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Research Article

THE OSSEODENSIFICATION DRILLING CONCEPT IN IMPLANT– A REVIEW

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A R T I C L E I N F O

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A B S T R A C T

The most important factor in the implant is the primary stability of implant mostly in the low-density bone which affects the integrity of the implant. Previously many different techniques have been discussed to increase the stability of implant but the promising result has not achieved. Recently Sala Huwais in 2013 introduces the novel implant site preparation technique termed osseodensification. A specially designed bur known as densah bur used in this technique which creates compaction of an auto graft layer at the periphery and apex of the implant rotating in a clockwise and counter-clockwise direction. This review article aims to emphasize osseodensification drilling concept and its various evidence-based study is discussed which proves that osseodensification concept is valid as biomechanical and histological and gives higher insertion torque value which increases the primary stability of the implant.

INTRODUCTION

The success rate of endoosseous implant is more than 90% in most of the cases[1] in which implant stability is utmost important.[2]

The primary stability of the implant is the mechanical stability of the implant at the time of surgery. Factors affecting primary stability of the implant is the insertion torque,[3] implant design, bone density,[4] and surgical technique.[5, 6]Initially bone to implant contact is mechanical and not biological, therefore, due to surgical trauma 1mm around the implant body gets devitalized, resorbed, and remodeled [7-9] which leads to decrease primary stability of the implant.

Insertion torque which is an initial bone to implant contact should be 25 Ncm according to Norton [10] which is increased to 32-45 Ncm in low-density bone.[11] Micro-motion of implant more than 50-100 micrometer affects the osseointegration and leads to fibrous integration, therefore, an implant is considered stable when its threshold of micro-motion [12] is less than this. Which can be measured by placement torque, periotest, periometer and resonance frequency analysis.[13,14]

The maxillary posterior region has low-density bone which makes it difficult to attain high insertion torque and leads to decreased primary stability mostly in immediate loading cases. Many surgical techniques developed to increase the primary stability of an implant placed in low-density bone such as

1. Bicortical fixation of the implant.
2. Undersized preparation of the implant bed.
3. Bone condensation by the use of osteotomes.

Apromising and desirable result is not achieved with these previous techniques,new technique have been introduced known as osseodensification.

Osseodensification Drilling Concept

Standard drills designs that are used in implantology do not produce precise circumferential osteotomy which may lead to elongated and elliptical osteotomy site due to chatter of the drills. These cases show poor implant primary stability due to reduced implant insertion torque.

In order to overcome the problems, Huwais in 2013 introduced a novel implant site preparation technique termed osseodensification.[15]Time-dependent low plastic deformation of trabecular bone tissue.[15,16]It is a non-extractive technique that employs specially designed bur.

This specially designed bur is termed as Densah bur. Densah burs have more than four lands and large negative rake angle, works in non-cutting mode and tapered shank, cutting chisel edge so as they enter deeper in the bone they expand the osteotomy. It creates a layer of compacted bone along the periphery and apex of the implant surface. This equipment has two modes Clockwise in cutting direction which has 800 to 1200 rpmand counter-clockwise in a non-cutting direction which has 800 to 1200 rpm.[16]This equipment uses typical Bouncing motion of bur which moves in and out of the osteotomy.[17]

This technique is useful in many situations where conventional techniquesmay not achieve the desired result. They are

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1. Immediate implant placement.[18]
2. Ridge expansion.[19,21]
3. Sub Crestal Sinus lift.[20]
4. Guided expansion graft.[21]

These densha burs cut hard bone when rotating clockwise direction when rotating counter-clockwise direction (non-cutting) is densify the soft bone copious amount of irrigation is needed between the bone and bur surfaces to minimize overheating.Investigators have proved that this compaction of bone is through controlled deformation includes viscoelastic and plastic mechanism.[17]The load is kept beneath the strength of the bone so these osseodensification technique increases the insertion torque of implant to approximately 49 Ncm in low-density bone in contrast to 25 Ncm using standard drilling technique.[17]

The bur to bone contact causes opposing axial force which is corresponding to the intensity of force applied by the surgeon which is known as Real-time haptic feedback [17] whichinforms the surgeon if more or less force is needed at an instant.

This drilling concept has Spring back effect[22] which creates a smaller osteotomy then standard drilling due to recovery elastic strain when the osteotome is removed from the site. This also helps in increasing the primary implant stability.

This technique is tried successfully by many clinicians globally and it is substantiated by various scientific data in the form of Evidence-based studies-

A study done by Salah Huwais.[17]72 osteotomies were created in porcine tibial plateu bone samples with three different surgical techniques. Control group was standard drilling technique, and the first experimental group was osseous extraction drilling with new multi-fluted tapered burs in clockwise direction alone to remove bone and the second experimental group was with same bur used in counter-clockwise direction in densifying mode.So,this study confirmed the hypothesis that the osseous densification technique increases primary stability,bone mineral density, and percentage of bone at the implant surface compared with another drilling. So it confirms that osseodensification preparation is histologically and biomechanically validated.

In 2016 P.Trisi et[23] al did in vivo study in 5-year-old two female sheep in which edge of iliac crest was exposed and 5 osteotomy site was prepared on each side of both the sheep left side they prepared osteotomy with standard drilling and right side with osseodensification method and them concluded that osseodensification technique enhances implant secondary stability, peri-implant bone density and bone expansion attitude.

Lahens *et al*[24]in 2016 had done a study on biomechanical and histologic basis of osseodensification drilling for endosteal implant placement in low-density bone in the ilium of 5 sheep to examine conical or parallel wall design. 30 implants were placed 15 parallel, 15 conical with three different techniques regular drilling, clockwise osseodensification drilling,and counter-clockwise osseodensification drilling. They concluded that bone area fraction occupancy was higher in parallel design when compared to conical and achieved higher insertion torque level in the osseodensification group due to thedensification of analogous bone debris at the bone walls.

A Study was done by Lopez etal[25] in 2017in vertebral bodies of the spine of 12 sheep because of low-density bone to evaluate biomechanical and histological effect of osseodensification. He concluded that in osseodensification group insertion torque levels were 65 N cm compared to standard drilling which is 35 N cm.Also, osseodensification group showed superior anchoring due to pullout strength compared to regular drilling collapsed over time.

Gaspar J [20] in 2018had done a study in the outcome of ossseodensification technique for maxillary implant sites preparation in different clinical situations. Reduced bone ridge width,sinus augmentation by crestal approach, implant placement immediately after extraction, an implant placed in immediate loading in full arch rehabilitation. Osseodensification technique in all these cases shows higher insertion torque value and increased primary implant stability and in sinus augmentation also it shows safe, simple, with reduced morbidity.

A Pilot study was done by Slete *et al*[26]in 2018 tocompare the histomorphometric structure of osteotomy preparation with standard drilling (SD), summers osteotome (SO) and osseodensification (OD)technique. Fresh porcine tibia plateau was used as specimen and 18 osteotomy site was prepared and the implant was placed. After implant placement for histological staining and sectioning, all porcine tibia plateauwere placed in a 10% formalin solution. Histomorphometric analysis proved that bone to implant contact in OD - 60.3% SO- 40.7% SD-16.3% and bone volume was also greater in osseodensification technique.

In 2018 Jimy H Tian[27] had done a study on implant placement in atropic mandibular alveolar ridge with alveolar ridge expansion conventional osteotome techniques (control group) and osseodensification technique (test group).Twelve endosteal implants were placed in porcine specimen six in the experimental group and six in the control group. Result revealed increased implant primary stability in osseodensification group from a biomechanical and histologic point.

In 2019 Jose Carlos[18] Published study in which he describes the combined technique of immediate dentoalveolar restoration(IDR) technique with osseodensification in periodontally compromised extraction sites. Hard and soft tissue was assessed in two clinical cases and the IDR technique with osseodensification implant sites was prepared in severe alveolar bone loss.Results revealed that osseodensification with IDR techniques increases primary implant stability with higher insertion torque value.

In 2019 Koutouzis T[21] had done a study on alveolar ridge expansion by osseodensification-mediated plastic deformation and compaction autografting-a multicenter retrospective study. He concluded the study that osseodensification can alter the ridge dimensions and allow for ridge expansion with adequate trabecular bone volume greater expansion can be expected at the crest in narrow ridges.

Contraindication

1. Osseodensification does not work in the cortical bone as it lacks plasticity.
2. A xenograft is contraindicated as its inorganic content provides bulk tissue without any viscoelasticity.

CONCLUSION

The primary stability of the implant is the most important factor in implant especially in low density of bone-like posterior maxilla. Recently Salah Huwais introduced a novel implant site preparation technique termed osseodensification . It increases the higher insertion torque by compacting autograft bone at the periphery and apex of the osteotomy. This article gives a review of the osseodensification drilling concept and evidence-based studies which proves that osseodensification concept is valid as biomechanical and histological, but for the long term successful outcomes, of this concept more studies are recommended in this field.

The patient always desires faster, shorter and minimally invasive surgical treatment. This concept is valid as it gives faster treatment in periodontally compromised patient and it is also a minimally invasive surgical technique.

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