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Original article

COMPARATIVE CEPHALOMETRIC AND 3D CONE BEAM COMPUTED TOMOGRAPHY ANALISIS OF ALVEOLAR BONE DESTRUCTION FOR TEETH IN ANTERIOR CROSSBITE

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ABSTRACT

Purpose: To assess the degree of bone destruction for teeth in anterior crossbite by means of 3D cone beam computed tomography and lateral cephalometry.

Material/methods: 20 patients with anterior crossbite underwent 3D cone beam computed tomography and lateral cephalometry of the anterior segments of the maxilla and mandible. The destruction of the bone in the anterior segments of the maxilla and mandible was measured (vestibularly and lingually)– the distance from the cemento-enamel junction to the top of the alveolar bone. The parameters of bone resorption for teeth 21 and 31 on cephalogramsand 3D computed tomography images were compared. For both incisors, the mean value registered by means of cephalometry was slightly higher than that registered with 3D.

Results: The total mean value of bone destruction for anterior teeth was significantly higher vestibularly compared to lingually, both for the maxilla ($p = 0.030$) and mandible ($p = 0.030$). Significantly higher mean values of bone destruction were found in the mandible compared to the maxilla. For both incisors (21 and 31), the mean value of resorption recorded by cephalometry was slightly higher than that recorded by 3D cone beam computed tomography, but without statistical significance.

Conclusion: We found significantly higher values of vestibular bone destruction compared to lingual bone destruction. Bone destruction in the mandible reached a significantly higher level than that in the maxilla. No statistically significant difference was found between the mean values of bone destruction measured by means of cephalometry and 3D cone beam computed tomography.

Keywords: crossbite, alveolar bone destruction, 3D cone beam computed tomography, cephalometry.

INTRODUCTION:

Anterior crossbite of single teeth or a group of teeth is a common masticatory trauma, leading to changes in the dental complex as a result of occlusal forces. Adequate tissue capacity is exceeded which results in bone destruction.[1, 2, 3, 4] The aim of the present study is to assess the degree of bone destruction for teeth in anterior crossbite in patients with completed growth by means of 3D cone beam computed tomography and lateral cephalometry.

AIM:

To assess the degree of bone destruction for teeth in anterior crossbite in patients with completed growth by means of 3D cone beam computed tomography and lateral cephalometry.

MATERIALS AND METHODS:

The study involved 20 patients withwith anterior crossbite of single teeth or group of teeth, of whom 16 (80%) men and 4 (20%) women, with a mean age 25.70±5.95 years. The patients' age ranged between 18 and 37 years. (Table 1) The number of teeth in crossbite varied between 2 and 12 for the individual patients, with a mean number of teeth in crossbite 8.0±3.0 teeth. The patients were admitted for consultation and treatment in the Department of Periodontology and Oral Diseases and the Department of Orthodontics in the Faculty of Dental Medicine-Plovdiv. Subjects underwent 3D cone beam computed tomography of the anterior segments of the maxilla and mandible and lateral cephalometry. They were informed about the nature and purpose of the study. They signed a Declaration of informed consent for participation and a Patient Information Form about the risks and expected benefits of the study. The study was approved by the institutional Ethics in Human Research Committee (protocol No.2106 /2020).

Table 1. Back groundin formation about the patients

Variables	Statistics
Age	
Mean ±SD	25.70±5.95
Minimal-Maximum	18-37
SexN (%)	
Men	16 (80%)
Women	4 (20%)
Numberofteethincrossbite	
Mean ±SD	8.0±3.0
Minimal-Maximum	2-12

Fig. 1. Analysis of the patient's 3D cone-shaped computed tomography of teeth 21 and 31

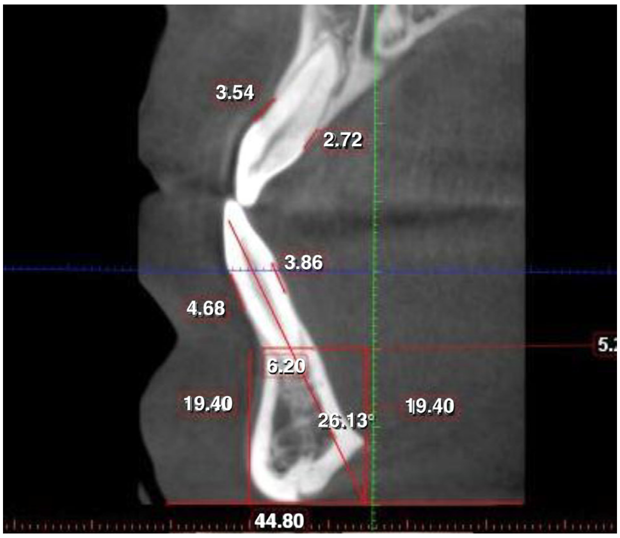
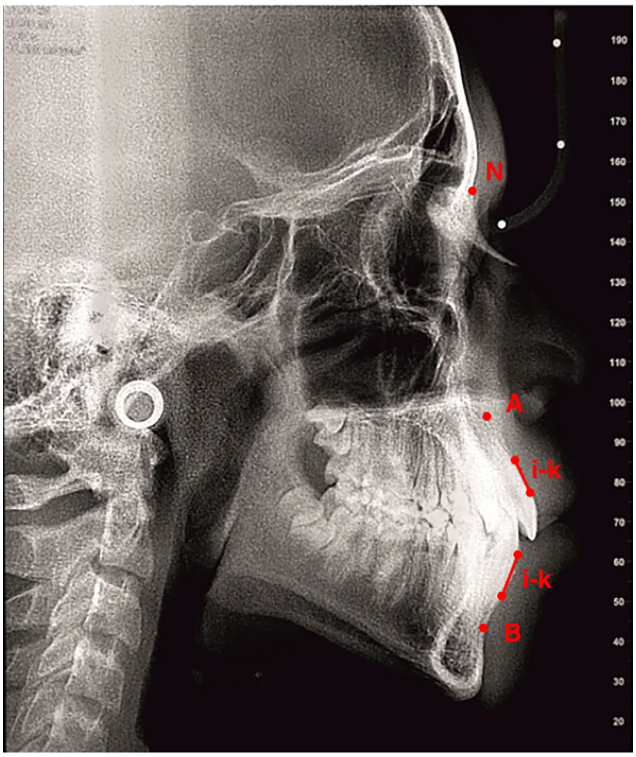


Fig. 2. Analysis of the same patient's cephalometry on teeth 21 and 3



The resorption of the bone in the anterior segments of the maxilla and mandible was measured (vestibularly and lingually)- the distance from the cemento-enamel junction to the top of the alveolar bone. (fig.1 and 2)

The parameters of bone resorption on cephalograms and 3D computed tomography images were compared: teeth #11(p=0.014), #12(p=0.049), #13(p=0.030) and #23(p=0.012), #42(p=0.027) and #43(p=0.009).

The data was analyzed through the following statistical programs: IBM SPSS, version 26 (2019); Med Calc, version 19.0.7 (2020); and Minitab, version 19, 2020. The parameters of bone destruction, were measured on continuous scales and normally distributed according to the Kolmogorov-Smirnov test (Kolmogorov-Smirnov $p > 0.05$ for all dimensions). The dimensions of bone destruction were presented as mean values and standard deviations. Bone destruction was analyzed for all target teeth separately and in total for each of the two jaws. The vestibular and lingual dimensions were compared through a paired-samplest-test. Bland-Altman's plot was used to establish the level of agreement between measurements based on lateral cephalogram and 3D cone-beam computed tomography. The mean value of the difference between the two methods was compared to zero through a one-sample t-test. Statistical significance was graded against the value of p as follows: * $p > 0.05$ - significant, ** $p < 0.01$ – very significant, *** $p < 0.001$ – highly significant.

RESULTS:

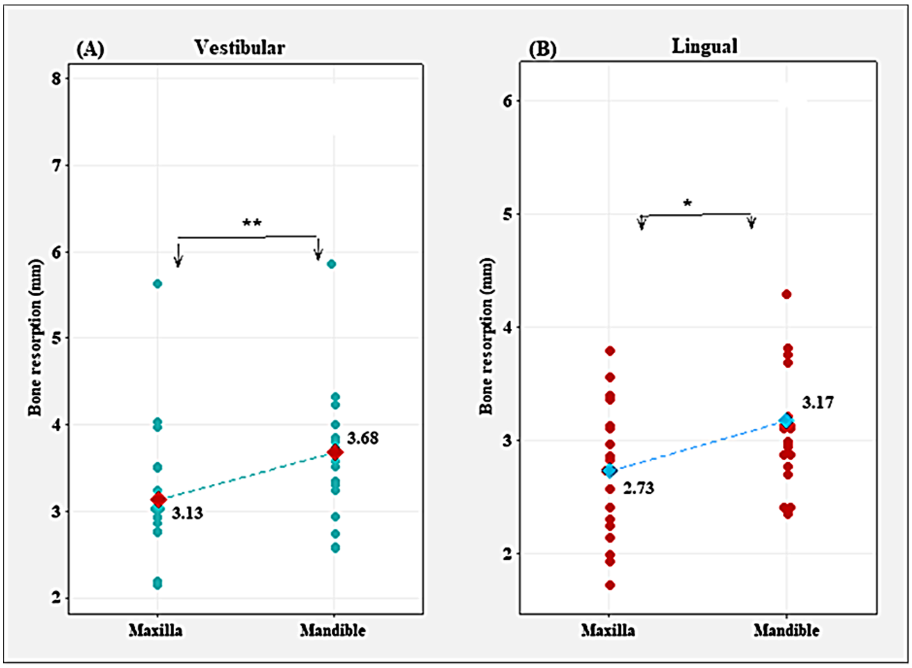
Vestibular and lingual boneresorption in the target teethwasassessedby 3D cone-beamcomputed tomography. (Table 2) In the maxilla, the vestibular values were consistently higher than the lingual with significant differences for the following teeth: #11 ($p = 0.014$), #12 ($p = 0.049$), #13 ($p = 0.030$) and #23 ($p = 0.012$). The average vestibular bone resorption was significantly higher than lingually ($p = 0.030$). A similar tendency was observed in the mandible, with vestibular bone resorption values being higher than lingually. However, the difference was significant for only two teeth: # 42 ($p = 0.027$) and # 43 ($p = 0.009$). The average vestibular bone resorption in the mandible was significantly higher than lingually ($p = 0.036$).

Table 2. Bone resorption assessed through 3D cone-beam computed tomography

Tooth	Vestibular		Lingual		p
#	Mean±SD	Min.-Max.	Mean±SD	Min.-Max.	
Maxilla					
11	**3.04**±0.35	1.72-8.23	**2.71**±0.45	1.17-4.25	0.014*
12	**3.17**±0.80	1.82-6.67	**2.70**±0.65	1.91-3.94	0.049*
13	**3.22**±0.72	1.90-5.91	**2.72**±0.68	1.80-4.12	0.030*
21	**3.11**±0.90	1.61-6.78	**2.96**±0.78	1.59-4.12	0.502
22	**3.06**±0.73	1.90-4.65	**2.72**±1.16	1.40-6.50	0.133
23	**3.03**±0.67	2.00-3.98	**2.56**±0.47	1.72-3.30	0.012*
Total	**3.13±0.64**	**2.15-5.63**	**2.73±0.56**	**1.73-3.80**	**0.030***
Mandible					
41	**3.65**±1.15	0.80-12.01	**3.27**±1.40	0.80-7.94	0.301
42	**3.75**±0.93	2.47-8.91	**3.11**±0.82	1.61-6.23	0.027*
43	**3.60**±0.86	1.81-5.44	**2.88**±0.78	1.68-5.06	0.009**
31	**4.32**±1.04	2.72-11.98	**3.74**±1.30	2.70-8.03	0.128
32	**3.42**±1.14	1.41-6.55	**3.15**±0.84	2.01-5.21	0.400
33	**3.28**±0.73	1.90-4.87	**3.11**±0.79	2.36-6.08	0.510
Total	**3.68±0.69**	**2.58-7.82**	**3.17±0.59**	**2.36-6.08**	**0.036***

Bone resorption between the maxilla and mandible showed significantly higher values in the mandible (Fig. 4). The average vestibular bone resorption was 3.68±0.69 mm in the mandible versus 3.13±0.64 mm in the maxilla, with a difference of 0.55mm, p = 0.006 (panel A). The average lingual bone resorption was 0.45 mm higher in the mandible (3.17±0.59 mm) than in the maxilla (2.72±0.56 mm), p = 0.019 (panel B).

Fig. 3. Individual and mean values of vestibular bone resorption in the maxilla and mandible (**panel A**). Individual and mean values of lingual bone resorption in the maxilla and mandible (**panel B**).



The measurement of bone resorption at incisors #21 and #31 through lateral cephalogram and 3D cone-beam computed tomography showed a small positive bias, which was not significantly different from zero: + 0.21mm for incisor #21, p = 0.229; +0.25 for incisor #31, p = 0.218 (Table 3).

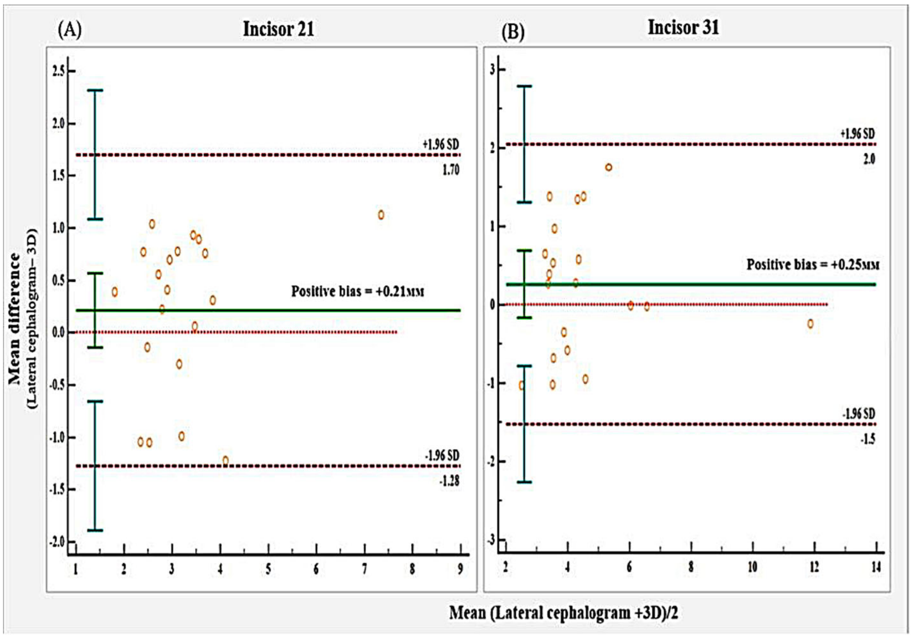
Table 3. Comparison of bone resorption measured on lateral cephalograms and 3D cone-beam computed tomography

Measurements	Mean ±SD	Difference (mm)	p
Tooth 21			
Lateral cephalogram	3.32±1.61	+0.21	0.229
3D tomography	3.11±1.21		
Tooth 31			
Lateral cephalogram	4.60±4.06	+0.25	0.218
3D tomography	4.34±4.20		

+ = The mean of lateral cephalogram is higher than the mean of 3D; - = The mean of lateral cephalogram is smaller than the mean of 3D.

The Bland-Altman plots (Fig. 4) illustrate the high level of agreement between lateral cephalogram and 3D cone-beam computed tomography in the measurement of bone resorption at incisor 21 (panel A) and incisor 31 (panel B).

Fig. 4. Bland-Altman'splots. **Panel A**: **Incisor 21** - The continuous line is located above the dotted line, showing a small (not significant) positive bias +0.21mm of lateralcephalogram in comparison with 3D tomography and all individual values are located within the 95% CI. **Panel B**: **Incisor 31**- The continuous line is located above the dotted line, showing a small (not significant) positive bias +0.25mm of lateralcephalogram in comparison with 3D tomography. All individual values are located within the 95% CI.



DISCUSSION:

The morphology of the alveolar bone is indicative of the occurrence of its destruction when there are negative influencing factors. Han JY and Jung GU (2011) assessed the vestibular bone thickness of t he frontal teeth. According to them the thickness of the vestibular plate is thinnest in the area of the alveolar ridge (0.78 mm-1.17 mm; 3 mm-6 mm apically from theridge) and mostly in the area of the lower lateral incisor. [5] Even seemingly minor dental discrepancies highly overload theperiodontal tissues. [6]

The masticatory forces change their normal direction in the case of incorrect occlusion of the incisors. A horizontal component of these forces occurs during biting off which exceeds the compensatory potential of the tissues. Teeth incross bite are subjected to excessive loading during their function.[3] When the masticatory forces exceed the compensatory potential of the tissues, the result is tissue damage, expressed in structural and functional changes in the periodontal tissues. The direction of the applied force is also important.They are usually oriented along the vertical axis of the teeth and are transferred to the alveolar bone, which reacts with destruction. When the masticatory forces with changed direction are present frequently and for long periods of time, the adjacent alveolar bone reacts with destruction. [2] In crossbite of the entire frontal area in class III malocclusion the lower incisors are often inclined lingually as a compensatory mechanism to reach intercuspation. Lingually inclined mandibular incisors (less than 85° of IMPA) are more susceptible to vestibular recessions and loss of alveolar bone. [7]

Our results showed a small positive bias, which was not significantly different from zero on lateral cephalogram and 3D cone-beam computed tomography . Kapila SD and Nervina JM in their review of clinical examination, CBCT and conventional radiological methods report that CBCT continues to gain popularity, its use currently is recommended in cases in which clinical examination supplemented with conventional radiography cannot supply satisfactory diagnostic information. [10]

Patients with an anterior crossbite, combined with sagittal changes in the posterior part of the dentition and with complete jaw growth exhibit an increased angle of the mandibular plane (hyperdivergent). They have a narrower symphysis and a thinner alveolar bone supporting the frontal mandibular teeth. [8]

The long and narrow symphysis predisposes towards progressive loss of both vestibular and lingual mandibular alveolar bone due to thinner alveolar bone support. [9] Our data correspond to the studies and conclusions of the cited authors.

CONCLUSION:

We found significantly higher values of vestibular bone destruction compared to lingual bone destruction. Bone destruction in the mandible (vestibular and lingual) reached a significantly higher level than that in the maxilla. Although cephalometric methods are to a certain extent similar to the 3D cone-beam computed tomography, when measuring bone resorption, they are quite limited. The former is informative about the condition of the alveolar bone only in the area of the central incisors. In order to obtain a more precise and comprehensive picture of the level of vestibular and lingual destruction of the entire frontal segment, 3D cone-beam computed tomography is required. Although there is no statistical difference between the two methods, we recommend the CBCT study because there the resolution is greater and a section can be made for any are, that we want to observe. Lateralcephalogram has limitations, as it can examines only the most protruding tooth.

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REFERENCES:

1. Andrade RN, Tôrres FR, Ferreira RFA, Cathanarino F. Treatment of anterior crossbite and its influence on gingival recession. *RGO, Rev Gaucha Odontol.* 2014 Oct-Dec;62(4):411-16. [Crossref]

2. Andreeva L, Dilkova N.A pilot study of the causes of recession- systematization of literature and blitz epidemiological study. *Orthodonticreview*. 2016; 18(2):54-65. [in Bulgarian]

3. Kundapur PP, Bhat KM, Bhat GS. Association of Trauma from Occlusion with Localized Gingival Recession in Mandibular Anterior Teeth. *Dent Res J (Isfahan)*. 2009 Fall;6(2):71-4. [PubMed]

4. Ustun K, Sari Z, Orucoglu H, Duran I, Hakki S. Severe Gingival Recession Caused by Traumatic Occlusion and Mucogingival stress: A case report. *Eur J Dent.* 2008 April;2:127-33. [PubMed]

5. Han JY, Jung GU. Labial and lingual/palatal bone thickness of maxillary and mandibular anteriors in human cadavers in Koreans. *J Periodontal Implant Sci.* 2011 Apr;41(2):60-6. [PubMed]

6. Richman C. Is gingival recession a consequence of an orthodontic tooth size and/or tooth position discrepancy? ”A paradigm shift”. *Compend Contin Educ Dent.* 2011 Jan-Feb;32(1):62-9. [PubMed]

7. Seehra J, Fleming PS, DiBiase AT. Orthodontic treatment of localized gingival recession associated with traumatic anteriorc rossbite. *Aust Orthod J.* 2009 May;25(1):76-81. [PubMed]

8. Kalina E, Zadurska M, Sobieska E, Górski B. Relationship between periodontal status of mandibular incisors and selected cephalometric parameters: Preliminaryresults. *J Orofac Orthop.* 2019 May;80(3):107-115. [PubMed]

9. Foosiri P, Mahatumarat K, Panmekiate S. Relationship between mandibula rsymphysis dimensions and mandibular anterior alveolar bone thickness asassessed with cone-beam computed tomography. *Dental Press J Orthod.* 2018 Jan-Feb;23(1):54-62. [PubMed]

10. Kapila SD, Nernina JM. CBCT in orthodontics: assessment of treatment outcomes and indications for its use. *Dentomaxillofac Radiol.* 2015 Jan;44(1):20140282. [PubMed]

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