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# Osseodensification: In Regulation Of Periodontal Bone Tissue Homeostasis. A Narrative Review

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## Abstract

The innovative method of osseodensification uses nonsubtractive drilling to preserve and condense bone during osteotomy preparation. The ability to rotate in the opposite direction of clockwise is made possible by specific burs. It is a non-extraction method that builds up a layer of compressed bone along an osteotomy's surface while also plastically expanding the bony ridge, which has a number of benefits in clinical practise.

**Keywords**: Osseointegration, primary stability, osseodensification

## Introduction

To establish implant osseointegration, the mechanical stability of the implant at the moment of surgery, or "primary stability," is essential [1-2]. Bone density, surgical technique, implant thread type, and shape are the main factors that affect implant primary stability. High insertion torque might dramatically improve the initial bone-to-implant contact percentage (%BIC) compared to implants inserted with low insertion torque values [1, 3-7]. The insertion torque peak was shown to be strongly connected to implant primary stability and host bone density [1]. Ottoni et al. showed that for every 9.8 N cm of additional torque, the failure rate in single tooth implant repair decreased by 20% [8, 9]. Osseointegration is defined as a direct structural and functional connection between living bone and an implant surface and is considered a prerequisite for implant loading and long-term clinical success.

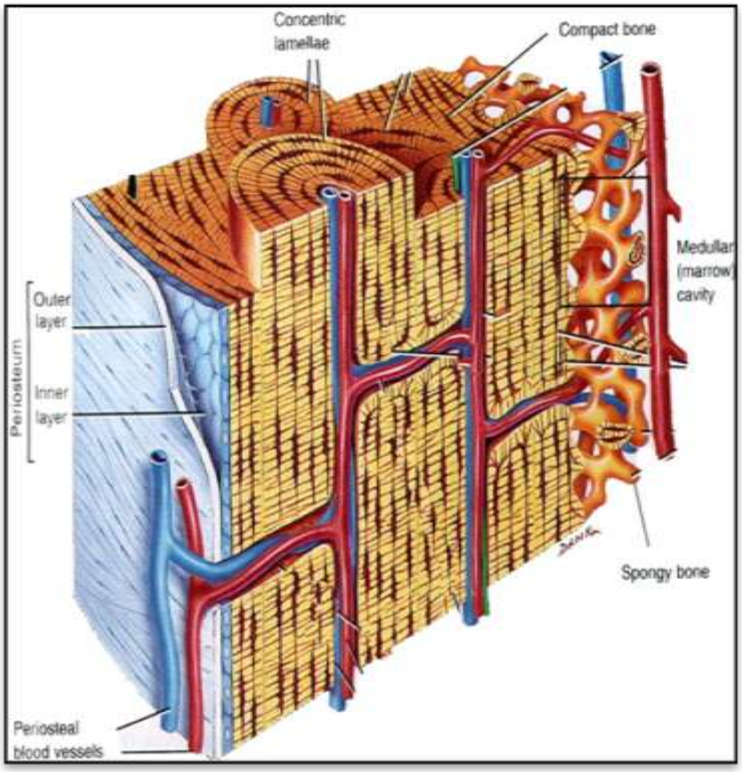
In 2013, Huwais created the non-extraction procedure known as osseodensification (OD), which is made possible by burs that are specifically tailored to improve bone density as they widen an osteotomy.

**Figure 1: Densah Kit**

**Physiology of Bone:**

The success of osseointegration is related to the kind and amount of bone at the implant contact [11].Bone's mechanical characteristics are connected not just too mineral density but also to collagen integrity and architectural distribution [12]. Collagen gives bone its tensile strength and its capacity to release energy; as a result, it has been discovered that collagen integrity is strongly related to bone flexibility [13-14]. Bone undergoes a progressive transformation known as plastic deformation, which is influenced by time and strain rate. In determining bone viscoelasticity, the fluid content of the bone is also crucial [15-17].

**Figure 2: Physiology of Bone**




**Osseodensification and Bone Density:**

Osseointegration is a process that causes bone to grow on the implant surface and adds to secondary stability between bone and dental implant [10]. Low bone density locations, such the maxillary posterior region, may have insufficient bone, which could negatively affect histomorphometric parameters like %BIC and %BV, hurting both primary and secondary implant stability. Using OD, imaging around the edges of osteotomies revealed a layer of enhanced bone mineral density. It has been demonstrated that the increase in bone density brought about by OD has a potentiating influence on secondary stability [9, 10].

**Osseodensification and Primary Stability:**

A key element in achieving implant osseointegration is the primary stability of the implant [1, 18]. In rapid loading protocols, high primary implant stability is essential, and it has been found that implant micromotions of more than 50 to 100 um can accelerate implant failure or peri-implant bone resorption [19-21]. In an in vivo investigation, Trisi et al. discovered a statistically significant relationship between micromotion, insertion torque, and peri-implant bone density [22]. With an increase in bone density values, it was observed that insertion torque significantly increased and micromotion decreased concurrently [22, 23].

In a review, Berardini et al. and Li et al. found no discernible difference in the failure rate and crestal bone resorption between implants implanted with high and low insertion torque values [23]. Additionally, they showed that, when compared to traditional osteotomies, OD drills could raise the BV and BIC for dental implants placed in low-density bone, which may aid in promoting osseointegration.[24-26]. Newer techniques, such as cutting torque resistance analysis established by Johansson and Strid, were also suggested as a tool to evaluate implant main stability [27]

## Controversies in Implant Site Preparation:

A number of methods have been developed to stop bone tissue from being lost during the osteotomy preparation procedure. In both clinical and histologic trials, the undersized preparatory drilling approach has been found to improve the early fixation of oral implants however, this improvement did not directly transfer to improved peri-implant bone volume and did not permit an enhanced healing process.

In both clinical and histologic studies, the undersized preparatory drilling approach has been demonstrated to enhance the early fixation of oral implants. The peri-implant bone volume did not improve as a direct result of this improvement, however, and the healing process was not accelerated. However, this improvement did not translate directly to improved peri-implant bone volume and did not allow an enhanced healing process [28]. Summers pioneered the use of bone compaction using the osteotome technique to boost the initial stability of dental implants without removing any bone tissue, and it is thought that this procedure will also promote final bone healing [29]. On the other hand, Buchter et al. observed that the osteotome approach impaired implant stability and linked this effect to microfractures that were generated in the peri-implant bone [30]. The osteotome technique was found to negatively affect osseointegration, according to Stavropoulos et al. Other methods to expand bone and generate an osteotomy without removing any bone stock but rather displace it include spreading and expanding ridges with screw-type expanders. On the other hand, buccal plate fracture during this procedure can affect the stability of the implant following insertion [31].

It has been demonstrated that using osteotome techniques with small-drilling techniques results in a layer of compacted bone at the implant interface, increasing primary stability of cancellous bone, a low-density bone. These methods do, however, have limits when used in surgery. The Summers osteotome must be advanced by repeatedly striking a mallet against it. This traumatic approach can be challenging for the surgeon to control and, in rare instances, can cause inadvertent displacement, fracture, or adverse patient symptoms including vertigo [29]. Expander drills provide an atraumatic approach, but their use by the surgeon may be burdensome or challenging due to the threading pattern's direct linkage of the feed rate and expansion rate, which restricts the surgeon's control.

## Structure of Conventional Drill Versus Densifying Drill:

Drills are composed of a shank with a predetermined length and diameter, often known as drill bits or burs. Cutting lips that reach the drill's outer diameter and a pointed chisel edge are present at the end. The shank has canals called flutes that clear the hole of debris and spiral guides called lands. A secondary cutting edge called the rake runs parallel to each flute and has a positive angle to help each flute remove a thin layer of material as it rotates. Twist drills with two or three flutes and cutting edges with a 25- to 35-degree rake angle are typically made for the most effective cutting of bone. However, the removal of bone during drilling can reduce the pullout strength and stability of the implant fixation. These flutes and lands on the densifying burs gently crush the bone and have four or more lands [32].

Densifying burs are cutting-edge surgical tools with a cutting chisel edge and a tapered shank. As they penetrate further into the osteotomy, the diameter of the burs gradually increases, managing the expansion process. By rotating in either the non-cutting direction (anticlockwise at 800-1,200 rotations per minute) or the cutting direction (clockwise at 800-1,200 rotations per minute), these burs can drill bone or densify bone.

Densifying burs are innovative surgical instruments that are made with a cutting chisel edge and a tapered shank, and as they move further into the osteotomy, their diameter gradually increases, controlling the expansion process. These burs are utilized with a typical surgical engine and have the ability to drill bone or densify bone by revolving in either the non-cutting direction (anticlockwise at 800-1,200



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rotations per minute) or the cutting direction (clockwise at 800-1,200 rotations per minute) [33].

**Osteotomy Site Preparation Using Densifying Bur:**

When preparing an implant site, conventional drills excavate and remove bone, whereas osteotomes maintain bone, they frequently cause trabeculae fractures that necessitate prolonged remodelling times and delayed secondary implant stability. The novel burs increase periimplant bone density (%BV), and in vitro testing revealed that the implant mechanical stability. Through compaction autografting during osteotomy preparation, the novel burs allow bone preservation and condensation.

**Figure 3: Densifying mode and cutting mode.**

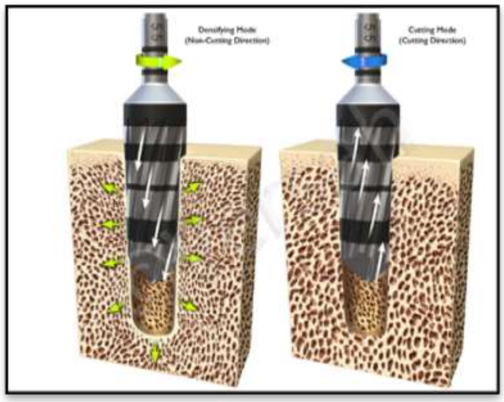
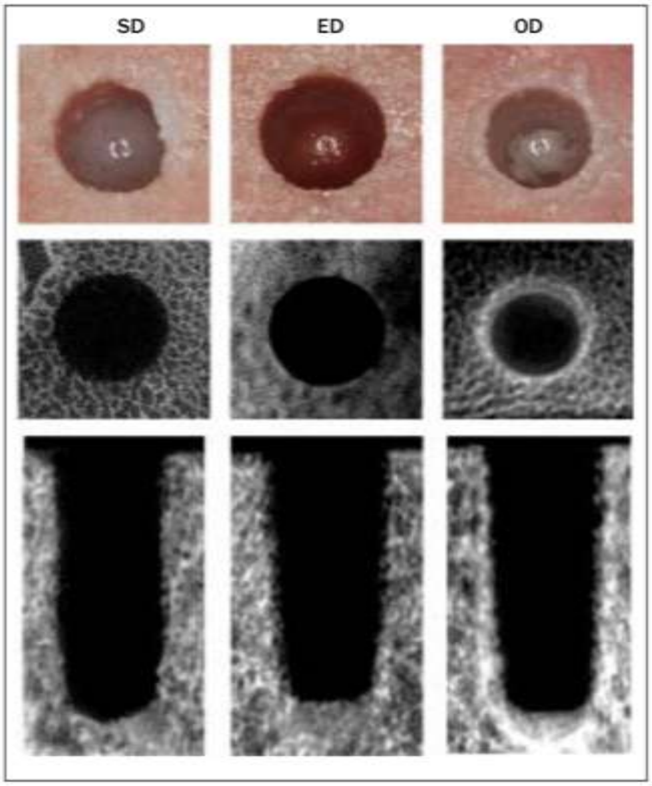



**Figure 4: Bouncing and bumping motion.**

To generate a rate-dependent stress that will result in a rate-dependent response, the bouncing motion (in and out movement) is helpful. Stress permits the bone walls to be softly pressurized by saline solution pumping. In order to retain bone mass, the osseous densification preparation approach compresses cancellous bone using viscoelastic and plastic deformation as well as compaction autografting of bone particles along the length and apex of the osteotomy.

**Figure 5: A surface image of osseous densification (OD), extraction drilling (ED), and 5.8-mm standard drilling (SD) osteotomies. The midsection and cross-section of a micro-CT scan. Huwais S et al.**




**Low-Density Bone and Osseodensification:**

The amount of bone surrounding implants in cases of low bone density, such as the upper jaw, may have a negative impact on histomorphometric parameters (such as BIC and bone volume percentage [%BV]), which in turn may affect the stability of both primary and secondary implants. Surgery methods proposed to increase primary implant stability and%BIC in low density bone include undersized implant site preparation and the use of osteotomes to condense bone.

**Healing patterns and Osseodensification:**

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Fracture and condensing of bone trabeculae are permitted by the use of osteotomes in poor density bone, however this method does not increase implant stability or periimplant bone density (%BV). It has been shown that fragmented trabeculae in periimplant bone induced by the osteotome technique result in a delayed secondary stability during healing compared to standard drilling techniques [34].

Due to the elastic strain and bouncing nature of bone, OD osteotomies were discovered to have smaller diameters than traditional osteotomies created with the identical burs. As a result, there was around a threefold increase in the amount of bone accessible for the implant location.



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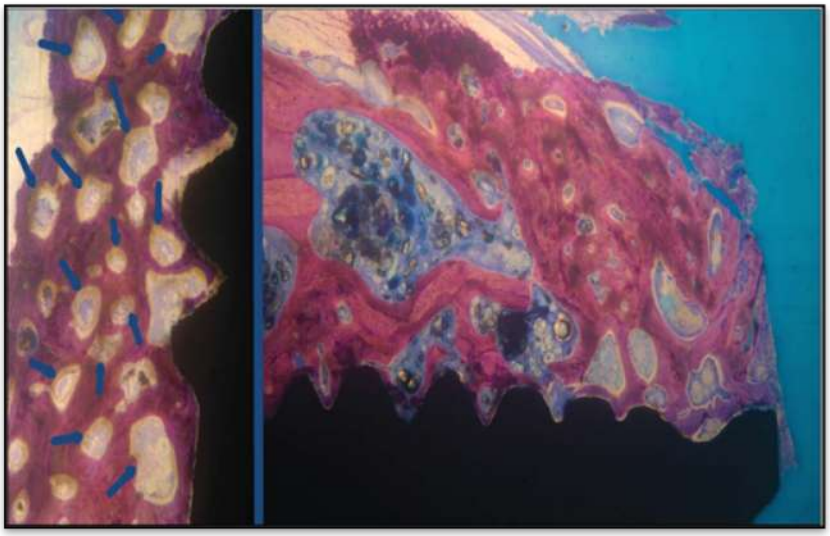
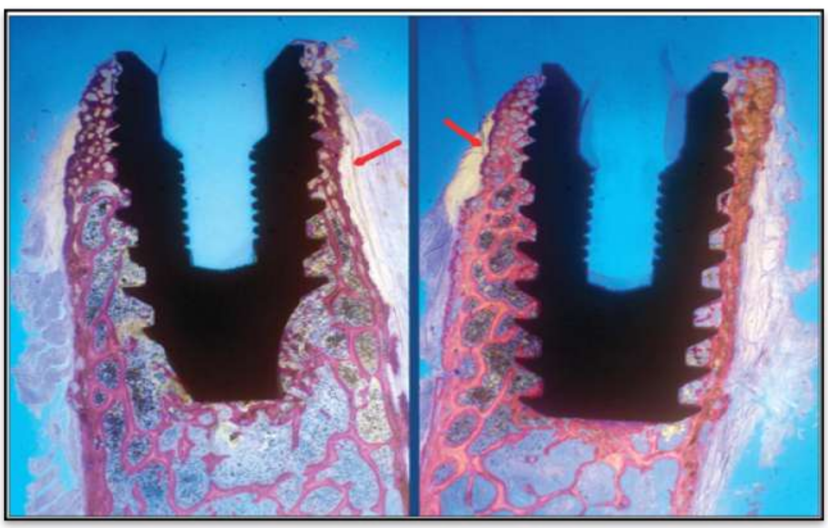
**Figure 6: The healing pattern's unusual granular nature was its most bizarre characteristic. The trabecular granules (highlighted by blue arrows) appeared to be mineralization nuclei. Around these granules, active osteoblasts and osteoid cells were present. Osteons, tissue, and toluidine blue (330x magnification) Implant coronal area in test group on the right. Resorption of bone was not noticed. The most coronal implant area (toluidine blue, 325 magnification) had a lot of mineralization nuclei. Paolo T et al.**





### Histological Outcomes of Ossointegration Using Densah Burs:

By using microradiographs and toluidine blue staining on histologic sections, it was possible to visualise the bone shape at the implant interface. These pictures illustrate that. When osseous densification was used instead of drilling, the amount of bone at the implant surface increased. For the 4.1-mm implant and the 6.0-mm implants prepared with normal drilling vs osseous densification, respectively, the mean bone percentage increased from 26% to 72% and 22% to 64%. The osseous densification procedure autografted bone fragments into the trabecular pores on the osteotomy's walls and at its base [35.36].

### Bone Expansion and Osseodensification:

Fracture and condensing of bone trabeculae are permitted by the use of osteotomes in poor density bone, however this method does not increase implant stability or periimplant bone density (%BV). It has



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**Sinus lift by crestal approach using osseodensification:**

For the first time, the sinus lift surgery by Gasper and colleagues incorporated osseodensification. The maxillary sinus was reached by 5–6 mm of residual bone height, according to CBCT. The treatment plan called for a sinus lift using a crestal approach along with osseodensification, a more contemporary technique that encourages the use of certain drills in an anticlockwise orientation to encourage bone growth and condensation. The burst was rotated anticlockwise at a modest speed (150 rpm) without irrigation to densify the NovaBone® bone graft material in the sinus. An IDCam 4,2mm x 12mm, IDI® platform-switched implant with a morse taper connection was inserted after sinus elevation. The idea of osseodensification has altered the paradigm of implant site preparation and can be utilised for maxillary sinus lift by crestal approach in a straightforward, secure, and effective manner.

In another study, in combination with osseodensification, synthetic and resorbable calcium phosphosilicate putty promoted more vertical augmentation than osseodensification alone.

**Use of Osseodensification during a Socket- Shield Technique in Esthetic Zone:**

A socket-shield approach, also known as the root-membrane technique, was used to extract the tooth and immediately place an implant in the aesthetic zone. OD burs were used in this treatment. The bone in the osteotomy was then densified using OD burs through lateral bone displacement. The osteotomy was filled with bone grafting putty (Novabone), and the implant was implanted using a primary implant stabilising device. For grafting between the implant body and face root, mineralized allograft was typically the material of choice. Importantly, after the 1.5-year follow-up, the facial wall bone thickness of the implant was still there, indicating positive treatment outcome [39].

## Conclusion

A biomechanical site-preparation method called osseodensification allows for the preservation of bone bulk and prevents the need to sacrifice bone. This review established the OD's ability to predictably expand the ridge while maintaining primary stability and increasing insertion torque values. Additionally, Type III and Type IV bone density can be treated with OD in a straightforward, safe, and predictable manner with minimal morbidity.

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