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ORIGINAL ARTICLES

POTENTIAL FACTORS FOR VERTICAL POST-EXTRACTION ALVEOLAR CREST RESORPTION—A CBCT STUDY

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ABSTRACT

INTRODUCTION: The changes in the alveolar crest after dental extraction lead to its reduction in height and width and are referred to as post-extraction resorption. The buccal socket wall is more prone to bone loss due to its width and structure, composed mainly of bundle bone. The extent of bone loss is individual and depends on various local and systemic factors.

AIM: This research aims to evaluate the influence of different factors (jaw—upper or lower, tooth type—premolars or molars, tooth diagnosis, smoking habit, and socket wall thickness) on vertical post-extraction resorption for 3 months using cone-beam computed tomography (CBCT).

MATERIALS AND METHODS: The sample size consisted of 20 participants who needed an extraction of a posterior tooth (molar or premolar).

RESULTS AND DISCUSSION: Two CBCT (Planmeca) examinations were performed—one after the procedure and the second was done after a 3-month healing period. There was no convincing evidence that the considered local and systemic factors (type of jaw—upper/lower, section of the dentition—premolar/molar, diagnosis—periodontitis/periapical lesion, and smoking) had an impact on the quantitative change in the height of the alveolar ridge for 3 months after extraction.

CONCLUSION: Further research is necessary to validate or contradict these findings.

Keywords: *alveolar ridge resorption, local factors, systemic factors, bone atrophy*

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INTRODUCTION

The changes in the alveolar crest after dental extraction lead to its reduction in height and width and are referred to as post-extraction resorption (1). This irreversible phenomenon is caused by the rapid disruption of the periodontal ligaments and the thin bone lining the inner side of the socket (bundle bone) (2). Post-extraction healing involves two opposite processes: bone deposition in the socket and

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bone resorption, causing vertical and horizontal alveolar crest reduction (3). The subsequent functional and aesthetic problems can necessitate guided bone regeneration or other augmentation procedures (4).

Usually, the horizontal loss is more pronounced, but both horizontal and vertical resorption can cause serious prosthetic challenges than the horizontal. It has been reported that the vertical resorption is related to the thickness of the buccal socket wall, but with a specific threshold in the width below which the bone loss is significantly greater (5–7). The buccal socket wall is more prone to bone loss due to its width and structure, composed mainly of bundle bone. The extent of bone loss is individual and depends on various local and systemic factors. The local factors can be surgery-related (amount of trauma, single or multiple extraction, flap elevation) or related to anatomical features and pathological processes (socket wall thickness, number of intact socket walls, periodontal health, fenestrations or dehiscence, marginal or periapical infection). The systemic factors that most commonly affect the resorption process are diabetes mellitus, metabolic disorders, medication affecting bone remodeling, and smoking (8–11).

It has been suggested that horizontal alveolar loss in the mandible and molar areas is significantly more pronounced than that in the maxilla and non-molar areas. On the other side, the vertical loss of the buccal plate is more common in the aesthetic zone. In contrast, a study from 2010 demonstrated that there was no statistically significant difference between the vertical resorption in single-rooted and multi-rooted sockets (12).

AIM

This research aims to evaluate the influence of different factors (jaw—upper or lower, tooth type—premolars or molars, tooth diagnosis, smoking habit, and socket wall thickness) on vertical post-extraction resorption for 3 months using cone-beam computed tomography (CBCT).

MATERIALS AND METHODS

The sample size consisted of 20 participants (aged between 18 and 65 years) who needed an extraction of a posterior tooth (molar or premolar) and had no uncontrolled systemic diseases or any other local/general contraindications for a dental extraction.

The study took place at the Faculty of Dental Medicine, Medical University of Varna, Bulgaria. It was approved by the Research Ethics Committee (approval № 118/ 23.06.2022).

The extractions were performed atraumatically by the same dentist (R.Y.) under local anesthesia, and the socket orifices were sutured with a 5-0 polyamide material.

Two CBCT (Planmeca) examinations were performed—one after the procedure and the second was done after a 3-month healing period. The scan was adjusted to a paraxial slice in the middle of the dental socket, and the length of the socket walls was registered using the following landmarks: the uppermost point of each plate to the bottom of the maxillary sinus or the ceiling of the mandibular canal. The thickness of both socket plates was measured on the same slice at 3 mm apically from the uppermost point of the walls (Fig. 1). When the socket bone septa were preserved, the measures were taken for the mesial and distal parts of the socket. Therefore, the number of analyzed measurements exceeded the number of extracted teeth.

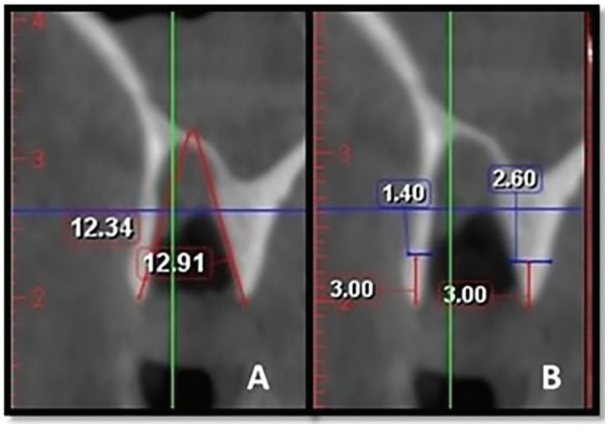


Fig. 1. CBCT scans after the extraction. A. Measurement of the socket wall heights; B. Measurement of the socket wall widths.

Statistical analysis was performed using descriptive statistics and parametric tests (IBM SPSS and MS Office Excel). The selected level of significance was $p = 0.05$.

Of the patients in this group, 12 (60%) were male and 8 (40%) were female, with no statistically significant difference by gender ($\chi^2 = 0.80$, $p = 0.37$).

RESULTS

Regarding smoking, smokers predominated among the patients in the group, without a statistically significant difference ($\chi^2 = 1.8$, $p = 0.2$) (Fig. 2).

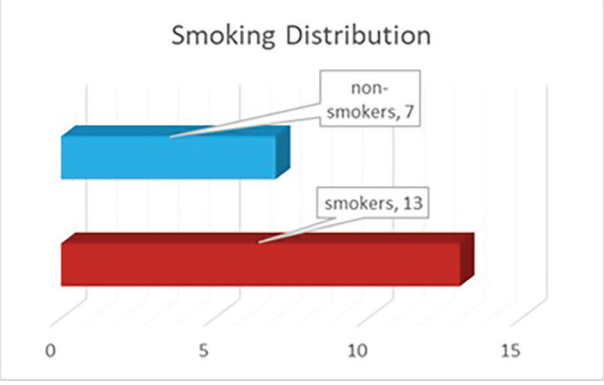


Fig. 2. Distribution of smokers and non-smokers among the participants.

No statistically significant difference was registered regarding the ratio of the tooth diagnoses ($\chi^2 = 3.2$, $p = 0.07$) (Fig. 3).

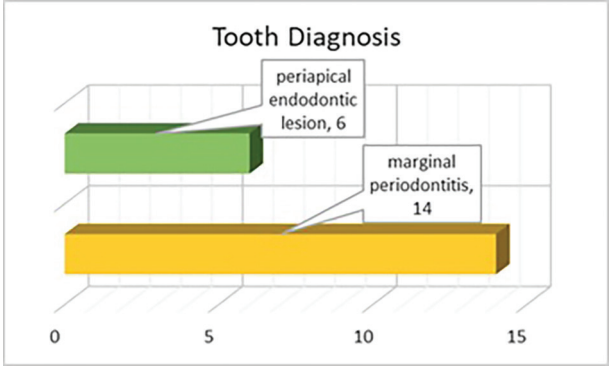


Fig. 3. Distribution of tooth diagnoses.

A statistically significant buccal wall resorption of 3.5 ± 2 mm was found (t = 8.66, $p < 0.0001$). Data analysis demonstrated no statistically significant difference in the buccal resorption according to the jaw type (upper/lower jaw), tooth type (premolar/molar), and smoking. However, there was a significant dif-

Table 1. Vertical buccal plate resorption according to the observed categories.

Buccal Plate Resorption		N	Mean ± SD	t	p
Jaw	Upper	11	2.9 ± 1.5	0.26	0.8
	Lower	13	3.9 ± 2.2		
Tooth	Premolar	8	3.6 ± 2.0	0.23	0.8
	Molar	16	3.4 ± 2.0		
Diagnosis	Periodontal disease	16	4.0 ± 2.1	2.10	0.05
	Periapical lesion	8	2.4 ± 1.1		
Smoking	Yes	15	3.7 ± 2.2	0.89	0.4
	No	9	3.0 ± 1.5		

Table 2. Vertical palatal/lingual plate resorption according to the observed categories.

Buccal Plate Resorption		N	Mean ± SD	t	p
Jaw	Upper	11	2.1 ± 1.1	-0.04	0.97
	Lower	13	2.1 ± 1.2		
Tooth	Premolar	8	2.0 ± 1.4	-0.37	0.71
	Molar	16	2.1 ± 1.0		
Diagnosis	Periodontal disease	16	2.1 ± 1.1	0.38	0.71
	Periapical lesion	8	2.0 ± 1.1		
Smoking	Yes	15	2.3 ± 1.1	0.94	0.36
	No	9	1.8 ± 1.1		

ference in the vertical resorption of the wall regarding the diagnosis, periodontal disease, or periapical lesions (t = 2.1, $p = 0.05$) (Table 1).

A statistically significant palatal/lingual wall resorption of 2.1 ± 1 mm was found (t = 9.27, $p < 0.0001$). Regarding the observed categories, the difference in the vertical resorption was insignificant (Table 2).

There was a weak, statistically insignificant correlation between the vertical loss of the two alveolar bone plates (Pearson's r = 0.21, p = 0.3). The mean difference in their resorption (1.4 mm) was statistically significant (t = 3.0; $p = 0.005$).

The measured widths of the plates on the day of the procedure were 1.7 mm for the buccal wall and 3 mm for the oral wall.

There was a moderate, negative, statistically insignificant correlation between the width of the buccal bone plate measured on day 0 and its vertical loss within 3 months (Pearson's r = -0.36, $p = 0.09$).

The same trend was observed for the palatal/lingual bone plate, but a weak, negative, statistically insignificant correlation was registered (Pearson's r = -0.29, $p = 0.18$).

DISCUSSION

The only indicator that demonstrated a significant difference in the vertical buccal plate loss was the tooth diagnosis. The mean bone loss in areas diagnosed with chronic periodontitis was 4.0 ± 2.1 mm, and in endodontic lesions, the mean loss was 2.4 ± 1.1 mm (with a mean difference of 1.6 mm). This can be attributed to the preliminary impairment of the marginal bone due to the periodontal infection.

Zhao et al. (13) studied the volumetric changes of the alveolar ridge after tooth extraction in the molar regions of the dentition, as well as in teeth with advanced periodontal disease. They did not find a statistically significant difference in the loss of ridge height in the two jaws over a period of 6 months. However, it was reported that the resorption in height was more pronounced in the buccal wall of the alveolar ridges in the mandible compared to that in the maxilla.

Although the difference in vertical resorption of the buccal bone between the two jaws was not statistically significant, the mean resorption in the mandible was 3.9 ± 2.2 mm and in the maxilla was 2.9 ± 2.5 mm. The mean difference between them was 1 mm, which is a clinically significant value and corresponds with the results obtained by Zhao et al. (13).

There was a statistically significant difference between the vertical resorption of the two plates in the present study, with a mean difference between them of 1.4 mm. The conclusion is that the resorption did not proceed evenly, but was more pronounced in the buccal wall.

It is important to note that the mean difference between the two widths of the buccal and lingual plates, measured immediately after extraction, was 1.3 mm and, most importantly, that the mean width of the buccal bone was less than 2 mm, while that of the palatal/lingual was more than 2 mm.

According to some authors, when the width of the buccal plate is < 2 mm, bone resorption is more evident (14–16), but the minimum width of the buccal plate to avoid vertical bone resorption has not yet been established (17).

Chappuis et al. reported a vertical resorption of over 7 mm for the buccal wall width ≤ 1 mm after 2 months. In areas with thicker buccal walls (> 1 mm), the authors reported a mean vertical loss of 1 mm (18). Similarly, Quhash et al. reported that the buccal bone must be at least 2 mm wide to maintain the ridge level (15).

However, an insignificant correlation was found between the buccal plate width and the subsequent vertical resorption after 3 months, suggesting that the width of the crest is not the only determining factor for the more pronounced vertical resorption.

This study evaluated some of the factors that were considered to influence vertical post-extraction resorption. There was no convincing evidence that the extent of the vertical plate resorption depended on the jaw and tooth type, the diagnosis, and the smoking habits. However, this research has several limitations, the most important of which is the relatively short follow-up period. Other limitations include: not considering anterior teeth, which are most likely to experience rapid resorption; not considering other non-infectious reasons for extraction; and a small sample size. Future clinical trials should address these limitations.

CONCLUSION

There was no convincing evidence that the considered local and systemic factors (type of jaw—upper/lower, section of the dentition—premolar/molar, diagnosis—periodontitis/periapical lesion, and smoking) had an impact on the quantitative change in the height of the alveolar ridge for a period of 3 months after extraction. Further research is necessary to validate or contradict these findings.

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