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Comparison Of Insertion Torque & Primary Stability Values In Dental Implants Placed With Two Techniques; Osseodensification V/S Expanders In Posterior Maxillary Region: An In Vivo Study

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Abstract-

Background: *Dental implant placement in the posterior maxillary region is often complicated by poor bone quality and quantity, particularly in cases of a compromised residual ridge. The inherent challenges associated with inadequate bone availability significantly impact treatment outcomes and long-term success. Innovative techniques such as osseodensification and expanders have been introduced precisely to address these limitations. Osseodensification aims to densify the bone during implant site preparation, improving its quality and enhancing primary stability. This process is particularly beneficial in cases of poor bone quality, where traditional methods may struggle to achieve adequate stability. Similarly, expanders are employed to augment the amount of bone available, facilitating implant placement in regions with deficient bone volume. By using these innovative approaches, clinicians can effectively overcome the challenges posed by poor bone quality and limited residual ridge dimensions, ultimately improving the predictability and success rates of posterior maxillary dental implant procedures.*

Aim: *To comparatively evaluate insertion torque and primary stability values in poor quality (D3,D4) bone sites of posterior maxillary region using Osseodensification v/s expander technique.*

Objectives: *To assess and compare the insertion torque and primary stability values of implants placed using osseodensification and expanders in the posterior maxillary region.*

Materials and Methods: *Twenty implants were placed in maxillary D3 and D4 bone, divided into two groups: Group A (Osseodensification) and Group B (Motorized Threaded Expander technique). Insertion torque values and ISQ values were recorded at the time of surgery using a torque wrench and Osstell ISQ device, respectively. Statistical analysis was performed using SPSS software.*

Results: *No significant difference was found in insertion torque values (p = 0.886) or ISQ values on both buccolingual (p = 0.562) and mesiodistal surfaces (p = 0.322) between the two groups. Both techniques demonstrated comparable primary stability*

Conclusion:

The study highlights a significant finding in the field of posterior maxillary implant placements, demonstrating that both osseodensification and motorized threaded expander techniques yield comparable levels of primary stability and insertion torque values. This finding underscores the effectiveness of these innovative approaches in overcoming the challenges posed by poor bone quality and limited residual ridge dimensions in this anatomical region. By providing reliable options for enhancing primary stability, both osseodensification and motorized threaded expanders offer promising avenues for improving treatment outcomes in challenging clinical scenarios.

Key Word*: Osseodensification, Expanders, Delayed Implant*

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I. Introduction

Bone is a special combination of mineral structure and protein molecules that combine to provide characteristics such as rigidity while also being flexible and light[1]. Bone is flexible enough to absorb energy and change shape (deform) without failing because it is inhomogeneous, anisotropic, and viscoelastic. It can also broaden under compression and extend in tension. The bone can bend further and undergo irreversible transformation through plastic deformation if the stress is greater than its elastic deformation capacity[2].

Osseodensification is one such innovative biomechanical technique introduced by Salah Huwais, Eric G Meyer in 2014 to prepare the site. It uses Densifying Burs to produce low plastic deformation owing to its non-removal densifying method of site preparation, which preserves the bone enhancing the host site.[3]

For an implant to succeed there are multiple factors that play a major role in the final outcome, such as some of them depend on the patient, presence of systemic diseases (such as diabetes mellitus, coagulation disorders, and others)[4], anticoagulant, bisphosphonate, and cardiovascular aspirin therapy [5], as well as the physiology and histology of the treated structures (available bone quantity and density, mental nerve near the level of the bone crest) [5]; other factors are operator-dependent (experience, methods, and instruments used, team skills).

It should also be considered that in a healthy patient and experienced operator there can be several complications even after a non-eventful surgery (peri-implantitis, bone dehiscence, and impossibility to obtain ideal implant stability). If the primary stability of the implant is insufficient, the early implant failure rate could escalate beyond critical levels. Immediate loading procedures are also not encouraged in the event of low primary implant stability or poor bone quality. [3]

The densifying bur rotates at 800-1500 RPM in the counterclockwise non-cutting direction (Densifying mode). They can also rotate clockwise (Cutting Mode) to cleanly cut bone if required. This dual use capability permits clinical versatility. [4]

Osseodensification does not excavate bone, opposing traditional bone drilling techniques. It rather preserves the bulk of the bone. Consequently, bone tissue is compacted in an externally expanding direction to form the osteotomy. Thus, it may permit the implant Surgeon to autograft the maxillary sinus and proficiently expands any ridge in either jaw with improved implant stability. [3]

Expander technique has been introduced to improve the quality and quantity of bone around the implant, it consists of using expanders that can facilitate width expansion of alveolar ridges. [5]

These expanders help to avoid the surgical trauma due to malleating and permit a precise control on pressure exerted during ridge expansion. Moreover, it can be used as condensers of trabecular bone increasing bone density around the newly placed implant, thereby improving the primary stability. [6]

This method of bone expansion is considered minimal invasive simple and useful technique to place implants in cases of horizontally resorbed ridges. [5]

To compensate for the poor bone quality, research teams have improved implants' texture and design to facilitate osseointegration using techniques like acid etching, grit blasting, titanium plasma spraying, surface coating. Osseodensification of osteotomy preparation is one such technique that has been developed to eliminate the guessing game of implant primary stability.

Standard drill designs used in dental implantology are made to excavate bone to create room for implant placement. They cut away bone effectively but typically do not produce a precise circumferential osteotomy. Osteotomies may become elongated and elliptical due to the chatter of the drills.[6]

There is literature on Osseodensification that shows it is superior to traditional osteotomies, as well as literature comparing Expander and conventional osteotomies. However, there is a scarcity of literature comparing Osseodensification and the Expander approach.

As a result, the goal of this in-vivo study is to compare the Osseodensification and Expander techniques, as well as the primary stability and insertion torque values of implants placed in D3 & D4 bone of maxilla in two different sites at the time of implant placement.

II. Material And Methods

Source Of Data –

The present study was conducted in the department of Prosthodontics, Crown and Bridge, Maxillofacial Prosthodontics and Oral Implantology, I.T.S. Dental College, Hospital and Research Centre, Greater Noida (U.P.)

Data Collection

Sample size –

Sample size: 10 patients, 20 implants sites

GROUP I: Will contain 10 implant sites placed with the technique of Osseodensification.

GROUP II: Will contain 10 implant sites placed with osteotomy using Expander technique.

- After an explanation of proposed study criteria, the participants will be asked to sign consent prior to the surgery.
- A total of 20 implants (10 subjects) will be placed in posterior edentulous maxilla of D3, D4 bone density with 2 different osteotomy techniques.
- The flap will be reflected at the site of implant placement and the osteotomy is done with 2 different techniques in two different sites, then the implants will be placed, cover screw is tightened, and the flaps will be sutured back.
- 10 dental implants will be placed with osseodensification technique with DENSAH® burs (VERSAH OSSEODENSIFICATION KIT) with sequential drilling pattern.
- 10 dental implants will be placed with EXPANDER technique, with the standard protocol of implant placement.
- Primary stability will be recorded with the help of RFA and Insertion torque values.
- All patients are prescribed with standard antibiotic and anti-inflammatory protocol.

III. Result

The present study was conducted in the Department of Prosthodontics, Crown & Bridge, Maxillofacial Prosthesis and Oral Implantology, ITS Dental College, Hospital and Research Centre, Greater Noida, to comparatively evaluate insertion torque & primary stability values in dental implants placed with two techniques; osseodensification v/s expanders in posterior maxillary region – an in vivo study.

A total of 20 implants were placed in maxillary D3 and D4 Bones and evaluated. The study was divided into two groups –

Group A – Osseodensification

Group B – Motorized Threaded Expander technique

The data for the present study was analyzed using SPSS statistical software 23.0 Version. The intergroup comparison was done using the independent t tests Shapiro–Wilk test was used to investigate the distribution of the data and Levene's test to explore the homogeneity of the variables.

Table 3 – Mean Age Among Study Subjects –

	Mean	Std Dev	Std Error
Group A	59.8000	7.22342	2.28425

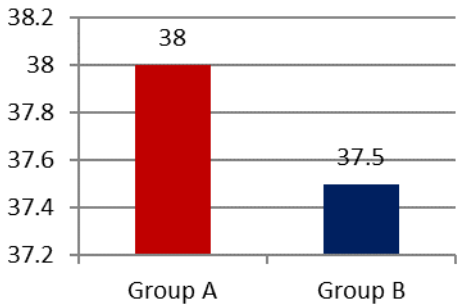
The mean (Standard deviation; SD) age of the participants was 59.80(7.22). The mean (SD) torque score in the Group A was 38.00 (5.68), whereas in the group B the mean score was 37.50 (7.16)

Table 4 – Comparison of insertion torque values between Group A and Group B using Torque Wrench at the time of surgery.

	Mean	Std Dev	Std Error	P value
Group A	38.0000N/cm	5.86894	1.85592	0.886 (Non-Sig)
Group B	37.5000 N/cm	7.16860	2.26691	

The intergroup comparison of torque values are represented in Table 2. There was no significant difference in the torque values between the groups

Independent t test at p value more than 0.05 is non-significant

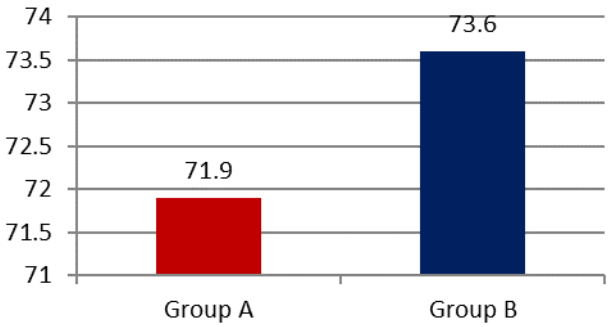


Graph -1 depicting insertion torque values between Group A and Group B

Table -5 : Comparison of ISQ values (BL) between Group A and Group B for primary stability at the time of surgery

	Mean	Std Dev	Std Error	P value
Group A	71.9000	8.11651	2.56667	0.562 (Non-Sig)
Group B	73.6000	5.12510	1.62070	

Independent t test at p value more than 0.05 is non-significant



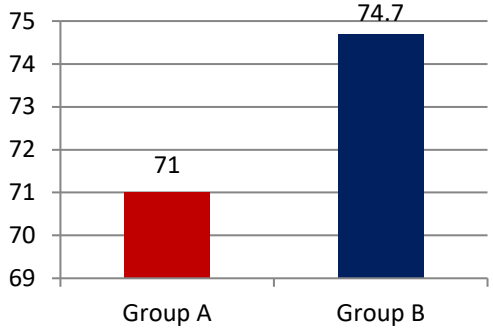
Graph 2 depicting ISQ values between Group A and Group B

Based on ISQ values in the Bucco lingual surface the mean score in the group A was 71.90 (8.11) and in the group B the mean score was 73.60 (5.12). The intergroup comparison of ISQ score are represented in Table 3. There was statistically no significant difference in the ISQ scores among the groups.

Table - 6 : Comparison of ISQ values (MD) between Group A and Group B for primary stability at the time of surgery

	Mean	Std Dev	Std Error	P value
Group A	71.0000	9.32142	2.94769	0.322 (Non-Sig)
Group B	74.7000	6.70075	2.11896	

Independent t test at p value more than 0.05 is non-significant



Graph- 3 depicting ISQ values between Group A and Group B

Based on ISQ values in the Mesio Distal surface the mean score in the group A was 71.00 (9.32) and in the group B the mean score was 74.70 (6.70). The intergroup comparison of ISQ score are represented in Table 4. There was statistically no significant difference in the ISQ scores among the groups

Statistical Analysis

The data for the present study was entered in the Microsoft Excel 2007 and analyzed using the SPSS statistical software 23.0 Version. The descriptive statistics included mean, standard deviation frequency and percentage. The level of the significance for the present study was fixed at 5%.

The intergroup comparison was done using the independent t tests Shapiro–Wilk test was used to investigate the distribution of the data and Levene's test to explore the homogeneity of the variables.

IV. Discussion

Studies have shown that primary implant stability (PIS) is correlated with bone density and implant outcome [1]. Different implant placement techniques, such as standard drilling, undersized drilling, and guided drilling, have been used to achieve good primary stability in areas with low bone density [1]. Undersized drilling has been found to increase initial implant stability in low-density bone, although the PIS may be lower [1]. Implant design and initial stability also play a role in primary implant stability, with conical implant designs and underdimensioned drilling are associated with increased stability [3]. Additionally, microstructured rough implant surfaces have been found to promote dental implant osseointegration and sustain high-bone contact levels [3].

In order to check Implant stability, such as ISQ (Implant Stability Quotient), are used in clinical practice as an indirect indicator to determine the appropriate time for practical implant loading and as a prognostic indicator for potential implant failure [1]. To estimate quantitative implant stability, various methods have been developed, including the periotest assay and resonance frequency analysis (RFA) [3]. These methods provide quantitative estimations of implant stability, allowing clinicians to monitor the progress of osseointegration and assess the success of the implant [3]. The use of such methods is crucial in ensuring the long-term success of dental implants [3].

The present study focuses on the use of ISQ values and Insertion Torque Values that help in measuring primary stability of the implant. The two groups, Group – A (Osseodensification) and Group -B (Motorized Threaded Expanders) show that the Buccolingial ISQ values are non-significant in nature as shown in Table -5, based on ISQ values in the Bucco lingual surface the mean score in the group A was 71.90 (8.11) and in the group B the mean score was 73.60 (5.12) and Mesio Distal surface the mean score in the group A was 71.00 (9.32) and in the group B the mean score was 74.70 (6.70) in Table – 6.

The modern ridge expansion instruments include motorized expanders and Densah burs. This study investigated the effects of two bone densifying techniques that showcase there is no difference in the primary implant stability and insertion torque values in both Group- A and Group – B.

Based on a study comparing the Densah bur drilling method and motorized threaded expanders, the amount of expansion achieved with Densah bur drilling was found to be same. The special design of the Densah bur allows for compression and compaction of bone laterally during its counterclockwise rotation, which creates plastic deformation on the lateral walls of the osteotomy and allows for expansion of the ridge. In contrast, the lateral walls of the expanders in the TET group contain several threads, causing greater compression on the tips of the threads. Even though with this difference in stress distribution along the inner walls of the osteotomy same average amount of expansion achieved with Densah bur drilling [2,3].

Unlike conventional technique of osteotomy preparation, Osseodensification process doesn't excavate bone but simultaneously keeps on compacting and autografting the particulate bone in an outward direction while creating the osteotomy, thereby conserving important bone tissue. This is achieved using specialized densifying burs. When the specialized drill is employed at high speed in an anti-clockwise direction with steady external irrigation (Densifying Mode), the dense and compact bone tissue is created along the walls of osteotomy.

The pumping action (in and out movement) creates ratedependent stress to provide rate-dependent strain and permits saline solution pumping to carefully pressurize the bone walls.

This facilitates increased bone plasticity and bone expansion. Huwais et al demonstrated that Osseodensification helped ridge expansion while maintaining the alveolar ridge integrity, thereby permitting implant placement in autogenous bone, conjointly achieving adequate primary stability. Osseodensification helped in preserving bone bulk and reduced the waiting period to the restorative phase. Trisi et al. in an in-vivo study found a statistically significant correlation between peri-implant bone density, insertion torque and micromotion. A major increase in insertion torque and a concomitant reduction in micromotion was noted with an increase in bone density values. Berardini et al. and Li et al. in a review reported no major difference in implant failure rate and crestal bone resorption between implants inserted either with high- or low-insertion torque values. They also demonstrated the ability of OD drills to increase the % Bone volume and % Bone-Implant contact for dental implants inserted in poor density bone sites as compared to conventional osteotomies, which may help in improving osseointegration.The threaded expander technique is a conservative and precise method for dental implant placement [1]. It offers superior manual control, reducing the risk of complications such as fenestrations and dehiscence [1]. This technique involves the use of a proprietary ridge expansion system, including a bur kit and motor-driven bone expanders [1]. The procedure begins with a pilot drill at high speed, followed by sequential drills at lower speeds [1]. This system allows for both expansion and preparation of implant sites in different bone types [1]. Research has shown that defects treated with motorized ridge expanders experience less bone width contraction during the initial healing period [1]. These expanders can be used in both anterior and posterior edentulous sites without impinging on facial tissues [1]. They also provide rotational control for expansion in the mandibular atrophic ridge region [1]. Expansion enables precise control over the application, timing, and direction of expansion forces [3].

V. Conclusion

Overall, both techniques offer advantages in terms of stability and precision, with no significant differences observed between them in this study. These findings contribute to the existing body of literature on implant placement techniques and highlight the importance of selecting the most appropriate technique based on individual patient factors and clinical considerations. To confirm these results in broader patient populations and over longer follow-up periods, more research could be necessary.