A comparative evaluation between osseodensification and conventional drill technique in assessment of crestal bone loss and implant stability – A clinico-radiographic study

[1]Dr. Yashasri Chatru, [2]Dr. Sachin B Mangalekar, [3]Dr. Rachana Agarwal, [4]Dr. Shruti S Khumbare, [5]Dr. Prachi Rathod

[1,3]Postgraduate (III) student, [2]Professor, [4]Postgraduate (II) student, [5]Postgraduate (I) student, Department of Periodontics, Bharati Vidyapeeth (Deemed to be University) Dental College and Hospital, Sangli, Maharashtra, India

Corresponding Author: Dr. Yashasri Chatru, Postgraduate (III) student, Department of Periodontics, Bharati Vidyapeeth (Deemed to be University) Dental College and Hospital, Sangli, Maharashtra, India **Email:** yashasri500@gmail.com

ABSTRACT

Introduction: Dental implants have currently become a common treatment option for replacing missing teeth. For long-lasting clinical results of implant therapy, it is essential to achieve primary implant stability. Other factors which are responsible for achieving primary stability are quality and quantity of available bone and surgical techniques used to prepare the osteotomy site. Osseodensification drills increases the primary stability via non-subtractive drilling unlike traditional drills. Densifying burs has the advantage during osteotomy to control the tactile and speed of drills.

Aim: To evaluate and compare the stability of the implant and the loss of crestal bone in the implants placed using OD drilling and traditional drilling technique.

Materials and Methods: Participants were selected after oral evaluation. This study was designed to include 16 patients. CBCT scans were taken to evaluate the quality of bone pre-operatively. The implant site was prepared using conventional drilling technique (group A) and osseodensification technique (group B). Radio frequency analysis (RFA)values were recorded at baseline and after 3 and 6 months. The crestal bone loss was measured using IOPA at baseline and after 3 and 6 months. Plaque index (PI) and gingival index (GI) were recorded and evaluated at baseline and after 3 and 6 months.

Results: The primary stability of implant placed using OD drills was found to be slightly higher than implant placed with traditional drilling; however, there was no statistical significance ($P > 0.05$). When the data obtained for crestal bone levels were statistically analyzed, no significant difference between the two groups was obtained ($P > 0.05$).

Conclusion: Osseodensification technique yielded higher primary stability than conventional drilling technique. However, this technique was not superior to conventional technique after 3 months.

INTRODUCTION

A dental implant is one of the treatments to replace missing teeth. The most common cause of teeth loss is periodontitis, and other causes include dental caries, trauma, developmental defects, and genetic disorders[1]. In 1952, Branemark discovered that osseointegration was feasible using titanium implants[2]. Dental implants are alloplastic biomaterial that is surgically inserted into the jawbone to solve functional and/or esthetic problems[3]. Osseointegration is defined as a direct structural and functional connection between ordered, living bone and the surface of a load carrying implant. Primary stability of dental implants has been considered as an important factor for achievement of successful osseointegration[4].

One of the major causes for implant failure is lack of primary stability. Achievement and maintenance of implant stability are prerequisite for long- term positive outcomes for osseointegrated implants. Thus, the success of immediate or early loading implant techniques is dependent on the ability of the clinicians to determine the degree of primary implant stability and changes in the stability along with new bone formation and remodeling[5].

Implant stability can be measured by resonance frequency analysis (RFA), which is a noninvasive and reproducible method. This technique is based on measuring the resonance frequency of a small transducer to an implant and presents data as numeric value termed "implant stability quotient (ISQ)[5]."

There have been many techniques tried in the past to increase the implant primary stability in areas of low bone density[6]. A few among them included bi-cortical fixation, under preparation for the implant bed, stepped osteotomy of the implant bed and the use of osteotomes and condensers[6]. Drilling technique has several drawbacks, such as heat generation and sacrificing bone, which worsens the situation in low-density bone. Osteotome technique is one of the alternatives, which was introduced by Summers et al. for low-density bone, particularly the maxilla[7]. This technique compresses the trabecular bone laterally and apically with minimal trauma, leading to improved bone density[7]. Although alveolar ridge expansion is achieved by the osteotome technique, the pressure exerted on the crestal cortical bone could cause increased peri-implant marginal bone loss, which eventually decreases secondary stability[8]. A new concept for osteotomy preparation known as osseodensification (OD)using specially designed burs (Densah™ burs) that help densify bone as they prepare an osteotomy[9].

Hence the present study was aimed to compare and evaluate the crestal bone level and primary stability of implant placed using traditional drills and osseodensification drills.

MATERIALS AND METHODS

Ethical approval: The institutional ethics committee of Bharati Vidyapeeth (Deemed to be University) medical college and hospital, Sangli (BV(DU)MC & H/Sangli/ IEC/ Dissertation 2020-21/ D-39) has approved the present study.

Source of data: Sixteen participants were provided for this study by the Outpatient Department (OPD) at the Bharti Vidyapeeth Dental College.

Inclusion criteria:

1. Patients aged 18-55years.
2. Patients with stable periodontal and dental health status.
3. Tooth missing in maxillary and mandibular posterior molar region of D3 and D4 bone quality.

Exclusion criteria:

1. Patients with history of systemic diseases.
2. Untreated periodontal diseases.
3. Patients who smoke cigarettes.
4. Pregnant/lactating women.

PROCEDURE

For the purpose of the study, patients were divided into two groups, i.e., Group I and Group II. In Group I, 8 implants were placed using traditional drilling technique, while in Group II, 8 implants were placed using OD drilling technique following the standard two-stage procedure of implant placement. Preoperative analysis of surgical site was done clinically and by using cone-beam computed tomography (CBCT). To reduce the postoperative swelling, patients were given antibiotic therapy, i.e., 500 mg amoxicillin + 125 mg clavulanate potassium (AUGMENTIN 625 mg Duo, Galaxo SmithKline) 24 h prior to surgery which was continued for 5 days postsurgery. Paracetamol 325 mg and dexamethasone 0.75 mg were given half an hour before commencing the surgery.The surgical site was prepared following standard surgical protocol. A crestal incision was made and a full thickness mucoperiosteal flap was raised at the site of implant placement. For the group A conventional drill technique was used for the osteotomy procedure. For group B, after preparing a pilot hole with a pilot drill (clockwise drill speed 800- 1500 rpm with copious irrigation) thereafter, osseodensification drills was used. The implants were placed into the site using torque wrench. The primary stability of the implants was assessed following insertion, and the implant mount and cover screw were subsequently installed. Once the implants were put in, the flaps were later sewn back together. The surgical site was cleaned using saline irrigation. Additionally, the patient received medication and post-operative care instructions. Seven days after surgery, patients were contacted again to have their stitches removed and to get a physical examination. The following soft tissue parameters were measured and assessed as the PI and GI at baseline, 3 and 6 months. All implants cover screw were uncovered and evaluated after 3 months. After implant uncovering, gingival formers were placed, and sutures were given. Patients were recalled after two weeks for suture removal. After 4 months, a permanent crown was placed in functional occlusion.

RADIOGRAPHIC ASSESSMENT

Crestal bone level was measured from the first thread of the implant using IOPA at the time of implant placement and after 3 and 6 months of surgery using Image J software (National Institutes of Health, Bethesda, Maryland, US).

RESONANCE FREQUENCY ANALYSIS

The implant stability quotient of each implant was measured clinically using resonance frequency analysis. Resonance frequency analysis was carried out at the time of implant placement and after 3 and 6 months of surgery. It was recorded three times for each implant at every interval. The system frequency response was measured by attaching transducer to the implant in buccolingual direction.

STATISTICAL ANALYSIS

The data obtained were subjected to unpaired t-test to make intergroup comparisons, while one-way ANOVA F-test was used to make intragroup comparisons.

RESULTS

Graph 1 shows intragroup comparison of mean Plaque index score between Group A and Group B using unpaired t test. Group A (Osseodensification) have higher mean Plaque index scores as compared to Group B (Conventional Drill) at baseline, 3 months, and 6 months. But no statistically significant difference was observed between both groups.Group B (Conventional) has higher change in mean plaque index score from baseline to 3 months, baseline to 6 months as compared to Group A (Osseodensification) but the difference was not found to be statistically significant.

Graph 2 shows intragroup comparison of mean plaque index score in Group A (OD), Group B (CD) using Repeated Measures Anova F test. In Group A (OD), no statistically significant difference ($p>0.05$) was observed in relation to change in mean score at baseline 2.31 (0.59) which further reduced to 2.08 (0.54) at 3 months and declined to 1.78 (0.67) in 6 months.In Group B (CD), no statistically significant difference ($p<0.05$) was observed in relation to change in mean score at baseline 2.3 (0.54) which further reduced to 2.01 (0.51) at 3 months and declined to 1.72 (0.49). Overall, no statistically significant difference ($p>0.05$) was observed from baseline to further follow up periods on overall comparison using Repeated measures Anova F test and pairwise comparison using Tukey's post hoc test.

Graph 3 shows intergroup comparison of mean Gingival index score between Group A and Group B using unpaired t test. Group A (Osseodensification) has lower mean Gingival index scores as compared to Group B (Conventional Drill) at baseline, 3 months, and 6 months. But no statistically significant difference was observed between both groups. Group B (Conventional) has lower decline in mean gingival index score from baseline to 3 months, baseline to 6 months as compared to Group A (Osseodensification) but the difference was not found to bestatistically significant.

Graph 4 shows intragroup comparison of mean gingival index score in Group A (OD), Group B (CD) using Repeated Measures Anova F test. In Group A (OD), statistically significant difference ($p<0.05$) was observed in relation to change in mean score at baseline 1.71 (0.32) which further reduced to 1.51 (0.31) at 3 months and declined to 1.28 (0.27) in 6 months. In Group B (CD), no statistically significant difference ($p>0.05$) was observed in relation to change in mean score at baseline 1.83 (0.34) which further reduced to 1.66 (0.39) at 3 months and declined to 1.42 (0.49). Overall, statistically significant difference ($p<0.05$) was observed from baseline to further follow up periods on overall comparison using Repeated measures Anova F test and pairwise comparison using Tukey's post hoc test.

Graph 5 shows intergroup comparison of mean Implant stability score between Group A and Group B using unpaired t test. At baseline, Group A (Osseodensification) has higher mean Implant stability scores as compared to Group B (Conventional Drill) at baseline, 3 months, and 6 months. Statistically significant difference was observed between both groups ($p< 0.05$). At baseline to 3 months, Group B (Conventional) has equal mean implant stability score from baseline to 3 months, but lower increase in scores from baseline to 6 months as compared to Group A (Osseodensification) but the difference was not found to be statistically significant.

Graph 6 shows an intragroup comparison of mean implant stability score in Group A (OD), Group B (CD) using Repeated Measures Anova F test. In Group A (OD), statistically significant difference ($p<0.05$) was observed in relation to change in mean score at baseline 60.37 (3.15) which further reduced to 63.87 (2.94) at 3 months and declined to 66.5 (3.25) in 6 months. In Group B (CD), statistically significant difference ($p<0.05$) was observed in relation to change in mean score at baseline 54.37 (3.2) which further reduced to 57.87 (2.99) at 3 months and declined to 60.12 (2.99). Overall, statistically significant difference ($p>0.05$) was observed from baseline to 6 months periods on overall comparison using Repeated measures Anova F test and pairwise comparison using Tukey's post hoc test. But no statistically significant increase was observed from baseline to 3 months, nor from 3 months to 6 months.

Graph 7 shows intergroup comparison of mean radiographic mesial crestal bone level between Group A and Group B using unpaired t test. At baseline, Group A (Osseodensification) have lower mean scores as compared to Group B (Conventional Drill) at baseline, 3 months, and 6 months. Statistically significant difference was observed between both groups ($p> 0.05$) at baseline, but no statistically significant difference was seen ($p>0.05$) at 3 months and 6 months. Group B (Conventional) has higher radiographic mesial crestal bone loss from baseline to 3 months, and from baseline to 6 months when compared to Group A (Osseodensification) and the difference was found to be of highly statistically significant ($p<0.001$).

Graph 8 shows intragroup comparison of mean radiographic mesial crestal bone levels in Group A (OD), Group B (CD) using Repeated Measures Anova F test. In Group A (OD), no statistically significant difference ($p>0.05$) was observed in relation to change in mean score at baseline 3.87 (0.29) which further reduced to 3.33 (0.31) at 3 months and declined to 3.13

(0.31) in 6 months. In Group B (CD), statistically significant difference ($p<0.05$) was observed in relation to change in mean score at baseline 4.21 (0.35) which further reduced to 3.47 (0.38) at 3 months and declined to 3.26 (0.38). Overall, no statistically significant difference ($p>0.05$) was observed from baseline to 3 months and from 3 months to 6 months on comparison using Repeatedmeasures Anova F test and pairwise comparison using Tukey's post hoc test. But statistically significant increase was observed from baseline to 6 months.

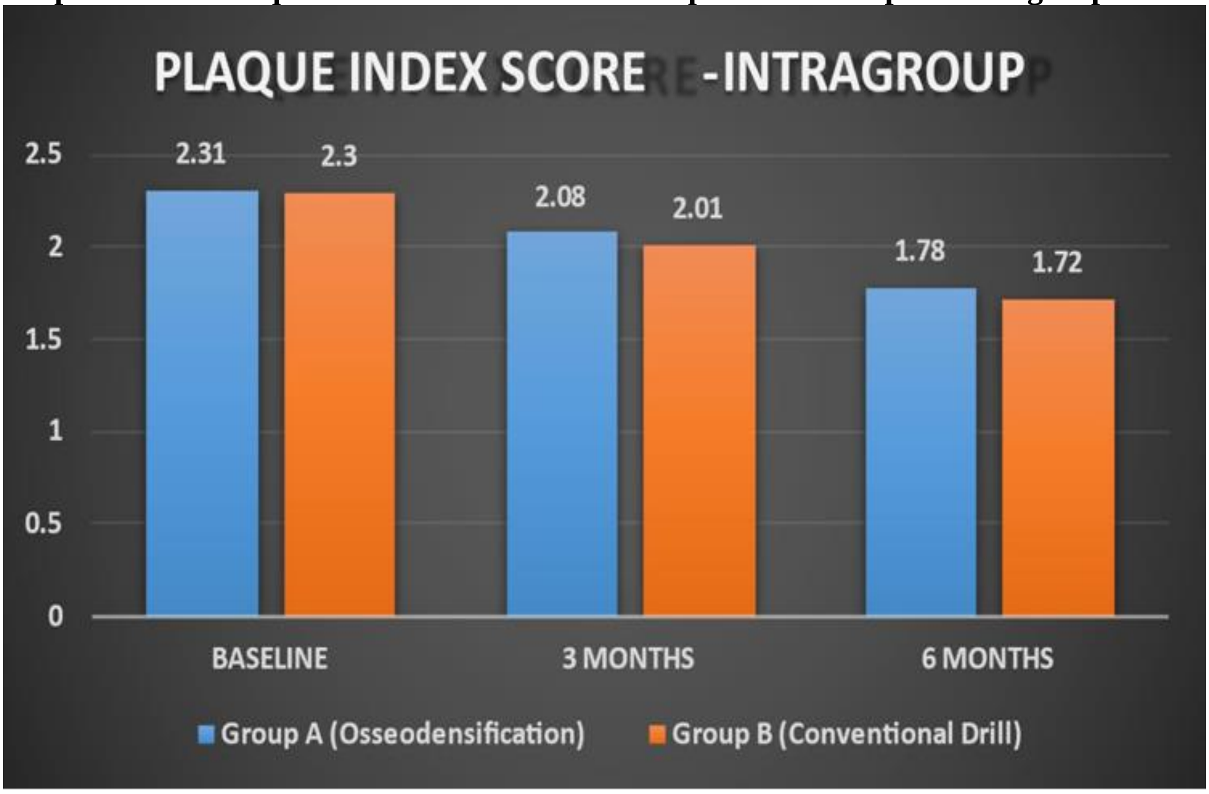
Graph 9 shows intergroup comparison of mean radiographic distal crestal bone level between Group A and Group B using unpaired t test. At baseline, Group A (Osseodensification) have lower mean scores as compared to Group B (Conventional Drill) at baseline, 3 months, and 6 months. Statistically significant difference was observed between both groups ($p> 0.05$) at baseline, but no statistically significant difference was ($p>0.05$) at 3 months and 6 months.

At baseline to 3 months, Group B (Conventional) has higher radiographic distal crestal bone loss from baseline to 3 months, and from baseline to 6 months when compared to Group A (Osseodensification) and the difference was found to be of highly statistically significant ($p<0.001$).

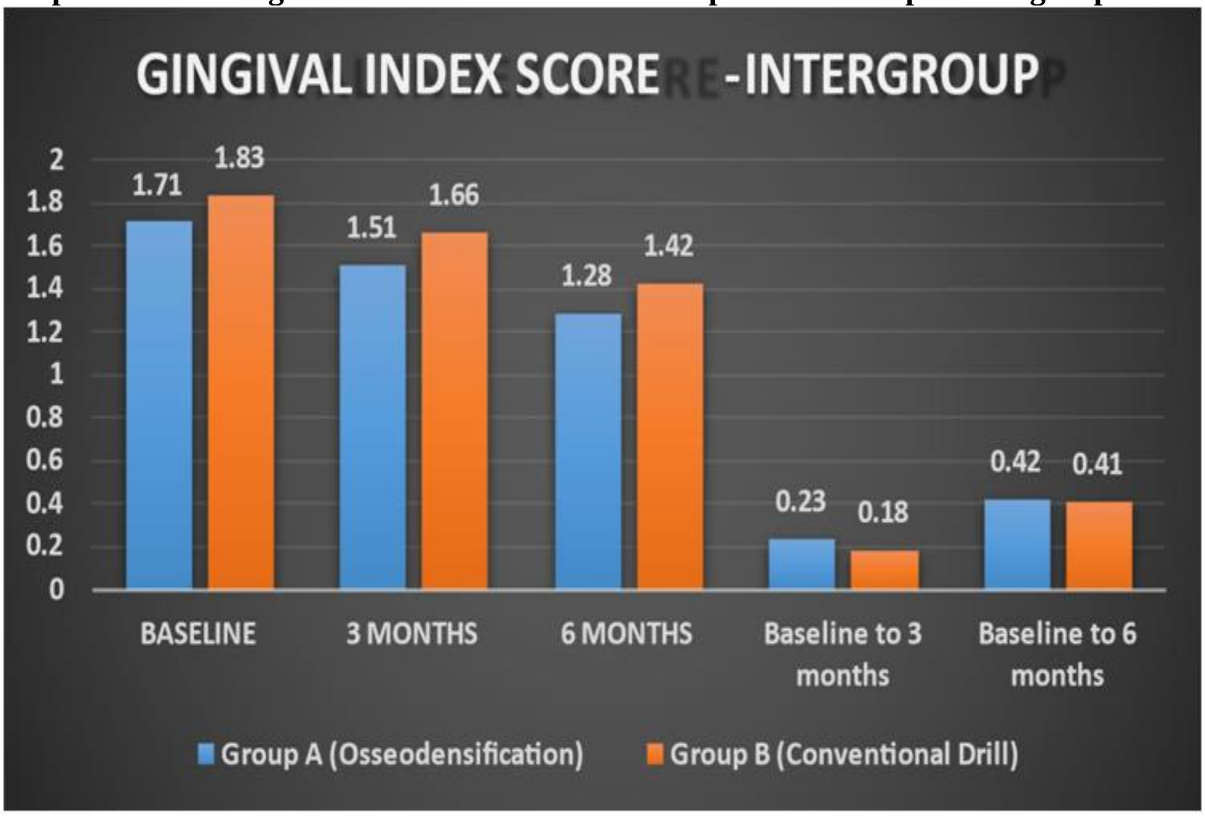
Graph 10 shows intragroup comparison of mean radiographic distal crestal bone level in Group A (OD), Group B (CD) using Repeated Measures Anova F test. In Group A (OD), no statistically significant difference ($p>0.05$) was observed in relation to change in mean score at baseline 3.8 (0.29) which further reduced to 3.26 (0.3) at 3 months and declined to 3.06 (0.3) in 6 months. In Group B (CD), statistically significant difference ($p<0.05$) was observed in relation to change in mean score at baseline was 4.27 (0.3) which further reduced to 3.53 (0.33) at 3 months and declined to 3.31 (0.34). Overall, no statistically significant difference ($p>0.05$) was observed on from baseline to 3 months and from 3 months to 6 months on comparison using Repeated measures Anova F test and pairwise comparison using Tukey's post hoc test.

Graph 1: Mean Plaque Index Score Between Group A And Group B –Intergroup

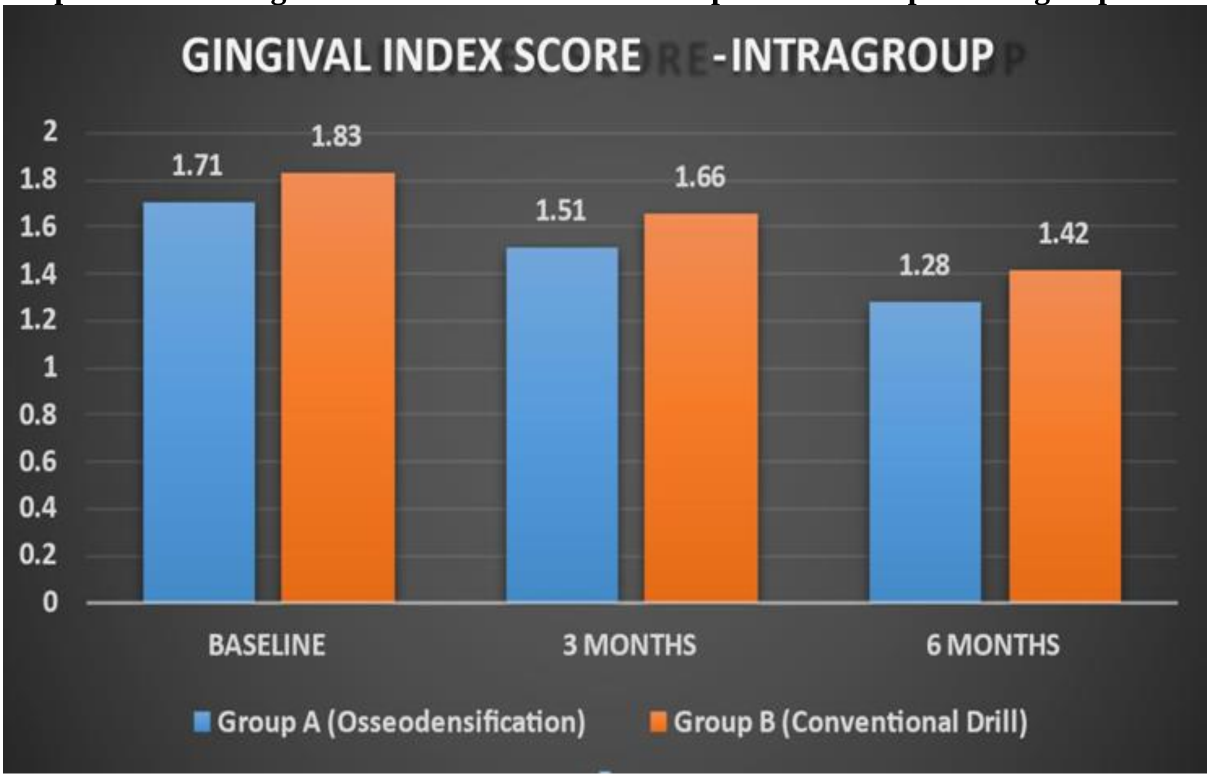
Graph 2: Mean Plaque Index Score Between Group A And Group B –Intragroup



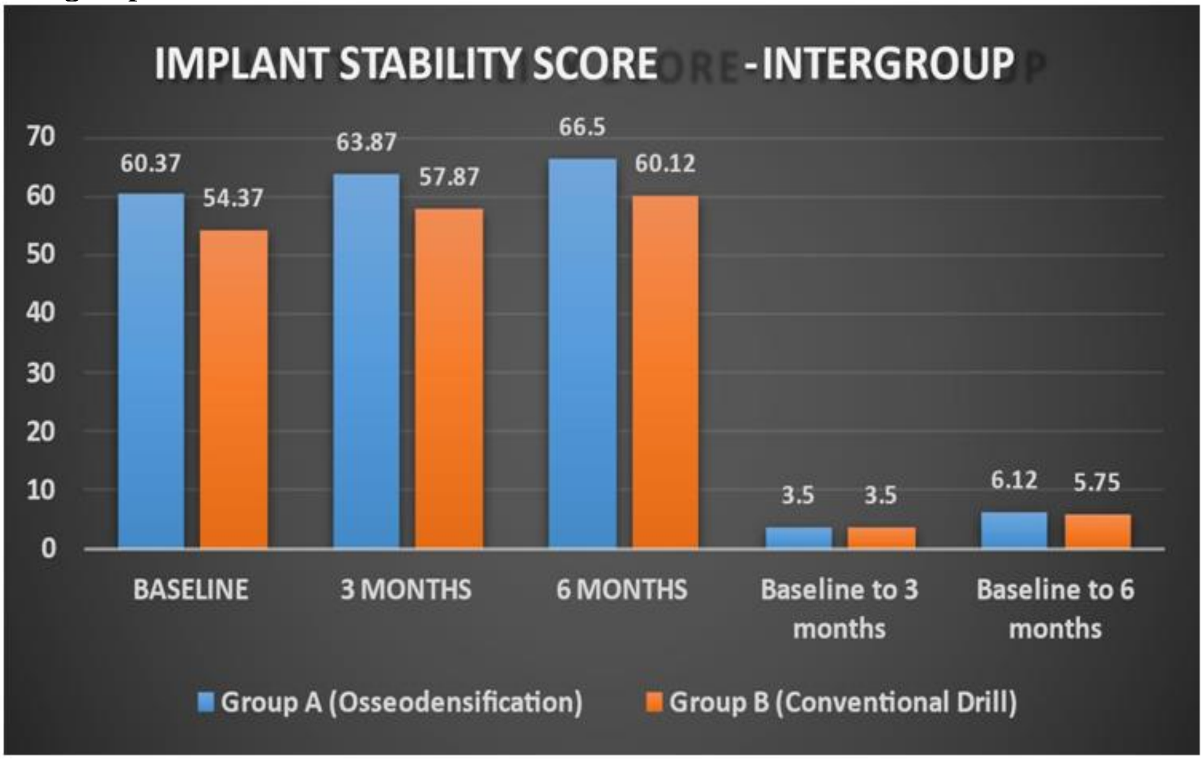
Graph 3: Mean Gingival Index Score Between Group A And Group B Intergroup



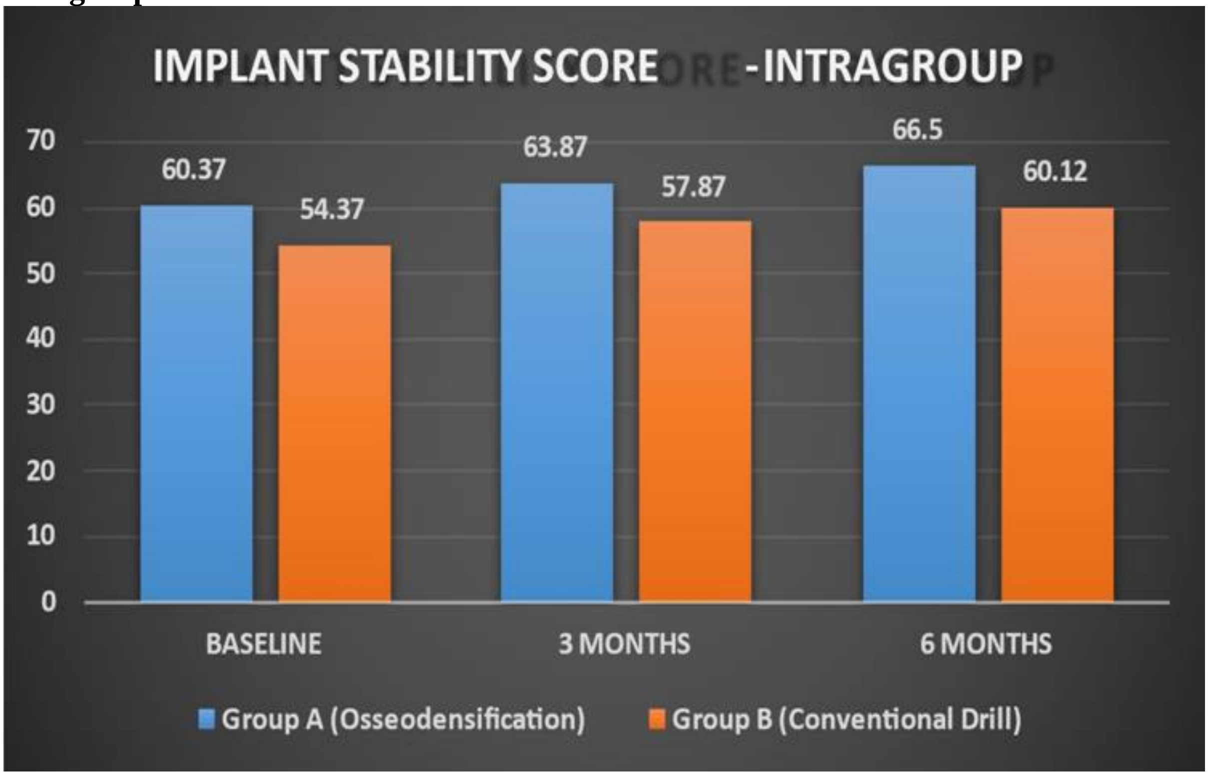
Graph 4: Mean Gingival Index Score Between Group A And Group B Intragroup



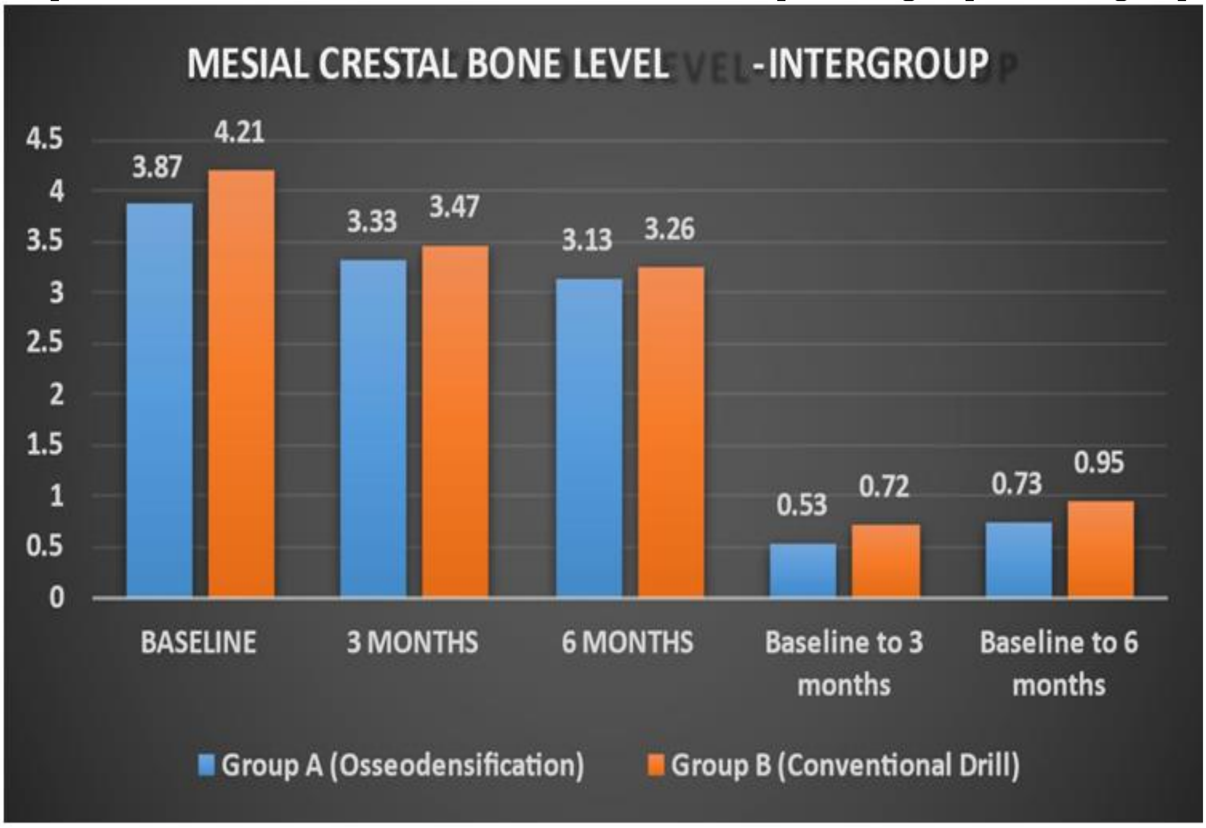
Graph 5: Mean Primary Implant Stability Score Between Group Aand Group B – Intergroup



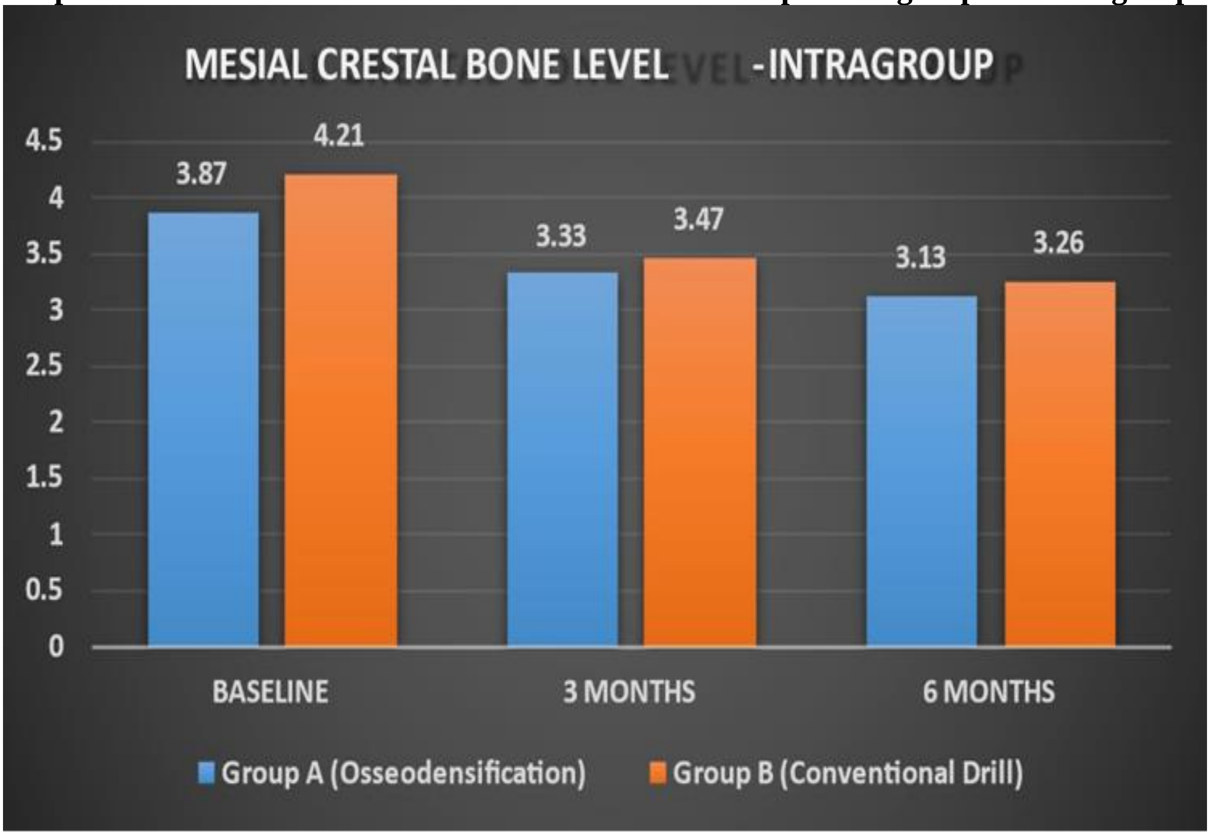
Graph 6: Mean Primary Implant Stability Score Between Group Aand Group B – Intragroup



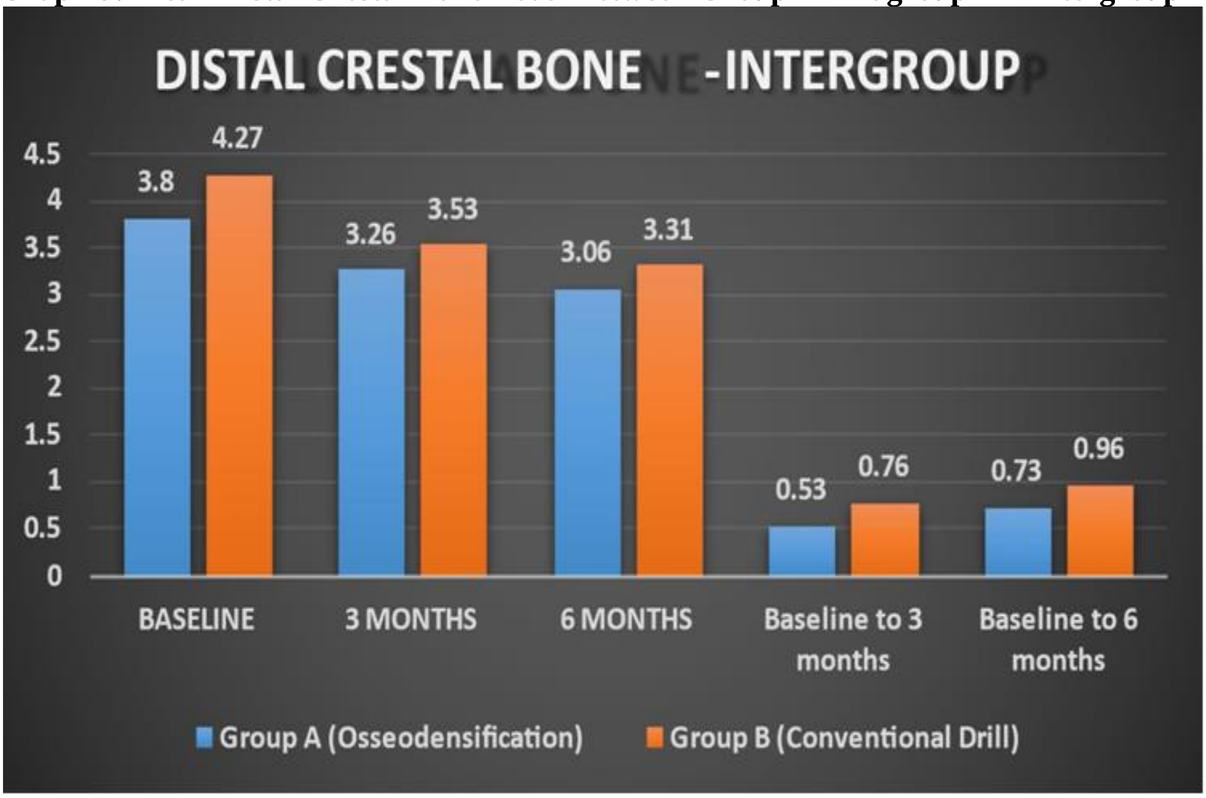
Graph 7: Mean Mesial Crestal Bone Level Between Group A And group B – Intergroup



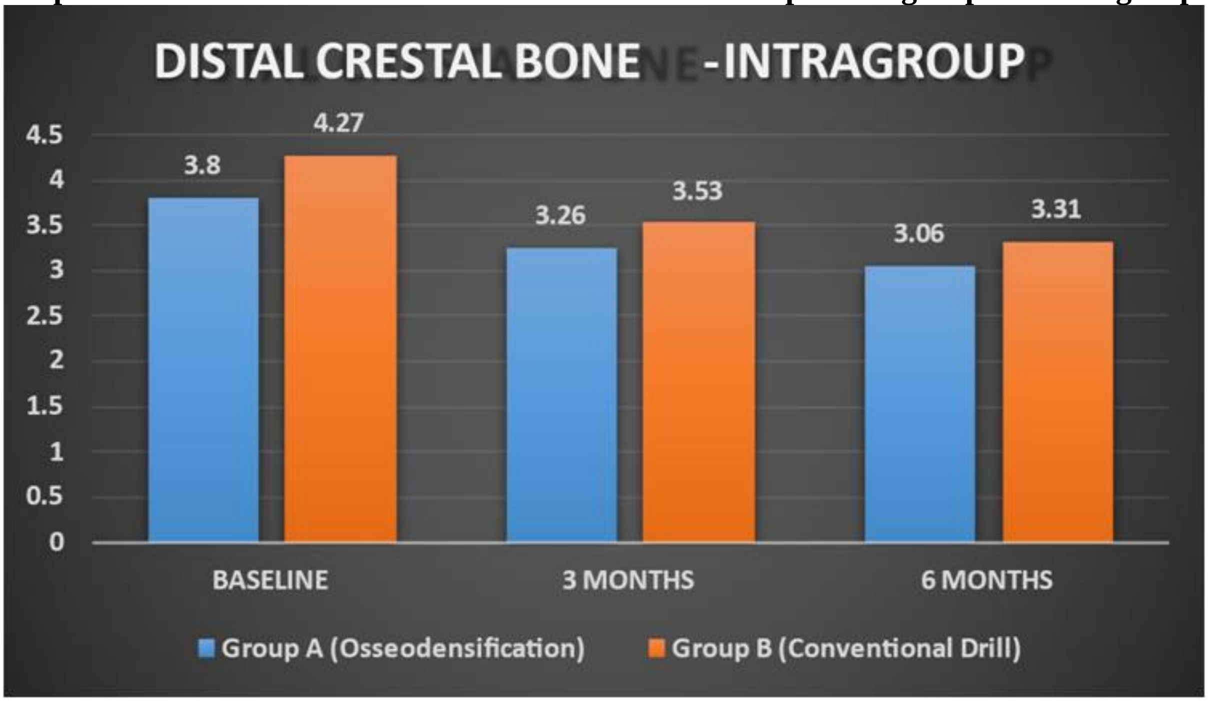
Graph 8: Mean Mesial Crestal Bone Level Between Group A Andgroup B – Intragroup



Graph 9: Mean Distal Crestal Bone Level Between Group A Andgroup B – Intergroup



Graph 10: Mean Distal Crestal Bone Level Between Group A Andgroup B – Intragroup



DISCUSSION

Primary implant stability basically depends on the quality and the quantity of bone in the immediate vicinity of the implant at the time of implant placement. Edentulous areas which are deficient in bone are always at a risk of poor primary stability after implant placement. Achieving a good primary stability is critical in areas such as posterior maxilla or regions with D3 and D4 bone. Thus, in simple terms, a good amount of bone should surround the implant at the time of implant placement to provide it a good mechanical anchorage. Nevertheless, quality of bone at the surgical site is a factor that is beyond control, quantity of bone could be manipulated by number of ways. Thus, osteotomy formation leads to inevitable loss of bone tissue to create spacefor implant in the bone, which will affect the implant primary stability[10].

Traditional drilling technique has been used extensively in implantology for the past many years. It has its limitations such as removal bone, elliptical osteotomy preparation which may have resulted in increased bone modeling time and low primary stability mainly in region of low density[10].

To address the potential limitations of conventional SD, an alternative approach has been proposed that an OD drilling sequence will maintain bone by compacting the particles into the osteotomy wall[11]. A successful osteotomy for dental rehabilitation allows the implant to be inserted in a biologically and restoratively driven three-dimensional position with adequate biomechanical stability, where the implant bed is adequately prepared to a precise size using a progressive series of drills, avoiding overheating-induced tissue damage[12]. Achieving high levels of biomechanical stability has been increasingly required in clinical practice to accommodate the current tendency toward early loading protocols, even for bone types with low density[13]. Therefore, the OD instrumentation has been demonstrated to improve bone quality as osteotomy size is expanded and guarantee greater levels of physical interlocking at the implant interface, especially in such challenging scenarios[11].

For evaluation of primary stability, insertion torque (IT) and resonance frequency analysis (RFA) are well-established methods[14]. IT is a mechanical parameter influenced by surgical procedure, implant design, and bone quality. Values above 32 Ncm indicate that the implant is firmly embedded in the bone and mechanically stable[15].

RFA assumes that the frequency is directly related to the stiffness of the bone-implant interface and the surrounding bone. High values show a stable implant and allow verification of osseointegration and secondary stability over time. RFA is measured by Ostell®-devices (Osstell ISQ, Osstell, Göteborg, Sweden). A sensor (SmartPeg, Osstell, Göteborg, Sweden) is mounted on the implant and is vibrated by moving it with magnetic pulses. With increasing stiffness of the bone-implant interface, the vibration frequency of the sensor increases. While RFA is expressed in hertz, implant stability quotient (ISQ) is the scale used to quantify RFA values (range 1–100)[16].

The bone loss, particularly at the level of the alveolar bone crest, continues to be one of the main complications of implant treatment that compromises osseointegration and the long-term success of rehabilitation. There is consensus in the literature that the average bone loss around implants is 1 mm in the first year of prosthesis installation and then remains constant at 0.1 mm per year[17]. Bone loss around the implant may also occur early due to etiological factors such as surgical trauma resulting from overheating implant position, the formation of biological space, surgical technique, and implant design[18]. Osteotomy, a procedure used for the placement of osseointegrated implants, has been indicated as one of the probable causes of early peri-implant bone loss due to the creation of devitalized bone around the implant[7]. This devitalized zone is the result of the interruption of blood supply and the heat generated during osteotomy, especially in cortical bone[7].

The Plaque Index was assessed to monitor the patient's oral hygiene as there is conclusive evidence regarding the importance of oral hygiene on the outcome of implant- related surgical procedures. In Group A (OD), no statistically significant difference ($p>0.05$) was observed in relation to change in mean score at baseline was 2.31 (0.59) which reduced to 2.08 (0.54) at 3 months and further decline to 1.78 (0.67) in 6 months. Overall, no statistically significant difference ($p>0.05$) was observed from baseline to 6 months. In Group B (CD), no statistically significant difference ($p>0.05$) was observed in relation to change in mean score at baseline was 2.3 (0.54) which reduced to 2.01 (0.51) at 3 months and declined to 1.72 (0.49). Overall, no statistically significant difference ($p>0.05$) was observed from baseline to 6 months. The results of our study are in accordance with **Koh et al.**[19] who also evaluated plaque accumulation on the facial aspect of teeth adjacent to dental implants and reported that all patients maintained a low level of plaque accumulation after four months of implant placement. In a study done by **Behneke et al.**[20] evaluating plaque index around implants for three years at an interval of six months each reported that the values stayed within physiologic levels throughout the entire observation period, so that healthy peri-implantconditions prevailed. Evaluating modified Plaque Index around the implants observe majority of scores were 0, implying good oral hygiene had been maintained around the implants throughout the duration of their study.

The Gingival Index was assessed to monitor the gingival health of teeth adjacent to the implant. In Group A (OD), no statistically significant difference ($p<0.05$) was observed in relation to change in mean score at baseline was 1.71 (0.32) which reduced to 1.51 (0.31) at 3 months and further decline to 1.28 (0.27) in 6 months. Overall, no statistically significant difference ($p<0.05$) was observed from baseline to 6 months. In Group B (CD), no statistically significant difference ($p>0.05$) was observed in relation to change in mean score at baseline was 1.83 (0.34) which reduced to 1.66 (0.39) at 3 months and declined to 1.42 (0.49). Overall, no statistically significant difference ($p>0.05$) was observed from baseline to 6 months. The results of our study are in accordance with **Koh et al.**[19] who also reported maintenance of good gingival health throughout the course of their study following crestal placement of dental implants. Similarly, the study done by **Rajpal J et al.**[21] observed an increase in BOP and gingival index from baseline to 1st month, but there was a subsequent decrease in BOP and gingival index from 1st to 6th month. They attributed this to the fact that after loading the implant hygiene could not be well maintained in the subgingival regions, but later when the repeated reinforcements of oral hygiene measures were given to the patient the inflammation subsided.

The long-term survival of dental implants is evaluated by crestal bone loss around the implant. A mean crestal bone loss of ≤1.5 mm during the 1st year after loading and ≤0.2 mm/year thereafter had been proposed as one of the major success criteria. In our study, the mean radiographic mesial crestal bone level in Group A (OD**)** was found to be 3.87 (0.29) at baseline which was reduced to 3.33 (0.31) at 3 months and further declined to 3.13 (0.31) in 6 months. The mean radiographic mesial crestal bone level in Group B (CD**)** was found to be 4.21 (0.35) at baseline which was reduced to 3.47 (0.38) months and further declined to 3.26 (0.38) in 6 months. Statistically significant difference was observed between both groups (p> 0.05) at baseline, but no statistically significant difference was (p>0.05) at 3 months and 6 months. Whereas the mean radiographic distal crestal bone level in Group A (OD**)** was found to be 3.8 (0.29) at baseline which was reduced to 3.26 (0.3) at 3 months and further declined to 3.06 (0.3) in 6 months. The mean radiographic distal crestal bone level in Group B (CD**)** was found to be 4.27 (0.3) at baseline which was reduced to 3.53 (0.33) at 3 months and further declined to 3.31 (0.34) in 6 months. Statistically significant difference was observed between both groups (p> 0.05) at baseline, but no statistically significant difference was (p>0.05) at 3 months and 6 months. **Nandal et al.**[22]radiologically evaluated marginal bone loss around dental implants using IOPA and reported a mean crestal bone level of 0.5675 mm for mesial and 0.5562 mm for the distal aspect of implants after six months. In another study done by **Kamburoglu et al.**[23] evaluating marginal bone loss using digitized radiographs reported that mean crestal bone loss was 1.61±0.48 mm and 1.59±0.46 mm for mesial and distal aspects respectively after six months of implant placement.

It was found that there is a decrease in crestal bone levels after 6 months from the baseline in both the groups. However, Group II showed comparatively higher crestal bone levels after 6 months. **Salah Huwais et al.**[9] examine the effect of osseous densification on primary stability, bone mineral density, and the percentage of bone at the implant surface when compared with drilling with standard drills or drilling with the newly designed bur and reported that Osseous densification preserves bone bulk in two ways: compaction of cancellous bone due to viscoelastic and plastic deformation and compaction of autografting of bone particles along the length and at the apex of osteotomy. In another study done by **Trisi et al.**[24] conducted a biomechanical and histological analysis after inserting 20 implants in the iliac crest of 2 sheep's and reported that Osseodensification procedure improved bone ridge width, density, and implant secondary stability. This was probably due to fine boney particle in the walls of the osteotomy and in between the threads of the implant body, which act as new bone growth initiator to enhance progression to secondary stability Furthermore, osteotomy production without extraction of existing bone preserves existing collagen and bone bulk. The presence of collagen and bone bulk enhances revascularization, a critical element in new bone growth and remodeling.

The implant stability was measured using the resonance frequency analysis (RFA) via the ostell ISQ system. **Meredith et al.**[25] stated that RFA could serve as a useful research technique and may prove to be valuable in studying the behaviour of implants in surrounding tissue. A non-contacting method was used allowing the testing of the implant stability from any surface in 360° around the implant fixture. In our study, the mean primary implant stability in Group A (OD**)** was found to be 60.37 (3.15) at baseline which was reduced to 63.87 (2.94) at 3 months and further declined to 66.5 (3.25) in 6 months. The mean primary implant stability in Group B (CD**)** was found to be 54.37 (3.2) at baseline which was reduced to 57.87 (2.99) months and further declined to 60.12 (2.99) in 6 months. Statistically significant difference was observed between both groups (p> 0.05) at baseline, but no statistically significant difference (p>0.05) was found at 3 months and 6 months. Statistically significant difference was observed between both groups (p> 0.05) at baseline, but no statistically significant difference (p>0.05) was found at 3 months and 6 months. **Shayesteh et al.**[8] osteotome technique yielded higher primary stability when compared with the conventional drilling technique but this technique is however not superior to conventional technique after 3 months. **Ibrahim et al.**[26] in a clinical trial reported that there is a significant improvement in both primary and secondary stability by using Densah burs and produced better bone quality around the implants when compared to conventional drills. **Sultana et al.**[10] in a vivo- comparative study compared the stability of the implant and the loss of crestal bone in the implants placed using OD drilling and traditional drilling technique and reported that there was no statistically significant difference in implant stability and crestal bone loss between the traditional drilling and OD drilling. **Hong et al.**[27] reported bone expansion technique substantially increased more ISQ values from primary stability and achieved comparable primary and secondary stabilities with the conventional technique.

The results strongly indicated that the OD drilling technique had no negative influence on bone healing as compared to traditional drilling. To the best of our knowledge, this is the first study to compare crestal bone loss and implant stability around implants using IOPA and ISQ. Further clinical trials with larger sample size and longer follow-up period should be done to further authenticate the results of our study.

No complications were encountered in any patient who participated in this study. The implants placed successfully osseointegrated and prosthetically restored for function. Not many human studies are available in literature where a comparison has been made between traditional drilling and standard drilling. However, the results of the present study are limited because of the short period of investigation and short sample size. Further investigations including many patients and considering long-term evaluation of peri-implant alveolar bone loss are necessary to enhance the power of the conclusion concerning use and predictability of osseodensification technique.

CONCLUSION

To summarise with, Osseodensification technique yielded higher primary stability than conventional drilling technique. However, this technique was not superior to conventional technique after 3 months.Thus, in this study, the crestal bone loss was found to be more in conventional drill group when compared with osseodensification group from baseline to 3 months but no significant difference was found in both the groups from 3 months to 6 months. However, within the limitations of our study, further clinical trials with larger sample size and longer follow up period are needed to assess the effect of osseodensification technique on crestal bone resorption, the success rate, and the complications after functional loading.

BIBLIOGRAPHY

1. ZohrabianVM,SonickM,HwangD,AbrahamsJJ.Dentalimplants.SeminUltrasoundCTMR.2015;36(5):415–426.
2. Sanz I, Garcia-Gargallo M, Herrera D, Martin C, Figuero E, Sanz M. Surgical protocols for early implant placement in post-extraction sockets: a systematic review. Clin Oral Implants Res. 2012;23(5):67–79.
3. RanjanGupta,NehaGupta,Kurt K.Weber.Dental Implants.Stat Pearls;2022.
4. Branemark PI. USA: Quintessence Books; 2005. The Osseointegration Book – From Calvarium to Calcaneus; p. 24.
5. Sennerby L, Maredith N. Implant stability measurements using resonance frequency analysis: Biological and Biomechanical aspects and clinical implications. Perio 2000 2008;47(1):51-66.
6. Padhye NM, Padhye AM, Bhatavadekar NB. Osseodensification -- A systematic review

and qualitative analysis of published literature. J Oral Biol Craniofac Res. 2020;10(1):375-380.
7. Summers R. A new concept in maxillary implant surgery. Osteotome Tech Compend. 1994;15(2):152-158.
8. Shayesteh 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 Dent Relat Res. 2013;15(1):350–7.
9. Huwais S, Meyer E. Osseodensification: A novel osseodensification approach in implant osteotomy preparation to increase primary stability, bone mineral density and bone toimplant contact. Int J Oral Maxillofac Implants. 2016;32(1):27–36.
10. Sultana A, Makkar S, Saxena D, Wadhawan A, Kusum CK. To compare the stability and crestal bone loss of implants placed using osseodensification and traditional drilling protocol: A clinicoradiographical study. J Indian Prosthodont Soc 2020;20(1):45-51.
11. Huwais S, Meyer E. Osseodensification: A novel osseodensification approach in implant osteotomy preparation to increase primary stability, bone mineral density and bone toimplant contact. Int J Oral Maxillofac Implants. 2016;32(1):27–36.
12. Stocchero M, Toia M, Cecchinato D, Becktor JP, Coelho PG, Jimbo R. Biomechanical, biologic, and clinical outcomes of undersized implant surgical preparation: a systematic review. Int J Oral Maxillofac Implants. 2016;31(6):1247-1263.
13. Cheng Q, Su YY, Wang X, Chen S. Clinical outcomes following immediate loading of single-tooth implants in the esthetic zone: a systematic review and meta-analysis. Int J Oral Maxillofac Implants. 2020;35(1):167-177.
14. Swami V, Vijayaraghavan V, Swami V. Current trends to measure implant stability. J Indian Prosthodont Soc. 2016;16(2):124–130.
15. Khayat PG, Arnal HM, Tourbah BI, Sennerby L. Clinical outcome of dental implants placed with high insertion torques (up to 176 Ncm). Clin Implant Dent Relat Res. 2013;15(2):227–233.
16. Meredith N, Book K, Friberg B, Jemt T, Sennerby L. Resonance frequency measurements of implant stability in vivo. A cross-sectional and longitudinal study of resonance frequency measurements on implants in the edentulous and partially dentate maxilla. Clin Oral Implants Res 1997:8(3): 226–233.
17. Turkyilmaz I, McGlumphy EA. Is there a lower threshold value of bone density for early loading protocols of dental implants? J Oral Rehabil. 2008;35(10):775–781.
18. Lomardi T, Berton F, Salgarello S, Barbalonga E, Rapani A, Piovesana f. Factors Influencing Early Marginal Bone Loss around Dental Implants Positioned Subcrestally: A Multicenter Prospective Clinical Study. J Clin Med. 2019;8(8): 1168.
19. Koh RU, Oh T, Rudek I, Neiva GF, Misch CE, Rothman ED. Hard and Soft Tissue Changes After Crestal and Subcrestal Immediate Implant Placement. J Periodontol. 2011;82(8):1112–20.
20. Behneke A, Behneke N, d'Hoedt B, Wagner W. Hard and soft tissue reactions to ITI screw implants: 3-year longitudinal results of a prospective study. Int JOralMaxillofac Implants. 2021;12(6):749–757.
21. Rajpal J, Srivastava A, Tandon P, Chandra C, Gupta K. Assessment of hard and soft tissue changes around Implants: A clinico-radiographic in vivo study. J Dent Implant. 2014;4(2):126-134.
22. Nandal S, Shekhawat H, Ghalaut P. A radiological evaluation of marginal bone around dental implants: An in-vivo study. Natl J Maxillofac Surg. 2014;5(2):126-137.
23. Genc Y, Paksoy CS. A Comparison of Peripheral Marginal Bone Loss at Dental Implants Measured with Conventional Intraoral Film and Digitized Radiographs. J Oral Implantol.

2012;38(3):211–219.

24. Paolo Trisi, Marco Berardini, Antonello Falco, Michele PodaliriVulpiani. New Osseodensification Implant Site Preparation Method to Increase Bone Density in Low-Density Bone: In Vivo Evaluation in Sheep. Implant Dent. 2016;25(1):24-31.
25. Meredith N, Book K, Friberg B, Jemt T, Sennerby L. Resonance frequency measurements of implant stability in vivo. A cross-sectional and longitudinal study of resonance frequency measurements on implants in the edentulous and partially dentate maxilla. Clin Oral Implants Res 1997:8(3): 226–233.
26. AhmedM.Ibrahim,SherifS.Ayad,AdhamElAshwah.Theeffectofosseodensification technique on implant Stability (Clinical Trial). *ADJ* 2020;45(2):1-7.
27. Hong, H.-H., Hong, A., Yang, L.-Y., Chang, W.-Y., Huang, Y.-F., & Lin, Y.-T. Implant Stability Quotients of Osteotome Bone Expansion and Conventional Drilling Technique for 4.1 mm Diameter Implant at Posterior Mandible. Clin Implant Dent Relat Res. 2016;19(2):253-260.