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Evaluation and comparison of crestal bone loss associated after bone expansion with three different osteotomy techniques for implant placement.

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Abstract

Aims: To evaluate and compare the amount of crestal bone loss after implant placement using Osteotome, expansion screws, Densah™ burs.

Materials and Methods: A total of 33 implants were placed, the number of implants were divided into 3 groups: 11 implants were placed in each group and data was recorded. (11 implants per group) were placed in. Group 1- osteotome technique, group 2- expansion screw technique, group 3 Densah™ burs. The crestal bone loss was measured at the time of implant placement(T0), 1 months(T1), 3 months(T2) and 6(T3) months after implant placement. (Statistical analysis used: ANOVA).

Results: The mean CBL of group 1 after 6 months was (mean 0.512 ± 0.224), Group 2 (mean 0.379 ± 0.273), and group 3 (mean 0.205 ± 0.084). CBL was maximum in group 1 followed by group 2 and least in group 3, after 1 month, 3 months and 6 months period each.

Conclusions: CBL was maximum in group 1 followed by group 2 and least in group 3, after 1 month, 3 months and 6 months period each.

Keyword: Osteotome, Expansion screws, Densah™ burs, Osseo densification, Crestal bone loss, bone expansion.

Introduction

Restoration with dental implants have become a popular choice in the oral and maxillofacial rehabilitation after the introduction of osseointegration. The quality and volume of the bone present at the site are important factors determining the type of surgical procedure and the type of the implant, and they are related to the success of dental implant surgery[1]. The rehabilitation of narrow edentulous ridges in maxilla or mandible using implants is often challenging due alveolar bone resorption or low bone density. Thus, an augmentation procedure is often indicated in this area. Ridge split technique or bone augmentation are the most common surgical techniques used for increasing the available bone volume to place implants and restore function and aesthetics. Maxilla and mandible present a wide variation in respect to the bone density and the type of bone present in different regions. A poor density bone, such as in the maxillary posterior region, can negatively influence the bone to implant contact and delay osseointegration[2,3]. Thus the management of insufficient bone volume can be handled in a number of ways that have been devised and tested.

Summers developed a new osteotomy technique for bone expansion and compaction to increase the bone density which would lead to increase implant primary stability[4].

Another technique using screws of increasing diameter for bone expansion and condensation. Lateral bone expansion or condensing for the implantation of an endosseous dental implant, it employs a "screw-type" configuration of expansion and condensing burs and thread-form with progressively larger diameters. These burs are intended to widen the osteotomy without significant bone loss[5].

Huwais in 2013 developed a bone non extraction technique osteotomy method with the use of Densah™ Burs.[6] This process of osseodensification and bone compaction takes advantage of the bone's viscoelastic and plastic properties to deform by applying a time-dependent stress (force) to produce a time-dependent strain (deformation)[7.] This method creates a circumferential and apical "burnished" crust of enhanced bone mineral density surrounding the osteotomy site[6.]

There is no study comparing the crestal bone loss after implant placement with osteotome, expansion screws, and Densah™ burs. Hence this study was done with an aim to compare all three techniques in narrow maxillary and mandibular alveolar ridge with D2 and D3 bone quality. This study included assessing the effects of these osteotomy techniques on maxillary posterior region as this region has softer bone, and thus densifying the area during placement might lead to improved prognosis.

Material And Methods

The study was conducted on subjects visiting outpatient Department of Prosthodontics and Crown and Bridge and Department of Oral Implantology. Approval from Institutional Ethical committee was obtained. Informed consent was obtained from each subject.

Inclusion Criteria

- Partially edentulous or completely edentulous patients with resorbed ridge in maxilla or mandible.
- D2 & D3 bone quality.

Exclusion Criteria

All patients with diabetes mellitus, hypertension, any soft or hard tissue pathology, parafunctional oral habits such as bruxism, smoking, and limited mouth opening will be excluded.

Sample Size Estimation

Study Design: At initial visit, screening and examination of patients based on the criteria planned for implant placement.

Session 2: Preoperative radiographic examination RVG (Radio Visio graphy), OPG (orthopantomogram) and CBCT (Cone beam computed tomography) was done for evaluation of the bone quality, width and height. Blood investigations were conducted to ensure normal levels are attained.

Session 3: Implant placement and RVG assessment for crestal bone loss.

Session 4: radiographic assessment after T1, T2, T3 postimplant placement, for evaluation of crestal bone loss.

Surgical Protocol

A total of 33 implant sites with inadequate alveolar ridge width were divided into 3 different groups for implant placement. Three different instruments were used for osteotomy preparation to expand the alveolar ridge width.

Group- 1 (Osteotome)

Group- 2 (Bone expansion screws)

Group- 3 (Densah™ burs)

Each patient received a detailed description of the study protocol, signed the inform consent form and gave written approval to be included in the study. All the patients were subjected to a preliminary assessment that included careful review of their dental and medical histories, clinical examination, and evaluation of oral hygiene. All patients underwent radiographic evaluation including both periapical radiographs, OPG and CBCT scans prior to implant placement for surgical planning and assessment of bone dimensions around the site of implantation. Preoperatively, patient's blood pressure was noted. Patients were instructed to rinse with 0.2% chlorhexidine solution for 1 minute. The surgical procedure was performed under local anaesthesia (Lignocaine 1:80,000)

After local anaesthesia was achieved, a mid-crestal incision was placed and a full thickness muco-periosteal flap was elevated.

Group 1

In group 1 set of cylindroconical osteotomes of diameter (2.5, 3.0, 3.5, 4.0, 4.5 mm) were used for osteotomy preparation and bone expansion. The technique consisted of preparing the initial osteotomy with a (1.5 mm) pilot drill at the planned implant site. A smallest calibrated osteotome 2.5 mm was used to expand the osteotomy, followed by next larger diameter osteotome. The expansion osteotome were tapped manually with the mallet until the desired height was reached. After the osteotomy preparation the implant were immediately placed to prevent the socket from collapsing. The implant was placed carefully to avoid fracture or dehiscence of the thin bony plate.

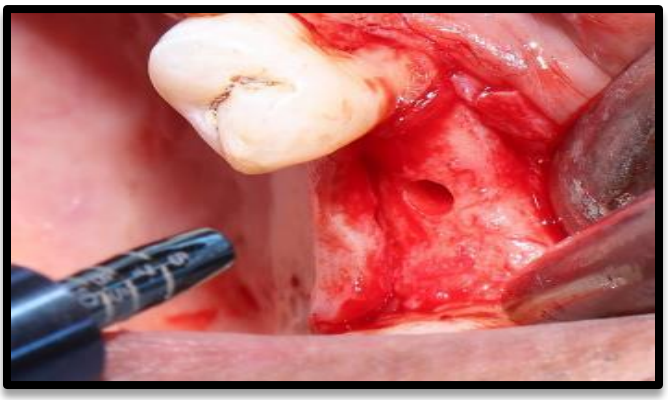


Figure 1: Osteotome used to expand the Osteotomy.

Group 2 bone expansion screws of size (2.6, 3.0, 3.4, 3.8, 4.3 mm) were used to prepare the osteotomies. The kit consisted of 5 expansion screws of increasing diameter and with a length of 15 mm, a carrier, and a hand driver. The expansion screws were used only after the 1st pilot drill (1.5 mm) for osteotomy preparation. Which was normally performed after reaching the

desired depth of the osteotomy, according to the length of the implant. Extreme care was taken to proceed as slowly as possible. After every half rotation, a 30 second waiting time was used before turning the screw another half turn. This waiting time is important because as the expansion screw sinks further the bone needs time to accommodate to expansion. After each of the expansion screws have reached the desired depth, an under-sized osteotomy was prepared to receive a greater diameter implant.

Figure 2: Bone expansion screws used to expand the Osteotomy.

Group 3

Group 3 Densah™ burs were used to prepare 11 osteotomy sites. These Densah™ burs set contains 12 burs of size (2.0, 2.3, 2.5, 3.0, 3.3, 3.5, 4.0, 4.3, 4.5, 5.0, 5.3, 5.5 mm) A (1.7 mm) pilot drill was used to create an initial osteotomy rotated in a clockwise direction at 800-1200 RPM. Once the correct osteotomy length was achieved, Osseo densification was utilized by initially using Densah™ burs VT 1828 running in counterclockwise direction with saline irrigation at 800 - 1200 RPM with a bouncing motion to expand the osteotomy. Sequential use of Densah™ burs in counterclockwise direction was followed to achieve the desired expansion of alveolar ridge.

The incision was sutured to close the wounds. All patients were instructed to follow a soft diet in the first 3 days after surgery, along with instructions for oral hygiene. They received a prescription for Amoxclav 625 mg, one tablet every 8 h for 5 days, starting 1 hour pre-surgery. Additional prescriptions included anti-inflammatory and analgesic drugs for 3 days. Sutures were removed 1-week after the surgery.

Figure 3: Densah™ burs used to expand the osteotomy.

Measurements

For Radiographic measurement, standardized radiographic images were obtained in the way that implant/abutment interface, and the threads would be clearly visible to assure that radiological evaluation and measurements were performed using RVG Windows software measurement program[8]. The following formula was used to calculate the corrected crestal bone level to adjust for magnification error:

$$\frac{\text{Length of implant in radiograph}}{\text{Original implant length}} = \frac{\text{Crestal bone level on radiograph}}{\text{Corrected crestal bone level}}$$

The amounts of bone loss on the mesial and distal sides of the implants were measured and the average value was used for analysis. Comparisons were made between radiographs taken T0, T1, T2, T3. Bone loss in mm were calculated by comparing the initial radiograph with the radiograph obtained after T1, T2, T3, after implant placement.

Statistical analysis

Sample Size Calculation

$$n = \frac{(Z_\alpha + Z_{1-\beta})^2 \sigma^2}{E^2}$$

Where, Z_α= 1.96 at 95% confidence level

$Z_{1-\beta}$= 0.8413 at 80% power of study

σ= be standard deviation of 0.002mm

E be difference of mean= 0.018

$n = \frac{(1.96+0.8413)^2}{(0.017)^2} = 11$

Since we are having 3 groups, total of 33 implants that is 11 in each group will be taken for the study.

Result

3 implants failed after using Osseo densification technique and were excluded from the study. Remaining implants osteointegrated successfully in all three groups and were clinically stable during second stage surgery after 3 months postoperatively. No patient complained of pain, and there was no sign of inflammation. Yet some patient mentioned discomfort at the time of surgery while using osteotome.

At T0 the crestal bone loss was 0.0 mm in all three groups. At T1 the mean CBL was 0.27±0.10 mm in group I, 0.19±0.09 mm in group II and 0.09±0.05 in group 3. At T2 the mean CBL was 0.40±0.17 mm in group I, 0.26±0.17 mm group II and 0.16±0.07 mm in group III. At T3 the mean CBL was 0.512±0.22 mm in group I, 0.37±0.27 mm in group II and 0.20±0.08 mm group III. All three groups showed a significant bone loss from T0 to T1, T2, T3 as shown in table 1.

Comparing the mean CBL of all three groups at different time interval showed that the CBL was higher in group I followed by group II and least in group III. (P<0.001) the CBL from T1 to T3 was 0.51±0.22 mm in group I, 0.37±0.27 mm in group II and 0.20±0.08 mm in group III. As shown in table 2.

Group I

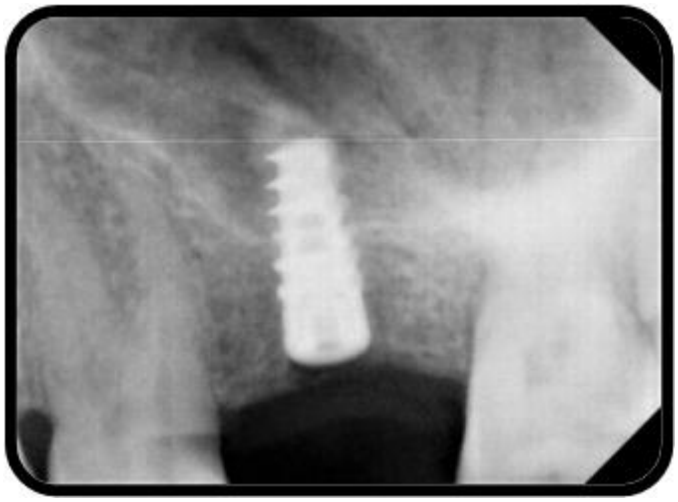


Figure 4: RVG immediately after implant placement.

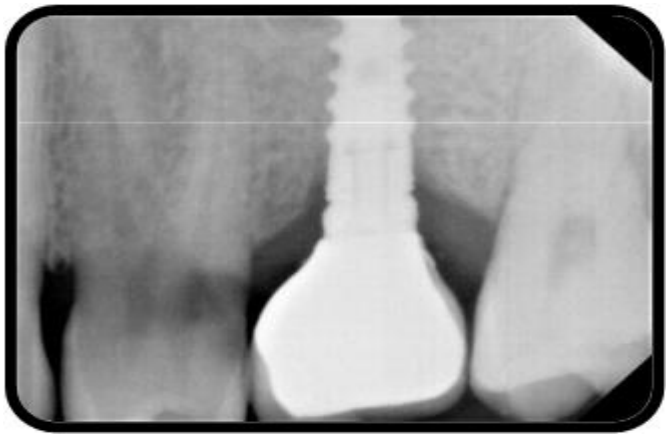


Figure 5: RVG after 6 months of implant placement.

Group II

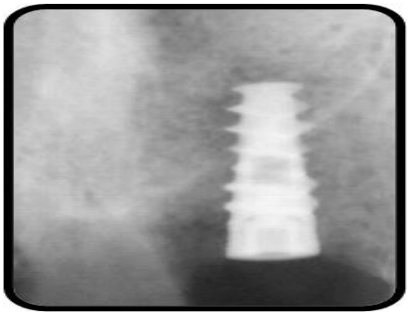


Figure 6: RVG immediately after implant placement.

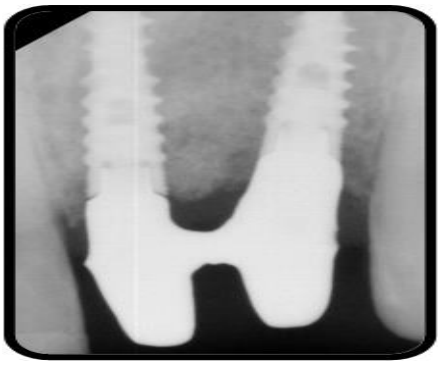


Figure 7: RVG after 6 months of implant placement.

Group III

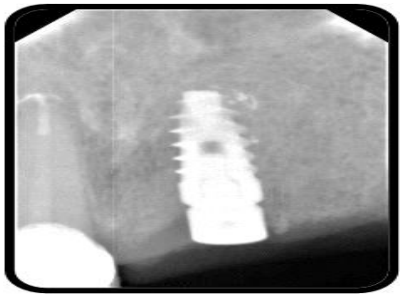


Figure 8: RVG immediately after implant placement.

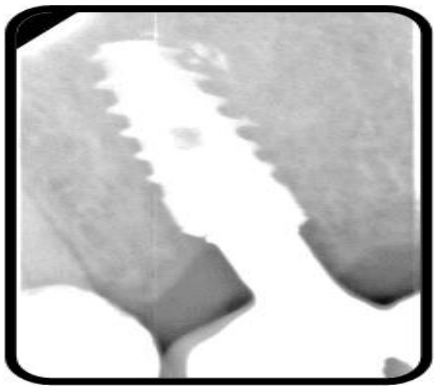


Figure 9: RVG after 6 months of implant placement.

Discussion

The main objective of this study was to evaluate the CBL after implant placement with Osteotome, expansion screws and Densah™ burs. A comparison was made of

Table 1: The radiographic evaluation of Crestal bone loss in each group from pre-operative period to 1month, 3 month and 6 months

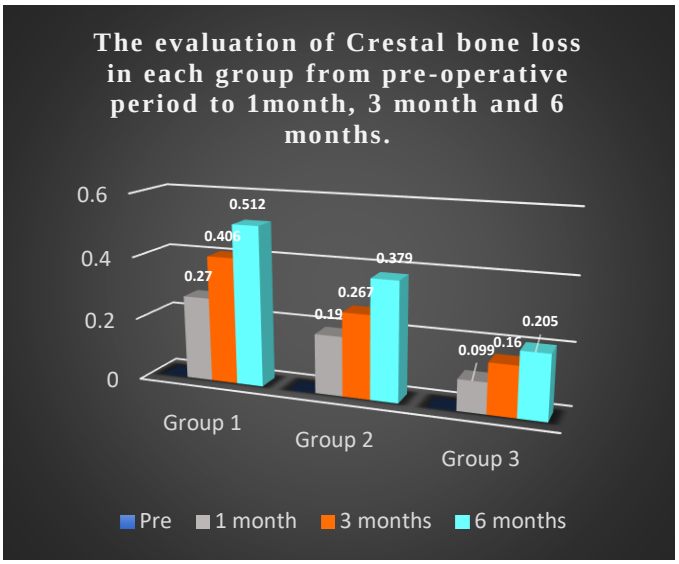
Group	Pre		1 month		3 months		6 months		p-value
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	
Group 1	0.000	0.000	0.270	0.109	0.406	0.178	0.512	0.224	<0.001*
Group 2	0.000	0.000	0.190	0.095	0.267	0.172	0.379	0.273	0.001*
Group 3	0.000	0.000	0.099	0.050	0.160	0.073	0.205	0.084	<0.001*

Repeated Measures ANOVA test; * indicates significant difference at p≤0.05.

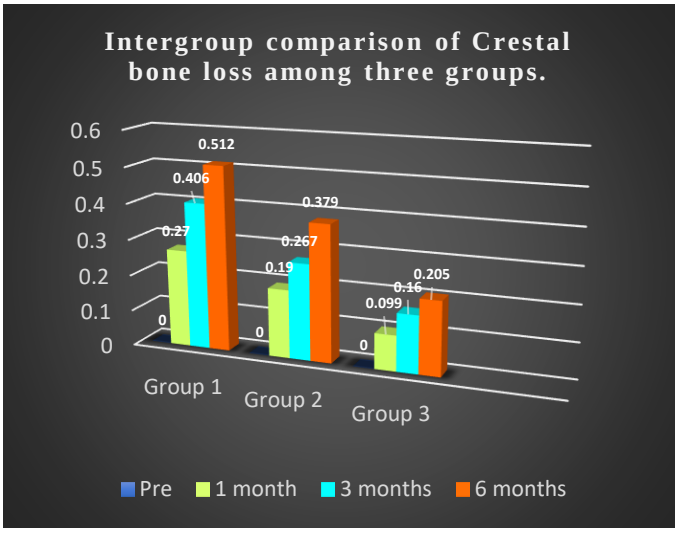
Table 2: Intergroup comparison of Crestal bone loss among three groups.

Interval	Group 1		Group 2		Group 3		P value
	Mean	SD	Mean	SD	Mean	SD	
Pre	0.000	0.000	0.000	0.000	0.000	0.000	--
1 month	0.270	0.109	0.406	0.178	0.512	0.224	<0.001*
3 months	0.190	0.095	0.267	0.172	0.379	0.273	0.002*
6 months	0.099	0.050	0.160	0.073	0.204	0.083	0.007*

One-way ANOVA test; * indicates significant difference at p≤0.05.



Graph 1: The evaluation of Crestal bone loss in each group from pre-operative period to 1month, 3 month and 6 months.



Graph 2: Intergroup comparison of Crestal bone loss among three groups.

These three techniques regarding the CBL. Considering the result of this study all three bone expansion procedure showed 100% implant survival rate for 6 months after loading. Literature reported that a bone loss of 1.0 mm after an average period of 6 months of functional loading with osteotome technique[9]. Previous results show higher CBL than this current study.

Bone expansion and compaction procedure in D2 and D3 bone quality the presence of crestal bone around the implant is the key for long term survival of the implant.

The CBL in the current study was 0.29-0.73 mm in group I, 0.1-0.64 mm in group II, 0.12-0.28 mm in group III. Studies suggests that use of osteotome technique should be considered critically with respect to the bone quality. Bone quality like D1 and D2 is not suitable for this kind of osteotomy preparation[9]. Higher Crestal bone loss in group 1 may be attributed to the fact that the original summers technique was designed for press fit implants[10]. Also, the osteotomy technique was not defined as it is for Densah™ burs. The osteotomes are for the standard sizes and are not as defined as Densah™

burs. For example: The 3.7 wide implant we use 3.8 wide Densah™ bur but for screw shape and osteotome, we undersized the osteotomy as the 3.8 osteotome and screws weren't recommended as protocol. So, we used 3.5 osteotome and 3.4 expansion screw. This resulted in compression of bone tissue by implant and might have resulted in higher crestal bone loss as compared to Densah™ Bur.

Though Densah™ is brilliant in making the osteotomy with, three implants failed in current study after Densah™ Osseodensification and were not considered as part of study. These failures though couldn't be classified but it is advisable to use slow speed and submerge the implant by 1 to 2 mm.

Conclusion

Thus, from the result of the current study it could be concluded that the crestal bone loss was higher in osteotome technique followed by expansion screw technique and least in Osseo densification technique by Densah™ burs.

The osteotomies prepared with osteotome and expansion screw technique, if done with similar sizes of implant might give lesser CBL.

References

1. Huwais S, Meyer EG. A Novel Osseous Densification Approach in Implant Osteotomy Preparation to Increase Biomechanical Primary Stability, Bone Mineral Density, and Bone-to-Implant Contact. Int J Oral Maxillofac Implants. 2017;32(1):27-36. Doi:10.11607/jomi.4817
2. Isoda K, Ayukawa Y, Tsukiyama Y, Sogo M, Matsushita Y, Koyano K. Relationship between the bone density estimated by cone-beam computed tomography and the primary stability of dental implants. Clin Oral Implants Res. 2012;23(7):832-836. Doi:10.1111/j.1600-0501.2011.02203.x
3. Cassetta M, Stefanelli LV, Pacifici A, et al. How accurate is CBCT in measuring bone density? A comparative CBCT-CT in vitro study. Clin Implant Dent Relat Res 2014;16(4):471–478.
4. Davarpanah M, Martinez H, Tecucianu JF, Hage G, Lazzara R. The modified osteotome technique. Int J Periodontics Restorative Dent. 2001;21(6):599-607.
5. Siddiqui AA, Sosovicka M. Lateral bone condensing and expansion for placement of endosseous dental implants: a new technique. J Oral Implantol. 2006;32(2):87-94. Doi:10.1563/786.
6. Huwais S, Meyer EG. A Novel Osseous Densification Approach in Implant Osteotomy Preparation to Increase Biomechanical Primary Stability, Bone Mineral Density, and Bone-to-Implant Contact. Int J Oral Maxillofac Implants. 2017;32(1):27-36. Doi:10.11607/jomi.4817
7. Pai UY, Rodrigues SJ, Talreja KS, Mundathaje M. Osseodensification - A novel approach in implant dentistry. J Indian Prosthodont Soc. 2018;18(3):196-200. Doi:10.4103/jips.jips_292_1
8. Zukauskas S, Puisys A, Andrijauskas P, Zaleckas L, Vindasiute-Narbute E, Linkevičius T. Influence of Implant Placement Depth and Soft Tissue Thickness on Crestal Bone Stability Around Implants with and Without Platform Switching: A Comparative Clinical Trial. Int J Periodontics Restorative Dent. 2021;41(3):347-355. Doi:10.11607/prd.525
9. Strietzel FP, Nowak M, Küchler I, Friedmann A. Peri-implant alveolar bone loss with respect to bone quality after use of the osteotome technique: results of a retrospective study. Clin Oral Implants Res. 2002;13(5):508-513.
10. Summers RB. A new concept in maxillary implant surgery: the osteotome technique. Compendium. 1994;15(2):152-162.