EVALUATION OF VOLUMETRIC MAINTENANCE AFTER SINGLE AND MULTIPLE DENTAL EXTRACTION USING LAMINATED TITTANIUM SHEET - TITÂNIO SEAL®"

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Abstract: The post-extraction border preservation is a fundamental procedure to the maintenance of alveolar volume prioritizing an aesthetical and functional improvement in the im- plant's positioning. This thesis's objective was to evaluate the titanium membrane (Sur- gitime Titânio Seal® – Bionnovation, Brasil) covered post extraction alveolar bone di- mensional alterations, while comparing areas to unitary and multiple exodontias. 20 pre

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and post-operation tomographical exams were evaluated, from areas where unitary den- tal extractions (G1) and multiple dental extractions (G2) occurred. In every case, using the Titanium Seal post extraction alveolar preservation treatment, with no alveolus fil- ling. Measurements were obtained from the central region of the axial and area sections previous to the proceadure at the most cervical zones of bone peaks, plus two more measurements from 2 and 4 mm under the first point. Following, those measurements were transfered from the previously obtained absolute refurbishment length. Measurements were taken from the new total border length – at the central virtually representative re- gion of the extracted dental element. In both groups, differences among baseline and 6 months in height: -0,95mm ±0,89 (G1) and -1,95mm ±1,04 (G2) and 2mm volume: -1,10mm ±0,48 (G1) and -2,48mm ±1,08 (G2) were statistically representative. In any cases, the 4mm volume presented differences. Statistically, the bone loss was higher in Group 2. The present study have shown that the titanium-laminated sheet was effective when it comes to post-extraction alveolar preservation, in both unitary and multiple ex- tractions.

Keywords: Dental Extraction. Alveolar border. Bone reabsorption.

INTRODUCTION

About modern odontology, osseointegrated implants are a regular choice for most cases of lost teeth. The post-extraction bony alveolar tissue preservation, especi- ally when there are bone

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deformities, is extremely important for the later implant setup, easing the implant placement and, therefore, it's aesthetical and prosthetic results (Sch- ropp et al., 2003; Van der Weijden et al., 2009).

Morphological and dimensional alveolar bone modifications have been re- lated in literature. Schropp et al's (2003) study has shown a standard horizontal reduc- tion of 5 to 7 mm of the alveolar bone during the first 12 months post extraction. This represents a loss around 50% of the original bone, considering that around two thirds of this loss occur during the first three months. In 2005, Araújo and Lindhe, through their study in dogs, presented that this reabsorption happens due to the functional stimulation proportioned by the tooth, enhancing the osteoclasts activity; and that the largest chunk of reabsorption occurs at the alveolar vestibular wall. Besides the bony reduction, there is also a mucous loss keratinized at the extraction points.

Many alveolar preservation techniques may be found in literature. Among them, there is: biomaterial alveolus filling (bony graft, fibrin enriched plasma); Alveolus covering through membrane (absorbable or not), which acts as a cellular selection barri- er; or a combination between them, that may, or may not, have cicatrization as first in- tention. (Avila-Ortiz et al., 2019).

The first non-absorbable membrane available for odonthological usage was made of expanded polyurethane (e-PTFE). PTFE is a stable polymer, biologically and chemically inert, capable of resisting microorganism's enzymatic attacks. However, e- PTFE membranes

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are highly porous, therefore, in spite of avoiding bacterial contamina- tion, there must always be a primary wound closure (Carbonell et al., 2014). Thereat the lack of tissue for side-to-side closing the alveolus, it was idealized some types of mem- branes able to remain intentionally exposed, sealing and protecting the alveolus content, so that the same may regenerate itself, while keeping its original volume.

Therefore, flatter surface membranes were developed, allowing to remain exposed at oral environment. Among them, there is high density polytetrafluoroethylene (n-PTFE) and plain titanium membranes. This kind of membrane acts as biological bar- rier, stopping the conjunctive tissue epithelial cells migration and/or bacteria that could inhibit bone growth. On the other hand, the titanium flat membranes, beside topographi- cal and constitutional characteristics, present biofilm formation inhibition – which might be best indicated to cases of oral cavity exposition cases.(Resende et al.,2020). Besides it's biocompatibility, mechanical resistance for outline formation and biological corrosion, not being pyrogenic, must offer eficient cellular blockage. The laminated ti- tanium sheets, beyond those characteristics, carry high osteophilia, which separates them from plastic membranes, atop of little attacking soft tissues (Mizutani et al., 2018).

MATERIALS AND METHODS

Ethical aspects and the studied sample

This research was performed through the evaluation

of medical records and computed tomographic exams of patients undergoing unitary or multiple tooth extrac- tions. The dimensional alterations of the alveolus post-extraction were compared after being preserved with the use of an anodized titanium sheet Titânio Seal®, without the alveolus being filled with biomaterials.

Tomographic exams of the type Cone Beam were selected from the archive of multicentric professionals after having been screened based on the cause of the dental loss, so as to follow our inclusion and exclusion criteria.

Sample size

20 pre- and post-operative tomographic exams performed in areas where unitary tooth extraction had occurred were evaluated (Group 1 - G1) and 20 pre- and post-operative tomographic exams performed in areas where multiple tooth extractions had occurred (Group 2 - G2). In all the cases being studied, post-extraction preservation treatment of the alveolus was performed using Titânio Seal®, without filling the alveo- lus with biomaterials.

Inclusion criteria:

In the present multicentric study, there have been included tomographic ex- ams taken from patients who presented the following indicative clinical conditions:

Tooth extraction was required due to dental fracture;

Tooth extraction was required due to inaccessibility and low endodontic predictability.

Tooth extraction was required due to periodontal disea-

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se.

The pre- and post-operational tomographic exams were conducted in the same radiology imaging center with a 6-month interval in between them.

Exclusion Criteria

Tomographic exams from patients with the following characteristics were not included in the studied sample:

Patients with periodontal disease with loss of osseous insertion greater than 2/3 of the dental root.

Patients with systemic metabolic disorders.

Areas which had a previous dental implant in its vicinity.

Patients with any systemic condition which impedes the realization of future dental implants.

Pre- and post- operational tomographic exams of the same patient were per- formed in different radiology imaging centers.

Evaluation of the tomographies:

Computed topographies of the type Cone Beam screened using a simple questionnaire (attachment I) to construct the sample within the inclusion and exclusion criteria were evaluated.

Millimeter measurements of the total length of the alveolar ridge (from the osseous base up to the cervical region) of the axial plane cut, in the central region of the dental element, were taken.

Millimeter measurements of the width of the most central region of the axial plane cuts of the toothed areas previous

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to the tooth extraction were taken in the most cervical zones of the osseous peaks. Additionally, two more measurements were taken located 2 and 4 millimeters below the first.

Next, the measurements of the total length of the alveolar ridge were trans- ferred and millimeter measurements of the new alveolar ridge length were taken at the most central region, a virtually representative of the extracted dental element.

Millimeter measurements were taken of the width of the most cervical re- gions relative to the first measurement as well as an additional two more measurements 2 and 4 mm below the original ones.

This data was transferred to a table (attachment II) in order to determine av- erage and standard deviation values to be compared.

Statistical analysis

After the data was collected, the respective averages and standard deviations were obtained.

The statistical analysis of the data was performed using the T-test and ANOVA and BONFERRONI tests.

RESULTS

In each group, there have been included 20 participants, 11 female and 9 male. Using the unpaired T-test, the ages of the participants have been compared. In the simple extraction group, the average age was calculated to be 42.9 years and in the mul- tiple extractions group the average resulted in 48.6 years.

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Vol. 02 - n 04 - ano 2022

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Values of CBCT outcomes with respect to width in mm at baseline and 6 mths single post extr						
PATIENT	GENDER	AGE	TOOTH	BASELINE	6 MONTHS	CHANGE
1	F	36	46	10,2	9,1	1,1
2	M	42	36	11	9,5	1,5
3	F	50	25	9	8,2	0,8
4	F	38	36	10,8	9,5	1,3
5	F	48	16	11,5	10,5	1
6	M	60	16	10,5	9,3	1,2
7	M	54	26	12	10	2
8	F	39	21	9,3	7	2,3
9	M	31	25	8,7	8	0,7
10	F	47	14	7,8	7	0,8
11	M	39	44	8,5	7	1,5
12	F	33	37	11	9,8	1,2
13	F	41	46	10,6	9,3	1,3
14	F	53	46	10	8,8	1,2
15	M	30	21	9	7,7	1,3
16	F	34	12	7	5,6	1,4
17	M	42	26	12,1	11,5	0,6
18	M	44	36	10,6	9,3	1,3
19	F	58	36	11	10,5	0,5
20	M	39	47	11,4	11	0,4

Table 1: Values obtained for G1 (unitary extractions)

Values of CBCT outcomes with respect to width in mm at baseline and 6 mths multiple post ext						
PATIENT	GENDER	AGE	TOOTH	BASELINE av	6 MONTHS	CHANGE
1	M	46	45/46	8	6,3	1,7
2	M	34	36/37	11	8,2	2,8
3	F	56	25/26/27	10	8,5	1,8
4	F	53	36/37	12	9,2	2,8
5	F	39	16/17/18	11,5	10	1,5
6	F	60	15/16	9	7,5	1,2
7	M	42	26/27	12	10,5	1,5
8	F	43	21/22/23	8	6,5	1,5
9	F	53	35/36/37	8,5	6	2,5
10	M	60	35/36	9,1	7,8	1,3
11	F	58	14/15	8,5	7	1,5
12	M	47	13/14/16	8,7	6,8	1,9
13	M	43	46/47	10,1	8,4	1,7
14	M	42	45/46/47	8,9	7	1,9
15	F	39	36/37/38	12	9	3
16	M	55	16/17/18	12,5	10,2	2,3
17	F	59	11/12/21	8	5,4	2,6
18	F	49	23/24/25/26	8	6,6	1,4
19	F	54	36/37/38	11,5	8,2	3,3
20	M	41	24/25/26/27	8,5	7	1,5

Table 2: Obtained values for G2 (multiple extractions)

The volume measurements (2 and 4 mm from the dental ridge) and the ini- tial height before the extraction were compared with the post-extraction measurements using a paired T-test. In the unitary extraction group (table 3), the differences in height were statistically significant. The average baseline was

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Vol. 02 - n 04 - ano 2022
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measured at 25.95mm (±10,73) and six months later it was measured at 25,00mm (±10,66). Regarding the volume at 2mm, it was measured at 9.98mm (±1,45) before the removal and 8,88mm (±1,55) six months after. The difference in volume between the initial and final values for the 4mm measurements was not statistically significant.

Table 3 - Unitary tooth removal (G1): Baseline x 6 months.

	Volume in 2mm		Volume in 4mm		Height	
	baseline	6 months	baseline	6 months	baseline	6 months
Average (±SD)	9,98 ±1,45	8,88 ±1,55	10,88 ±2,15	10,38 ±2,24	25,95 ±10,73	25,0 ±10,66
P value	*p<0.0001		p=0.4761		*p<0.0001	

Paired T-test, α=0.05

The same verification was performed for the multiple extractions group (ta- ble 4). Again, the differences in volume in the 4mm height between the initial and final measurements were not statistically significant. In contrast, there were statistically sig- nificant differences in height and in volume for the 2mm height measurements. The ini- tial and final values for the volume for the 2mm height were measured at 9,58mm (±1,85) and 7,10 (±1,59), respectively. The initial and final values for the height were 21,15mm (±11,78) and 19,20mm (±11,48), respectively.

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Table 4 – Multiple Tooth Extraction (G2): Baseline x 6 months:

	Volume 2mm		Volume 4mm		Height	
	baseline	6 months	baseline	6 months	baseline	6 months
Average (±SD)	9,58 ±1,85	7,10 ±1,59	10,58 ±1,91	9,70 ±2,02	21,15 ±11,78	19,20 ±11,48
P value	*p<0.0001		*p=0.0008		*p<0.0001	

Paired T-test, α=0.05

Afterwards, a comparison between the unitary and multiple extractions groups was performed (graph 1). To obtain this comparison, the ANOVA test was per- formed, followed by the Bonferroni test. The comparison was done to observe whether the variation in the measurements differed between the two groups. For the 4mm vol- ume measurement, no difference was observed. However, for the 2mm volume and height measurements, the variation in the measurements was greater for the multiple extractions group. Hence, statistically, group 2 had a higher bone loss.

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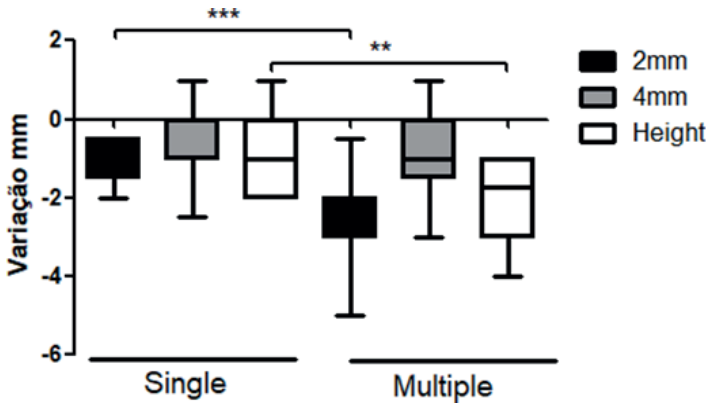

Graph1: Comparison between G1and G2

DISCUSSION

Diverse studies display that, after an extraction operation, an alveolar bone reabsorption occurs, especially around the vestibular wall height (vertical reabsorption) and volume (horizontal reabsorption) dimensions (Araújo e Lindhe, 2005).

At the last 20 years, many alveolar preservation techniques have been de- scribed in literature. Among the most representative methods is the bone graft employed as absorbable walls (Maiorana et al., 2017). However, the research for simpler, cheaper and faster-healing techniques, the non-absorbable barriers were developed. Its first ex- ample is the expanded polytetrafluoroethylene (e-PTFE). This barrier, although, is por- ous; so it may not be exposed to the oral environment; situation that might occur, par- ticularly around large alveoli, at molar regions – where, oftentimes, the first-intention closure represents a hard task (Carbonell et al., 2014).

For this reason, new membranes – able to remain exposed to oral environ- ment,

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emerged. Such as the high-density polytetrafluoroethylene (n-PTFE) and flat tita- nium membranes (Surgitime Titânio Seal® – Bionnovation, Brasil).

Alveolar regeneration--preservation-oriented membranes must be biocompat- ible, possess mechanical resistance for the alveolus outline maintenance and must offer efficient cellular blockage (avoiding soft tissue competition and invagination). The lam- inated titanium sheets, diverging from plastic barriers, present high osteophilia and deal less damage to soft tissues. Thanks to its anodized surface treatment, it affords less bac- terial adherence. This process also performs the conversion of amorphous titanium ox- ide to a thin, crystalline, anatase-enriched layer, which provokes cytocompatibility, rais- ing the adhesion of osteoblasts and fibroblasts, while also reduces the growth of specific buccal bacteria (Mizutani et al., 2018).

Studies argue that the post-extraction alveolar bone, if not subjected to preservation procedure, might present an average reduction of 5 to 7 mm, dimensions able to express 50% of the lingual-vestibule volume (Schropp et al., 2003) within 12 months, considering that two thirds occur during the first 3 months. In the present essay, both the unitary and the multiple extraction groups, presented average volumetric reab- sorption distancing 2 mm from the fold's border, within 6 months, of 1,1mm (±0,48) e 2,48mm (±1,08) respectively and, at 4mm from the fold, the reabsorption was not statis- tically meaningful, so proving the method's effectiveness.

The post-extraction height reabsorption is also notable.

Considering lasella et al. (2003), this loss's exponent was 2,5mm. In unitary extraction regions, the vertical reabsorption is less representative than the horizontal (Araújo et al.m 2015). The inves- tigation displayed thorough this thesis, displayed average reabsorption of 0,95mm (±0,89) in group 1 and 1,95mm (±1,04) in group 2.

Despite studies display that the bone reabsorption can increase due to aging, mostly at patients over 50 years old (Imirzalioglu et al., 2012), the age difference be- tween groups 1 and 2 (42,9 years old and 48,6 years old, respectively), does not express significance to the obtained results.

Studies suggest that the multiple adjacent teeth extraction are compromised both by the alveolar bone and the interdental bone ridge blood support (Nawwaf Al- Hamoud et al., 2015).

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