

## EVALUATION OF PRIMARY STABILITY FOR MANDIBULAR IMPLANT OVERDENTURE AFTER OSSEODENSIFICATION USING DENSAH BUR

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### ABSTRACT

**Objectives:** To evaluate the effect of osseodensification using Densah bur on the primary stability of mandibular implant overdenture. **Materials and Methods:** Ten completely edentulous patients were selected and two implants were inserted in the interforaminal region for each patient in a split mouth design; one implant with the conventional drilling system and one implant with the Densah bur drilling system. Implant primary stability was measured using Resonance Frequency Analysis by Osstell immediately after torquing the implants and every two weeks for 2 months. **Results:** No significant difference was found regarding Osstell values at all follow up appointments for both groups. **Conclusions:** comparable results for primary stability with and without osseodensification which still requires further investigation with longer follow up period.

**KEY WORDS:** implants, osseodensification, primary stability.

### INTRODUCTION

The use of implants to retain a mandibular overdenture has been recommended as the first treatment choice for the edentulous mandible. From the available evidence; it shows that this treatment leads to a great improvement in both clinical function and patient's reported outcomes when compared to conventional complete dentures.

Successful dental implant placement requires sufficient amount of bone thickness covering the implant so that primary stability is achieved, which is an important requirement for long term success

of the implant.<sup>1-3</sup> From the factors affecting implant primary stability are bone density, surgical protocol, and implant design.<sup>4</sup> Ample bone thickness covering the implant is not often found as bone resorption after extraction can reach approximately 50% of the original bone width in under a year.<sup>5</sup> Also in areas of low bone density maintaining sufficient bone bulk and density is essential to achieve necessary bone to implant contact for obtaining a biomechanically stable implant.<sup>6</sup>

Horizontal bone augmentation for implant placement is often necessary in deficient alveolar

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ridges. Various methods have been demonstrated in the literature to treat horizontal defects such as guided bone regeneration (GBR), autogenous block grafts, alveolar distraction osteogenesis, ridge splitting, ridge expansion procedures that have been developed and used to augment and treat bone volume defects.<sup>7-12</sup>

Ridge expansion, utilizing motorized rotary expanders, has been suggested as an alternative technique to expand bone by displacing it. Osseodensification is a non-excavating (no cutting) implant site preparation technique. It creates a densified layer of surrounding bone through compaction autografting while simultaneously plastically expanding the bony ridge at the same time. The autografting occurs along the entire length of the osteotomy through a hydrodynamic process with the use of irrigation. The result is a consistently cylindrical and densified osteotomy.<sup>13-16</sup>

The longevity of any implant prosthesis depends on successful osseointegration and implant stability.<sup>17,18</sup> Consistent osteotomies and densification are important to implant primary stability and to early loading.<sup>13</sup> One technique for measuring implant stability is resonance frequency analysis aiming to provide an objective measure of implant stability and Osseointegration, which is a noninvasive and does not damage the implant tissue interface.<sup>19</sup> The resonance frequency analysis technique has been extensively used in experimental and clinical research for the last 10 years.

This study was conducted to investigate the effect of Osseodensification using the Densah bur drilling system on the primary stability in mandibular implants with immediate loading when compared with conventional drilling system.

## **MATERIALS AND METHODS**

### **Patient Selection**

Ten completely edentulous male patients were selected from the outpatient clinic of the

Prosthodontics Department; Faculty of Oral and Dental Medicine, Cairo University. The patients' ages ranged from 50-65 years old and were systemically free from any disease that may interfere with dental implant placement and/or osseointegration. Patients also had adequate bone height and width for implant placement, as well as sufficient inter arch space for overdenture construction with normal maxillo-mandibular relation. Patients also had adequate bone height and width for implant placement (4 to 6 mm width), as preliminary detected from cone beam computed tomography CBCT confirmed later during pilot drilling. Only cooperative patients capable of following instructions and those with proper neuromuscular coordination were included in the study. Thorough patient history, clinical examination and radiographic assessment were carefully done for verification of the selection criteria. The patients were familiarized with the nature of the study and requested to sign consent forms before beginning the study.

### **Construction of Complete Dentures**

Study casts were produced from primary alginate impressions for the upper and lower arches of each patient. Acrylic resin special trays were constructed on the diagnostic casts and used in recording the final impressions using zinc oxide and eugenol impression material. Master casts were obtained and occlusion blocks were constructed for jaw relation registration, followed by mounting of the master casts on the articulator. Setting-up of cross linked acrylic resin teeth was done following the lingualized occlusion concept. Try-in was performed, after which the dentures were processed following conventional techniques using high impact acrylic resin.

### **Implant Placement**

At the delivery appointment, final occlusal adjustments and refinements were done and the denture was delivered to the patients 6 weeks before the surgical appointment to achieve sufficient

patient adaptation. The finished lower denture was duplicated for each patient and processed in clear acrylic resin in order to construct a surgical guide template to facilitate implant placement during surgery at canine or first premolar area.

After flap reflection, for both osteotomy sites implant manufacturer's pilot drill was used to perform a standard osteotomy of 10 mm depth. Then the sequential use of Densah Bur (Versah) \* 2.0mm pilot, 2.8mm, and 3.4mm multi-fluted tapered burs in a counterclockwise direction (figure 1) under copious irrigation was done in one osteotomy site while drilling the other site using the conventional sequential drilling system. Two 3.6 mm in diameter, 10 mm in length implants were placed using the torque wrench in each osteotomy site.\*\*

(Figure 2) Attachment of the smart peg on the implants and the Osstell was used to record the ISQ. Suturing was done after placement of the healing collars.

All patients received 2gm/day amoxicillin-clavulanate and 50 mg/8 hours non-steroidal anti-inflammatory analgesics for 5 days postoperatively.

Postoperative instructions included a soft diet



Fig. (1) Universal Densah Bur Kit.

and appropriate oral hygiene measures with 0.2% chlorhexidine mouth rinse.

### Overdenture Pick-up

The dentures were picked up three to five days after surgery for immediate loading protocol. Holes corresponding to the healing collars were drilled in the fitting surface of the denture to allow seating of the denture without any interference with the housings, as proved by absence of rocking, pressure indicating paste and proper occlusion. Soft relined denture material\*\*\* was placed in the relieved areas of the denture and the denture was seated in the patient mouth. The resin was left to polymerize while the patient was closing in centric jaw relation with gentle pressure. The overdenture was removed, trimmed and polished. The dentures were delivered and oral hygiene instructions were given to the patients.

### Implant Stability Measurement

Implant primary stability measurements for each implant was done at the time of surgery and at 2, 4, 6 and 8 weeks. Implant stability was assessed using the Osstell.\*\*\*\* The Osstell was used according to the

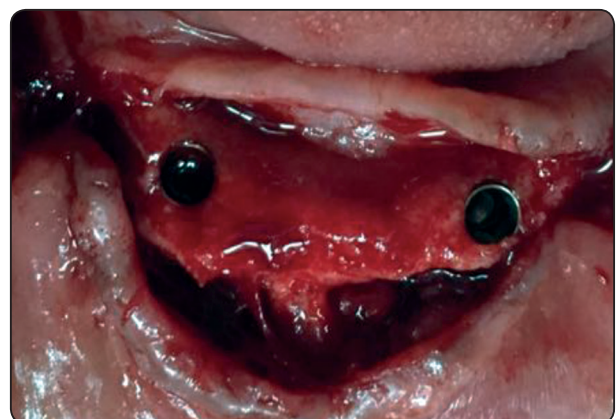


Fig. (2) Implants placed in the osteotomy sites

\* DENSAH Bur Kit VDBK

\*\* Dentium implant system (Dentium, Samsung-dong, Seoul, Korea)

\*\*\* Superline Dentium implant system

\*\*\*\* Dura base soft cushion rebase, Reliance Dental Mfg. Co. warth, Illinois 604B2

\*\*\*\*\* Siemens AG, Bensheim, Germany

manufacturer's instructions and held perpendicular to the provided implant smart peg. (fig 3) Osstell values (ISQ) were obtained for the buccal, lingual, mesial and distal surfaces of each implant. Three measurements were made for each surface and the mean was obtained for statistical analysis.

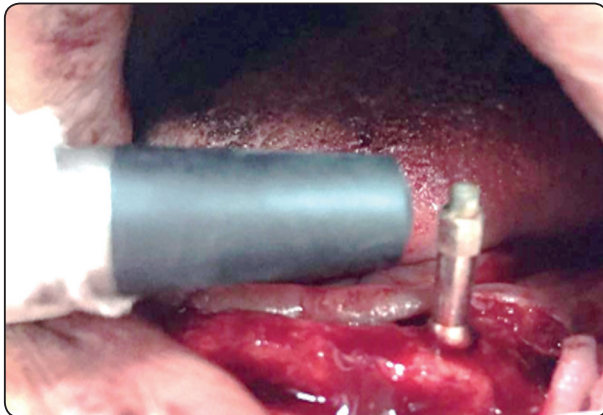


Fig. (3) The Osstell used for implant stability measurements.

### Statistical Analysis

Mean values were obtained for each implant for Osstell values. The mean and standard deviation values were calculated for each group in each test. Data were explored for normality using Kolmogorov-Smirnov and Shapiro-Wilk tests, data showed parametric (normal) distribution. Independent

sample t-test was used to compare between two groups in non-related samples. Repeated measure ANOVA was used to compare between more than two groups in related samples. Paired sample t-test was used to compare between two groups in related samples. (Split mouth technique), Two-way ANOVA was used to test the interaction between variables. The significance level was set at  $P \leq 0.05$ . Statistical analysis was performed with IBM® SPSS® Statistics Version 20 for Windows.

## RESULTS

### Implant Stability

The results of this study showed a decrease in ISQ values after implant insertion at 2,4,6 and 8 weeks in both groups. Table (1) These changes were statistically significant at all follow up appointments in the two groups. In group I (densah) the highest mean value of ISQ was  $76.00 \pm 6.41$  found at the implant insertion, while the lowest mean value of ISQ was  $70.13 \pm 5.22$  found at 6 weeks. As for group II (conventional) the highest mean value of ISQ was  $78.88 \pm 7.18$  found at implant insertion, while the lowest mean value of ISQ was  $65.88 \pm 15.34$  found at 2 weeks. On comparing the two groups there was no statistically significant difference between (Densah) and (Conventional) groups at 0,2,4,6 and 8 weeks.

Table (1): The mean, standard deviation (SD) values of stability of different groups.

Variables	Densah		Stability Conventional		p-value
	Mean	SD	Mean	SD	
0w	76.00	6.41	78.88	7.18	0.413ns
2w	75.13	6.22	65.88	15.34	0.136ns
4w	71.00	2.56	70.38	4.37	0.732ns
6w	70.13	5.22	74.75	2.38	0.039*
8w	72.88	4.73	74.88	0.35	0.253ns
p-value	0.013*		0.006*		

\*; significant ( $p < 0.05$ ) ns; non-significant ( $p > 0.05$ )

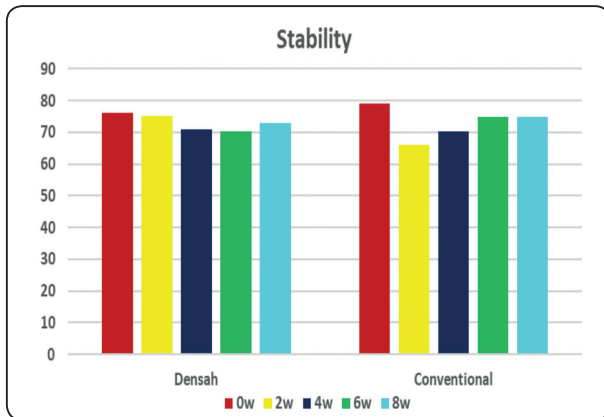


Fig. (4): Bar chart representing stability for different groups

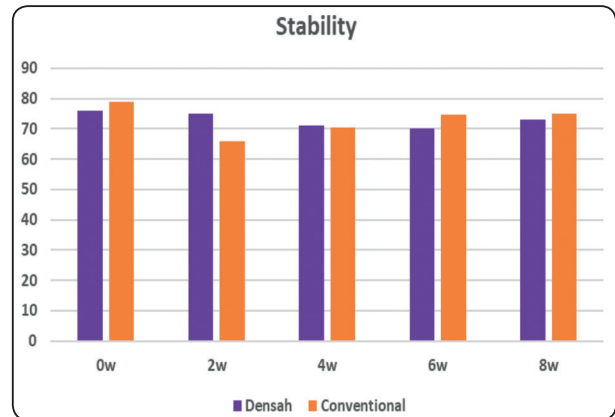


Fig. (5): Bar chart representing stability for different groups

## DISCUSSION

The immediate implant loading approach has been studied extensively since it has been introduced. However, careful planning and case selection are needed to ensure implant stability and success to improve the prosthetic outcomes.<sup>20,21</sup>

The hard and the soft tissue have a significant biological response to immediate implant loading with the highest mechanical stability achieved with threaded implants.<sup>13</sup> Also implant to bone contact, implant stability and osseointegration are improved by progressive lateral compression during drilling.<sup>22</sup>

The new concept for osteotomy called osseodensification (OD) has been at the forefront of changes in surgical site preparation for implantology. Osseodensification is a surgical instrumentation technique where bone is compacted into open marrow spaces during drilling, increasing implant insertion torque through densification of osteotomy site walls.<sup>23</sup> It achieves bone expansion at different sites of varying bone densities. This procedure has also shown improvement in achieving better implant primary stability and better osteotomy than conventional implant drills.<sup>6</sup> In low-density bone, implants presents higher insertion torque levels when placed in osseodensified drilling sites, with no osseointegration impairment compared to standard drilling methods.<sup>13</sup>

Implant stability is considered one of the important indications of successful osseointegration<sup>24</sup>. The clinical perception of primary implant stability is usually based on the cutting resistance of the implant during insertion.<sup>25</sup> Resonance frequency analysis (RFA) offers a noninvasive clinical measurement of stability and osseointegration of implants; it is a useful tool to establish implant loading time. The RFA values are represented by a quantitative unit called the Implant Stability Quotient (ISQ) on a scale from 1 to 100.<sup>26</sup>

The results of this study showed a decrease in ISQ values after implant insertion at 2,4,6 and 8 weeks in both groups; which may be attributed to the dome shaped healing abutments which are 2 to 4 mm in height that provide support and disseminate the lateral forces during osseointegration. Also this can be attributed to the fact that implants are mechanically stable right after insertion with high ISQ values denoting high primary stability and then decline due to the process of bone necrosis that happens after the osteotomy site preparation which is then replaced with new bone formation after week 8.<sup>27,28,29</sup> However this decrease in stability was statistically insignificant at all appointments. The difference between the two groups at the end of the follow-up period was also found to be insignificant.

As opposed to previous in vivo and invitro studies that were performed in low density bone and in the maxilla; <sup>6,23,30-35</sup> the results of this study showed insignificant difference between drilling with Densah bur and conventional burs on implant primary stability; that can be attributed to the area of the performed osteotomy; as the mandibular interforaminal region is composed of dense cancellous bone as opposed to the low density bone found in posterior mandible region. On the other hand Densah bur can play an important role in expanding narrow ridges during osteotomy site preparation, however Osseodensification in areas of dense bone still requires further investigation with longer follow up.

## CONCLUSION

- There is no difference in primary stability of mandibular interforaminal implants when drilling is carried out by Densah bur or conventional bur.

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