



A NOVEL OSSEOUS DENSIFICATION APPROACH IN IMPLANT OSTEOTOMY PREPARATION TO INCREASE BIOMECHANICAL PRIMARY STABILITY

Dentistry

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ABSTRACT

Prosthetic rehabilitation of missing teeth (partial/complete) using dental implant has been an established procedure for a long time. Conventionally it involves the use of twisted drills to prepare the implant site. However, the use of modified drills such as Densah burs is relatively new. It works in densifying mode by compacting the bone into a prepared osteotomy site which leads to an increase in primary stability due to an increase in bone-implant contact. This method is based on the principle of bone conservation and it can be used as an essential treatment alternative. The case report presented here describes the utilization of the novel technique for the implant site preparation when there is alveolar ridge deficiency and the successful osseointegration of dental implant without the need for any additional surgical procedure to carry out any bone augmentation. The results of this study concluded that, adequate implant stability with preservation of alveolar ridge integrity was achieved, resulting in a shorter duration of restoration for the patient.

KEYWORDS

Densifying burs, Dental implant, Implant stability, Insertion torque, Osseodensification, Osteotomy

INTRODUCTION

Prosthetic rehabilitation of edentulism (partial or complete) using dental implants is a well-established procedure. It involves the direct structural and functional integration of the implant's outer surface with the surrounding bone. This direct structural and functional relationship is an essential prerequisite for implant success and is termed as "osseointegration".¹ There are various other factors that influence implant stability such as surgical implant site preparation, type of bone, bone mineral density, diameter, taper, surface design of implants.² Implant stability is achieved by mechanical and biological integration of the implant surface with the surrounding bone. The mechanical integration, known as primary implant stability, is an essential prerequisite for successful osseointegration.³ It is achieved by the interlocking of the implant threads with the prepared bone surface, which results in the prevention of the micromovements of the implant till osseous remodeling takes place.

Conventional implant osteotomy involves surgical intervention using twisted drills which cut the bone tissue. This leads to the preparation of a cylindrical osteotomy for receiving an implant fixture later on. However, certain limitations are associated with conventional osteotomies, such as necrosis induced by heat generation in the absence of sufficient irrigation, inaccurate preparation due to vibration of the instrument. Various clinical and histological studies have been conducted with techniques such as bone compaction using an osteotome, undersized preparation of the implant site. These techniques have enhanced the primary stability successfully. However, there was no translation of the result in the secondary stability and therefore achieving adequate osseointegration. With the advancement in implant dentistry, immediate and early loading has been introduced to fulfill the patient's desire for the restoration of the edentulous site without much delay. To achieve implant stability, bone conservation is required as compared to the conventional drilling procedure, which cuts through the bone tissue. Conventional drills have a positive rake angle which involves a subtractive technique and cuts the tissue in a clockwise direction. This leads to the production of strains in the remaining bone exceeding the bone microdamage threshold and thus requiring more than three months to repair the osseous tissue.⁴ To overcome the limitation of the conventional drilling technique, a novel concept of additive drilling protocol, known as osseodensification (OD), was introduced in 2014 by Meyer et al.⁵ It involves the use of specially designed drills which has a negative rake angle and works in a densifying mode in the anticlockwise direction. The rationale of the OD technique is that it compacts the bone into the prepared osteotomy site. This not only increases the primary stability due to an increase in bone to implant contact (BIC), it also facilitates osteoblastic nucleation on the implant surface so that successful osseointegration can be

achieved. This paper aims to present a case where implant site preparation was carried out using the OD technique using specifically designed drills (Densah burs), (Fig 1), as a treatment alternative to conventional drilling in prosthetically driven implant placement to conserve bone tissue especially in the case of ridge deficient cases.



Fig 1: Osseodensification drills used in sequence along with manual wrench used for inserting implant.

Case Report

A 37-year-old male patient reported to the dental center with a complaint of missing teeth w.r.t tooth no. 36 and desired restoration of the same. The patient's medical history was non-contributory. The patient's clinical and radiographic assessment revealed edentulous ridge with respect to 46. (Fig 2)

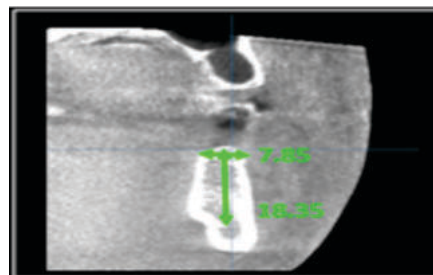


Fig 2: CBCT analysis showing ridge dimension and average bone density in Hounsfield units.

Dental implant was planned with implant site preparation using the OD approach, for which consent was taken from the patient. The mandibular right segment region was anesthetized using nerve block technique of inferior alveolar nerve as well as buccal nerve with 1.8 mL 2% Lignocaine HCl with 1:80,000 epinephrine. Once anesthetized, a mid-crestal incision was given using the #15c blade, and a full-thickness flap was reflected to reveal the crestal alveolar ridge.

Implant site preparation was then carried out using the specifically designed OD drills (Densah burs) as per Densah protocol.⁶ Considering the ridge dimensions, the dental implant of size 5×10 mm was planned for insertion. After the pilot drill, the implant site was prepared using VT1525 (2.0 mm), VT2535 (3.0 mm), VT2838 (3.3 mm), and VT3545 (4.0 mm) in a counterclockwise (CCW) direction (densifying mode) at 1200 rpm (Figures 3), using bouncing-pumping motion.⁷ After the implant site osteotomy was completed (Figure 6), a dental implant measuring 4.5 × 10.5 mm was inserted at a maximum insertion torque value of up to 50 N cm by manual wrench (Figure 7). The preparation carried out in densifying mode led to implant insertion within the autogenous bone without exposure of any implant threads on any aspect.



Fig 2: Implant site preparation with Densah drills in CCW rotation at 1200 rpm.

Primary implant stability is the most crucial factor for the successful osseointegration of the dental implant.³ Successful osseointegration is achieved by bone formation on the implant surface which contributes toward the implant's secondary stability. Factors such as bone density as well as the ridge dimensions may directly affect the implant stability (both primary and secondary).

After placement of the healing cover screw, flap closure was done using 3-0 interrupted silk suture (Figure 7). Twelve weeks post-placement, implants were uncovered using a crestal incision and subsequent placement of the healing abutments was carried out. After the soft tissue healing in the peri-implant region, the screw-retained prosthesis for the implant was placed.

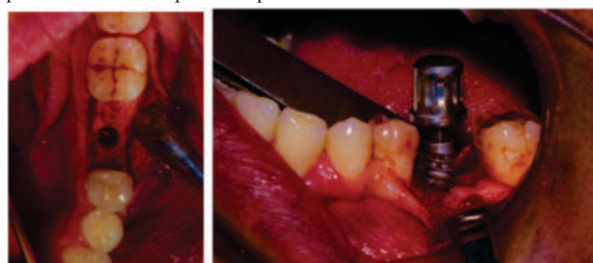


Fig 3: Implant site prepared and implant placement

DISCUSSION

The effect of the quality of bone on the osseointegration can be measured. Primary implant stability is the most crucial factor for the successful osseointegration of the dental implant.³

Successful osseointegration is achieved by bone formation on the implant surface which contributes toward the implant's secondary stability. Factors such as bone density as well as the ridge dimensions may directly affect the implant stability (both primary and secondary). The effect of the quality of bone on the osseointegration can be measured histomorphometrically using parameters such as bone-implant contact percentage (%BIC) and bone volume percentage (%BV). Therefore, in low bone density regions, lack of sufficient bone may impact both %BIC and %BV negatively, affecting the implant stability.

Conventional implant site preparation is a subtractive technique involving the removal of bone tissue. In the region of lower bone density and areas with ridge deficiency, prosthetically driven implant placement may lead to bone dehiscence and implant thread exposure. Procedures for bone augmentation such as guided bone regeneration, ridge split technique, autogenous block graft, and various techniques have been reported in the literature.⁷ This not only adds to an additional surgical procedure with a longer healing time but also

increases the duration of restoration of the missing teeth. However, preservation of bone especially in ridge deficiency should always be accorded priority. Osseodensification is the novel approach toward the preservation of bone to reduce the need for multiple surgical procedures and a long waiting duration for the prosthetic rehabilitation of the missing teeth. Osseodensification drills are uniquely designed drills that have a negative rake angle and it works in both clockwise (CW) and counter-clockwise (CCW) modes. Clockwise mode is the cutting mode while CCW is the densifying mode. When the OD drills are used for the implant site preparation, they preserve the bone by compacting the autograft bone particles along the periphery of the implant site throughout the length and apex. It utilizes the viscoelastic property of the cancellous bone and results in plastic deformation of the bone in such a way that it results in compaction of the cancellous bone. The negative rake angle in CCW motion creates a "burnishing-like effect" and condenses the bone with a compressive force lesser than the ultimate strength of the bone.⁷ For hard trabecular bone such as in the mandibular posterior region, the diameter of the final osteotomy should be 0.2–0.5 mm smaller than the average implant diameter.

Further, implant site preparation using OD burs which allowed for adequate bone compaction towards the buccal aspect as well as alveolar ridge expansion due to viscoelasticity and the plasticity of the cancellous bone.⁷ This led to final implant insertion completely within the autogenous bone without any implant thread exposure on the buccal aspect resulting in horizontal ridge expansion from 5.5 to 8.5 mm postoperatively. Another important factor in assessing the primary implant stability is the absence of micromovements and high insertion torque values. Trisi et al. found a significant increase in insertion torque value in the OD group (49 N cm) compared to the conventional drilling technique (25 N cm).⁹ Lahens et al. similarly reported an increase in Implant insertion torque values in the OD group when compared to conventional drilling.

A significant correlation was found between an increase in torque values with %BIC (70% in OD group than 50% in conventional drilling).¹⁰ High insertion torque value is a good indicator of good primary stability for consideration of immediate or early loading. An insertion torque value of 35 N cm has been reported in the literature, as optimal for achieving implant stability. Implant insertion torque in the case presented here was 50 N cm suggestive of achieving optimal primary stability using the OD technique. Hence this case report demonstrated horizontal ridge expansion in a compromised bone by utilizing the OD technique. This also ensured the maintenance of the alveolar ridge after implant site preparation with adequate primary stability. This technique is based on the principle of preservation of tissue, thus eliminated the need for any additional augmentation procedure and ensured a shorter waiting duration for the restoration.

CONCLUSIONS

Osseodensification is a novel approach in implant dentistry that utilizes the concept of bone conservation. Implant osteotomy using conventional twisted drills leads to loss of hard tissue leading to more strain and more healing time. Due to the preservation of bone bulk and the compaction of the autograft particles in the implant site, adequate implant primary stability with preservation of alveolar ridge integrity was achieved, resulting in a shorter duration of restoration for the patient. Since there is inadequate evidence for this technique as an alternative to the traditional drilling technique, randomized controlled trials with long-term results are the need of the hour.

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