








BONE EVALUATION OF SINGLE EDENTULOUS AREAS OF MAXILLA: SHORT COMMUNICATION

Avaliação óssea de regiões maxilares candidatas à reabilitação unitária implantossuportada: uma comunicação curta

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ABSTRACT

Objective: Evaluate the height and bone thickness in healed sites of single implant areas. **Materials and Methods:** In this cross-sectional study, cone-beam computed tomography (CBCT) images of single edentulous areas of maxilla of patients who needed aesthetic single implant rehabilitations were evaluated for measure the height and thickness using an implant planning software. Data were statistically analyzed using the Mann-Whitney and Pearson correlation test, considering the time, reason and region of tooth loss. For all tests, a p-value <0.05 was considered significant. **Results:** 48 patients with single tooth loss were included. The statistical analysis demonstrated that reason for the loss was not related to height or bone thickness. Bone thickness was statistical significant higher in the posterior region. For the anterior region, the bone thickness was significantly higher when the tooth was lost within 5 years. Pearson correlation test showed a moderate negative significant correlation between time of tooth loss and bone thickness in anterior region. **Conclusion:** Reason for tooth loss had no influence on the bone measurements of the residual ridge. In contrast, bone thickness may vary according to the region of tooth loss. The time of tooth loss and bone thickness in the anterior region were inversely proportional. Registration number at <https://ensaiosclinicos.gov.br/rg/RBR-5cnyjj>.

Keywords: Dental Prosthesis, Implant-Supported. Alveolar bone loss. Cone-beam computed tomography.

RESUMO

Objetivo: Avaliar a altura e espessura óssea em sítios unitários cicatrizados. **Materiais e Métodos:** Neste estudo transversal, imagens de tomografia computadorizada de feixe cônico (TCFC) de regiões edêntulas unitárias maxilares de pacientes candidatos a reabilitação unitária implantossuportada foram mensuradas em relação à altura e espessura óssea usando um software de planejamento de implante. Os dados foram analisados estatisticamente por meio do teste Mann-Whitney e de correlação de Pearson, considerando o tempo, o motivo e região da perda dentária. Para todos os testes, um valor de p <0,05 foi considerado significativo. **Resultados:** Foram incluídos 48 pacientes com perda dentária unitária. A análise estatística demonstrou que o motivo da perda dentária não influenciou na altura ou na espessura óssea. A espessura óssea foi estatisticamente maior na região posterior. Para a região anterior, a espessura óssea foi significativamente maior quando o dente foi perdido em até 5 anos. O teste de correlação de Pearson demonstrou uma correlação significativa negativa moderada entre o tempo de perda do dente e a espessura óssea na região anterior. **Conclusão:** O motivo da perda dentária não influenciou nas medidas ósseas do rebordo residual. Em contraste, a espessura do osso pode variar de acordo com a região da perda dentária. O tempo de perda dentária e a espessura óssea da região anterior foram inversamente proporcionais. Número de registro em <https://ensaiosclinicos.gov.br/rg/RBR-5cnyjj>.

Palavras-chave: Prótese dentária fixada por implante. Perda do osso alveolar. Tomografia computadorizada de feixe cônico.

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Received: 27/07/2021 | **Accepted:** 30/09/2021



INTRODUCTION

Bone dimensional changes, both in height and thickness, tend to occur over time, especially in the first year after tooth loss¹. Bone quality and quantity represent decisive factors in long-term implant success², since contribute to the primary stability of implants, and the management of implant placement, such as its length³. Thus, for adequate insertion and rehabilitation with dental implants, a minimum quantity of bone is necessary.

Cone-beam computed tomography (CBCT) is the assessment of choice for the preoperative analysis of bone; this technique offers excellent image quality, as it employs 3D technology, and exposes the patient to low radiation levels⁴. CBCT provides information regarding the amount of bone available for dental implant placement, making it a fundamental part of management for long-term clinical success.

The rehabilitation of a single tooth in maxilla is considered a clinical challenge, not only due to the esthetics, but also due to the bone changes after extraction. Therefore, the bone dimensions (height and thickness) of the site to be rehabilitated have a great impact on treatment success. Thus, the objective of this study is to measure bone availability (height and thickness) in single healed edentulous areas of maxilla of patients who needed aesthetic single implant rehabilitations, considering the time, reason and region of tooth loss.

MATERIALS AND METHODS

A cross-sectional study was carried out and received the approval of the local Research Ethics Committee (protocol number: 900.542/CAAE:3838164.1.0000.5292) and registered at <https://ensaiosclinicos.gov.br/rg/RBR-5cnyjj>. All patients signed a consent form. Participants were selected from individuals looking for single implant-supported rehabilitation. To participate in this study patients should have single tooth loss in the esthetic region of maxilla (visible in the smile) and present the homologous tooth with acceptable color and shape. Patients with no occlusal stability, requiring orthodontic treatment, with residual root and/or already had a bone graft in the region to be implanted were excluded.

CBCT images, carried out with multifunctional guides, were analyzed in order to quantify the available bone area (height and thickness). The references for height measurements were 2.0 mm below the bone crest to the floor of the nasal cavity or maxillary sinus. To evaluate thickness, the distance between the buccolingual cortex was measured at 2.0mm from the ridge crest (Figure 1). All measurements were performed using CBCT scan software (Dental Slice 2.1, BioParts, Brasilia, DF, Brazil) and collected in millimeters.

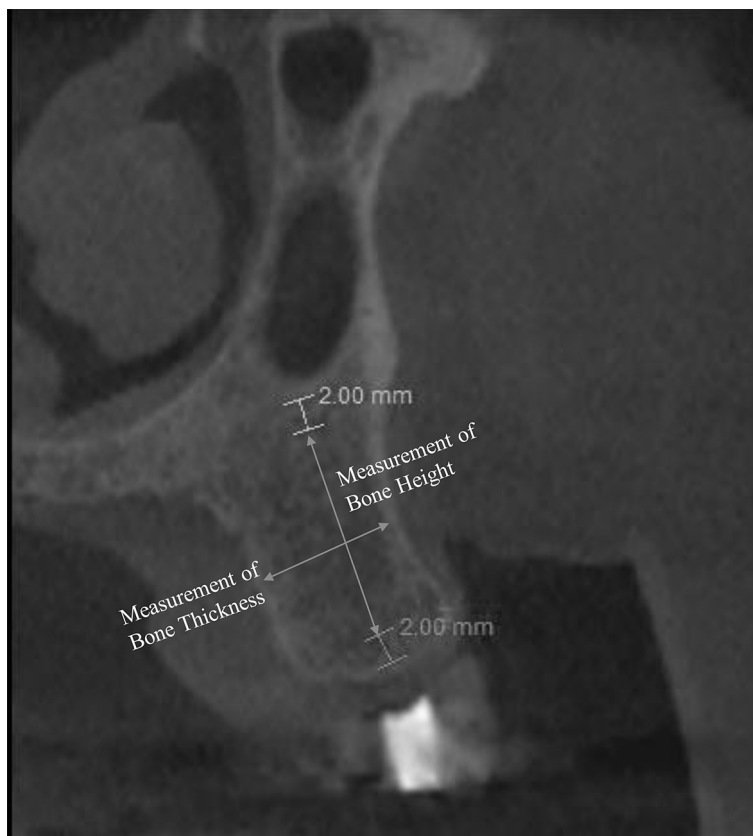


Figure 1: CBCT measurements of bone height and thickness.

Personal information (gender, age, time of tooth loss in years and reason of tooth loss) and information about the location of the tooth loss were recorded. The region of tooth loss was categorized in anterior (incisors and canine) and posterior (premolars and first molar). The reason for tooth loss was categorized in caries (not endodontically treated), loss after endodontic treatment, trauma or periodontal disease without association with the other reasons already mentioned.

Data were analyzed using Mann-Whitney test for the assessment of bone height (BH) and bone thickness (BT), considering the time, and region of tooth loss and Kruskal-Wallis for bone height and thickness, considering the reason for tooth loss. Pearson's correlation was applied to analyze the correlation between the time of tooth loss and BH and BT. A significance level of 95% was adopted ($p < 0.05$).

RESULTS

Forty-eight patients were included in the study, 32 (66.7%) were women and 16 (33.3%) were men, and patients had a mean age of 40.13 ± 11.40 years. Due to the homogeneity in the distribution of the responses, the time of tooth loss was categorized into up to 5 years and over to 5 years. Thus, there were 25 (52.10%) and 23 (47.9%) cases of tooth loss up to 5 years and over 5 years, respectively.

Table 1 presents the BH and BT, considering the reason and region of tooth loss. Four patients were unable to report the reason for tooth loss and were excluded from this analy-

sis. No patient reported tooth loss due to periodontal disease. The reason for tooth loss did not influence bone measurements ($p=0.833$; $p=0.46$). For the region of loss, a significantly greater BT was observed in the posterior region ($p<0.001$).

Table 1: Bone height and thickness, considering the region and reason for tooth loss.

	Height			Thickness		
	n	Median (Q ₂₅ -Q ₇₅)	p	n	Median (Q ₂₅ -Q ₇₅)	p
Region						
Anterior	25	14.68 (12.17-16.81)	0.397	25	4.13(3.14-5.11)	<0,001
Posterior	23	13.3 (7.8-17.5)		23	6.61(5.20-8.05)	
Reason						
Loss after endodontic treatment	20	14.60 (8.18-16.86)	0.833*	20	5.01 (3.69-5.86)	0.946*
Caries	19	14.08 (11.39-17.02)		19	5.19 (3.16-6.90)	
Trauma	5	14.23 (7.43-20.63)		5	5.04 (4.06-8.81)	

Median (interquartile range). Mann-Whitney test, Kruskal-Wallis test*. Significant difference, $p<0.05$.

Due to differences in the pattern of bone loss over time in the anterior and posterior regions, the analysis of BH and BT in relation to the time of tooth loss was performed separately (Table 2). Pearson correlation analysis indicated a significant, but moderate, negative correlation between the time of tooth loss and BT for the anterior region, Table 3 ($r = -0.532$; $p=0.006$).

Table 2: Bone height and thickness, considering the time of tooth loss.

		Height		p	Thickness		
		n	Median (Q ₂₅ -Q ₇₅)		n	Median (Q ₂₅ -Q ₇₅)	p
Time of tooth loss							
Anterior	Up to 5 years	10	15.04 (13.19-20.64)	0.292	10	4.63 (4-5.45)	0.031
	More than 5 years	15	14.23 (11.39-16.68)		15	3.4 (2.98-5.04)	
Posterior	Up to 5 years	15	8.50 (4.30-16.50)	0.020	15	6.90 (5.31-8.10)	0.466
	More than 5 years	8	17.77 (13.92-18.70)		8	5.35 (4.76-7.91)	

Median (interquartile range). Mann-Whitney test. Significant difference, $p<0.05$.

Table 3: Correlation between time of tooth loss and bone height and thickness, considering tooth loss region.

		Pearson Correlation	p
Anterior	Time of tooth loss X Bone height	-0.051	0.810
	Time of tooth loss X Bone thickness	- 0.532	0.006
Posterior	Time of tooth loss X Bone height	0.217	0.319
	Time of tooth loss X Bone thickness	- 0.044	0.841

DISCUSSION

Tooth extraction can cause significant changes in residual alveolar bone dimensions that may influence future rehabilitation treatments. The present study observed a smaller bone thickness in the anterior region when compared with the posterior region. In addition, an inverse proportion between the time of tooth loss and the bone thickness in the anterior region was found. Inadequate bone thickness may not only make implant insertion unfeasible, but can also affect the esthetics.

In the present study, bone dimension (height and thickness) was analyzed by means of CBCT images, a method that is widely used to evaluate the residual alveolar bone^{3,5,6}. Fortin et al.⁷ compared implant plans in severely resorbed maxillae using panoramic images and a three-dimensional planning software, and observed that panoramic images overestimate the need for a sinus augmentation procedure. Thus, the authors concluded that the performance of CBCT images and the use of planning software could increase patient acceptance, since the sinus augmentation procedure can raise the cost, risk of morbidity and treatment time⁷.

Tooth loss can be caused by caries, periodontal disease, trauma or fractures. In this study, more than 80% of patients reported the reasons for tooth loss to be caries or fractures after endodontic treatment. This factor may be the reason for the lack of significant differences in BH and BT, since no patient reported periodontal disease, a disease that causes bone loss, as a reason for tooth loss⁸.

As expected, the anterior region presented a significantly lower thickness than the posterior region; a similar result was also observed by Huynh-Ba et al.⁹. Braut et al.¹⁰, evaluated the thickness of the buccal wall of the anterior teeth and observed a statistically significant decrease in the thickness of the facial bone wall from the first premolars to the central incisors. Thus, the difference between the BT of the anterior and posterior region of the maxilla was expected; however, tooth loss can lead to an even more significant difference, since the anterior region has a thinner vestibular wall, making it more susceptible to alveolar fractures during tooth extraction³.

For the anterior region, the BT was significantly higher when the tooth loss had occurred within 5 years, demonstrating that, in this region, BT tends to decrease over time. Study¹ has reported a decrease in BT over time; furthermore, the maxilla region seems to be most affected by this process, due to the bone quality and anatomical features of the buccal wall^{1,9}.

Tooth loss in the posterior region of the maxilla can generate local changes such as sinus pneumatization and alveolar crest resorption⁵ and the combination of these factors could result in vertical bone loss in this region⁶. Unexpectedly, our results showed a signi-

ificantly higher BH for teeth that had been lost more than 5 years previously; however, the correlation between BH and the time of tooth loss was weak and not statistically significant.

Our findings can be useful for planning graft surgeries, especially in rehabilitations in the anterior region with a long period of tooth loss. However, the results should be interpreted with caution due to limitations like the fact that the time and reason for tooth loss were analyzed by patient reports, which can lead to memory bias. In addition, it was not possible to obtain information about the position of the floor of the maxillary sinus immediately before tooth extraction and the extent of trauma resulting in the extraction process.

CONCLUSION

Bone thickness may vary according to the region of tooth loss. Time of tooth loss can play a role in BT in the anterior region, a finding that was not observed in the posterior region.

FUNDING

Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES)/ Postgraduate scholarship.

CONFLICT OF INTERESTS

The authors declare that they have no conflict of interest.

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