ISSN: 2581-5989
PubMed - National Library of Medicine - ID: 101738774

International Journal of Dental Science and Innovative Research (IJDSIR)

IJDSIR : Dental Publication Service

Available Online at:www.ijdsir.com

Volume – 7, Issue – 6, December – 2024, Page No. : 101 - 106

Osseodensification in Dentistry

[1]Dr. Jincy Thomas, MDS Student, Department of Prosthodontics and Implantology, Meenakshi Ammal Dental College, Chennai

[2]Dr. Krithika A, MDS, Assistant Professor, Department of Prosthodontics and Implantology, Meenakshi Ammal Dental College, Chennai

[3]Dr. Shyam Sundar S, MDS, Associate Professor, Department of Prosthodontics and Implantology, Meenakshi Ammal Dental College, Chennai

[4]Dr. H. Annapoorni, MDS, PhD, HOD, Professor, Department of Prosthodontics and Implantology, Meenakshi Ammal Dental College, Chennai

Corresponding Author: Dr. Krithika A, MDS, Assistant Professor, Department of Prosthodontics and Implantology, Meenakshi Ammal Dental College, Chennai

Citation of this Article: Dr. Jincy Thomas, Dr. Krithika A, Dr. Shyam Sundar S, Dr. H. Annapoorni, "Osseodensification in Dentistry", IJDSIR- December – 2024, Volume –7, Issue - 6, P. No. 101 – 106.

Type of Publication: Review Article

Conflicts of Interest: Nil

Abstract

Osseodensification is an innovative technique in dentistry that enhances bone density and implant stability during implant placement. Unlike conventional drilling methods, which remove bone, osseodensification compacts and preserves bone around the implant site, promoting better primary stability and faster osseointegration. This review explores the principles and mechanics of osseodensification, its advantages over traditional techniques, and its impact on clinical outcomes. We also discuss its applications in various dental procedures, such as implantology, ridge expansion, and sinus augmentation. By examining recent studies and clinical data, this article aims to provide a comprehensive overview of osseodensification's role in modern dentistry and its potential for improving patient outcomes in implant-based treatments. Further research is recommended to validate long-term success rates and expand its applications across diverse clinical scenarios.

Keywords: Osseodensification, Dental implants, Implant stability, Bone compaction, Osseointegration, Ridge expansion, Bone density, Implantology, Surgical techniques in dentistry

Introduction

In today's appearance-driven society, maintaining healthy and long-lasting teeth is essential for a confident smile and overall well-being.[18] Tooth loss, caused by factors such as trauma, decay, or periodontal disease, not only affects esthetics but also impacts both oral and general health. The field of prosthodontics has advanced

significantly, offering a range of restorative materials, techniques, and strategies to manage tooth loss effectively.[19] Modern dentistry focuses on restoring oral health while ensuring that the solutions are both functional and aesthetically pleasing. These advancements now allow both partially and completely edentulous patients to regain their natural function and self-confidence.[20]

One of the most effective solutions for tooth replacement is the dental implant, which has emerged as a reliable treatment option over the past few decades. Dental implants are now widely used across various dental disciplines, from full-arch restorations to single-tooth crowns. Their increasing popularity is due to their ability to restore both the function and appearance of natural teeth.[4]

The success of dental implants, however, largely depends on their integration with the alveolar bone, a process known as osseointegration. Pioneered by Per-Ingvar Brånemark, osseointegration revolutionized implantology by establishing a stable connection between the bone and the implant surface, which is crucial for the long-term success of dental implants.[27]

An important factor influencing the success of osseointegration is bone density. Carl Misch's bone density classification system is widely used to evaluate the quality of bone at the implant site. It ranges from D1, representing dense compact bone, to D5, which refers to non-mineralized immature bone. Higher bone density is associated with better primary stability of implants, which is vital for successful osseointegration. Therefore, any technique that enhances bone density at the implant site is considered critical for ensuring the stability and longevity of the implant.[23]

Traditional implant site preparation involves the use of end-cutting metal drills, which remove bone to create space for the implant. While effective, these methods come with the drawback of bone loss, which can compromise implant stability. Additionally, traditional techniques may increase surgical trauma, prolong healing times, and raise the risk of complications such as bone fractures or damage to surrounding tissues.[4]

To address these challenges, Dr. Salah Huwais introduced a novel technique in 2013 called osseodensification. This method, which uses motor-driven bone expanders, compacts and preserves the existing bone at the implant site instead of removing it. By increasing peri-implant bone density and preserving autologous bone, osseodensification enhances primary implant stability and promotes faster osseointegration. This technique is particularly advantageous in cases of low bone density, such as Type IV bone in the posterior maxilla, narrow bone crests, sub-antral bone grafts, and immediate post-extraction implants.[23]

This review aims to explore the principles, mechanisms, tools, and protocols involved in osseodensification, while also addressing the challenges and limitations of the technique. It seeks to provide a comprehensive understanding of how osseodensification influences implant stability, osseointegration, and overall treatment outcomes.

Discussion

Historical Background of Osseodensification

The origins of osseointegration research can be traced back to Lund and Goteborg universities in the 1950s, where early studies using rabbit fibula bone marrow laid the foundation for the discovery of osseointegration. Brånemark's studies in the 1960s highlighted the reaction of bone tissue to titanium chambers, paving the way for the integration of bone with dental implants. Until the 1970s, histological evidence supporting osseointegration was scarce, but the works of Schroeder

and Cameron helped establish the critical role of restricted movement between the implant and the bone for successful bone growth on biocompatible materials.[4]

In 1994, Summers introduced the osteotome technique, which sought to overcome the limitations of traditional drilling methods for implant site preparation. The osteotome technique involved using cylindrical instruments to compact and expand the edentulous ridge without removing additional bone.[3] Although this technique was beneficial, it had significant drawbacks, including surgical trauma, patient vertigo, and potential bone fractures. Furthermore, the increased bone density was observed only in the periapical area, and micro-fractures in the trabeculae were often noted in histological studies.[17]

To address these issues, Fabio Mazzocco introduced threaded expanders in 2011, which allowed for ridge expansion without the use of a surgical mallet. These expanders enabled precise control over pressure during bone preparation, reducing surgical trauma and providing better control during ridge expansion.[24]

Figure 1: Threaded expanders introduced in 2011[24]

In 2018, Huwais introduced the concept of osseodensification, a biomechanical bone preparation technique that utilizes specially designed burs known as Densah burs. This technique marked a significant leap forward in implantology, as it allowed for the preservation and compaction of bone without removing the bone matrix, thus increasing bone density and improving implant stability.[3] Osseodensification uses the viscoelastic properties of bone to enhance both implant stability and osseointegration, making it suitable for a variety of clinical scenarios, including low-density bone cases, narrow bone crests, and immediate post-extraction implants.[17]

Principles of Osseodensification

Osseodensification is a bone preparation technique that relies on specially designed burs to preserve and compact bone during drilling. Unlike traditional drilling methods, which remove bone, osseodensification compacts bone outwardly, thereby enhancing bone density around the implant site. This technique can lead to improved implant stability, both immediately after placement and during the healing process.

One of the key principles of osseodensification is **compaction autografting**, where autogenous bone fragments are preserved and pushed laterally and apically within the osteotomy. This compacted bone increases mechanical primary stability and provides a better environment for new bone formation, leading to enhanced stability during the early healing stages. Additionally, this technique can reduce the need for guided bone regeneration (GBR) procedures, as it enables bone width expansion while preserving the natural bone matrix.[9]

Techniques and Procedures

The osseodensification technique involves the use of Densah burs, which are rotated in a non-cutting, reverse direction while maintaining constant irrigation.[28] This motion compacts bone and creates a dense, compacted layer of bone tissue along the osteotomy walls and base. The burs' design combines the advantages of osteotomes

with the precision and speed of modern drills, offering an efficient and minimally invasive method for implant site preparation.[30]

Figure 2: Presentation of the Densah Bur Kit.[49]

Densah burs are used in a **bouncing motion**, which, combined with saline irrigation, enhances bone plasticity and facilitates bone expansion. This technique allows for better control during the surgical procedure and ensures that the bone is compacted rather than excavated, leading to higher bone density and improved implant stability. Clinicians are advised to use these burs at 800–1500 rpm with torque settings ranging from 5–50 Ncm. Additionally, the burs should be replaced after 12–20 osteotomies to ensure optimal performance and avoid heat generation, which could damage the surrounding bone.[31]

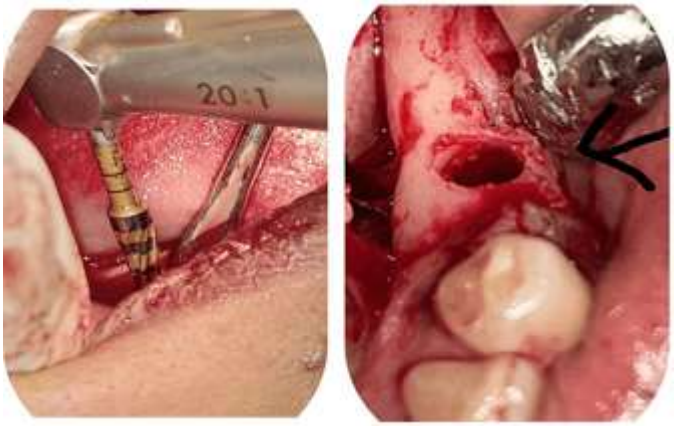

Figure 3: Expanded osteotomy site in narrow alveolar ridge using Densah burs.[45]

Healing Process after Osseodensification

The healing process following osseodensification shows a distinct pattern, particularly in the cortical walls near the implant site. Bone in these regions exhibits a granular appearance, with osteoid tissue bands, osteons, and newly formed bone trabeculae. The compacted bone fragments act as nucleation sites, promoting new bone formation around the implant. This leads to increased bone density in the most coronal region of the implant and more rapid healing compared to traditional methods. The process focuses more on bone apposition and density enhancement rather than resorption, further promoting long-term stability.[21]

Comparison with Traditional Implant Site Preparation

Traditional implant site preparation methods involve the removal of bone tissue, which can compromise primary stability, especially in low-density bone.[34] These methods often lead to elongated or elliptical osteotomies, which reduce the torque during implant placement and increase the risk of implant failure. Additionally, poorly prepared osteotomies may lead to complications such as buccal or lingual dehiscence, requiring additional bone grafting and prolonging the healing time.[36]

Figure 4: Clinical images of the worst defects in the buccal aspect of groups Conventional drilling (left) and Osseodensification (right).[37]

In contrast, osseodensification not only preserves bone but also increases the bone volume available at the implant site. This technique creates a compacted layer of bone around the implant, which enhances primary stability and reduces the risk of complications. Studies have shown that osseodensification reduces buccal and lingual bone defects and increases buccal ridge thickness compared to traditional drilling methods.[37]

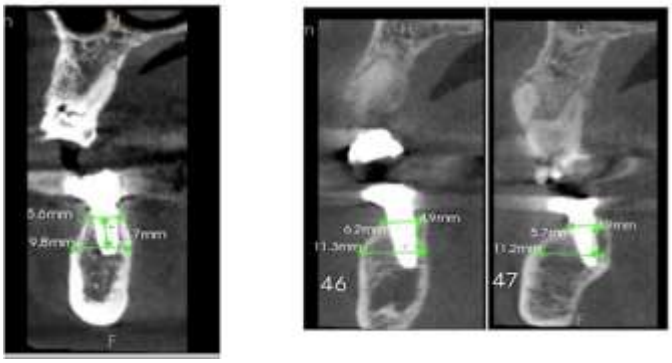

Figure 5: Six-month postoperative cone-beam computed tomography to evaluate alveolar ridge expansion.[45]

Clinical Applications

Osseodensification is particularly useful in cases with narrow ridges and low bone density. It allows for lateral and vertical bone expansion, facilitating the placement of larger implants and reducing the need for additional bone grafting procedures. This technique has been shown to improve implant stability in challenging cases, such as those involving compromised bone anatomy or immediate post-extraction implants.[1]

Indications for osseodensification:

- For narrow ridges (<3mm), it aids lateral expansion.
- In maxillary sinus autografting, it aids vertical expansion.[30]

Contra-indications for osseodensification:

- OD is ineffective with cortical bone due to its non-dynamic nature and lack of plasticity.
- Avoid densifying xenografts; they differ biomechanically from bone tissue.
- Xenografts consist only of inorganic content, providing bulk without viscoelasticity.[1]

Advantages of osseodensification

- Compaction autografting/condensation:
- Uses undersized implant site preparation and osteotomes to condense bone.
- Aims to increase primary implant stability and bone-implant contact (BIC) percentage in low-density bone.
- Maintains bone bulk through condensation, resulting in higher BIC.
- Enhances bone density
- In vitro testing shows densah burs preserve and condense bone during osteotomy preparation.
- Increases peri-implant bone density (BV %) and implant mechanical stability[31]

Conclusion

Osseodensification represents a significant advancement in dental implantology, offering a minimally invasive technique that preserves and compacts bone while improving implant stability and osseointegration. By utilizing the viscoelastic properties of bone, osseodensification enhances both the primary and long-term stability of dental implants. This technique not only reduces the need for invasive procedures such as bone grafting but also accelerates the healing process, providing better outcomes for patients. As more research continues to validate its benefits, osseodensification is likely to become a standard practice in implant dentistry.

References

1. Al-Omiri MK, Karasneh JA, Lynch E, Lamey PJ, Clifford TJ. Impacts of missing upper anterior teeth on daily living. International dental journal. 2009 Jun 1;59(3):127-32. (18)
2. Al-Johany S, Al Zoman HA, Al Juhaini M, Al Refeai M. Dental patients' awareness and

knowledge in using dental implants as an option in replacing missing teeth: A survey in Riyadh, Saudi Arabia. The Saudi dental journal. 2010 Oct 1;22(4):183-8. (20)

3. Pandey C, Rokaya D, Bhattarai BP. Contemporary concepts in osseointegration of dental implants: a review. BioMed research international. 2022 Jun 14;2022. (4)
4. Misch C. E., Contemporary Implant Dentistry, Second Edition. St. Louis, Mosby Year book, Inc., 1999; (27)
5. United States Patent (10) Patent No.: US 9,022,783 B2 (23)
6. Huwais (45) Date of Patent: May 5, 2015 (24)
7. Fontes Pereira J, Costa R, Nunes Vasques M, Salazar F, Mendes JM, Infante da Câmara M. Osseodensification: An Alternative to Conventional Osteotomy in Implant Site Preparation: A Systematic Review. Journal of Clinical Medicine. 2023 Nov 11;12(22):7046. (3)
8. Koutouzis T, Huwais S, Hasan F, Trahan W, Waldrop T, Neiva R. Alveolar ridge expansion by osseodensification-mediated plastic deformation and compaction autografting: a multicenter retrospective study. Implant dentistry. 2019 Aug 1;28(4):349-55. (9)
9. Huwais S. Autografting Osteotome. WO2014/077920. Geneva, Switzerland: World Intellectual Property Organization Publication; 2014 (28)
10. 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. (30)
11. Huwais S. Enhancing implant stability with osseodensification. A two year follow up Implant Practice 2015, vol.8 (1), 28-34. (31)
12. Trisi P, Berardini M, Falco A, Vulpiani MP. New Osseodensification Implant Site Preparation Method to Increase Bone Density in Low-Density Bone: In Vivo: Evaluation in Sheep. Implant dentistry. 2016 Feb 1;25(1):24-31. (21)
13. Alghamdi H, Anand PS, 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 Dec 1;69(12):e506-12. (34)
14. Lahens B, Neiva R, Tovar N, Alifarag AM, Jimbo R, Bonfante EA, Bowers MM, Cuppini M, Freitas H, Witek L, Coelho PG. 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 Oct 1;63:56-65. (36)
15. Frizzera F, Spin-Neto R, Padilha V, Nicchio N, Ghiraldini B, Bezerra F, Marcantonio Jr E. Effect of osseodensification on the increase in ridge thickness and the prevention of buccal peri-implant defects: an in vitro randomized split mouth pilot study. BMC Oral Health. 2022 Jun 13;22(1):233. (37)
16. Kanathila H, Pangi A. An Insight into the Concept of Osseodensification-Enhancing the Implant Stability and Success. Journal of Clinical & Diagnostic Research. 2018 Jul 1;12(7). (1)