

A NOVEL TECHNIQUE TO ENHANCE BONE DENSITY IN IMPLANT DENTISTRY - OSSEODENSIFICATION

A NOVEL TECHNIQUE TO ENHANCE BONE DENSITY IN IMPLANT DENTISTRY - OSSEODENSIFICATION

¹ Kirubha P ² Deeptha Mathi R ³ Gowthami GR ⁴ Lambodharan R

^{1,2,3} Post graduate Students (Final year)
⁴ Professor and Head, Department of Prosthodontics and Crown & Bridge, CSI College of Dental Sciences Research, Madurai, Tamilnadu, India

ABSTRACT

Primary stability is the crucial among the many factors which contributes to osseointegration. In low bone density regions such as the posterior maxilla the primary stability is often found to be compromised which is mainly attributed to the decreased density of bone present. Numerous techniques have been introduced over the years to overcome this shortcoming. One among the latest techniques is the osseodensification, which uses specially designed Densah burs. These burs are designed to rotate in both clockwise and counter clockwise direction. In counter clockwise direction, these exhibit a condensing action thereby autografting the cancellous bone to the implant bed. The purpose of this article is to emphasize the fact that osseodensification technique contributes in a very favourable way to the implant primary stability. This also outlines the mechanism underlying the use of thistechnique.

Keywords: Osseointegration, Primary implant stability, Osteotomy, Osseodensification, Densah burs

INTRODUCTION

Dental implants are the foremost predictable treatment modality for rehabilitation in edentulous patients both partial and complete with highest success and survival rates among all the treatment options available.^[1] Osseointegration in clinical dentistry depends on the essential understanding of the healing of soft and hard tissues and also their capacity to repair. Osseointegration is that the direct structural and functional connection that exists between bone and surface of implant. It's considered as the major pre-requisite for loading of implant and is crucial for stability of implant. ^[2] It was Alberktsson et al in the year 1981, who listed six criteria for achieving complete osseointegration.

Access this article online

Quick Response Code:



Website:
www.jiadsr.org

Address for correspondence:

DR. P.Kirubha

Post graduate Student (Final year), Department of Prosthodontics and Crown & Bridge, CSI College of Dental Sciences and Research, The Tamilnadu Dr.M.G.R. Medical University, Madurai, Tamilnadu, India.

Mobile no: 7373181975

E-mail - kirubhahelen@gmail.com

A NOVEL TECHNIQUE TO ENHANCE BONE DENSITY IN IMPLANT DENTISTRY - OSSEODENSIFICATION

The parameters included implant material, implant surface, implant design, host factors, implant surgical techniques and implant loading conditions.^[3] Achieving primary stability is taken into account as the foremost important factors in achieving successful osseointegration.^[4] The factors to be considered to reinforce the primary stability include the density of bone, surgical protocol followed and therefore the implant design including the thread type and geometry. Primary stability is achieved by the mechanical friction that happens between the external surface of implant and implant osteotomy wall. The insertion torque value is directly associated with the density of bone and primary stability of implant.^[5]

Methodology:

The inclusion criteria for the choice of articles included clinical studies which related primary and secondary stability to that of osseodensification, systemic reviews and meta-analysis on clinical studies on osseodensification and success of osseodensification and also the studies including the surgical procedure involved.

For identifying the relevant studies to be considered of the review, keywords like “dental implants”, “osseodensification”, “primary stability”, “secondary stability”,

“stability quotient”, “osseointegration”, “osteotome techniques” were used.

A search was performed with these keywords including the articles published till October 2021. After selection, the articles which fulfilled the mentioned criteria were processed to extract information and summarized with relevant data.

Primary stability – the key factor:

Primary stability of dental implants is nothing but the mechanical anchorage of biocompatible implant because it is wedged in a very properly prepared host bed of living bone. Though primary stability generally is merely a mechanical connection, in case of living bone because of surgical trauma, at the periphery 1mm round the implant body is predicted to be devitalized, resorbed and remodeling occurs. This process will loosen the bone- implant contact and thus the primary stability is going to be decreased. However, as bone will form around the body of implant and osseointegration occurs, the connection of implant to the new bone that's formed are going to be increased. Hence, the stability is reestablished which is cited as secondary stability thereby enhancing osseointegration.^[6] Implant stabilization reduces fibrous tissue formation around implant. Primary stability is that the substantial factor for secondary stability.

A NOVEL TECHNIQUE TO ENHANCE BONE DENSITY IN IMPLANT DENTISTRY - OSSEODENSIFICATION

Primary stability depends on various factors such as the surgical technique, quantity and quality of bone, design and characteristics of implant. Whereas, secondary stability relies on primary stability itself and the modelling and remodeling of bone and surface treatment of implants.^[7]

Primary stability is achieved when there's no micro movement of implant within the complete seated position. This position interlocks the implant mechanically to bone tissue until secondary stability is achieved.^[4] Various methods are present to achieve primary stability. Presently implant insertion torque and Resonance frequency analysis (RFA) are the foremost commonly used biomechanical parameters. Both of them vary in their mechanism of action. Implant insertion torque calculates the resistance that's encountered when implant is advanced apically. Resonance frequency analysis detects the natural vibration frequency of implant within bone which successively relies on the rigid connection of implant to bone and also the degree of micro movement.^[8]

Increasing the primary stability:

Misch in the year 1988 proposed four bone density groups D1, D2, D3 and D4 independent of the regions of the jaws, supported macroscopic cortical and trabecular bone characteristics. In this,

D4 bone consisted of fine trabecular bone and almost no crestal cortical bone present within the posterior maxilla^[9]

Dental implants inserted in this region shows lowest success rates because of the low density of trabecular bone which has only minor influence on stability of implant.^[6] If implants are placed in such poor quality of bone, the insufficient bone negatively influences the bone implant contact and therefore the bone volume percentage and hence difficulty in achieving adequate primary and secondary stability.^[10]

Therefore it becomes important to change the drilling techniques, operator experience and also the macro design of implant so as to boost the primary stability and hence osseointegration.^[8]

Techniques proposed to reinforce the primary stability include undersized preparation of implant site and using osteotomes so as to condense bone.^[10]

Under drilling is that the process of preparation of implant bed with a diameter smaller than that of the implant diameter which thereby improves the primary stability. However the primary stability achieved is insufficient. Bone expansion using osteotomes was an alternate method which condensed the bone trabeculae thereby improving the peri implant bone density instead of removing the bone by drilling.^[11] This

A NOVEL TECHNIQUE TO ENHANCE BONE DENSITY IN IMPLANT DENTISTRY - OSSEODENSIFICATION

condensation of bone is alleged to boost primary stability however considered insufficient. The osteotomes that are employed in condensation procedure has a further disadvantage of causing great surgical trauma.^[8]

Osseodensification:

Huwais in the year 2013 developed an osseous densification technique in implant osteotomy preparation to extend biomechanical stability, bone mineral density and bone to implant contact.^[12]

Osseodensification represents a unique method utilizing the buildup of autogenous bone within the implant site via the compaction of cancellous bone, which has good viscoelastic and plastic deformation characteristics.^[13]

Conventionally, the techniques undergone for implant site preparation are subtractive techniques which uses increasing diameter drills successively that rotates in a clockwise direction with irrigation so as to excavate the bone and to organize the implant site.^[14]

Osseodensification is a recently introduced non-subtractive drilling technique. During this technique, specially designed drills are used that rotate in counter clockwise direction thereby compacting bone at the walls of osteotomy preparation and hence facilitates close engagement of implant to

the site of preparation therefore increases the primary stability^[14]

Here, bone compaction method is by applying controlled deformation. It's due to rolling and sliding contact along the inner surface of osteotomy preparation with rotating side of densifying burs.^[12]

Huwais in the year 2015 from his in vitro study stated that in osteotomy preparation for osseodensification, the new burs allowed preservation and also condensation of bone by autografting via compaction. Thereby this increases the bone density and biomechanical primary stability.^[15] During this procedure, the operator can control the densification of bone easily and safely because the bur to bone contact applies an opposite axial reaction force. This force that's exerted is often in proportion to the force applied by the operator. Hence, this provide a haptic feedback so as to regulate the force based on the density of bone that's encountered and it also provides strain rate controlled plastic deformation which compacts the bone and expands osteotomy.^[12]

The DENSAH burs:

The creation and introduction of Densah burs was mainly the results of Huwais in creating instruments and procedures that maintains a healthy bone during osteotomy preparation. He mainly focused on preserving the bone rather than removing it which paved way to the new concept of

A NOVEL TECHNIQUE TO ENHANCE BONE DENSITY IN IMPLANT DENTISTRY - OSSEODENSIFICATION

osseodensification and introduction of Densah burs. These burs do their action both in clockwise direction and counter clockwise direction. In clockwise direction, it cuts bone precisely whereas in counter clockwise direction, the goal is densifying bone during a non-cutting action when in the middle of copious irrigation. [4]

The dual action facilitates clinical resourcefulness. This allows autografting of bone along the peripheries and therefore the apex of the preparation site by the operator and also proficiently expand the ridge and hence also contributes to improved implant stability. [16] It's also claimed that bone compaction is completed with controlled deformation by viscoelastic mechanism and plastic mechanism when load is below the bone strength. [6] The in and out bouncing action is claimed to help create a rate dependent stress which produces a rate dependent strain and hence this permits the saline which is pumping to softly pressurize the walls of bone. This contributes to the increase in bone plasticity and expansion. [10] These burs progressively increase in their diameter through the procedure and help preserve and condense bone at a speed of 800-1500 rpm in counter clockwise direction. So as to remove bone, 800-1500 rpm speed is required during a clockwise direction. They possess a cutting chisel edge and also a shank that's tapered. So, when going deep within the bone, they have a

tendency to expand the preparation site smoothly compacting the bone meanwhile in peripheral areas. The Densah burs have multiple flutes that lie within a tapered geometrical design and produces faster feed rate and also the heat elevation is additionally comparatively low. [4]

Discussion:

Osseodensification involves condensation instead of removal the bone and hence maintains the majority of bone that's present which thereby increases the bone implant contact. [4]

Trisi et al in their in vivo evaluation in sheep analyzed the efficiency of osseodensification technique on whether it improves bone density, ridge width and implant secondary stability. It had been demonstrated that osseodensification was found to increase the bone volume percentage around implants inserted in a low density bone when put next to the conventional techniques. [10]

Ibrahim et al conducted a clinical trial to evaluate the effect of osseodensification technique on implant stability. The study was carried out in 10 patients and 20 implants were placed in posterior maxilla. Each patient received one implant using conventional technique and one using osseodensification technique. The results showed a huge improvement in both primary and secondary stability using Densah burs. [16]

A NOVEL TECHNIQUE TO ENHANCE BONE DENSITY IN IMPLANT DENTISTRY - OSSEODENSIFICATION

Lahens et al studied the effect of osseodensification technique on primary stability in low density bone in sheep. The results showed significantly higher bone implant contact to osseodensification techniques in comparison to regular drilling. [17]

Huwais and Meyer (2017) showed that osseodensification increased the insertion and removal torques significantly compared to conventional drilling procedure and extraction drilling procedure. No differences in ISQ values were demonstrated among the three groups significantly, thereby confirming the safe use of osseodensification. It had been concluded that using osseodensification technique, by preserving bone, the method of healing was found to be accelerated and primary implant stability was found to be increased while autograft bone was maintained along the surface of the osteotomy site. [12]

Using osseodensification technique incorrectly may result in failure of implant that might otherwise not have occurred with standard conventional technique. Selection of cases for osseodensification and use of Densah burs in counter-clockwise direction is vital because it isn't usually recommended in D1 and D2 bone qualities in other words dense bone. Cortical bone is a non-dynamic tissue which lacks plasticity and hence osseodensification doesn't work well with it. Undersizing the implant osteotomy with

osseodensification isn't recommended as this might cause bone necrosis and implant failure. Before proceeding with the technique, the operator must remember that there's a particular limit to which bone is compressed or densified. [13]

Conclusion:

Osseodensification is effective for various clinical situations when utilized in low-density bone. It's a unique implant osteotomy procedure which has shown to preserve bone volume through compaction because of the viscoelasticity and plastic deformation properties of cancellous bone. The ability to get improved primary stability is obtained with the utilization of Densah burs that rotate in counter clockwise direction to condense bone thereby improving primary stability and enhancing the success rate. However case selection and proper treatment planning are the key factors contributing to the success of osseodensification.

Conflict of interest:

It is declared that the authors don't have any conflict of interest

References:

1. R. Adell, U. Lekholm, B. Rockler, P.I. Branemark, A 15-year study of osseointegrated implants in the

A NOVEL TECHNIQUE TO ENHANCE BONE DENSITY IN IMPLANT DENTISTRY - OSSEODENSIFICATION

- treatment of the edentulous jaw, *Int. J. Oral Surg.* 10 (1981) 387–416.
2. Branemark PI. Osseointegration and its experimental background. *J prosthet Dent.* 1983;50:399-410.
 3. Albrektsson T, Branemark PI, Hansson HA, Lindstrom J. Osseointegrated titanium implants. Requirements for ensuring a long lasting, direct bone to implant anchorage in man. *Acta Ortho Scand,* 1981;52:155-70.
 4. Kanathila H, Pangi A, An Insight into the Concept of Osseodensification-Enhancing the Implant Stability and Success. July 2018. *Journal of Clinical and Diagnostic Research.*(7): ZE01-ZE03.
 5. Pai UY, Rodrigues SJ, Talreja KS, Mundathaje M. Osseodensification- A novel approach in implant dentistry. *J Indian Prosthodont Soc.* 2018 Jul-Sep; 18(3):196-200.
 6. Podaropoulos L. Increasing the stability of dental implants: the concept of osseodensification. *Balk J Dent Med.* 2017;133-140.
 7. Meredith N, Books K, Friberg B, Jemt T, Sennerby L. Resonance frequency measurements of implant stability in vivo. A cross-sectional and longitudinal study of resonance frequency measurements on implants in the edentulous and partially dentate maxilla. *Clin Oral Implants Res.* 1997;8:226-33
 8. Barberá-Millán J, Larrazábal-Morón C, Enciso-Ripoll JJ, Pérez-Pevida E, Chávarri-Prado D, Gómez-Adrián MD. Evaluation of the primary stability in dental implants placed in low density bone with a new drilling technique, Osseodensification: an in vitro study. *Medicina Oral, Patología Oral y Cirugía Bucal.* 2021 May;26(3):e361.
 9. Misch CE. Contemporary implant dentistry. 2nd ed. St. Louis: Mosby;1998
 10. Trisi P, Berardini M, Falco A, Vulpiani MP. New osseodensification implant site preparation method to increase bone density in low-density bone: in vivo evaluation in sheep. *Implant Dent.* 2016;25(1):24-31.
 11. Summers RB. A new concept in maxillary implant surgery: The osteotome technique. *Compendium.* 1994;15:152,154-56, 158 passim; quiz 162
 12. 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.

A NOVEL TECHNIQUE TO ENHANCE BONE DENSITY IN IMPLANT DENTISTRY - OSSEODENSIFICATION

13. Pikos MA, Miron RJ.. To Drill or to
Densify? Clinical Indications for the
Use of Osseodensification. *Compend
Contin Educ Dent.* 2019
May;40(5):276-281
14. Hindi AR, Bede SY. The effect of
osseodensification on implant stability
and bone density: A prospective
observational study. *Journal of
Clinical and Experimental Dentistry.*
2020 May;12(5):e474.
15. Huwais S, Meyer E.
Osseodensification: A novel approach
in implant o preparationto increase
primary stability, bone mineral density
and bone to implant contact. *Int J Oral
Maxillofac Implants.* 2015
16. Ibrahim AM, Ayad SS, ElAshwah A.
The effect of osseodensification
technique on implant stability (clinical
trial). *Alexandria Dental Journal.* 2020
Aug 1;45(2):1-7.
17. Lahens B, Neiva R, Tovar N, Alifarag
AM, Jimbo R, Bonfante EA, et al.
Biomechanical and histologic basis of
osseodensification drilling for
endosteal implant placement in low
density bone. An experimental study
in sheep. *J Mech Behav Biomed
Mater.* 2016;63:56-65