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OSSEODENSIFICATION: A METHOD TO IMPROVE PRIMARY STABILITY

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Abstract:

Osseodensification is a recently introduced interesting technique that enhances the bone density around dental implants and increases the primary stability. It is well established that implant stability is critical for osseointegration. It is directly related to surrounding bone quantity and quality. Maintaining and preserving bone during osteotomy leads to increased primary stability, mechanical properties and bone to implant contact, thereby enhancing secondary stability and healing.

Introduction

Osseointegration is a prerequisite for successful implant treatment. The term Osseointegration was coined by Brånemark (1985).[1] Primary stability of dental implants has been considered as an important factor for achievement of successful osseointegration and thereby secondary stability.[2] Primary stability has a direct relationship with density of bone. Thus maintenance and preservation of bone or the compaction of less dense bone during osteotomy facilitates enhanced primary stability and Bone to Implant Contact (BIC). The main concept of osseodensification technique is that instead of bone excavation, the drill design allows densification of the osteotomy site walls by compaction and autografting of bone tissues in an outwardly expanded direction.[3]

Why implant stability is important?

Dental implant stability is the measure of the anchorage quality of an implant in the alveolar bone. Implant stability can occur at two different stages: primary and secondary. It has been proven to affect the process of osseointegration, the pattern of implant loading, and, finally, the success of an implant.

Primary stability of an implant mostly comes from mechanical engagement with cortical bone. Thus it prevents the formation of a connective tissue layer between implant and bone, ultimately ensuring bone healing.[4] Secondary stability, on the other hand, offers biological stability through bone regeneration and remodeling.[4 HYPERLINK "http://www.jdionline.org/article.asp?issn=0974-6781;year=2012;volume=2;issue=2;spage=103;epage=109;aulast=Rao"]

Degree of implant stability may also depend on the condition of the surrounding tissues. The quantification of implant stability at various time points helps to predict the long-term prognosis.[1] A secure primary stability leads to a predictable secondary stability.

Factors Enhancing Primary Stability of Dental Implants

The key factors in enhancing implant primary stability are bone density, surgical protocol, implant thread type and geometry. Poor bone density is associated with excessive bone resorption and will impair bone healing, therefore considered

as a risk factor for implant failure.

The posterior maxilla has a thinner cortical bone and thicker trabecular bone when compared with mandible, which has thick cortical bone. Hence the chance of implant failure in posterior maxilla is more. So it is always desirable to have a technique to improve the density of osteotomy site.

Implants of parallel, cylindrical and tapered designs are available in market. Parallel design implants are not appropriate for most applications. Tapered designs provide a degree of compression of the cortical bone in an implant site with inadequate bone.

Implant surface topography and roughness also have an effect on the healing process by promoting favorable cellular responses and cell surface interactions. Rough implant surface will allow a firm mechanical contact with the surrounding tissues due to its larger surface area. Sandblasted implant surfaces enhance the growth and metabolic activity of osteoblasts by promoting peri-implant osteogenesis.

Methods to improve primary stability

Primary stability can be improved by increasing the bone to implant contact by various methods such as adapting to surgical techniques and by implant selection.

The use of thinner drills and wider and tapered implant designs will result in lateral compression of the bone trabeculae, an increase of the interfacial bone stiffness and primary stability.[5] Under preparation of the implant bed is another widely used surgical technique to improve the implant stability. This is usually achieved by using one or more sizes smaller last drill than the implant diameter.[6] Surface texturing of implants may reduce the risk of stability loss thereby facilitating osseointegration. Certain studies also show that bicortical anchorage improves the primary stability of apical portion of implants.[6]

Why osseodensification technique was introduced?

Traditionally, standard osteotomy drills are used to excavate bone from the implant osteotomy site. But the imprecise cutting of the osteotomy drills makes the design elliptical or elongated, which will reduce the torque during implant placement. This ultimately contributes to poor implant stability. Osteotomies tend to fracture the bony trabeculae, resulting in long remodeling time and delayed

Figure 1: Densah bur kit

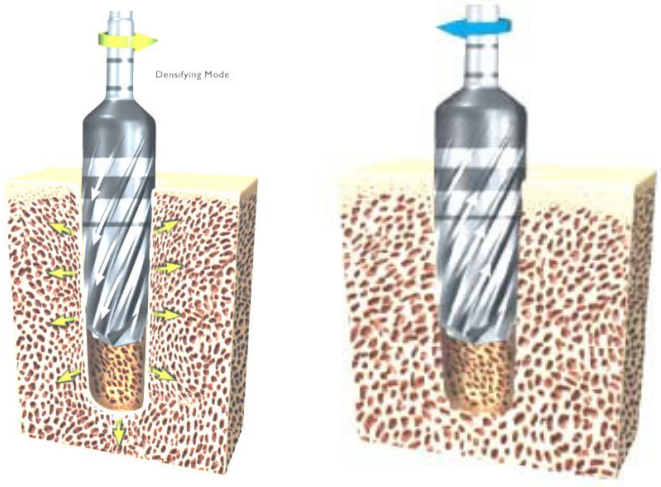

Figure 2:Anti-clockwise (densifying mode) and clockwise rotation (cutting mode) of Densah Bur

secondary implant stability.

Also, osteotomies prepared in deficient bone or narrow ridges may produce buccal or lingual dehiscence that necessitates additional bone graft increasing the healing period and cost. Some cases might require sinus lift procedures, which require a separate appointment. Because of these limitations, a newer biomechanical bone preparation method called "osseodensification" was introduced into the field of implant dentistry.

What is Osseodensification?

Dr. Salah Huwais developed osseodensification in 2013 using specially designed burs (Densah™ burs) that help densify bone as they prepare an osteotomy. It is a bone non-excavation technique. The procedure is characterized by low plastic deformation of bone that is created by rolling and sliding contact using a densifying bur that is fluted such that it densifies the bone with minimal heat elevation.[7]

Due to osteoblasts nucleating around the bone which is in close proximity with the implants, osseodensification will initiate new bone growth formation. It will densify the bone contacting the implant. There is a need for ≥2 mm of trabecular bone core and more than 1:1 trabecular/ cortical bone ratio to achieve a predictable plastic expansion. This technique is indicated in narrow crest with wider base. It facilitates lateral ridge expansion if the ridge width ≤ 3 mm. It is used for maxillary sinus autografting where it facilitates vertical ridge expansion. It is not indicated for resorbed ridge with narrow base.

Densah burs

Densah burs (Fig 1) are special burs having the ability to expand narrow bone ridges similar to split crest techniques. They increase bone density in the peri-implant area & thereby improving the implant mechanical stability of dental implants. Osseodensification does not excavate the bone but simultaneously compacts and autografts the particulate bone in an outward direction to create the osteotomy, thereby preserving vital bone tissue. These burs rotate both in clockwise (cutting mode) and counterclockwise (densifying mode) direction simultaneously at a speed of 800-1500 rpm with steady irrigation (Fig 2). In clockwise direction, it will cut the bone precisely along the created osteotomy walls and in anti-clockwise direction, it will densify the precisely cut bone. Thus, the bony fragments will act as an autograft maintaining the bulk of bone.

This pumping motion (in and out movement) creates a rate-dependent stress to produce a rate-dependent strain and allows saline solution pumping to gently pressurize the bone walls. This combination facilitates an increased bone plasticity and bone expansion.[6] This will increase the residual strain. Huwais demonstrated that osseodensification helped ridge expansion while maintaining alveolar ridge integrity, thereby allowing implant placement in autogenous bone, also achieving adequate primary stability. Osseodensification helps in preserving bone bulk and shortened the waiting period to restorative phase.[8]

This technique cannot be used in cortical bone, as the cortical bone is a non-dynamic tissue, which lacks plasticity. Xenografts should not be used for densification as they behave biomechanically different than the bone tissue. They contain only inorganic content that provide the bulk without any viscoelasticity.[2]

Conclusion

Placement of dental implants in poor density bone (D3 and D4 bone type) is always arduous in implantology as it compromises primary stability of dental implants. Osseodensification, a bone non-excavating technique can be used in low bone density ridges. It not only improve primary stability and bone contact through the

reversed compression exerted due to elastic bone spring back effect but also densify the bone due to instrumentation related autografting.[9] The Densah burs by rotating in both clockwise and counterclockwise direction will precisely cut and densify the bone, thereby increasing the bone bulk. This ultimately increases the primary stability of dental implants placed in low density bony ridges. Therefore, it is time to think about bone preservation to enhance its ability to heal faster, regardless of implant macro- or micro-geometry.[8]

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