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Five Techniques of Osseodensification in One Case

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Abstract

Initial stability of implants is an important factor for the osseointegration of dental implants. Initial stability of implants can be lost when the bone is insufficient in cases of immediate implantation or when the bone density is insufficient, making it difficult to ensure good initial stability. Many techniques have been used to increase bone density. This study tested the use of five methods to increase bone density in one patient. This study concluded that the five methods used were effective in densifying the bone and achieving clinically acceptable primary stability in low-density bone.

Keywords: Initial Stability; Primary Insertion Torque; Implant Stability Quotient; Densah Burs; Magnetic Mallet.

Introduction

Primary implant stability is a critical factor for achieving osseointegration of the dental implants. Primary implant stability is critical in immediate loading protocols. Implant micromovement greater than 50-100 µm has been reported to increase peri-implant bone resorption or implant failure [1].

In an in vivo study, a statistically significant association between peri-implant bone density, primary insertion torque, and micromovement was reported. A significant increase in insertion torque and a concomitant decrease in micromovement were observed with increasing bone density values [2].

A systematic review reported no significant difference in maxillary bone resorption and failure rate between implants inserted with high or low insertion torque values [3]. It was also noted the ability of densifying drills to increase the bone volume and bone-to-implant contact (BIC) ratio in dental implants inserted in low-density bone compared to conventional densification, which may help promote osseointegration [4].

Unlike conventional densification, in Densah densification, the bone is not drilled but compressed and the autologous bone is implanted during cutting, thus preserving the vital bone tissue [5].

A novel method for preparing the dental implant site by densifying the recipient's bone is the Magnetic Mallet. Dynamic magnetic technology exploits the physical principles of electromagnetism to apply controlled forces to the body while reducing the time of action. Control and stability of applied forces make procedures safe for patients and surgeons [6].

The magnetic mallet consists of a handpiece activated by a power control device, delivering forces according to the timing of application, where different inputs can be attached to the handpiece, which drives a wave on its tip according to the surgical procedure [7].

The present study describes the use of five methods for densifying

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low-density bone when implanting nine maxillary implants in one individual to test the hypothesis that there are no differences in healing among different techniques.

Subject and Results

A 43-year-old female with no systemic diseases and a non-smoker with complete edentulous upper jaw, except for teeth 11, 13, 21, and 22 that were non-restorable root remnants, looked for care in our clinics.

She underwent a radiological examination using both panoramic imaging and cone beam computed tomography (CBCT) to plan for dental implants. After studying the radiograph, it was found that the bone three dimensions were suitable for dental implant placement. However, the bone density around the premolars and maxillary molars was low (class IV according to Lekholm and Zarb classification), with an average of 250 Hounsfield units.

Local anesthesia was performed with infiltration using 4% articaine with 1:80,000 adrenaline, and extraction of the root remnants was performed (Figure 1).

After that, a gingival flap was raised (Figure 2) over the entire upper jaw, where it was decided that nine dental implants were going to be placed.

The maxillary first and second molar implants on the right side were initially prepared using Densah densification burs (JKSurgical, Pakistan). The sites were initially prepared using a 2 mm diameter pilot drill, and were gradually increased using Densah burs (Figure 3), until they reached a diameter of 3.3 mm. Two implants of 4 mm diameter and 8 mm in lenght (AnyOne, Megagen, Korea) were placed in the first and second molar sites, and the primary insertion torque was measured using a Megagen AnyOne ratchet. The Implant Stability Quotient (ISQ) was measured using a MEGA ISQ (Megagen, Korea) device.

Then the maxillary first and second molar implants on the left side were prepared using a Magnetic Mallet (Meta Ergonomica Srl; Turbigo MI, Italy) (Figure 4), where they were initially prepared using a 2 mm diameter pilot drill, then gradually increased using heads until they reached a diameter of 3 mm. Two implants of 4 mm diameter and 8 mm in length (AnyOne, Megagen, Korea) were placed in the first and second molar sites, and the primary insertion torque was measured using a Megagen AnyOne ratchet. The Implant Stability Quotient (ISQ) was measured using a MEGA ISQ (Megagen, Korea) device.

The first premolar implant sites (between the first premolar site and the second premolar site) were prepared on both sides using osteotomes (Friadent, USA) (Figure 5), after expansion to 2 mm was done using a driving drill. Then, the tampers were graduated to a diameter of 3.8 mm. Implants with a diameter of 4 mm and a length of 8 mm (AnyOne, Megagen, Korea) were placed into the premolar sites. The primary insertion torque was measured using a Megagen AnyOne ratchet, and the Implant Stability Quotient of the dental implants (ISQ) was measured using a MEGA ISQ (Megagen, Korea) device.

Then, the right and left canine implant sites were prepared using the Bonex expanders (Megagen, Korea), where they were initially prepared using a 2 mm diameter pilot drill, then mechanical expanders were used to reach a diameter of 3.3 mm. Two implants with a diameter of 4 mm and 8 mm in length (AnyOne, Megagen, Korea) for the left canine site and 10 mm in length (AnyOne, Megagen, Korea) fort the right canine site were placed. The primary insertion torque was measured using a Megagen

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AnyOne ratchet, and the Implant Stability Quotient of the dental implants ISQ was measured using a MEGA ISQ (Megagen, Korea) device.

Eventually, the implant site was prepared in the right incisor site using the undersized preparation technique, and preparation was carried out using a pilot drill with a diameter of 2 mm, reaching 10 mm, then moving to the second drill with a diameter of 2.5 mm, and then to the final drill of 2.8 mm in diameter. An implant with a diameter of 4 mm and 8 mm in length (AnyOne, Megagen, Korea) was placed in the right incisor site. The primary insertion torque was measured using a Megagen AnyOne ratchet, and the Implant Stability Quotient of the dental implants ISQ was measured using a MEGA ISQ (Megagen, Korea) device.

The gingival flap was then sutured with continuous and interrupted sutures using 5/0 nylon sutures (Figure 6). The patient was given postoperative instructions.

The sutures were removed two weeks after surgery and the patient did not suffer from any complications during the healing period up to four months, where the gingival healing abutment was applied (Figure 7). Interrupted sutures were performed using 5/0 nylon sutures. The sutures were removed after two weeks, and an impression was taken using open transfer (Figure 8). A PFM restoration was performed (Figure 9).

The patient was followed up for 18 months and a panoramic X-ray was performed (Figure 10).

Implant details can be seen in Table 1.

Figure1. The upper jaw after extractions.

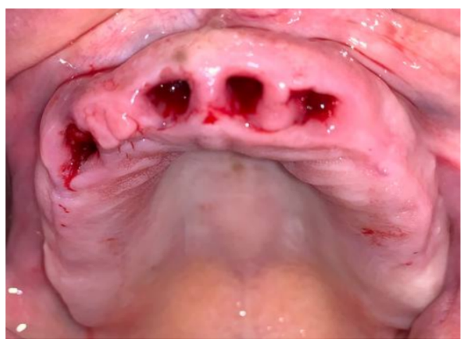

Figure 2. The gingival flap elevation.

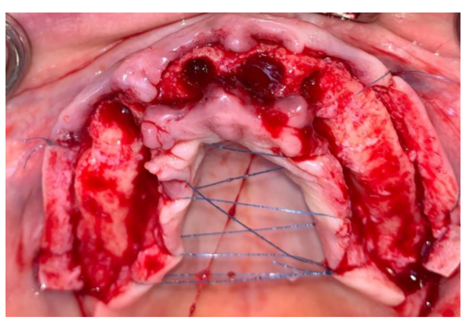

Figure 3. Densah burs, BonEx expanders, osteotomes, and the AnyOne implant kit.

Figure 4. The Magnetic Mallet handpiece and head.

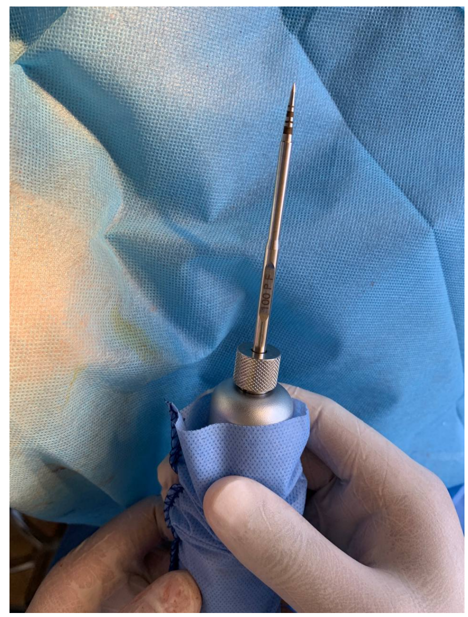

Figure 5. Densification using osteotome.

Figure 6. Suture after implantation.

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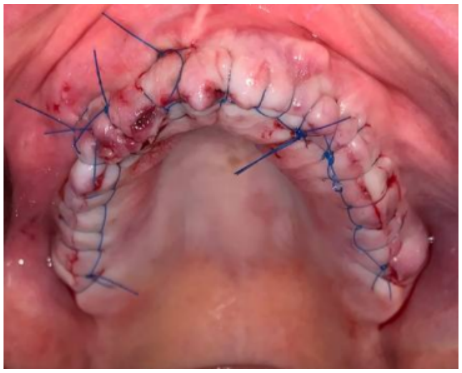

Figure 7. The tissue appearance after healing abutment application.

Figure 8. The open tray impression.

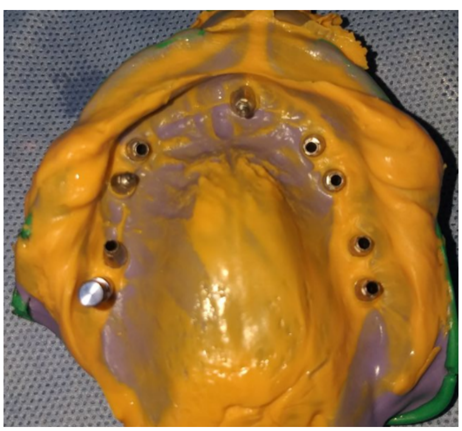

Figure 9. The final PFM prosthetic.

Figure 10. Panoramic X-ray after 18 months of implantation.

Discussion

The superiority of the magnetic mallet in primary insertion torque can be explained by the minimal bone removal with the pilot study drill compared to other methods, where the required preparation before starting the densification was just 1.2 mm in size. Densah burs were the second most conservative, and this is also due to the lateral densification that these burs perform at the preparation site, as both their designs and their counterclockwise rotations ensure good bone densification.

These two techniques outperformed the bone compactors, and this may be attributed to the anatomical compatibility between these two methods and the shape of the implant, while compactors are generally cylindrical or slightly graduated, which means a wider diameter for preparation in the apical region and less apical stability.

The superiority of the preparation technique using bone densification burs in ISQ over other methods can be explained by its special bone densification mechanism, thanks to the unique design of the drill shape and the counterclockwise rotation, which helps in densifying the bone apically and laterally, and enhances the local density, increasing the contact surface area between the implant and the surrounding bone, thus positively improving the stability of the implant.

The good ISQ values in the magnetic hammer preparations and osteodensification burs can also be explained by the lateral and apical bone density achieved by the tools for preparing the implant site using the magnetic hammer device and the minimal bone removal, thus increasing the contact surface area between the implant and the bone.

The good implant stability values obtained with the bone expander preparation can be explained by the minimal bone removal in the implant site and the lateral bone density it performs.

The undersized preparation technique achieved acceptable ISQ values for the implants and this is attributed to the significant difference between the diameter of the last drill used to prepare the

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site and the diameter of the implant and the effect of it on improving the local bone density and increasing the contact surface area between the implant and the surrounding bone.

Previous work [8] looked at traditional preparation and Densah densification burs in increasing implant stability at implant sites prepared in the bone of pigs after slaughter and concluded that densification using Densah burs led to a greater insertion torque than the traditional method and to a greater ISQ than the traditional preparation.

Densah densification burs with expanders in the upper premolar region, measured immediately after implant placement and after two months, six months, and eight months, showed that the implant stability score immediately after implant placement was statistically significantly greater in favor of the expanders [9].

Magnetic mallet was also previously shown to outperform the traditional preparation in achieving greater implant stability [10].

Conclusion

Within the limitations of this clinical case, we conclude that the five methods used were effective in densifying the bone and achieving clinically acceptable primary stability in low-density bone, with both Densah burs and magnetic mallet outperforming the other methods.

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Table 1. Length, diameter, Primary Insertion Torque, and Implant Stability Quotient of the placed implants.

Implant Site	Implant length (mm)	Implant Diameter (mm)	Primary Insertion Torque (N/cm^2)	Implant Stability Quotient
17	8	4	41	81
16	8	4	39	82
14	8	4	33	75
13	10	4	37	68
11	8	4	32	71
23	8	4	35	67
24	8	4	34	77
26	8	4	40	79
27	8	4	38	80