



## Effective length of premaxilla and thicknesses of facial alveolar bones around maxillary central incisors in adults

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### Abstract

**Objective:** To evaluate the thickness of facial alveolar bones around maxillary central incisors according to gender, inclination type, and to the first time with a linear value, which is Effective Length of the Premaxilla (ELP).

**Materials and Methods:** We studied facial alveolar bones around 88 maxillary central incisors in 44 adult CBCT cases (22 females and 22 males, aged 18-40 years). The measurements were taken to the effective length of the premaxilla (ELP), the inclination of maxillary central incisors, as well as to the facial thicknesses of the alveolar crest and at each third of alveolar plates. We performed statistical comparison, thinning study of facial alveolar plates, and correlations investigation Analysis.

**Results:** Statistically significant differences were appeared according to gender and inclination types between ELP values. High distribution of thin alveolar plates at the levels of coronal and middle thirds were found, when ELP < 13 mm. Half cases had good bone thicknesses at the level of apical third. No significant strong correlation was found between ELP and gender, alveolar plate thickness, or inclination types.

**Conclusion:** A potential risk at the levels of coronal and middle thirds of facial alveolar plates maybe exist when moving maxillary central incisors labially, especially with decreased values of ELP (less than 13 mm).

**Keywords:** adults, alveolar bone, CBCT, central incisors, effective length of premaxilla

### Introduction

Talking about orthodontic movements in isolation from the alveolar bones is not possible, considering that these bones constitute a restriction to the movements of teeth<sup>[1, 2]</sup>. As well, Proffit and Ackerman confirmed that there is restriction of the incisors movements, especially in the anterior and posterior directions<sup>[3]</sup>.

Among the benefits of orthodontic treatment is the teeth alignment within this dentoalveolar envelope, thus improving the periodontal status by improving oral health and removing occlusal trauma<sup>[4]</sup>. Whereas, the results of orthodontic treatment associated with dental movements outside this envelope may cause negative dental and periodontal (bone and gingival) complications<sup>[1, 2]</sup>.

Cephalometric Sassouni Plus Analysis is one of the very important analyses, which is widely used in the phases of diagnosis and comprehensive planning for orthodontic treatment<sup>[5]</sup>. This analysis is applied also in evaluating the outcomes of treatment through studying skeletal and bony changes, as in the study of Flis *et al*<sup>[6]</sup>. One of the measurements used in this analysis is the Effective Length of the Premaxilla (ELP), and its normal value is 13 mm<sup>[5]</sup>.

Through our readings, and to the best of our knowledge, we can confirm that the facial alveolar bone of the maxillary central incisors has never been studied in terms of this linear value. So, we did that for the first time in this paper.

### Materials and Methods

44 cases were selected out of 320 recorded cases (including CBCT imaging) in the Regional Clinical Dental Polyclinic, Volgograd, Russia.

Initially, all Patients' names have been deleted and replaced with numbers to preserve their privacy and confidentiality of their files. Then, the selection was made according to the following criteria:

- 1. Inclusion criteria:** 1) Age between 18 and 40 years. 2) CBCT cases involving the maxilla completely. 3) Cases of untreated patients. 4) No severe rotations. 5) No spaces between teeth. 6) No eruption disorders. 7) No missing any anterior teeth or supernumerary disorder. 8) Healthy maxillary anterior teeth (teeth shape and surround supportive tissues).
- 2. Exclusion criteria:** 1) Age under 18 and older than 40 years. 2) CBCT cases for part of maxilla only. 3) Cases of treated patients. 4) Severely rotated teeth. 5) Spaces between teeth. 6) Disorder of eruption. 7) Disorders of missing or supernumerary any maxillary anterior teeth. 8) Shape disorder of maxillary anterior teeth. 9) Periodontal diseases of bone and gingiva.

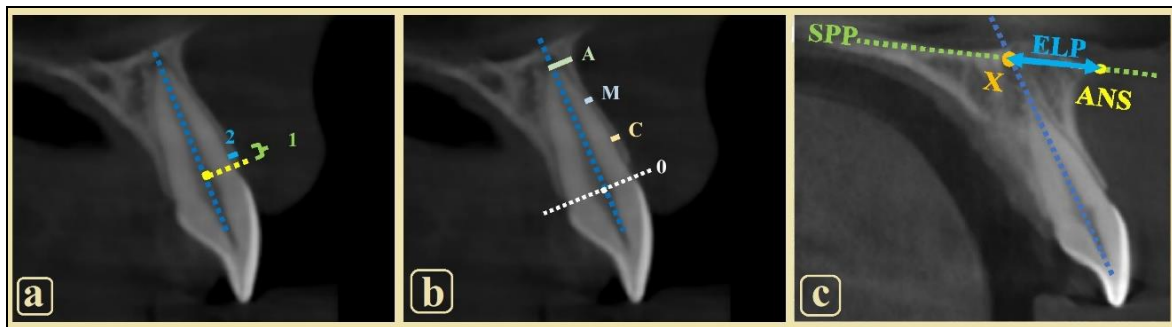
Thus, the final distribution of selected cases was 44 CBCT cases (88 maxillary central incisors), 50% females and 50% males. CBCT 3D cases were already taken using the Vatech machine (PaX-i 3D, Republic of Korea). Whilst, the basic software to get the findings for this study was "Ez3D plus".

The alveolar bone evaluation was conducted on sagittal views by measuring the thicknesses of facial alveolar plates, perpendicular to the long axis of the central incisors, as follows: 1) Thickness of the alveolar crest: at 0.5 mm apical to the crest. 2) Thickness at each third of root length from CEJ: coronal third (C), middle third (M), and apical third (A). Then, we classified the thicknesses into three groups (thin < 1 mm, medium 1 - 2 mm, and good > 2 mm), aiming to study the thinning. The inclination of maxillary central incisors was also measured and classified based on the values.

From another hand, to get the value of the Effective length of the premaxilla (ELP), we measured the distance between the anterior nasal spine (ANS) and the intersection point of the long axis of the maxillary central incisor with the spinal palatal plane (SPP).

According to studied variables, we divided cases into groups as follows:

- 1) According to gender (females and males).
- 2) According to ELP value-types (< 13 mm, or  $\geq$  13 mm).
- 3) According to inclination type of the central incisors (Labial, Normal, and Lingual).



**Fig 1:** Fig a: (1) 0.5 mm apical far from alveolar crest. (2) Measured alveolar crest thickness. Fig. b: Facial alveolar plate thicknesses at Levels of the Coronal third (C), Middle third (M), and Apical third (A) of the root length. (0): Line refers to the beginning of the root. Fig. c: (ELP) Effective Length of the Premaxilla: distance from the anterior nasal spine (ANS) to intersection point (X) between the spinal palatal plane (SPP) and the incisor axis.

## Results

By using SPSS software package for statistical data analysis, we performed descriptive statistics for the data (Table 1), and compared them ( $P < 0.05$ , assuming a level of significance of 95%) according to gender, inclination type, and Effective Length of the Premaxilla by using T-Test analysis (Independent Samples Test) and One-Way Anova.

**Table 1**

Gender		ELP (mm)	Inclination (degree)	Facial Alveolar Crest Thickness	Facial Plate Thickness at level C	Facial Plate Thickness at level M	Facial Plate Thickness at level A
Females	Mean	10.626	70.345	0.805	0.852	0.869	2.319
	SD	2.4463	8.2423	0.1396	0.2639	0.3375	0.9890
Males	Mean	11.452	71.721	0.802	0.921	0.795	1.986
	SD	2.7085	8.6332	0.2200	0.3205	0.2603	0.9233
Total	Mean	11.039	71.033	0.803	0.887	0.832	2.152
	SD	2.5986	8.4175	0.1831	0.2939	0.3019	0.9656

## Findings showed that

1. *According to gender:* There were statistically significant differences ( $\text{Sig} < 0.05$ ) between ELP value-types (Table 2). Whereas, no statistically significant differences ( $\text{Sig} > 0.05$ ) between the inclination types, and the same between measured thicknesses of the alveolar sites.  $\text{ELP} < 13$  mm was more proportion in females, whilst  $\text{ELP} \geq 13$  mm was more proportion in males.

**Table 2**

ELP value-types Gender	< 13 mm	$\geq 13$ mm	P - value
Females	44.05%	5.95%	0.021%
Males	34.52%	15.48%	
Total	78.57%	21.43%	

2. According to inclination types: There were statistically significant differences (Sig < 0.05) between ELP value-types (Table 3).

ELP < 13 mm was the most common with different types of inclination, especially in cases of retroclined central incisors. Whereas with normal inclination, the proportion of ELP < 13 mm was three times more than ELP ≥ 13 mm. The least proportion of ELP ≥ 13 mm was accompanied by retroclined central incisors obviously.

**Table 3**

<i>ELP value-types</i>	< 13 mm	≥ 13 mm	<i>P - value</i>
<i>Inclination Type</i>			
<i>Labial</i>	<b>19.05%</b>	<b>9.52%</b>	<b>0.016%</b>
<i>Normal</i>	<b>33.33%</b>	<b>10.72%</b>	
<i>Lingual</i>	<b>26.19%</b>	<b>1.19%</b>	
<i>Total</i>	<b>78.57%</b>	<b>21.43%</b>	

(Sig < 0.05)

3. The thinning study of facial alveolar plates presented that (Table 4):

1. at the level of the coronal third: thin bone was the most common (two-thirds of cases), especially when ELP < 13 mm in all inclination types.
2. at the level of the middle third: thin bone was the most common (more than 70% of cases), especially when ELP < 13 mm in cases of normal and lingual inclination types.
3. at the level of the apical third: bone thickness was good (> 2 mm) in more than half of the cases. Whereas, cases of proclined central incisors with ELP ≥ 13 mm, showed much more good bone thickness.

**Table 4**

ELP value-types	Inclination Type	Facial Plate Thickness at level C			Facial Plate Thickness at level M			Facial Plate Thickness at level A		
		< 1 mm	1 - 2 mm	> 2 mm	< 1 mm	1 - 2 mm	> 2 mm	< 1 mm	1 - 2 mm	> 2 mm
< 13 mm	Labial	14.28%	4.76%	-	9.52%	9.52%	-	-	4.76%	14.28%
	Normal	23.80%	9.52%	-	28.57%	4.76%	-	-	16.66%	16.66%
	Lingual	16.66%	8.33%	1.19%	21.42%	4.76%	-	4.76%	15.47%	5.95%
≥ 13 mm	Labial	4.76%	4.76%	-	3.57%	5.95%	-	-	1.19%	8.33%
	Normal	4.76%	5.95%	-	7.14%	3.57%	-	-	4.76%	5.95%
	Lingual	1.19%	-	-	1.19%	-	-	-	1.19%	-
Total		65.47%	33.33%	1.19%	71.42%	28.57%	-	4.76%	44.04	51.19

4. Correlations Study by Spearman/Pearson statistical Analyses showed that there is: 1) Positive Weak Correlation between ELP and facial alveolar plate thicknesses at levels of each root third (P < 0.01). 2) Positive Very Weak Correlation between ELP and gender (P < 0.05). 3) Negative Very Weak Correlation between ELP and inclination type of the central incisor (P < 0.05).

### Discussion

The outcomes of data analysis in this paper showed that: No confirmed strong correlations were found between ELP and gender, facial alveolar plate thickness, or inclination type of the central incisor. Means of thicknesses of coronal and middle thirds of facial alveolar bone plates were less than 1 mm in females and males. Therefore, we can consider according to the bone-thinning at these two levels that there are probable risks with labial movements of incisors in both genders. From another side, based on the above results we can assume that there are potential risks on the coronal and middle thirds of facial alveolar bone plates when moving incisors labially in the context of orthodontic treatment, especially in cases with ELP values less than 13 mm as follows:

1. Potential risks on the coronal third: when ELP < 13 mm accompanied by any type of inclination.
2. Potential risks on the middle third: when ELP < 13 mm accompanied by normal or lingual inclination.

### Conclusion

We were able to discover a new factor associated with probable risk of moving the maxillary central incisors labially in the context of orthodontic treatment at the levels of coronal and middle thirds of superior facial alveolar plates. This factor is the decreased value of the Effective Length of the Premaxilla (less the 13 mm), which differs according to gender and the inclination types.

**References**

1. Kaley J, Phillips C. Factors related to root resorption in edgewise practice. *The Angle Orthodontist*,1991;61(2):125-32.
2. Vasconcelos G, Kjellsen K, Preus H, Vandevska-Radunovic V, Hansen BF. Prevalence and severity of vestibular recession in mandibular incisors after orthodontic treatment: a case-control retrospective study. *The Angle Orthodontist*,2012;82(1):42-7.
3. Sarver DM, Proffit WR, Ackerman JL. Diagnosis and treatment planning in orthodontics. *Orthodontics, current principles and techniques*. 3rd ed. St Louis: Mosby,2000:27:128.
4. Johal A, Katsaros C, Kiliaridis S, Leitao P, Rosa M, Sculean A, Weiland F, Zachrisson B. State of the science on controversial topics: orthodontic therapy and gingival recession (a report of the Angle Society of Europe 2013 meeting). *Progress in orthodontics*,2013;14(1):1-5.
5. Beistle RT. Sassouni plus. A comprehensive cephalometric system for diagnosis and treatment planning in functional therapy. *The Functional orthodontist*,1984:1(1):39-48.
6. Flis PS, Filonenko VV, Doroshenko NM. Cephalometric Sassouni plus analysis usage for evaluating the effectiveness of distal bite treatment with an orthodontic appliance with a movable ramp. *Ukrainian Dental Almanac*,2017:2:43-8.