment [17, 18]. To limit the impact of gender on soft tissue changes following the incisor development, male patients were taken for our research. A few investigations have revealed that the proportion between lip change and incisor retraction went from 1:0.45 to 1.25 for the upper lip, and from 1:1.2 to 1:6.2 for the lower lip in not growing patients with bimaxillary protusion [19, 20]. Likewise there is a noted soft tissue thickness change [19, 21]. In the current examination, we noted that after incisor retraction the soft tissue thickness also increased. This might be because of the decreased pressure in the lower lip muscles [14].

Another explanation might be the thickness estimated in the examination, indeed, incorporated the thickness of the lower lip just as the labial vestibule that may change after incisor retraction [17]. The mandibular rotation could likewise impact the pressure of soft tissues around the chin region. But no huge change existed in SN-MP and Stimi-Me'. No relationship was found between the difference in ANB and the difference in soft tissue thicknesses though ANB decreased. Concerning the thickness change of the lower lip, Kuhn tracked down that the lower lip thickness diminished about 2.5 mm in patients with extractions done [22]. Contrary to this few studies reported a increases in the the thickness of the lower lip [23]. They ascribed these lip thickness changes to the muscular tensions [17, 24, 25]. Some reported no changes. [22, 26].

The multiple regression analysis in our investigation showed that the thickness of L1c-LL was influenced by the retraction of upper and lower incisors simultaneously. Numerous researchers recognized that the upper incisors had impacts on the shape and position of the lower lip, presumably in light of the fact that the lower lip frequently covers the upper incisor by a third [2]. Consistent with our observations few studies found the thickness of B-B′ had lowered [17, 24, 27]. The Pearson coefficient showed a negative connection among the soft tissue thickness change of B-B′ and lower incisor retraction which is usually less than zero. In this way, the more the retraction, the greater the thickness decrease of B-B′. However, the changes of soft tissue thickness around the chin following incisor retraction are as yet uncertain, particularly for the difference in Pog-Pog' [13].

The changes of soft tissue are complex [28]. Dai identified the buccal buccal facial depth decreased in adult female patients undergoing extraction with a three-dimensional structured light scanning system [29]. To quantify the volume changes, CBCT is ideal. Its application may not always be advised. Hence we used 2D cephalogram. In this investigation, other than linear and angular measurements on the cephalography, incisor retractions, and soft-tissue thicknesses, the areas of soft tissue chin and lower lip were also noted using a digital planimeter [16].

In our study the muscle strain around the chin area diminished with the level of maxillary incisor retraction, which may increase the area of the soft tissues around the chin [14]. But, no huge change was found in the areas of the soft tissue jaw and lower lip in the investigation. This may on the grounds that the soft tissues around the chin are generally appended to the basal bone with less mobility. As indicated by this finding, the areas of soft tissue chin and lower lip ought to be set as invariants in software programming. In view of this, an accurate prediction could be made for the morphological changes of the soft tissue chin along with the changes of other anatomical landmarks spots after incisor retractions. Likewise, if the areas of soft tissue chin increased, we

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would presume that filling material existed in the soft tissue jaw.

There were few limitations in our only males with one ethnicity were considered in our study. We propose that in future both the sexes and multiple ethnicities may be incorporated and the three-dimensional CT are used. [29], for the predicting of the soft tissue changes following various sorts of tooth movements.

Conclusion

There was no significant variation in the area of soft tissue chin and lower lip after orthodontic incisor retraction. After the incisor retraction, the soft tissue thicknesses of L1c-LL and Pog-Pog' augmented, while in the soft tissue thickness of B-B′ lowered. High-quality and well-designed prospective trials are desired for correct conclusions.

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