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IMPROVED DENTAL IMPLANT SUCCESS BY A NOVEL OSSEODENSIFICATION TECHNIQUE- A REVIEW

Dental Science

Dr. Premraj Jadhav MDS, H.O.D & PROF., Department of Prosthodontics,Crown & bridge including Implantology, Yogita dental college and hospital, Khed, Ratnagiri.

Dr. Chetan Modgi* MDS, READER, Department of Prosthodontics, Crown & bridge including Implantology Yogita dental college and hospital, khed, Ratnagiri. *Corresponding Author

Dr. Gauri Deore PG STUDENT, Department of Prosthodontics, Crown & bridge including Implantology Yogita dental college and hospital, khed, Ratnagiri.

Dr. Poonam Upadhyay PG STUDENT, Department of Prosthodontics, Crown & bridge including Implantology Yogita dental college and hospital, khed, Ratnagiri.

ABSTRACT

Successful osseointegration of dental implants depends upon the primary stability. Implants restoration in the posterior region of the maxilla have lowest success rates due to its the low-density bone .

The primary stability of an implant in low density bone can achieved through many surgical techniques , such as bi-cortical fixation of the implant, undersized preparation of the implant bed and bone condensation by the use of osteotomes .It is also crucial to achieve high-insertion torque which is important for obtaining primary stability.

To achieve primary stability in dental implants it is imperative to maintain sufficient bone bulk and density as it is required to achieve higher BIC (bone to implant contact).

KEYWORDS

INTRODUCTION

Nowadays, the replacement of lost natural tooth by means of dental implants has become a routine procedure in dental practice. Osseointegration, "a direct structural and functional connection between ordered, living bone and the surface of a load-carrying implant", is a predominant parameter determining the success of an implant" .[1]

Glossary of Prosthodontic Terms has defined "Osseointegration as: 1. The apparent direct attachment or connection of osseous tissue to an inert, alloplastic material without intervening fibrous connective tissue; 2. The process and resultant apparent direct connection of an exogenous material's surface and the host bone tissues, without intervening fibrous connective tissue present; 3. The interface between alloplastic materials and bone".

Primary stability in implant placement is one of the most critical factors determining the outcome of implant therapy. The key factors in enhancing implant primary stability are bone density, surgical protocol, and implant thread type and geometry.

Primary stability is provided by the mechanical friction between the external implant surface and walls of the implant osteotomy.[3]

The insertion torque peak is directly related to implant primary stability and host bone density; high-insertion torque could significantly increase the initial bone-to-implant contact percentage (% BIC) compared to implant inserted with low-insertion torque values.

The advance of surgical techniques and modifications with respect to the surface and microgeometry of dental implants, such as immediate and early loading, can help to reduce the time of rehabilitation for the patient for whom excellent primary stability is the primary prerequisite.[4-5]

Bone density is considered as a key factor to take into account while predicting implant stability.[6] The quality and quantity of the histological structure of bone at the implant interface is strongly correlated with the density of bone available at the implant site and bone strength is directly related to its bulk of mineral density and collagen integrity. Therefore, it is important to preserve bone bulk during the preparation of an osteotomy in order to achieve implant stability and long-term clinical success.[7]

Traditional drilling method for osteotomy preparation involves cutting and extraction of bone tissue to create a cylindrical hole that will receive an implant fixture.[8]

Over the past decades, several surgical techniques have been developed to improve conditions of local bone at implant recipient sites by preserving the existing bone volume and increasing its density, especially in situations where bone density is low.

Sennerby suggested that omission of the stage of bone tapping in low density bone might improve primary implant stability".[9]

Degidi., *et al.* reported modification of the surgical protocol by using 10% undersized osteotomic implant site preparation in respect to the implant diameter.[10]

In stepped osteotomy technique the under preparation is performed only in the apical area of the implant site, whereas the crestal portion is treated with a standard protocol.[10-11]

"Bone condensation technique with osteotomes is another surgical technique aimed to compact the bone with the mechanical action of cylindrical steel instruments along the osteotomy walls to improve localized bone density.[12-13]

MATERIALS AND METHODS:

Search Method For Identification Of Studies:

An electronic database search was conducted in PubMed & Medline database using keywords such as "Osseodensification," "Implant primary stability," and "Conventional Osteotomy technique." A total of 232 articles were collected and subjected to screening using inclusion and exclusion criteria.

Criteria For Considering Studies For This Review:

The inclusion criteria comprised clinical studies conducted in patients, systematic meta-analyses that evaluated the association between implant primary and secondary stability and surgical technique.

Inclusion Criteria:

Only full-text articles were considered.

- Implant stability: Primary stability/secondary stability
- Drills: conventional osteotomy.
- Osseodensification techniques

Exclusion Criteria:

Case series/ Case Reports

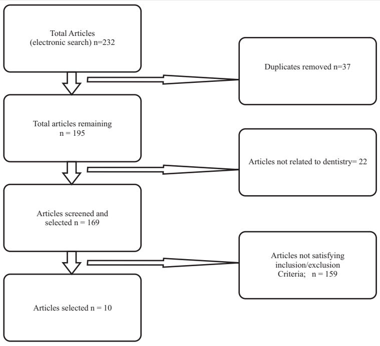
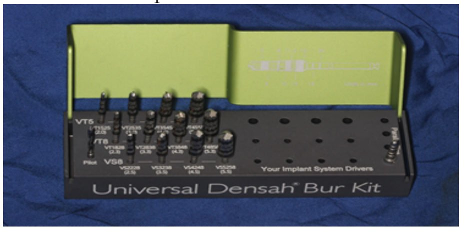


Fig. 1. Schematic Representation Of The Search Protocol Used For The Selection Of Studies Used In The Review.

OSSEODENSIFICATION TECHNIQUE[16]:

- OD is a novel biomechanical bone preparation to place a dental implant, using burs (densah burs) which are rotated in reverse at 800 to 1500 rpm.
- The rationale behind this process is the densification of the bone that will be in immediate contact to the implant results in higher degrees of primary stability due to physical interlocking between the bone and the device, faster new bone growth formation due to osteoblasts nucleating on instrumented bone that is in close proximity with the implant.
- **Huwais S** - created Densah bur which precisely cut bone in the clockwise direction and densify bone in a non-cutting counter clockwise direction combined with copious irrigation which facilitates the surgical technique during implant placement.
- Densah burs progressively increase in diameter throughout the surgical procedure and they preserve and condense bone at 800-1500 rpm in a counter clockwise direction (OD) and precisely remove bone at 800-1500 rpm in a clockwise direction (cutting mode).
- They have many lands with negative rake angle that work in a non-cutting action. They have a cutting chisel edge and a tapered shank so that when entering deep into the bone, they expand the osteotomy preparation smoothly compacting the bone in the peripheral area. Hence, rather than removing the bone chips and debris, they work to forward the bone chips and debris inwards the implant bed.



UniversalDensahBurKit.*source:*www.versah.com/ltu

- The outward pressure combined with irrigation at the point of contact creates a hydrodynamic compression wave so that the bone is compressed laterally by continuously rotating and concurrently forcibly advancing the bur.
- The taper design of the bur allows the operator to instantly lift away from contact to allow for irrigation.
- The tip design along with flutes facilitates compaction autografting.

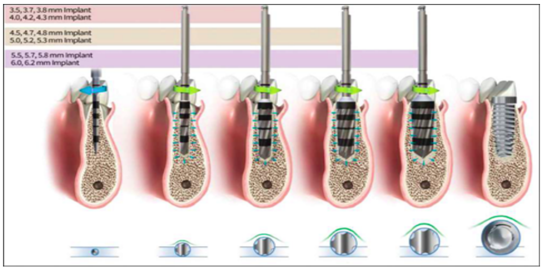


Fig. 1. Osseodensification Burs Were Used In Small Increments Of Width Increase. Small Increasing Width Increments Allow For Controlled Plastic Deformation Of Bone Tissue.

Table 1: Table With Relevant Studies On Osseodensification:

Sr.No.	Study Authors&Year of Publication	Sample Size	Insertion Torque value	Bone To Implant Contact	Bone Area Fraction Occupancy	Duration of the Study
1.	Trisietal.,201635	Iliaccrest of 2sheeps, 20 implants (10implants with	Not measured	49.58%±3.19%for test group,	Not measured	2months
2.	Lahensetal.,201631	osseoden sification) Ilium of 5sheeps, 20implants(10 implants with	100Ncm*fortest group,25Ncmfor controlgroup	46.19%±3.98%for controlgroup. 70%*intestgroup, 50%incontrol	44%intestgroup,	6weeks
3.	Huwaisetal.,201720	osseodensification) Porcinetibialplateaubonesample, 48implants(24	108±56Ncm*for6 mmdiameterimplant and49±24	group Notmeasured	42%incontrol group Notmeasured	N/A
		implantswithosseodensification)	Ncm*for4.1mm diameterimplantfor testgroup;50±21			
			Ncmfor6mm diameterimplantand 25±15Ncmfor			
4.	Lopezetal.,201732	Sheepcervicalspine,48implants (24implantswith	4.1mmdiameter implant for control group 65Ncm*fortest group,35Ncm for control group	58%*intestgroup, 33%incontrol	70%*intest group,	6weeks
		osseodensification)		group	40%incontrol group	
5.	Alifaragetal., 201833	Sheepilium,48implants(24 implantswith osseodensification)	70Ncm*fortest group,52Ncmfor controlgroup	48%*intestgroup, 38%incontrol group	40%*intest group, 32%incontrol group	3weeks
6. 7.	Oliveiraetal.,201829 Sleteetal.,201828	Sheepilium,40implants(20 implantswithosseodensification) Porcinetibia,18implants(6 implantswith	78Ncm*fortest group,10Ncmfor controlgroup Notmeasured	32%*intestgroup, 24%incontrolgroup 60.3%*intestgroup, 16.3%incontrol	35%intestgroup, 32%incontrol group 62%*intest group,	6weeks N/A

8.	Gasparetal.,201834	osseodensification) 41subjects,97implantswith osseodensification(onlyin	≥45Ncmforall implants	group Notmeasured	54%incontrol group Notmeasured	N/A
9.	Neivaetal.,201835	maxilla) Sheep,36implants(12implants with	91.45Ncm	25%intestgroup, 22.5%incontrol	29%intestgroup,	6weeks
10.	Neivaetal.,201836	osseodensification) 28subjects,21implantswith osseodensification(Group	Group1–36.4Ncm	group Notmeasured	27%incontrol group Notmeasured	6and12
		1),21implantswith osseodensificationcombinedwith bonegraft(Group2)	Group2–39.1Ncm			months

DISCUSSION:

A new technique termed as osseodensification was developed by Huwais in 2015. It is carried out using specially designed drill burs (Densah burs) which combine the advantages of osteotomes along with provision of tactile control during the expansion.[27]

They have 4 or more lands with a negative rake angle making the edges of the bur non cutting and thus, smoothly compact the bone. These drills have a cutting chisel edge and a tapered shank. They thus can enter deeper into the osteotomy site while, the progressive increasing diameter of the drill helps in gradual expansion of the site.

In a clockwise rotation (Cutting mode), the drills are used to enter into the bone till the desired depth of the osteotomy.[35]

Following that, counter clockwise rotations (Densifying mode) cause a strong and dense layer of bone tissue to be formed along the walls and base of the osteotomy. This technique burnishes bone along the inner layer of the osteotomy site through controlled deformation.[39]

The purpose is to create a condensed layer of autografted bone along the periphery and apex of the implant. This would, in turn, increase the bone-implant contact enhancing the insertion torque values, and thus, implant primary stability.[44]

Osseodensification may thus be particularly useful during implant insertions in the maxillary arches due to the relatively high amount of cancellous bone present. It might however be needed to be used with caution in primarily corticated or denser bone like the mandibular anterior region due to limited published data for these sites. Also, the drills used for osseodensification have found to increase the temperature and might result in necrosis of the neighbouring osteoblasts if not used along with copious irrigation.[27]

CONCLUSION:

- Preservation of bone bulk during implant osteotomy preparation is crucial for securing primary implant stability, which is highly associated with successful osseointegration and longer successful clinical outcome.
- The osseodensification technique reduces bone sacrifice that appears unavoidable with conventional drilling procedures.
- The osseodensification technique is shown to increase the primary stability, the bone mineral density, and the percentage of bone at the implant surface.

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