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Original Article

Dentistry Section

Comparison of Proposed Drilling Technique with Osseodensification and Standard Drilling for Enhancing Primary Stability of Implants in Low Density Bone: A Randomised Clinical Trial

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ABSTRACT

Introduction: Primary implant stability is a critical factor in successful osseointegration. It is influenced by several variables such as bone density, implant design, and the surgical technique employed. The surgical technique plays a particularly crucial role in low-density bone.

Aim: To evaluate the primary stability of implants placed using the proposed drilling technique, the osseodensification technique, and the standard drilling technique in low-density bone.

Materials and Methods: This randomised clinical study was conducted in the Department of Implantology, Rajarajeswari Dental College and Hospital, Bengaluru Karnataka, India, from March 2022 to February 2023. A total of 57 participants (75 dental implants - 40 in maxilla and 35 in mandible) were enrolled and randomly assigned to one of the three drilling protocol groups, group I- Proposed drilling protocol (n=25 implants) were placed and group II- Osseodensification technique (n=25 implants) and group III- Standard drilling technique (n=25 implants). Insertion Torque (IT) and Implant Stability Quotient (ISQ) were measured as a measure of primary stability. Descriptive statistics were used to measure IT, Resonance Frequency Analysis (RFA) value in terms of mean and standard deviation for each group. One-way Analysis of Variance (ANOVA) test followed Tukey's post-hoc test was used to compare the mean IT and RFA between the three groups. The level of significance was set at p-value <0.05.

Results: This study included 57 patients, of whom 34 were females and 23 were males, with an age range of 20–62 years and a mean age of 41 years. The mean Insertion Torque (IT) value in group I was 46.75±4.94 Ncm, in group II was 43.25±3.73 Ncm, and in group III was 31.50±4.01 Ncm. Group I demonstrated a significantly higher mean IT compared to group II (p=0.03) and group III (p<0.001). Additionally, group II showed a significantly higher mean IT compared to group III (p<0.001). The mean Implant Stability Quotient (ISQ) in group I was 65.90±3.74, in group II was 60.83±3.29, and in group III was 56.78±3.25. Group I demonstrated a significantly higher mean ISQ compared to both group II and group III (p<0.001).

Conclusion: Primary stability of implants placed in low-density bone was enhanced with the proposed drilling and osseodensification techniques when compared to the conventional drilling technique.

Keywords: Implant stability quotient, Insertion torque, Osteotomy, Under drilling technique

INTRODUCTION

The goal of implant placement is to achieve osseointegration for which it is well established that primary implant stability is a critical factor [1-3]. Primary stability of dental implants is determined by multiple variables, including the quality and quantity of bone, implant macro and micro architecture and the surgical technique used during placement. The primary stability is defined as the biometric stability achieved at the time of implant insertion and is regarded as an important prognostic marker for implant success.

Primary implant stability plays an important role in limiting micro-movements of the implant and promotes direct contact between the bone and the implant surface. It is commonly evaluated using IT values and the ISQ. These two parameters are widely accepted biomechanical indicators for assessing implant stability and are considered reliable, non-invasive methods for measurement [4]. The implant IT refers to the amount of force required to place a dental implant into osteotomised site and this value can be measured only at the time of implant placement [4]. The ISQ is measured through Resonance Frequency Analysis (RFA), this technique measures the vibration frequency of implant within the surrounding bone and allows stability to be assessed at different stages after placement. Achieving good primary implant stability is often difficult in bones with low density, particularly in D3 and D4 bone types.

The importance of surgical technique modification arises from previous research [5]. The high implant failure rate reported in low density bone can be substantially reduced by modifying the surgical protocol and increase the success rates up to 93-97% [6]. Therefore, careful surgical planning and execution are crucial for a successful outcome in low density bone. There are various modifications in the surgical techniques to increase primary stability. The most commonly advocated is under sized drilling technique.

The recent techniques such as osseodensification improve the quality of the osteotomy by densifying the surrounding bone. This technique has been shown to achieve higher levels of implant stability compared to the conventional subtractive drilling technique [7-10]. Cone Beam Computed Tomography (CBCT) has showed a significant increase in the bone density around the implants placed with osseodensification technique postoperatively [11]. The Osseodensification technique requires a set of special drills for implant placement with the conventional twist drills, a modification in the drilling depth and sequence to achieve implant stability in the low-density bone is required. Hence, a hybrid modified under-drilling technique is proposed with the aim to locally optimise the bone

density in low density bone is proposed. An ex-vivo study was done to compare the proposed drilling technique with osseodensification and standard drilling technique which showed increase in primary stability with proposed drilling technique [12]. The results of this ex-vivo study served as basis for the present clinical study.

Therefore, the current study aimed to compare and evaluate the primary stability of dental implants placed in low-density bone using the proposed drilling technique and the osseodensification technique in comparison with the standard drilling protocol, by assessing IT values and ISQ.

The proposed technique is a hybrid under-drilling approach, in which the apical half of the osteotomy is under-prepared while the coronal half undergoes full osteotomy preparation. This design facilitates lateral and apical bone condensation in the apical region, enhancing primary stability, while the fully prepared coronal portion accommodates the implant crest module without inducing undue stress concentration at the crestal bone. This technique aims to improve the primary stability and preserve the marginal bone, thereby improving the long-term success of the implant which has to be clinically studied.

MATERIALS AND METHODS

A randomised clinical trial was conducted on patients who reported to the Department of Implantology, Rajarajeswari Dental College and Hospital, Bengaluru, Karnataka, India, for the replacement of missing teeth with implant-supported prostheses over a period of one year, from March 2022 to February 2023. The Institutional Ethics Committee approval (RRDCH/IEC21/49) was obtained and an informed consent was taken from all the patients to participate in the study. CTRI registration was done for this clinical trial the registration number is CTRI/2022/02/040695 [Registered on: 28/02/2022].

Sample size calculation: The sample size has been estimated using the GPower software v. 3.1.9.4 (Franz Faul, Universität Kiel, Germany) Considering the effect size to be measured (f) at 40% - a larger effect size (based on the pilot study results with ISQ as the parameter of interest for estimating the sample size), power of the study at 80% and the alpha error at 5%, the sample size needed is 66. Considering 15% drop out of patients during the follow-up period, the final sample size is inflated to 75 implants. Each study group will comprise of 25 samples (25 samples x three groups = 75 implants).

Inclusion criteria: Medically fit patients of both genders, 18 years of age and above, requiring implant placement in the maxillary and/or mandibular posterior region, with sufficient horizontal and vertical bone dimensions (minimum bone width ≥ 6.5 mm and bone height ≥13 mm to accommodate standard implant dimensions without additional augmentation). Edentulous sites with low-density bone (D3-D4 according to Misch bone classification), corresponding to< 850 Hounsfield Units (HU) on CBCT evaluation, were included [10].

Exclusion criteria: Patients presenting with high-density bone (D1 and D2); implant sites with a history of previous bone augmentation; presence of active infection or pathology at the proposed implant site; patients with parafunctional habits.

Study Procedure

A preoperative CBCT was taken to assess bone density. All implants were placed by the same surgeon and implant sites were maxilla and mandible posterior region. Dental implants of dimension 4.2x11.5 mm of MIS SEVEN XD™ internal hexagon Implant system was standardised in the study. The study adhered to the consort guidelines for documentation.

Each participant was randomly assigned using lottery method (1:1:1ratio) to one of the three drilling protocol groups, 25 implants were placed Proposed drilling protocol (group I) and 25 implants with Osseodensification technique (group II) and 25 implants with Standard drilling technique (group III).

- **Drilling protocol**

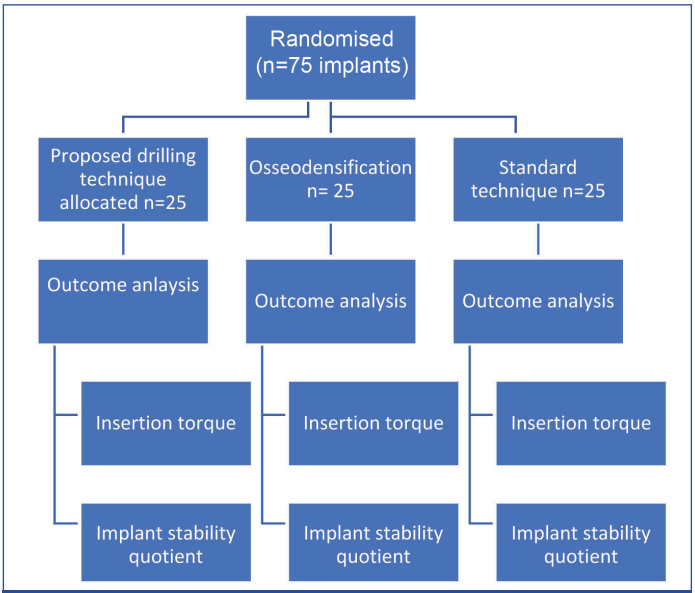
Group I: Proposed drilling protocol (n=25 implants), the drilling sequence was 2 mm and 2.4 mm drills to prepare the osteotomy up to 11.5 mm length. Subsequently, 3.2 mm and 3.65 mm drill were used to prepare coronal half of the osteotomy, i.e., 50% of the total implant length at 900 rpm and torque of 35 Ncm [6].

Group II: Osseodensification technique (n=25 implants), the Universal drills with a tapered design (Densah Bur, Versah LLC, Jackson, MI, USA) was used. The initial pilot drill was with 2 mm in clockwise direction followed by 2.3 mm, 2.5 mm, 2.8 mm, 3 mm, 3.3 mm, 3.5 mm and 3.8 mm drill in counterclockwise at 800 rpm up to the full depth.

Group III: Standard drilling protocol (n=25 implants), the sequence drilling was 2 mm, 2.4 mm, 3.2 mm, 3.65 mm, 4 mm up to 11.5 mm in length at 950 rpm and 35 Ncm torque.

The dental implant was placed into the osteotomy site using the motorised method at 45 rpm and 35 Ncm torque and final implant position was done manually.

Outcome measured: The implant primary stability parameters like IT value were measured with ratchet and ISQ was measured using Penguin RFA system (International Diagnostics Sweden AB, Goteborg, Sweden). The resonance frequency was measured on mesial, distal, buccal and lingual sides of the implant with no contact technique and average was taken as a reference for analysis. the Consolidated Standards of Reporting Trials (CONSORT) flow diagram is shown in [Table/Fig-1].



[Table/Fig-1]: CONSORT flow chart.

STATISTICAL ANALYSIS

Statistical Package for Social Sciences (SPSS) for Windows Version 22.0 Armonk, NY: IBM Corp., was used to perform statistical analyses. Descriptive Statistics analysis includes expression of IT, Primary ISQ values in terms of Mean and SD for each group. Inferential Statistics analysis includes One-way ANOVA Test followed by Tukey's Post-hoc Test was used to compare the mean IT, Primary ISQ values between three groups. The level of significance was set at p-value <0.05.

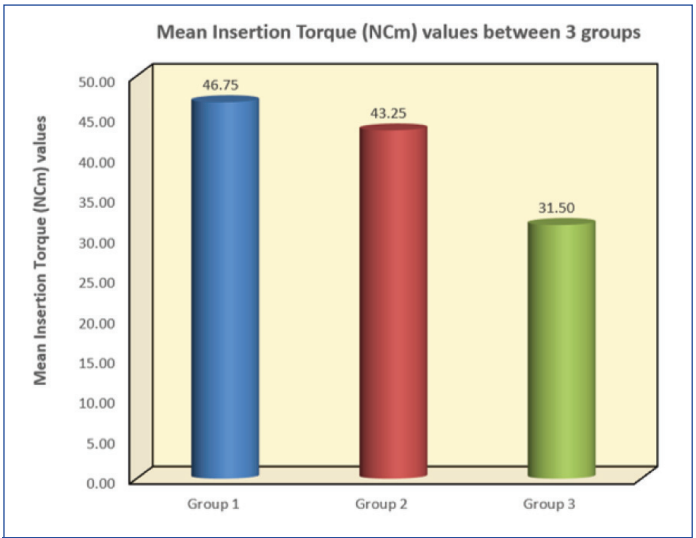
RESULTS

A total of 57 patients, 34 females, and 23 males with an age range of 20-62 years (mean age 41 years) participated in the study. A total 75 dental implants were placed, 40 in maxilla and 35 in mandible. Out of which, 58 implants were placed in D3 bone (350-850 HU) and 17 implants in D4 bone (150-350 HU).

The mean IT values in group I was 46.75±4.94 Ncm, group II was 43.25±3.73 Ncm and in group III was 31.50±4.01 Ncm [Table/Fig-2,3].

Comparison of Mean Insertion Torque (IT) (Ncm) values between three groups using One-way ANOVA test				
Groups	n	Mean±SD	Min-Max	p-value
Group I	25	46.75±4.94	40-60	<0.001
Group II	25	43.25±3.73	35-50	
Group III	25	31.50±4.01	20-35	

[Table/Fig-2]: Comparison of mean Insertion Torque (IT) values between the three groups.



[Table/Fig-3]: Bar diagram showing comparison of mean Insertion Torque (IT) values between the three groups.

Multiple comparison of mean differences between groups revealed that group I demonstrated significantly highest mean IT as compared to group II and group III and the mean differences were statistically significant at p=0.03 and p<0.001, respectively. This was then followed next by group II which showed significantly higher mean IT as compared to group III and the mean difference was statistically significant at p<0.001. This indicates that the mean IT was significantly highest in group I, followed by group II and least in group III [Table/Fig-4].

(I) Groups	(J) Groups	Mean Diff. (I-J)	95% CI for the Diff.		p-value
			Lower	Upper	
Group I	Group II	3.5	0.26	6.74	0.03
	Group III	15.25	12.01	18.49	<0.001
Group II	Group III	11.75	8.51	14.99	<0.001

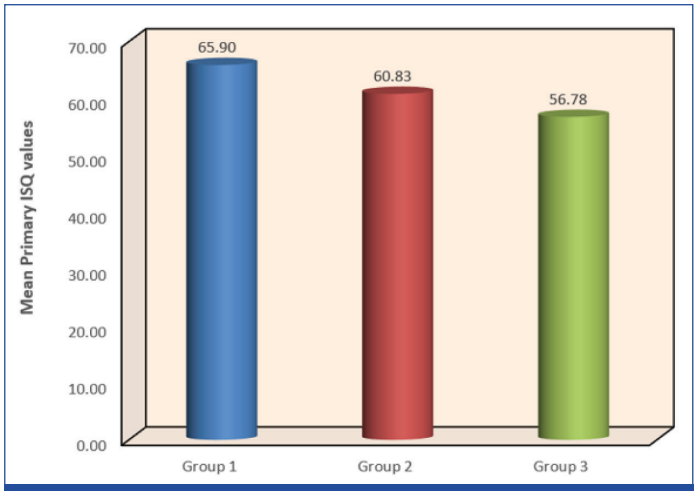
[Table/Fig-4]: Multiple comparison of mean difference of Insertion Torque (IT) values b/w groups using Tukey's post-hoc test.

The mean primary ISQ values in group I was 65.90±3.74 ISQ, group II was 60.83±3.29 ISQ and in group III was 56.78±3.25 ISQ [Table/Fig-5,6].

Groups	n	Mean±SD	Min-Max	p-value
Group I	25	65.90±3.74	61.0-75.0	<0.001
Group II	25	60.83±3.29	50.0-65.5	
Group III	25	56.78±3.25	47.0-59.5	

[Table/Fig-5]: Comparison of mean primary Implant Stability Quotient (ISQ) values between three groups using One-way ANOVA test.

Multiple comparison of mean differences between groups revealed that group I demonstrated significantly highest mean primary ISQ values as compared to group II and group III and the mean differences were statistically significant at p<0.001, respectively. This was then followed next by group II which showed significantly higher mean primary ISQ values as compared to group III and the mean difference was statistically significant at p=0.001. This infers that the mean primary ISQ values were significantly highest in group I, followed by group II and least in group III [Table/Fig-7].

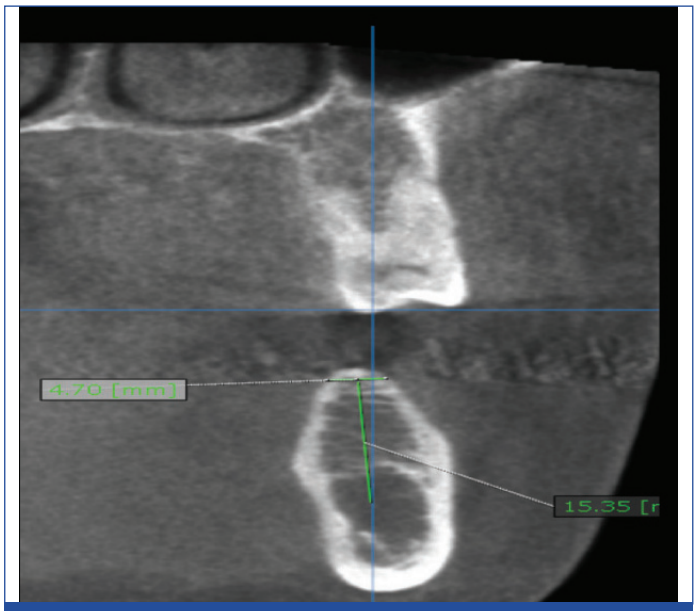


[Table/Fig-6]: Bar diagram showing Mean primary Implant Stability Quotient (ISQ) values between the three groups.

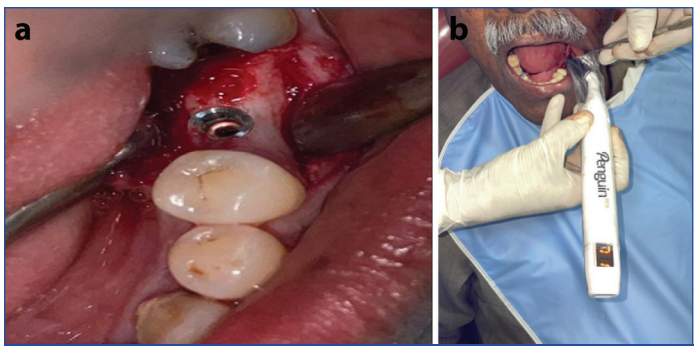
(I) Groups	(J) Groups	Mean Diff. (I-J)	95% CI for the Diff.		p-value
			Lower	Upper	
Group I	Group II	5.075	2.462	7.688	<0.001
	Group III	9.125	6.512	11.738	<0.001
Group II	Group III	4.05	1.437	6.663	<0.001

[Table/Fig-7]: Multiple comparison of mean difference of primary Implant Stability Quotient (ISQ) values b/w groups using Tukey's post-hoc test.

The clinical and radiographic images from group III using standard drilling protocol are shown in [Table/Fig-8,9]. Representative clinical and radiographic images corresponding to each group are shown in [Table/Fig-8-13]

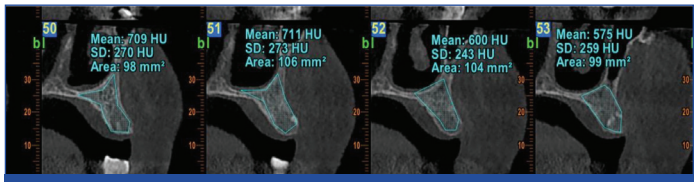


[Table/Fig-8]: Preoperative CBCT showing edentulous region i.r.t 36 region (with D3 bone).



[Table/Fig-9]: a) Implant placed I.r.t 36 region using standard drilling protocol; b) Measurement of primary Implant Stability Quotient (ISQ) using RFA.

The clinical and radiographic images from group II using Osseodensification technique are shown in [Table/Fig-10,11].



[Table/Fig-10]: Preoperative CBCT showing edentulous region l.r.t 25,26 region (with D3 bone).

[Table/Fig-11]: a) Implant placed l.r.t 25, 26 region using osseodensification technique; b) Measurement of primary Implant Stability Quotient (ISQ).

[Table/Fig-12,13] show the clinical and radiographic images from the proposed drilling protocol are shown in [Table/Fig-12,13].

[Table/Fig-12]: Preoperative CBCT showing edentulous region l.r.t 46 region (with D3 bone).

[Table/Fig-13]: a) Implant placed l.r.t 46 region using proposed drilling technique; b) Measurement of primary Implant Stability Quotient (ISQ) using RFA.

DISCUSSION

Achieving primary stability is essential for osseointegration and the ultimate success of dental implants. In dense bone, predictable primary stability is usually attainable; however, in low-density bone, it often poses a challenge. Friberg B et al., first proposed that under-drilling the implant site may enhance primary stability in such cases [13]. To increase the primary implant stability in low density bone, summers proposed bone condensing technique using condensers after the pilot drill [14]. This study proposes a hybrid under-drilling approach for osteotomy preparation aimed at enhancing primary stability in areas of low bone density.

Mean IT values observed in this study were 46.75 Ncm for the proposed drilling technique, 43.25 Ncm for the osseodensification technique, and 31.50 Ncm for the standard drilling technique. The proposed drilling technique demonstrated significantly higher IT compared to the other two techniques.

Lopez CD et al., in an animal study compared osseodensification with standard drilling technique. The mean IT in osseodensification was higher than that in the standard drilling technique [15]. Comuzzi L et al., in an in-vitro study, compared standard protocol to Osseodensification technique and observed Osseodensification produces a positive influence on primary stability in poor density bone [7]. The results of the present study are also in accordance with this study. Huwais S and Meyer E compared three different surgical techniques: Standard technique, clockwise drilling with Densah burs and Osseodensification with Densah burs. It was found that mean IT, Removal torque was almost double with Osseodensification when compared to standard drilling protocol [9]. The proposed drilling protocol produced higher IT values compared to osseodensification technique.

A systematic review on influence of different implant placement techniques to improve primary stability in low density showed that undersized drilling improved the initial implant stability in low density bone [16]. The present study also proposes a similar under sized drilling technique which produced similar results.

The mean ISQ in the present study with proposed drilling techniques was 65.90±3.74 ISQ, 60.83±3.29 ISQ in osseodensification technique and 56.78±3.25 ISQ in standard drilling protocol.

The proposed technique is a hybrid under-drilling approach, in which the apical half of the osteotomy is under-prepared while the coronal half undergoes full osteotomy preparation. This design facilitates lateral and apical bone condensation in the apical region, enhancing primary stability, while the fully prepared coronal portion accommodates the implant crest module without inducing undue stress concentration at the crestal bone. This technique aims to improve the primary stability and preserve the marginal bone, thereby improving the long-term success of the implant which has to be clinically studied. According to Tabassum A et al., in a study found implants inserted with 5% and 15% under sized drilling protocol compared to 25% had higher bone implant contact [6].

It was observed that undersized drilling not only increased primary stability but also translocated bone particles on to the implant surface increasing bone implant contact and favouring a positive osteogenic response which was confirmed with histologic examination, micro Computed Tomography (CT), scanning electron microscopy and measurement of calcium deposition on the surface of implant.

Degidi M et al., in an ex-vivo study compared conventional drilling protocol with undersized protocol and found that 10% undersized protocol was ideal further reduction did not improve the primary stability [2].

Alghamdi H et al., in a clinical study, comparing undersized drilling with standard drilling technique in low density bone and found that undersized drilling technique enhanced the primary stability and its overall survival [1].

Various studies comparing bone compactors versus osseodensification drills showed higher ISQ values with osseodensification [11,17-19]. The osseodensification technique is a non subtractive technique, auto-compacting the bone, leading to increase in the bone volume around the implant thereby increasing primary stability, bone mineral density of the bone at the implant surface Barberá-Millán J et al., compared osseodensification with conventional under drilling in an in-vitro study The mean IT and RFA (The mean RFA was 65.16±7.45 ISQ in Under drilling technique group and 69.75±6.79 ISQ in Osseodensification group) was higher in Osseodensification technique [8]. Huwais S and Meyer E compared the osseodensification with standard drilling showed significantly higher removal torque of ISQ values compared to

implant sites prepared with standard drilling technique [9]. The ISQ value of proposed technique is higher than osseodensification technique and it is statistically significant, showing that proposed drilling technique and osseodensification technique have a possible clinical application in low density bone. A systematic review by El-Kholey K and Elkomy A reported that existing surgical techniques may not significantly enhance osseointegration in low-density bone [20]. Systematic reviews by Padhye N et al. , and Inchingolo et al. , demonstrated increased bone-to-implant contact with osseodensification compared to conventional drilling [21,22]. An experimental study on biomechanical and histologic basis of osseodensification drilling for endosteal implants conducted by Lahens B et al., concluded that there are an improved primary stability and bone to implant contact [23]. A critical review by Elsayyad A and Osman R provided weak evidence in favour osseodensification technique [19].

A systematic review and meta-analysis on prognosis of dental implants in patients with low density bone reported implant placement in low density bone requires modification in the surgical technique, when it is adopted provided equivalent implant stability, survival as in the higher density bone [24].

In the present clinical study, the relationship between IT value, ISQ a measure of primary stability with three different surgical techniques in low density bone were assessed. The higher stability results were obtained with proposed drilling technique and osseodensification technique compared to standard drilling technique. These results are consistent with clinical studies which conclude bone condensation techniques improve primary stability in low density bone Similar findings have been reported in clinical studies demonstrating improved primary stability with modified surgical techniques [25,26].

In osseodensification technique the bone is condensed in the apical and lateral to implant body whereas in the proposed drilling technique the bone condensation occurs lateral and apical to the implant in the apical half of the osteotomy, thereby achieving primary stability and also allows optimum bone healing for osseointegration without excessive pressure along the implant surface. The full range of osteotomy at the coronal half of the osteotomy site accommodates crest module of implant without undue stress. This should preserve the marginal bone and evaluation of this requires long-term follow-up of the patients. From the biomechanical point this hybrid technique not only enhances primary stability but also should preserve crestal bone in the long-term. CBCT of the planned implant site provides a valuable insight into bone density; this guides us to select an appropriate surgical technique. In case of low-density bone, surgical technique may be modified to provide a better primary stability The proposed hybrid under-drilling technique can be implemented using the standard surgical kit and has demonstrated a level of primary stability comparable to that achieved with Osseodensification- a technique that typically requires specialised drills. Based on the results of the current study, this proposed approach is an alternate approach in Misch's D3 and D4 bone.

Limitation(s)

The present study only assessed the primary stability of the implant placed in low density bone with proposed drilling technique, osseodensification and standard drilling technique. However, long-term follow-up to assess the secondary stability and marginal bone response to mechanical loading with larger sample size is desired.

CONCLUSION(S)

Based on the findings of the present study, it can be concluded that in low-density bone, modifying the conventional surgical technique is pivotal. The proposed drilling technique demonstrated outcomes comparable to those of the osseodensification technique. The Proposed technique presents a viable alternative for improving primary stability in low-density bone.

REFERENCES

[1] Alghamdi H, Anand P, Anil S. Undersized implant site preparation to enhance primary implant stability in poor bone density: A prospective clinical study. Journal of Oral and Maxillofacial Surgery. 2011;69(12):e506-e512.

[2] Degidi M, Daprile G, Piattelli A. Influence of underpreparation on primary stability of implants inserted in poor quality bone sites: An in-vitro study. Journal of Oral and Maxillofacial Surgery. 2015;73:1084-88.

[3] Delgado-Ruiz R, Gold J, Somohano Marquez T, Romanos G. Under-drilling versus hybrid osseodensification technique: Differences in implant primary stability and bone density of the implant bed walls. Materials. 2020;13(2):390.

[4] Swami V, Vijayaraghavan V, Swami V. Current trends to measure implant stability. J Indian Prosthodont Soc. 2016;16(2):124-30. Doi: 10.4103/0972-4052.176539. PMID: 27141160; PMCID: PMC4837777.

[5] Fanuscu MI, Chang T-L, Akça K. Effect of surgical techniques on primary implant stability and peri-implant bone. Journal of Oral and Maxillofacial Surgery. 2007;65(12):2487-91. ISSN 0278-2391, https://doi.org/10.1016/j.joms.2007.04.017.

[6] Tabassum A, Meijer G, Frank Walboomers X, Jansen J. Biological limits of the undersized surgical technique: A study in goats. Clinical Oral Implants Research. 2010;22(2):129-34.

[7] Comuzzi L, Tumedei M, Piattelli A, Iezzi G. Osseodensification drilling vs. standard protocol of implant site preparation: An in-vitro study on polyurethane foam sheets. Prosthesis. 2020;2(2):76-86.

[8] Barberá-Millán J, Larrazábal-Morón C, Enciso-Ripoll J, Pérez-Pevida E, Chávarri-Prado D, Gómez-Adrián M. Evaluation of the primary stability in dental implants placed in low density bone with a new drilling technique, Osseodensification: An in-vitro study. Medicina Oral Patología Oral y Cirugia Bucal. 2021;26(3):e361-e367.

[9] Huwais S, Meyer E. A Novel osseous densification approach in implant osteotomy preparation to increase biomechanical primary stability, bone mineral density, and bone-to-implant contact. The International Journal of Oral & Maxillofacial Implants. 2017;32(1):27-36.

[10] Cáceres F, Troncoso C, Silva R, Pinto N. Effects of osseodensification protocol on insertion, removal torques, and resonance frequency analysis of BioHorizons® conical implants. An ex-vivo study. Journal of Oral Biology and Craniofacial Research. 2020;10(4):625-28.

[11] Hindi AR, Bede SY. The effect of osseodensification on implant stability and bone density: A prospective observational study. J Clin Exp Dent. 2020;12(5):e474-e478. Doi: 10.4317/jced.56727. PMID: 32509230; PMCID: PMC7263779.

[12] Siddalingappa MN, Singh M, Chowdhary R. Modified drilling technique in enhancing primary stability in low density bone-An Ex-vivo study. Natl J Maxillofac Surg. 2025;16(2):354-58. Doi: 10.4103/njms.njms_104_23. Epub 2025 Aug 30. PMID: 41019676; PMCID: PMC12469066.

[13] Friberg B, Ekestubbe A, Mellstrorn D, Sennerby L. Branemark implants and osteoporosis: A clinical exploratory study. Clin Implant Dent Relat Res. 2001;3:50-56.

[14] Summers RB. A new concept in maxillary implant surgery: The osteotome technique. Compendium. 1994;15:152,154-56,158.

[15] Lopez CD, Alifarag AM, Torroni A, Tovar N, Diaz-Siso JR, Witek L, et al. Osseodensification for enhancement of spinal surgical hardware fixation. J Mech Behav Biomed Mater. 2017;69:275-81. Doi: 10.1016/j.jmbbm.2017.01.020. Epub 2017 Jan 13. PMID: 28113132; PMCID: PMC5434975.

[16] Palaskar JN, Joshi N, Shah PM, Gullapalli P, Vinay V. Influence of different implant placement techniques to improve primary implant stability in low density bone: A systematic review. J Indian Prosthodont Soc. 2020;20:11-16.

[17] Antonelli A, Bennardo F, Brancaccio Y, Barone S, Femiano F, Nucci L, et al. Can bone compaction improve primary implant stability? an in-vitro comparative study with osseodensification technique. Applied Sciences. 2020;10(23):8623.

[18] Pai U, Rodrigues S, Talreja K, Mundathaje M. Osseodensification – A novel approach in implant dentistry. The Journal of Indian Prosthodontic Society. 2018;18(3):196.

[19] Elsayyad A, Osman R. Osseodensification in implant dentistry. Implant Dentistry. 2019;28(3):306-12.

[20] El-Kholey K, Elkomy A. Does the drilling technique for implant site preparation enhance implant success in low-density bone? A systematic review. Implant Dentistry. 2019;28(5):500-09.

[21] Padhye N, Padhye A, Bhatavadekar N. Osseodensification- A systematic review and qualitative analysis of published literature. Journal of Oral Biology and Craniofacial Research. 2020;10(1):375-80.

[22] Inchingolo A, Inchingolo A, Bordea I, Xhajanka E, Romeo D, Romeo M, et al. The effectiveness of osseodensification drilling protocol for implant site osteotomy: A systematic review of the literature and meta-analysis. Materials. 2021;14(5):1147.

[23] Lahens B, Neiva R, Tovar N, Alifarag A, Jimbo R, Bonfante E, et al. Biomechanical and histologic basis of osseodensification drilling for endosteal implant placement in low density bone. An experimental study in sheep. Journal of the Mechanical Behavior of Biomedical Materials. 2016;63:56-65.

[24] Radi IA, Ibrahim W, Iskandar SMS, AbdelNabi N. Prognosis of dental implants in patients with low density bone density: A systematic review and meta-analysis. Journal of Prosthetic Dentistry 2018;120(5):668-77.
[25] Markovic A, Calvo-Guirado JL, Lazic Z, Gómez-Moreno G, Ćalasan D, Guardia J, et al. Evaluation if primary stability of self-tapping and non-self-tapping dental implants: A 12-week clinical study. Clin Implant Dent Relat Res. 2013;15:341-49. https://doi.org/10.1111.j.1708-8208.2011.00415.x.
[26] Shayetesh YS, Khojasteh A, Siadat H, Monzavi A, Bassir SH, Hossaini M, et al. A comparative study of crestal bone loss and implant stability between osteotome and conventional implant insertion techniques: A randomized controlled clinical trial study. Clin Implant Dental Relat Res. 2013;15:350-57. https://doi.org/10.1111/j/1708-8208.2011.00376.x.

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