 DOI: 10.21608/adjalexu.2024.273378.1478

OSSEOINTEGRATION OF DENTAL IMPLANTS IN ANTERIOR MAXILLA VIA OSSEODENSIFICATION TECHNIQUE WITH AND WITHOUT ADVANCED PLATLET RICH FIBRIN

Mohamed M. Elkamah[1]* *BDS,* Magda M. Saleh[2] *PhD,* Saeeda M. Osman[2] *PhD,* Mona S. Oraby[3] *PhD*

ABSTRACT

INTRODUCTION: Osseodensification using DensahTM burs is a technique that increases the density of bone at the walls of the osteotomy by condensing it using burs rotating in an anticlockwise direction. The advanced platelet rich fibrin (A-PRF) increases bone healing and soft tissue regeneration after implant placement by osseodensification technique.
THE AIM OF THE STUDY: was to evaluate crestal bone level, implant stability, bone density using the osseodensification technique with and without Advanced Platelet-Rich Fibrin (A-PRF) in the anterior maxilla.
MATERIALS AND METHODS: Twenty patients were divided into two groups, each receiving ten dental implants in the maxillary aesthetic zone using osseodensification technique with and without A-PRF. Clinical and radiographic evaluation of implant stability, crestal bone level, bone density was done immediately postoperatively and after 6 months.
RESULTS: There was a statistical increase in group I than group II regarding stability immediately and after 6 months (P< 0.05). There was a statistically significant increase in group I compared to group II regarding bone density after 6 months (P< 0.05). it was found that there was no significant difference between the two groups (p >0.05) regarding to crestal bone level
CONCLUSION: We concluded that osseodensification with advanced platelet rich fibrin in anterior maxilla was a safe and efficient method that improved bone density surrounding the implant and increased the implant stability.
KEYWORDS: osseodensification, implant stability, advanced platelet rich fibrin. osseointegration.
RUNNING TITLE: Effectiveness of osseodensification technique and advanced platelet rich fibrin on dental implants

---

1 BDS 2017, Oral and Maxillofacial Department, Faculty of Dentistry, Pharos University, Alexandria, Egypt
2 Professor of Oral and Maxillofacial Surgery, Oral and Maxillofacial Department, Faculty of Dentistry, Alexandria University, Alexandria, Egypt
3 Lecturer of Oral and Maxillofacial, Oral and Maxillofacial Department, Faculty of Dentistry, Alexandria University, Alexandria, Egypt

** Corresponding Author:*
E-mail: mohamedrana2018@gmail.com

INTRODUCTION

Dental implant placement in esthetic zone is considered to be one of the most challenging procedures for many oral and maxillofacial surgeons. Recent dental implantology attempts to make a satisfying esthetics result as well as secure osseointegration for functional and esthetical consideration (1,2).
An amount of bone resorption happens following tooth extraction due to trauma, periodontal disease, congenital tooth loss, and long-term edentulism (3). Furthermore, bone density decreased with time as the functional load on bone decreased (4).
In their 1981 study, Albrektsson et al. identified a number of factors that are related to implant success: (1) implant-related factors, such as loading conditions; (2) host-related factors, such as bone quality, density, and volume; (3) surgical factors, such as achieving primary stability, preventing infection, and avoiding mechanical and thermal damage; and (5) systemic factors, such as parafunctional habits, systemic diseases, and medications that affect bone healing. (5)
Primary stability is one of the most crucial elements in achieving osseointegration. Bone density, surgical technique, implant thread type, and shape can all influence this (6,7).
For many years, implantology has make extensive use of traditional drilling techniques. Its drawbacks include bone loss, elliptical osteotomy preparation that could have prolonged the time needed for bone modelling, and limited primary stability, particularly in low-density areas. (8)
When planning a dental implant surgery, alveolar deficiencies can be challenging. If the defect occurs in the buccal or lingual cortex following tooth extraction, this might provide serious complications for implant insertion, and this due to anatomical

and pathologic conditions such as dental trauma and acute or chronic infection. (3) So alveolar ridge augmentation in the anterior maxillary region is important to improve function and aesthetics. (9)

There are many bone augmentation techniques that have been developed to counteract alveolar bone loss that affects the aesthetic zone, such as guided bone regeneration, ridge splitting, autogenous onlay block grafting, socket preservation, and alveolar distraction osteogenesis. These procedures can help improve alveolar defects for a successful dental implant insertion. (10)

In 2013, *Huwais and Meyer* (11) introduced a new concept for implant site preparation that can compensate for bone defects by creating a densified osteotomy with minimal heat formation and a non-bone cutting technique to achieve biomechanical primary stability, which is referred to as the osseodensification technique by using Densah™Burs that help bone densification during the osteotomy (8).

These burs condense and preserve bone by compaction autografting of osseous material into the trabecular space and increased bone density in the peri-implant area; also, this bone compaction increases the ridge width. This technique could be applied in the clinical evaluation of poor bone quality (11, 12).

Platelets are added to tissue regeneration procedures because they include a range of cytokines, growth factors, and other substances that are crucial for wound healing and inflammation (13).

A recent modification of the platelet rich fibrin was the A-PRF, which was described by *Ghanaati* (14). This method used a lower centrifugation force to obtain higher growth factor release in comparison to PRF to increase bone healing and soft tissue regeneration after implant placement using the osseodensification technique (15).

There were no studies that combine osseodensifcation technique with advanced platelet rich fibrin to measure implant stability, bone density and crestal bone level.

So, the aim of this study was to evaluate, crestal bone level changes, implant stability and bone density of implant placed via osseodensification technique with and without advanced platelet rich fibrin.

MATERIALS AND METHODS

Study design

This was a randomized controlled clinical trial, with group I & group II with 1:1 allocation ratio. In accordance with the CONSORT standards. Twenty patients were selected from the Oral and Maxillofacial Surgery Department (OMSD) of the Faculty of Dentistry at Alexandria University and main university hospitals. The ethical committee approval (0509-10/2022) of the Alexandria University Faculty of Dentistry approved the study protocol, and each patient gave their informed consent indicating that they were prepared to participate in the study and would make themselves available for follow-up appointments.

Randomization and allocation concealment

Participants will be randomly allocated into test and control groups with ratio (1:1) using computer generated random list. [16] The participant allocation lists will be kept in opaque, sealed envelopes and arranged sequentially by a dental assistant who will not be involved in the study. Each envelope will be opened at the time of intervention.

Study population

In group I study group patients had implant placement using osseodensification technique with A-PRF. Group II control group patients had implant placement using osseodensification technique without A-PRF.

The criteria of **included** patients have good oral hygiene and adequate keratinized mucosa, Patients of both sexes with missing one or more of the maxillary anterior teeth, age ranged from 25-40 years old and ridge width not less than 6mm (17) with Edentulous gap not less than 5 mm (18). **Exclusion criteria** were; patients with immunological diseases, bad oral hygiene, heavy Smokers (8), pregnant patients (8) and Patient with parafunctional habits (17).

Materials

1- Dental implant system (vitronex, Italy).
2- Osseodensification surgical kit (densah burs, Versah, LLC).
3- Implant stability measuring device (osstell, U.S.A. Company)
4- Centrifuge device (Centrifuge 80-1, China)

Methods

I. Preoperative phase

Pre-operative clinical examination had been performed on every patient: the patient's name, sex, age, and medical and dental histories were also obtained. Preoperative cone beam computed tomography for implant surgical planning and proper studying of the case was done. (Figure 1)

III. Operative procedure (19)

Plaque-control strategies and oral hygiene advice were given to the patients. The patients were instructed to just before to surgery rinse with mouthwash containing chlorhexidine HCL 1.25%. All operations employed local infiltration anesthesia at surgical site using 4% articaine with epinephrine 1:10000 (Inibsa, S.A, Spain) . Incision by blade number #15 then mucoperiosteal flap reflection by using periosteal elevator to allow adequate exposure for the surgical site. **(Figure 2, 3)** pilot osteotomy was created by a pilot drill in a clockwise direction at 800- 1200 RPM to full depth. Then densah burs running in counterclockwise direction in a densifying mode under copious sterile saline irrigation in up and down motion at 500-1800 RPM using a surgical handpiece and a surgical motor to expand osteotomies. **(Figure 2, 3)** Preparation of advanced platelet rich fibrin for

study group (12) **(Figure 2)** Prior to implant installation, ten to twenty cubic centimetres (CC) of the patient's venous blood are extracted from a vein in the forearm. Blood is drawn into glass-coated test tubes without the use of an anticoagulant, and the tubes are centrifuged for eight minutes at a speed of 1300 rpm. Three distinct layers are seen in the tube after centrifugation. Red blood cells make up the base layer, fibrin buffy coat layer (A-PRF) is in the middle, and platelet rich plasma is at the top. After that A-PRF membranes were divided into tiny pieces and inserted into the study group's osteotomy site. Dental implant placement (Italy Company Dental Express). **(Figure 2,3)** Primary stability was measured by using osstell monitor obtaining ISQ reading (20). **(Figure 2,3)** Flap was returned to its normal position and sutured with silk interrupted sutures. **(Figure 2,3)**

IV- Postoperative phase

Postoperative instructions

All the patients were instructed to apply cold fomentation in the first 24 hours followed by warm fomentation in the next day. The patients will be advised to directly contact if there is any unexplained complications.

Postoperative medication

Antibiotic in the form of Augmentin 1gm (amoxicillin 875mg+ clavulanic 125mg: GlaxoSmithKline, UK) tablets for 5 days twice daily. Diclofenac Potassium (cataflam 50mg: Novartis-Switzerland tablets for 5 days 3 times daily. Alphintern (chymotrypsin +trypsin Amoun Pharmaceutical Company, Egypt) tablets for 3 days 3 times daily. Warm mouth wash chlorhexidine (Hexitol Arab drug company, Egypt) in the next day of surgery for one week. The sutures were removed after seven days postoperatively.

Follow up phase

Clinical evaluation

- Primary stability was measured immediately by Osstell (20).
- Secondary stability after 6 months by osstell (20).
- Pain using visual analogue scale (VAS) from one to ten where pain intensity score scaled 0 (no pain) to 10(unbearable pain) according to visual analogue scale. (21).
- The ability to pit the examiner's fingers into the dependent area for five seconds was used to measure edema, and the pitting was graded on a scale from +1 to +4 (22).
- Examination of surgical wound for any signs and symptoms of inflammation and infection (23).
- **Post-operative radiographic evaluation (figure 4)**
- Cone beam computerized tomography was taken immediately postoperative and after 6 months to assess the changes in crestal bone level and bone density.
- Marginal bone level was measured at 4 different points around the implant at immediately and compared to its reading after 6 months.
- Bone Density was measured by using OnDemand 3D software in the cone beam computed tomography at four points from buccal, palatal, mesial and distal. And the main was taken.

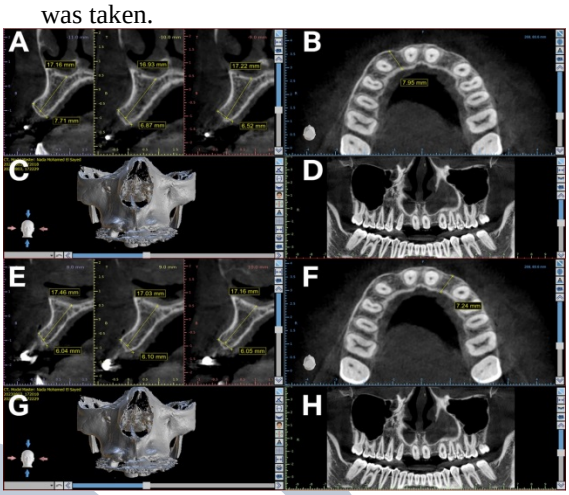

Figure (1): Preoperative CBCT for study and control group. (A,E) sagittal cuts, (B,F) Axial cut, (C,G) 3D view (D,H) Panoramic view.

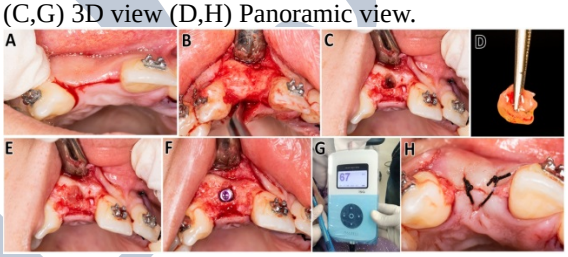

Figure (2): For study group (A) incision (B) flap reflection (C) osteotomy site using densah (D) advanced platelet rich fibrin (E) A-PRF inserted into osteotomy site (F) implant insertion (G) Measuring primary stability using Osstel (H) suture.

Figure (3): For control group (A) preoperative clinical view (B) incision and flap reflection (C) osteotomy site using densah (D) implant insertion (E) Measuring primary stability using Osstel (F) suture.

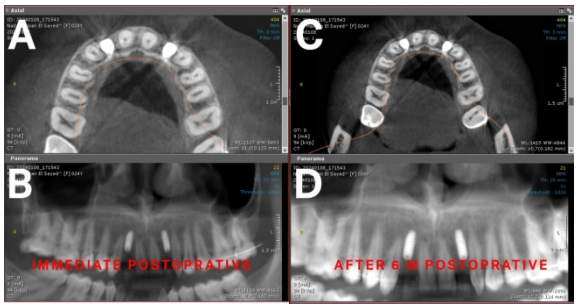

Figure (4): Postoperative CBCT for study and control group. Immediate -postoperative (A) axial cut (B) panoramic view. After 6 months (C) axial cut (D) panoramic view.

Statistical analysis

The computer received data through (IBM ***SPSS software package version 24.0).***

Numbers and percentages were used to describe the qualitative data. The Chi-square test was used to compare the category variables between the groups.

Quantitative data were described using mean and standard deviation for data that normally distributed.

For normally distributed data, to compare between two independent population independent t-test were used.

The results of significance tests are expressed as two-tailed probability. The results were deemed significant at the 5% level.

RESULTS

Demographic Data

Males to female's ratio in two studied groups were the same 2(20%) to 8(80%) respectively. Age in group I ranged from 25-40 years with mean value 32.1±5.95 and in group II ranged from 26-39 years 32.9±4.18.

Clinical results

Pain

There was no statistically significant difference between both groups regarding to pain. Both groups had moderate pain at first day which decreased to become mild pain at third day. By the seventh day pain disappeared in both groups. It was found that there was no significant difference between the two studied groups regarding visual analogue scale after 1, 3 and 7 days post operative (p >0.05).

Edema

there was no significant difference between the two studied groups regarding incidence of edema after 1, 3, 7 and 14 days post operative (p >0.05),

Primary and Secondary Stability at 6 months (Table 1)

There was statistical increase in group I than group II regarding stability immediate and after 6 month (P< 0.05).

Radiographic results

Bone density (Table 2)

Showed that bone density after 6 months in group I ranged from 1388.1-2001.8 with mean value 1574.29±188.52 and in group II ranged from 1203.2-1810.2 with mean value 1338.6±176.6.

There was statistically significant increase in group I than group II regarding bone density after 6 month (P< 0.05) while there was no significant difference regarding bone density immediate (P> 0.05).

Crestal bone level (Table 3)

There was no significant difference between the two groups regarding the crestal bone level immediately post-operatively; the mean crestal bone level in group I was 1.26±0.56 immediately post-operatively, while in group II it was 1.12±0.45. This was demonstrated by radiographic evaluation of the crestal bone level both immediately post-operatively and six months later.

After 6 months the crystal bone level in group I was 1.31±0.50 and in group II was 1.14±0.43, no significant difference between the two groups regarding crystal bone level after 6 months.

On comparing the crystal bone level in group I and II after 6 months post-operative with immediate post-operative it was found that there was no significant difference

Table (1): Comparison between the two studied groups regarding primary and secondary stability immediate and after 6 months.

	Group I	Group II	T test P 1
Primary stability Range Mean±SD	65-78 71.6±4.60	41-51 46.0±3.86	5.11 0.001*
Secondary stability Range Mean±SD	71-84 79.3±4.40	44-57 50.2±3.88	4.85 0.001*
t-test P2	2.05 0.026*	1.98 0.045*	

P1 comparison between the two studied groups at the same time

P2 comparison between immediate and after 6 months in the same group.

T= student t-test

P was significant if ≤ 0.05

* Significant difference

Table (2): Comparison between the two studied groups regarding bone density immediate and after 6 months.

	Group I	Group II	T test P value
Bone Density Immediate Range Mean SD	1050.6-1710.2 1278.24±192.58	1150.3-1710.2 1263.8±167.3	0.944 0.430 N.S.
Bone Density After 6 m Range Mean SD	1388.1-2001.8 1574.29±188.52	1203.2-1810.2 1338.6±176.6	3.12 0.005*
t-test P2	2.45 0.013*	2.11 0.018*	

P1 comparison between the two studied groups at the same time

P2 comparison between immediate and after 6 months in the same group.
T= student t-test
P was significant if ≤ 0.05
** Significant difference*

Table (3): Radiographic evaluation of crestal bone level immediate post-operative and after 6 months in the two groups.

Crystal bone level	Group I	Group II	T1 test P1 value
Immediate Post operative			
Range	0.02-2.33	0.16-2.35	1.62
Mean±SD	1.26±0.56	1.12±0.45	0.089 N.S.
After 6 m post-operative			
Range	0.23-2.14	0.17-2.29	1.55
Mean±SD	1.31±0.50	1.14±0.43	0.097 N.S.
T2	0.98	0.41	
P2	0.38 N.S.	0.825 N.S.	

T= student t-test
P was significant if ≤ 0.05
N.S. = Not significant
T1 comparison between group I and II at the same time
T2 comparison between immediate post operative and after 6 months post operative in the same group.

DISCUSSION

The osseodensification technique has specially designed drills known as densah burs that work in an anticlockwise direction to condense bone and enhance primary stability. Drills are cone-shaped, each having at least four cutting grooves at negative tilts. Through this technique, bone preservation is achieved through autografting and compacting fine bony particles against the socket bed walls (11).

Platelet-rich fibrin, an autogenous graft material, is frequently utilised as a solitary filler or in conjunction with other bone substitutes to induce bone development in oral surgical treatments. The PRF is easy, quick, and affordable to prepare, and it doesn't require an anticoagulant. This substance promotes neoangiogenesis and maintains hemostasis. It also provides leukocytes and growth factors that aid in maturation and healing (24).

According to Bergamo et al. (17), the repaired bone location should have at least 4 months to heal after extraction, with a minimum ridge width of equal to or more than 6mm. Because of this, the current study's ridge thickness was 6 mm, which allowed for a successfully placed implant by using osseodensification technique

According to our finding, there was no significant difference between the control and studied group regarding pain and edema. This study conducted with Gulsen et al. (25) that examined the impact of PRF treatment on edema and pain following surgery to remove the mandibular third molars. The postoperative pain and edema with and without PRF following surgery were expected to be identical, according to the null hypothesis. Even while dental implant insertion and tooth extraction appear to be different from one another, they both involve stressing the mucosa and alveolar tissues, which results in similar inflammatory pain processes. Patients in this trial suffering from mild pain due to atraumatic procedure using densah burs with copious saline irrigation, placing A-PRF in study group and the time of operation was short so pain and edema was reduced to minimal.

There was no dehiscence or infection in both groups in our study but the study group using A-PRF showing faster healing. As described by Pan et al., (26) follow-up intervals following surgery, all patients in the study showed excellent wound healing over time with no signs of tissue dehiscence, infection, or inflammation. As platelets and leucocytes are interconnected within the three-dimensional fibrin network that makes up PRF. Over the course of seven to fourteen days, numerous growth factors and cytokines, including insulin-like growth factor, transforming growth factor, vascular endothelial growth factor, and platelet-derived growth factor, were gradually released and also Due to the stimulation of multiple biological processes, including chemotaxis, angiogenesis, proliferation, differentiation, and regulation these characteristics of PRF have the tendency to expedite soft-tissue repair.

In this study the ISQ values were evaluated twice. First, immediately after implant insertion to check the primary implant stability and second after 6 months to assess secondary stability in which the value increased in group I than group II which indicated a well oseointegrated implants so, there was statistical increase in group I than group II regarding stability immediate and after 6 months. Furthermore, the compacted autografting provides support for these findings and addition of advanced platelet rich fibrin acting locally and promoting new bone formation around the implant so, improving osseointegration as described by Diana et al. (24), Öncü and Alaaddinoglu (27) reported that twenty patients were studied, and two conventional implants were given to each patient; one implant was coated with PRF, while the other acted as a control. As indicated by better ISQ values at 4 weeks of healing, the use of PRF improved implant stability.

Deshwai et al. (28) stated that using of autogenous platelet rich fibrin following osteotomy via osseodensification technique improved bone density and healing process due to autografting of bone matrix. Because the study group's bone density was higher than that of the control group after six months owing to the osseous regeneration of A-PRF, group I had a statistically significant increase in bone density after six months compared to group II, but there was no statistically significant difference in bone density immediately.

There was an increase in bone density in relation to mean values in agreement with Kalash et al. (29) that showed increased in bone density according to CT scan due to the various growth factors present in A-PRF and also other finding showed the effect of PRF on improving bone quality and speed up of the process of healing as described by Ozdemir et al. (30). In contrary to this trial Hauser and associates (31) used microcomputed tomography to compare the general bone density, the results indicated that there was no statistically significant difference between the study group and the control group. Another study using a dental CT scan, Das and colleagues (32) compared PRF with beta‑tricalcium phosphate and discovered a substantial increase in bone density following surgery at the coronal, middle, and apical one-thirds of the socket showed greater bone density in the PRF group when compared to the b-TCP control group.

There were no significant differences between groups I and II regarding crestal bone levels at 6 months following surgery compared to the immediate postoperative period. On the other hand, according to Boora et al. (33) statistically significant changes in the crestal bone level were observed within three months in both groups.

This study recommended that using osseodensification technique is an easy and available method for placing implants in anterior maxilla with addition of advanced platelet rich fibrin has a beneficial impact on improving bone density and osseointegration of dental implant which accelerate healing process so, this technique can be considered a secure approach to use in such situation.

CONCLUSION

We concluded that osseodensification with advanced platelet rich fibrin in anterior maxilla was a safe and efficient method that improved wound healing, enhanced bone density surrounding the implant and increased the implant stability. The Osseodensification technique seems to be a promising treatment approach for implant in the esthetic zone

CONFLICT OF INTEREST

The authors did not receive any particular funding for this work.

FUNDING

No dedicated funding was obtained for this work.

REFERENCES

1. Esposito M, Grusovin MG, Chew YS, Coulthard P, Worthington HV. Interventions for replacing missing teeth: 1- versus 2-stage implant placement. Cochrane Database Syst Rev. 2009; CD006698.
2. Paolantoni G, Cioffi A, Mignogna J, Riccitiello F, Sammartino G. “M” flap design for promoting implant esthetics: technique and cases series. Management. 2013;1:29-35.
3. Lakshmaiahenkatesh PM, Suryaprakash MS, Varadan KB, Rajanna S. Pre prosthetic reconstruction of alveolar ridge. J Int Clin Dent Res Organ. 2011;3:78-83.
4. Frost HM. A 2003 update of bone physiology and Wolff's Law for clinicians. Angle Orthod. 2004;74:3-15.
5. Sezin M, Croharé L, Ibañez JC. Microscopic Study of Surface Microtopographic Characteristics of Dental Implants. Open Dent J. 2016;10:139-47.
6. Meyer EG, Huwais S. Osseodensification is a novel implant preparation technique that increases implant primary stability by compaction and auto-grafting bone. San Francisco, CA: American Academy of Periodontology; 2014.
7. Trisi P, De Benedittis S, Perfetti G, Berardi D. Primary stability, insertion torque and bone density of cylindric implant ad modum Branemark: is there a relationship? An in vitro study. Clin Oral Implants Res. 2011;22:567-70.
8. 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;20:45-51.
9. Rocchietta I, Fontana F, Simion M. Clinical outcomes of vertical bone augmentation to enable dental implant placement: a systematic review. J Clin Periodontol 2008;35:203-15.
10. McAllister BS, Haghighat K. Bone augmentation techniques. J Periodontol 2007; 78:377-96.
11. Huwais S, Meyer EG. A Novel Osseous Densification Approach in Implant Osteotomy Preparation to Increase Biomechanical Primary Stability, Bone Mineral Density, and Bone-to-Implant Contact. Int J Oral Maxillofac Implants. 2017;32:27-36.
12. Huwais S. Fluted osteotome and surgical method for use. US2013/0004918. US Patent Application. 2013.
13. Verma UP, Yadav RK, Dixit M, Gupta A. Platelet-rich Fibrin: A Paradigm in Periodontal Therapy - A Systematic Review. J Int Soc Prev Community Dent. 2017;7:227-33.
14. Ghanaati S, Booms P, Orlowska A, Kubesch A, Lorenz J, Rutkowski J, et al. Advanced platelet-rich fibrin: a new concept for cell-based tissue engineering by means of inflammatory cells. J Oral Implantol. 2014;40:679-89.

15. Fujioka-Kobayashi M, Miron RJ, Hernandez M, Kandalam U, Zhang Y, Choukroun J. Optimized platelet-rich fibrin with the low-speed concept: growth factor release, biocompatibility, and cellular response. J Periodontol. 2017;88:112-21.
16. Random sequence generator. 1981. Available at: http://www.random .org/sequences/
17. Bergamo ETP, Zahoui A, Barrera RB, Huwais S, Coelho PG, Karateew ED, et al. Osseodensification effect on implants primary and secondary stability: Multicenter controlled clinical trial. Clin Implant Dent Relat Res. 2021;23:317-28.
18. Ducommun J, El Kholy K, Rahman L, Schimmel M, Chappuis V, Buser D. Analysis of trends in implant therapy at a surgical specialty clinic: Patient pool, indications, surgical procedures, and rate of early failures-A 15-year retrospective analysis. Clin Oral Implants Res. 2019;30:1097-106.
19. Padhye NM, Padhye AM, Bhatavadekar NB. Osseodensification—A systematic review and qualitative analysis of published literature. Journal of oral biology and craniofacial research. 2020 Jan 1;10(1):375-80.
20. Herrero-Climent M, Santos-García R, Jaramillo-Santos R, Romero-Ruiz MM, Fernández-Palacin A, Lázaro-Calvo P, Bullón P, Ríos-Santos JV. Assessment of Osstell ISQ's reliability for implant stability measurement: a cross-sectional clinical study. Med Oral Patol Oral Cir Bucal. 2013;18:e877-82.
21. Johnson C. Measuring Pain. Visual analog scale versus numeric pain scale: What is the difference? J Chiropr Med. 2005;4:43-4.
22. Malanga GA, Mautner K. Musculoskeletal Physical Examination: An Evidence-Based Approach. New Jersey: Elsevier Health Sciences; 2016.
23. Politis C, Schoenaers J, Jacobs R, Agbaje JO. Wound healing problems in the mouth. Front Physiol. 2016;7:507.
24. Diana C, Mohanty S, Chaudhary Z, Kumari S, Dabas J, Bodh R. Does platelet-rich fibrin have a role in osseointegration of immediate implants? A randomized, single-blind, controlled clinical trial. Int J Oral Maxillofac Surg. 2018;47:1178-88.
25. Gülşen U, Şentürk MF. Effect of platelet rich fibrin on edema and pain following third molar surgery: a split mouth control study. BMC Oral Health. 2017;17:79.
26. Pan J, Xu Q, Hou J, Wu Y, Liu Y, Li R, et al. Effect of platelet-rich fibrin on alveolar ridge preservation: A systematic review. J Am Dent Assoc. 2019;150:766-78.
27. Öncü E, Alaaddinoğlu EE. The effect of platelet-rich fibrin on implant stability. Int J Oral Maxillofac Implants. 2015;30:578-82.
28. Deshwal R, Salaria SK, Dahiya R, Deshwal N. Socket-shield technique with minimally invasive osteotomy preparation as well as simultaneous sinus lift utilizing Densah Bur and platelet-rich fibrin membrane followed by immediate implant placement in a symptomatic posterior endodontically treated decayed root stumps site: A case report with 1-year follow-up. J Indian Soc Periodontol. 2022;26:507-11.
29. Kalash S, Aboelsaad N, Shokry M, Choukroun J. The efficiency of using advanced PRF-xenograft mixture around immediate implants in the esthetic zone: a randomized controlled clinical trial. J Osseointegration. 2017;9:317-22.
30. Ozdemir H, Ezirganli S, Isa Kara M, Mihmanli A, Baris E. Effects of platelet rich fibrin alone used with rigid titanium barrier. Arch Oral Biol. 2013;58:537-44.
31. Hauser F, Gaydarov N, Badoud I, Vazquez L, Bernard JP, Ammann P. Clinical and histological evaluation of postextraction platelet-rich fibrin socket filling: a prospective randomized controlled study. Implant Dent. 2013;22:295-303.
32. Das S, Jhingran R, Bains VK, Madan R, Srivastava R, Rizvi I. Socket preservation by beta-tri-calcium phosphate with collagen compared to platelet-rich fibrin: A clinico-radiographic study. Eur J Dent. 2016;10:264-76.
33. Boora P, Rathee M, Bhoria M. Effect of Platelet Rich Fibrin (PRF) on Peri-implant Soft Tissue and Crestal Bone in One-Stage Implant Placement: A Randomized Controlled Trial. J Clin Diagn Res. 2015;9:ZC18-21.