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OSSEODENSIFICATION CONCEPT IN IMPLANT DENTISTRY

Periodontology

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ABSTRACT

Implant success is evaluated on the basis of the stability gained at the junction of the bone to the implant. The stability needed for the successful future outcomes are of two types, i.e., primary stability which is acquired while placing the implant and secondary stability acquired by osseointegration. At present a new idea of Osseodensification has been established for the preparing the osteotomy site for the insertion of the implant. It is a bone non-extraction technique for osteotomy site preparation. There is a low plastic deformation of bone caused by rolling plus sliding contact with osteotomes or densifying burs which have flutes to densify bone as it drills into it and expand osteotomy site. This technique permits bone preservation along with its condensation by compaction autografting of bone through osteotomy site preparation resulting in enhanced peri-implant bone density, healing and mechanical stability as well as minimised micromotion of the implant. This clinical approach is valuable at the sites where there is anatomic paucity of the bone.

KEYWORDS

Osseointegration, Primary Stability, Osseodenification, Osteotomes, Ridge Expanders, Densifying Drills

INTRODUCTION

Implant success is evaluated on the basis of the stability gained at the junction of the bone to the implant. The stability needed for the successful future outcomes are of two types, i.e., primary stability (PS) which is acquired while placing the implant and secondary stability acquired by osseointegration.[1] At present a new idea of Osseodensification (OD) has been established for the preparing the osteotomy site for the insertion of the implant by **Huwais (2013)**. He also invented modified densifying drills for the same purpose.[2]

OD is a bone non-extraction technique for osteotomy site preparation , given by **Salah Huwais (2013)** This is a new biomechanical bone preparation for placing a dental implant. There is a low plastic deformation of bone caused by rolling plus sliding contact with osteotomes or densifying bur which have flutes to densify bone as it drills into it and expand osteotomy site.[3]

HISTORICAL BACKGROUND OF OSSEODENSIFICATION CONCEPT

Summers RB (1994) used bone condensation procedure with osteotomes which is different surgical approach to enhance density of bone via mechanical action of cylindrical instruments alongside the osteotomic walls. This method comprises a small pilot hole along the compression of osseous tissue with implant shaped instrument or spreader apically or laterally.[4]Huwais S (2013) introduced a new bone preserving, non-extraction site preparation of osteotomy procedure established on the concept of OD drilling for implant bed preparation.[5]

RATIONALE OF OSSEODENSIFICATION

This technique permits bone preservation along with its condensation by compaction autografting bone through osteotomy site preparation resulting in enhanced peri-implant bone density, healing and mechanical stability as well as minimised micromotion of the implant. This clinical approach is valuable at the sites where there is anatomic paucity of the bone.[6]

The rationale of this procedure is that compacted, autologous bone in direct contact of the implant not only enhances PS due to physical interlocking of the bone with implant but also enhances osseointegration as the osteoblasts enucleate on the instrumented bone that is in absolute contact with the implant.[6]

Table 1. Indications and contraindications of osseodensification[7]

Indications	Contraindications
1. Site of bone preparation with soft trabecular bone.	1. Immunocompromised patients 2. Patients having bleeding disorders 3. Patients with titanium allergy.
2. Lateral ridge expansion. (Less than 3mm ridge width)	
3. Maxillary sinus lift.	

Table 2. Advantages and disadvantages of osseodensification[7]

Advantages	Disadvantages
1. Enhance mineral density of bone	1. Cortical bone being a non-dynamic tissue lacks plasticity and therefore this technique doesn't work with it.
2. Condensation and bone preservation at osteotomy site.	2. Densification of xenografts is not done with this technique as they differ biomechanically from the bone tissue, contains inorganic contents only and they only provide bulk with no viscoelasticity.
3. Produce smooth OD site hole by autografting bone pieces.	
4. It increases bone density, BIC and PS.	
5. Preservation of bone and scope for expansion of the ridge coronally.	
6. It decreases remaining strain.	
7. It results in increased insertion torque values that produce better prognosis.	

TECHNIQUES OF OSSEODENSIFICATION

1. Osseodensification by osteotomes:

The term osteotome is extracted from latin terms "osteo", which means bone and "tome" which means to cut.(8) In 1970s osteotomes were first brought up by Dr Hilt Tatum as set of hand instruments for condensation and expansion of the bone, and were utilised to enhance the bone density prior to implant placement while osteotomy preparation.(9) Summer in 1994 introduced osteotome technique for attaining improved PS as well as to expand the series of indications for implants within reduced quality bone. Summers used blunt instruments known as osteotomes for this purpose. [10]

2. Osseodensification with Ridge Expanders:-

A. Manual Ridge Expanders (Bone Screws)

Even though there are many pros of using osteotomes for the expansion of the bone prior to implant insertion, the major shortcoming of this technique was that it was mainly indicated for the maxillary arch. The force which was used for malleting in the osteotome technique could be daunting for both the dentist as well as patient. Also, in the instances of uncontrolled force fracture of the bone at the site may result. So, in previous years another technique to expand the bone prior to implant placement with bone expansion screws was introduced. This technique did not involve the usage of mallets.[8]

B. Motor Driven Ridge Expanders

This alternative method of expanding alveolar ridge, resulting in OD of the implant site, which is done with motor driven rotary expanders by expanding the bone through its displacement. With the utilization of this technique atraumatic osteotomy site preparation can be acquired as the usage of surgical mallet is eliminated. It is an exclusive system of expanding ridge that has motorised ridge expanders (e.g., BTI, PA, Blue Bell) including a bur kit. Better regulation of the expansion site and reduced trauma due to surgery is achieved with this technique as motor driven expanders are placed into the bone instead of tapping with the hammers. As the instrument goes deeper into the alveolar bone it compacts the bone laterally by the virtue of its threaded design. With this system Type II and Type III bone of the implant site can be prepared and expanded and Type IV bone can be compacted. [11]

3. Osseodensification using Densifying Drills

In 2003, Salah Huwais devised specially designed densifying burs known as Densah burs, manufactured by Versah LLC Company in Jackson, Michigan. These instruments provided a special, superior means of bone preparation for insertion of the implants. Non-substrative drilling by these burs enhance the PS not like the traditional drills that cut and scoop out bone at the time of osteotomy preparation which fracture the trabeculae resulting in longer remodelling time and delayed secondary implant stability. It helped in osteotomy site OD, that is why this technique is also known as "The Densah Technology by Dr. Huwais". Densah burs have mixed benefits of the speed of the osteotomes and tactile control of the drills while osteotomy. [7]

TECHNIQUES TO MEASURE OSSEODENSIFICATION

I. Histological and morphological methods [12][13]

II. Radiographic method

- Micro-computed tomography (mCT) [12]
- Quantitative-computerized tomography (qCT) [14]
- Cone beam computed tomography [15-17]
- Dual energy X-ray absorptiometry (DXA) scan [18]

III. Clinical method

- Torque-measuring micromotor [19]

COMPLICATIONS OF OSSEODENSIFICATION

Reduced bone-implant space results in tight junction and thereby there is restriction of the blood supply here, hindering the movement of the cellular elements through it. This results in pressure necrosis.[20–22] Pressure necrosis is the most common and serious complication of the OD which leads to implant failure. Gap amid the implant and the bone is a critical factor for the implant success as it facilitates the movement of the osteogenic cells through it from the marrow space to the implant surface. If the gap is increased above 500 μm it would result in delayed formation of a bad quality bone.[23]

Bone being a plastic tissue, resists breaking by adapting to the external forces. But in instances with higher forces applied for the insertion of the implants, as in osteotome technique, microfracture or microdamage within the trabecular bone occurs. This causes considerable reduction in the peak removal torque values and poorly affects the tissue collagen integrity. According to Burr et al. (1995) trabecular microdamage grow into the cracks within the bone. This considerably reduces the traumatized bone strength. Repair of the bone is strained as there is poor stabilization of the bony fragments against the turning forces due to their micromovements. This delays the duration for healing of the bone at the implant site. Buchter et al (2005) showed in their study that normal remodelling of bone requires 4 weeks following the implant insertion. Whereas, according to Frost (1998) bone remodelling of microfracture requires minimum 3 or more months to repair. [24]

CONCLUSION

Conservation of the bone at the time of the preparation of the implant bed is important to attain PS that is linked with osseointegration and the final clinical success of the implant. OD procedure has revolutionised the implant site preparation technique and is of high value in producing a strong enlarged osteotomy for the insertion of the implant via autograft condensation of the surrounding bony walls, especially in low density sites. It significantly improves PS, bone mineral density and BIC% at the surface of the implant. [6]

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