International Journal of Nutrology
(Official Journal of the ABRAN - Brazilian Association of Nutrology)

REVIEW ARTICLE

DOI: 10.54448/ijn25208

Nutrological importance in bone loss recovery for the efficiency of dental implant process: a systematic review

Guilherme Augusto Lima Garcia[1*]

[1] Oral Unic Implants Paulínia. Avenue José Paulino, 1821, Jardim de Itapoan, Sao Paulo, Brazil.

*Corresponding author: Guilherme Augusto Lima Garcia.
Oral Unic Implants Paulínia. Avenue José Paulino, 1821,
Jardim de Itapoan, Sao Paulo, Brazil.
E-mail: drguilhermelima05@outlook.com
DOI: https://doi.org/10.54448/ijn25208
Received: 01-22-2025; Revised: 03-28-2025; Accepted: 04-16-2025; Published: 04-18-2025; IJN-id: e25208

Editor: Dr. Thodur Madapusi Balaji, MDS, Ph.D., GCSRT.

Abstract

Introduction: The global dental implant market generated approximately 13 billion dollars in 2023, with an annual growth of 6%. It is prioritized that the nutritional status significantly influences the osseointegration process. **Objective:** It was to conduct a systematic review to discuss the nutritional importance of optimizing the dental implant osseointegration process. **Methods:** The PRISMA Platform systematic review rules were followed. The search was carried out from November 2024 to January 2025 in the Scopus, PubMed, Science Direct, Scielo, and Google Scholar databases. The quality of the studies was based on the GRADE instrument and the risk of bias was analyzed according to the Cochrane instrument. **Results and Conclusion:** 123 articles were found, 25 articles were evaluated in full and 22 were included and developed in the present systematic review study. Considering the Cochrane tool for risk of bias, the overall assessment resulted in 27 studies with a high risk of bias and 32 studies that did not meet GRADE. Most studies did not show homogeneity in their results, with X^2=81.2%>50%. It was concluded that a specific dietary regimen and micronutrients may play a key role in the different phases of dental implant osseointegration. Some micronutrient deficiencies increase oxidative stress and inflammation, in addition to affecting collagen structure and bone mineralization. However, data are lacking for many micronutrients that may modulate bone metabolism. There is evidence for the role of vitamin D as well as vitamin C supplementation in facilitating the success of dental implant surgery.

Keywords: Dental implants. Bone loss. Osseointegration. Nutrients. Nutrology.

Introduction

The global dental implant market generated approximately 13 billion dollars in 2023, with an annual growth of 6%. Dental Medicine besides art is a science that aims to alleviate human suffering, since its main focus of work is the entire stomatognathic system **[1,2]**. The diverse areas of this science act in an orchestrated way, in order to transform this suffering into equilibrium, within the biological and technical limits **[3]**.

In this way, it is prioritized that the nutritional status significantly influences the osseointegration process. Many micronutrients act as triggers in the osseointegration processes of dental implants, as they act on the cellular and molecular metabolic pathways of the alveolar bone, such as the healing of the socket after tooth extraction. For example, coenzyme Q10, calcium, fluorides, magnesium, potassium, vitamin B6, vitamin D, and zinc positively influence bone health. Diets rich in fat, carbohydrates, and cholesterol and reduced calcium intake have detrimental effects on the maxillary and alveolar bone **[1]**. In this context, vitamin D stands out in the context of bone consolidation and the success of dental implants, as it acts in the regulation of calcium and phosphate metabolism, promoting the differentiation and activity of osteoblasts, cells responsible for bone formation, and modulates osteoclasts that reabsorb bone tissue.

Adequate levels of vitamin D are not only essential for maintaining bone density but also accelerate the healing process in bone tissues affected by dental implant procedures **[2,3]**. Furthermore, zinc can inhibit bone resorption by inhibiting osteoclasts, as well as induce the reprogramming of senile osteogenesis and osteoclastic dialogue by modifying the exosome through intercellular communication, including microRNAs transported by exosomes **[4]**. Thus, implant dentistry is one of the branches of dental medicine that has evolved most as a result of the investigations carried out in the last fifty years. The treatment of oral rehabilitation with implants obtained a substantial evolution. At the time when the concept of osseointegration was pioneered by Branemark, the primary focus was directed toward functional rehabilitation **[5-7]**.

Over the years, patients and professionals have begun to perform implant treatments not only to restore masticatory function, but also to acquire prostheses that are aesthetically pleasing, easy to clean, and fixed. However, for the convergence of function and aesthetics to be possible, several processes are required, such as boneimplant integration, long-term implant stability, stable bone maintenance around the implant, and tissues healthy and aesthetically acceptable peri-implant moles **[6,7]**.

A physiological process of peri-implant bone remodeling was observed during numerous investigations related to osseointegration and implantology. This process is characterized macroscopically as loss of bone support around the implant, in the cervical portion, with or without osseointegration. Initially, acceptable standards and loss levels were adopted to frame the case as successful. With the development of techniques and materials, ie, increased static requirement and higher longevity expectancy, such acceptable levels have also changed **[8,9]**.

Also, peri-implant cervical remodeling or pericervical bone remodeling, also known as pericervical saucerization or simply saucerization, is present in almost all osseointegrated implants **[5-7]**. The presence of the saucerization is inexorable and does not depend on the macro and micro implant design, the surface type, the form of connection of the prosthetic abutment and implant, the trademark, and the local and general conditions of the patient. Knowledge of its biological and biomechanical mechanism is important to understand and, if possible, reduce or control this periimplant cervical bone loss, and also provide guidance when acquiring, using, and evaluating this behavior in a particular implant system. It is important to distinguish it from peri-implantitis because it is pathological, progressive, and requires treatment **[1-3]**.

Studies and comparative studies of saucerization between different implant systems and types should be viewed with care and reservations **[10]**. It is necessary to take into account the differences between the methodologies used, the differences between surgical techniques, implant forms, implant depth to the bone level, and many other factors. In the studies that intend to carefully evaluate the degree of saucerization in osseointegrated implants, all these variables should be considered in the evaluation of the results. Many theories and explanations have sought to explain the occurrence of saucerization, but find it difficult to explain one aspect or another **[11]**.

Therefore, the present study conducted a systematic review to discuss the nutritional importance of optimizing the dental implant osseointegration process.

Methods

Study Design

This study followed the international systematic review model, following the PRISMA (preferred reporting items for systematic reviews and meta-analysis) rules. Available at: http://www.prisma-statement.org/?AspxAutoDetectCookieSupport=1. It was accessed on: 01/22/2025. The AMSTAR-2 (Assessing the methodological quality of systematic reviews) methodological quality standards were also followed. Available at: https://amstar.ca/. It was accessed on: 01/22/2025.

Data sources and research strategy

The literature search process was carried out from November 2024 to January 2025 and developed based on Web of Science, Scopus, Embase, PubMed, Lilacs, Ebsco, Scielo, and Google Scholar, covering scientific articles from various periods to the present day. The descriptors (DeCS / MeSH Terms. Available on: https://decs.bvsalud.org/) were used *Dental implants. Bone loss. Osseointegration. Nutrients. Nutrology*, and using the Boolean "and" between MeSH terms and "or" between historical findings.

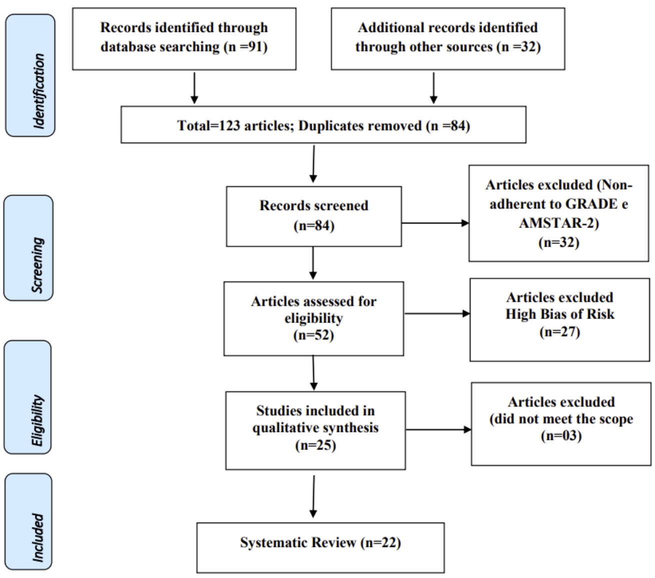
Study Quality and Bias Risk

The quality was classified as high, moderate, low, or very low regarding the risk of bias, clarity of comparisons, precision, and consistency of analyses. The most evident emphasis was on systematic review articles or meta-analysis of randomized clinical trials, followed by randomized clinical trials. Low quality of evidence was attributed to case reports, editorials, and brief communications, according to the GRADE instrument. The risk of bias was analyzed according to the Cochrane instrument by analyzing the Funnel Plot graph (Sample size versus Effect size), using Cohen's d test.

Results and Discussion

A total of 123 articles were found. Initially, duplicate articles were excluded. After this process, the abstracts were evaluated and a new exclusion was performed, removing the articles that did not include the theme of this article, resulting in 84 articles. A total of 25 articles were evaluated in full and included in this study, and 22 were developed in the systematic review item (Figure 1). Considering the Cochrane tool for risk of bias, the overall evaluation resulted in 27 studies with a high risk of bias and 32 studies that did not meet GRADE and AMSTAR-2. According to the GRADE instrument, the 22 studies that composed the systematic review presented homogeneity in their results, with X^2= 81.2% >50%, with p<0.05.

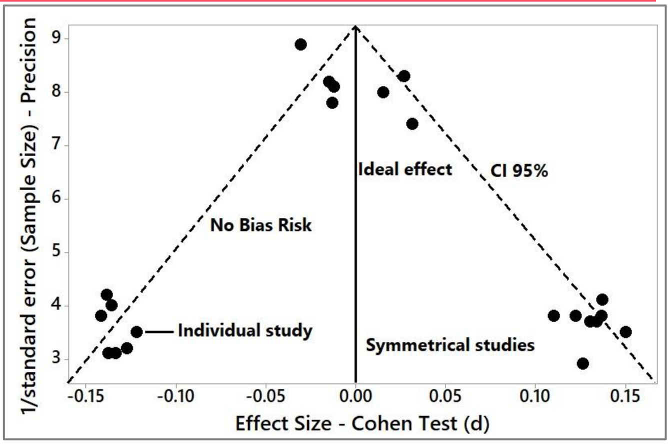
Figure 1. Study Eligibility (Systematic Review).



Source: Own Authorship.

Figure 2 presents the results of the risk of bias in the studies using the Funnel Plot, through the calculation of the Effect Size (Cohen's Test). The sample size was determined indirectly by the inverse of the standard error. The graph showed symmetric behavior, not suggesting a significant risk of bias in studies with small sample sizes, which are shown at the bottom of the graph.

Figure 2. The symmetric funnel plot does not suggest a risk of bias between the small sample size studies that are shown at the bottom of the graph. N=22 studies.



Source: Own Authorship.

Major Clinical Findings

The findings suggest that vitamins, especially A, B, E, and CoQ10, as well as combinations of vitamins, may play key roles in periodontal outcomes for improving dental implant success **[12]**. The nutritional status of patients may affect the process of dental implant osseointegration. One study analyzed dietary supplements for optimizing osseointegration after implant insertion surgery. Nineteen studies were identified on vitamin D, magnesium, resveratrol, vitamin C, a mixture of calcium, magnesium, zinc, and vitamin D, and synthetic bone mineral. Vitamin D deficiency is associated with reduced osseointegration and early implant failure **[13]**.

The authors Werny et al. (2022) **[14]** systematically reviewed the efficacy of vitamin D supplementation or depletion on implant osseointegration. The potential impact of vitamin D supplementation on implant osseointegration has been observed in individuals with diabetes mellitus, osteoporosis, and chronic kidney disease. Studies and case reports involving humans have shown that patients with low serum levels of vitamin D are more likely to experience early dental implant failure. When supplemented with vitamin D, osseointegration was successful in case reports, and a beneficial impact on bone level changes during osseointegration was determined.

In addition, significant masticatory improvements were observed in fixed dental prostheses on implants compared to conventional removable prostheses. However, bioavailability remained stable for most nutrients, especially in completely edentulous patients. These results indicate the importance of a multidisciplinary approach during oral rehabilitation (nutrient specialist) to improve dietary choices and promote health benefits for patients **[15]**. Furthermore, nutraceuticals are foods that can be useful for preventing and treating dental diseases **[16]**.

In this context of nutritional importance, it is known that osseointegrated implants were initially applied in the treatment of total edentulous patients, to reduce the negative psychological impact of the absence of dental elements [1-3]. Within this context, the purpose of the treatment was to give the patient adequate masticatory function. In the longitudinal clinical study of the follow-up of treatment with osseointegrated implants, greater bone loss was observed in the first year of prosthetic function, when compared to the mean bone loss of subsequent years. This report measured bone loss using the first implant thread as a starting point (0 mm) and not the original level of the bone crest at the time of insertion [7].

With the evolution of the technique and with the good results obtained in the use of osseointegrated implants, the clinical need for implants fell on the rehabilitation of cases of partial edentulism [8]. Some theories seek to explain the phenomenon of peri-implant bone loss. Among them, it is worth mentioning the effect of bacterial biofilm accumulation at the interface between the implant and the prosthetic abutment. This discussion promotes the scientific effort and the technological development towards the implementation of new surgical approaches and implant projects that minimize this effect, aiming at reducing the phenomenon of peri-implant marginal bone loss and its potential risk of compromising the clinical results in aesthetic regions [9].

The use of intraosseous implants is currently a treatment modality widely used in the rehabilitation of total and partial edentulous [1,2]. Obtaining a rigid fixation condition between the implant and bone around the implant site is critical. Such a condition is called osseointegration. Osseointegration was originally defined as a direct functional and structural connection between organized living bone tissue and the surface of an implant under load. Currently, it is permissible for an implant to be considered as osseointegrated when there are no relative and progressive movements between this same implant and the bone in which it is in direct contact [8]. Furthermore, it is possible to cite that in practice, in osseointegration, there is an anchoring mechanism in which non-vital components can be reliably and predictably incorporated into living bone, and from that anchorage can remain under all conditions of normal loads [9].

Osseointegration is also described as a series of remodeling phenomena and/or bone regeneration, which will result in the formation of new bone, organized around the implant installed [10]. In the same way, it is exposed that the surgical technique, even being extremely careful and rigorous, at the time of implantation, will cause bone necrosis. The tissue repair of this necrotic portion can occur in three ways: formation of fibrous tissue, formation of bone sequestration, and bone regeneration. The latter is the most desired hypothesis [11].

In order for osseointegration to occur, basic requirements are: specific cells (osteoblasts, osteocytes and osteoclasts) and adequate vascular network, as well as the presence of a stimulus of adequate frequency and intensity [17]. Factors such as volume and bone structure, bone involvement, vascular and cellular conditions should be taken into account when there is intention to osseointegration of a dental implant [18].

Osseointegration is not a process with a specific term or a final phase of the bone regeneration process attached to the implant surface. It is a dynamic process that lasts throughout the maintenance of the perimplant bone. Therefore, the longevity of the process, as well as the clinical success of implantation, will depend not only on the initial surgical steps and bone regeneration but also on other factors that may affect the implant throughout its useful life [19].

The process of osseointegration depends not only on the characteristics of the implants but also on the cellular and matrix condition of the surface of the surgical bed [2]. Other factors influence the healing of bone around the implant, such as the extent of surgical trauma and bone deformations related to functional loads [8].

The main function of the interface between the bone and the implant is to provide, effectively and safely, the transfer of the occlusal loads through the implant and from there to the bone tissue [9]. Johanson and Albrektsson, in 1987, showed that there is a direct relation between the bone degree in contact with the implant and the removal torque, which can reach a percentage of 90.0 % of direct bone contact, cortical level after one year of implantation [10].

The success of osseointegration as a biological concept depends on careful planning, meticulous surgical technique, and specialized prosthetic work, as well as being evaluated both by clinical and radiographic parameters so that it is possible to quantify perimplant osseous loss [17]. The scope of osseointegration is not restricted to dental implants, but also to maxillofacial prostheses, replacement of injured joints, and placement of artificial limbs [18].

Despite the high success rate of osseointegration, the initial failures during the regeneration process can occur, affecting it [18]. Such defects may have biological causes, such as peri-implantitis and/or systemic diseases, or biochemical factors, which may negatively influence regeneration/healing, as well as physical factors such as bone overheating during the surgical procedure, occlusal overload, shearing and compression under the perimplantar bone tissue [20-

22].

The process of osseointegration requires an adequate amount of force for normal bone repair. If there is excessive pressure, irreversible damage to peri-implant bone tissue may occur **[23,24]**. On the other hand, if there is little or no compression, an unsatisfactory stimulation may occur, compromising repair in the perimplantar bone tissue **[25]**.

Embryonic bone development is a highly regulated process and occurs in two ways: intramembranous or endochondral. During intramembranous ossification, mesenchymal progenitor cells migrate through vascularized areas rich in collagen, in which condensation occurs **[5-9]**. Several factors can influence bone loss as age, hormonal changes, drugs and inflammation **[17]**. In implantology, osteoclastic action due to local inflammation is desired, in order to reabsorb necrotic bone formed in the early stages of dental implant integration. However, bone resorption may persist due to chronic inflammation resulting from bacterial contamination or autoimmune diseases, leading to a prolonged action of osteoclasts **[18]**.

The process of bone resorption, observed on the surface of the osseointegrated bone plane, is termed saucerization **[19]**. This cervical bone resorption - observed in all types of osseointegrated implants, irrespective of their design, surface type, platform, connection, trademark, and patient conditions - takes the form of a saucer, ie, shallow and superficial. Due to this analogy, the term in English is called saucer **[1,2]**. Its velocity may be higher or lower, but its occurrence is part of the integration of the implants with the epithelium and gingival connective tissue. The knowledge of its biological mechanism is important to understand it and, if possible, reduce or control this perimplant cervical bone loss. The saucerization may also be referred to as cervical perimplantar bone remodeling **[3]**.

It has been reported the possibility of observing different reactions of perimplantar bone crest that can differ significantly, both in radiographic and histomorphic form under certain conditions. It further adds that such differences are dependent on the cervical edge implant rough/smooth in single-body implants, and dependent on the location of the micro-gap between the implant and the prosthetic component in two-piece implants **[11]**.

Several theories and explanations have been given for saucerization, however, many of them have difficulty explaining one or the other aspect **[17]**. One of these theories attributes the saucerization as being the result of occlusal masticatory loading in which the implants are submitted. However, when osseointegrated implants are out of occlusion or only with the gingival cicatrister for many months or even years, and have never entered into occlusion, they also present saucerization.

When implants remain submerged for a few months/years, the bone tissue advances toward the more cervical surface and may even cover the cover screw. This bone gain often requires osteotomy maneuvers for the placement of the healing or prosthetic intermediate **[18]**. When an epithelium is ulcerated, its cells are left with the membranes exposed to external mediators so that they interact with their receptors, as occurs in oral ulcers and surgical wounds, including perimplanar.

The epithelial growth factor of saliva, as well as that of epithelial cells, stimulates perimplantar epithelial proliferation and the formation of the perimplantar junctional epithelium begins **[7]**. The perimplantar junctional epithelium gains more layers of cells and assumes a conformation similar to the junctional epithelium of the natural teeth. This new conformation of the perimplantar junctional epithelium approximates it to the osseointegrated surface, increasing the local concentration of epithelial growth factor and, consequently, accelerating the bone resorption, beginning the saucerization. Once the perimplantar junctional epithelium and the saucerization are formed, which occurs after a few weeks or months, a stable biological space is established between the implant-integrated cervical bone and the perimplantar junctional epithelium, as occurs in natural teeth **[1]**.

The gingival tissue thickness seems to have a considerable influence on the bone loss of the alveolar ridge. When this thickness is 2 mm or less, cervical bone loss tends to be significantly greater. The thicker the gingival tissues at the time of implant placement, the greater the distance between the implant junctional epithelium to be formed and the bone tissue, that is, the epithelial growth factor molecules will arrive in a lower concentration at the bone surface **[18]**.

The success of prosthetic restoration supported by osseointegrated implants and the health of surrounding tissues, such as the reduction of bone loss, are closely related to the precision and adaptation of the components, the stability of the implant / abutment interface, as well as the resistance of this interface when is subjected to loads during the masticatory function. The mismatch between the prosthetic component and the implant platform may lead to treatment failure, mainly due to the induction of stress concentration, bacterial infiltration, and biofilm formation **[18]**.

Some theories try to explain this phenomenon, which was even described decades ago and is a current topic, contradictory, and extremely important in Oral

Implantology **[6]**. Displacement of the periosteum: In the long bones, 90.0% of the arterial blood supply and 100.0% of the venous return are performed by the periosteum. When the periosteum is displaced, blood supply at the bone level is reduced drastically, causing necrosis and non-viability of osteoprogenitor cells. Such observations support the theory of the effect of the displacement of the periosteum on bone resorption **[9]**.

The result of the periosteal displacement would be a uniform horizontal loss, rather than the usual pattern of vertical bone loss. In addition, in the second-stage surgery, this loss would be noticed, a fact not observed **[17]**. Osteotomy for implant installation: The osteotomy procedure performed for the installation of osseointegrated implants has been pointed out as one of the probable agents causing the initial perimplantar bone loss, due to the creation of a devitalized zone around the implant **[19]**.

Finally, this devitalized zone is attributed to the interruption of the blood supply and the heat generated during the osteotomy, especially in the cortical region. Following the reasoning presented in the previous example, this theory may not be directly responsible for marginal bone loss, since most implants do not present such condition under a clinical and visual inspection during reopening surgery **[1-3]**.

Limitations

Additional studies are needed to investigate the hypothesis of the influence of micronutrients and nutraceuticals on dental implant osseointegration and long-term success, as well as the opportunity for dietary integration to improve peri-implant wound healing, bone consolidation, and peri-implant tissue stability.

Conclusion

It was concluded that a specific dietary regimen and micronutrients may play a key role in the different phases of dental implant osseointegration. Some micronutrient deficiencies increase oxidative stress and inflammation, in addition to affecting collagen structure and bone mineralization. However, data are lacking for many micronutrients that may modulate bone metabolism. There is evidence for the role of vitamin D as well as vitamin C supplementation in facilitating the success of dental implant surgery.

CRediT

Author contributions **Conceptualization**; **Data curation**; **Formal Analysis; Investigation**; **Methodology**; **Project administration**; **Supervision**; **Writing - original draft and Writing-review & editing-** Guilherme Augusto Lima Garcia.

Acknowledgment

Not applicable.

Ethical Approval

Not applicable.

Informed Consent

Not applicable.

Funding

Not applicable.

Data Sharing Statement

No additional data are available.

Conflict of Interest

The authors declare no conflict of interest.

Similarity Check

It was applied by Ithenticate@.

Application of Artificial Intelligence (AI)

Not applicable.

Peer Review Process

It was performed.

References

1. Li XL, Zhao YQ, Miao L, An YX, Wu F, Han JY, Han JY, Tay FR, Mu Z, Jiao Y, Wang J. Strategies for promoting neurovascularization in bone regeneration. Mil Med Res. 2025 Mar 3;12(1):9. doi: 10.1186/s40779-025-00596-1.
2. Buzatu BLR, Buzatu R, Luca MM. Impact of Vitamin D on Osseointegration in Dental Implants: A Systematic Review of Human Studies. Nutrients. 2024 Jan 9;16(2):209. doi: 10.3390/nu16020209.
3. Thim T, Scholz KJ, Hiller KA, Buchalla W, Kirschneck C, Fleiner J, Woelber JP, Cieplik F. Radiographic Bone Loss and Its Relation to Patient-Specific Risk Factors, LDL Cholesterol, and Vitamin D: A Cross-Sectional Study. Nutrients. 2022 Feb 18;14(4):864. doi: 10.3390/nu14040864.
4. Yin S, Lin S, Xu J, Yang G, Chen H, Jiang X.

Dominoes with interlocking consequences triggered by zinc: involvement of microelement-stimulated MSC-derived exosomes in senile osteogenesis and osteoclast dialogue. J Nanobiotechnology. 2023 Sep 23;21(1):346. doi: 10.1186/s12951-023-02085-w.

5. Hooton TA, Neill BC, Rajpara A. Single Saucerization Biopsy Technique for Blistering Diseases. J Am Acad Dermatol. 2019 Jul 25. pii: S01909622(19)32449-1. doi: 10.1016/j.jaad.2019.07.059.
6. Nevins M, Capetta E, Horning C, Kerr E, Kim DM, Kirshner K, Machell JC, Marcus E, Romanos G, Silverstein S, Strauss G, Wang HL, Winston M. Osseointegration Foundation Charity Overdenture Program Study. Int J Periodontics Restorative Dent. 2020 Mar/Apr;40(2):279-283. doi: 10.11607/prd.4531.
7. Hoellwarth JS, Tetsworth K, Kendrew J, Kang NV, van Waes O, Al-Maawi Q, Roberts C, Al Muderis M.Periprosthetic osseointegration fractures are infrequent and management is familiar. Bone Joint J. 2020 Feb;102-B(2):162169. doi: 10.1302/0301-620X.102B2.BJJ-2019-0697.R2.
8. Zhang H, Komasa S, Mashimo C, Sekino T, Okazaki J. Effect of ultraviolet treatment on bacterial attachment and osteogenic activity to alkali-treated titanium with nanonetwork structures. Int J Nanomedicine. 2017 Jun 28;12:4633-4646. doi: 10.2147/IJN.S136273. eCollection 2017.
9. Albanese M, Ricciardi G, Donadello D, Lucchese A, Gelpi F, Zangani A, DE Santis D, Rizzini A, Rossetto A, Bertossi D. Alveolar splitting with piezosurgery, bone bank grafts and Nobelactive implants as an alternative to major bone grafting for maxillary reconstruction. Minerva Stomatol. 2017 Jul 4. doi: 10.23736/S0026-4970.17.04006-7.
10. Weiner S, Simon J, Ehrenberg DS, Zweig B, Ricci JL. The effects of laser microtextured collars upon crestal bone levels of dental implants. Implant Dent. 2008 Jun;17(2):217-28. doi: 10.1097/ID.0b013e3181779016.
11. Bruno F. Mello, Jefferson T. Pires, Danilo Jorge Racy, Michelini S. Trentin, Adriano Piattelli, Jamil Awad Shibli. Espaço biológico ao redor de implantes osseointegrados: uma análise fisiológica e histológica em tecido peri-implantar humano. (Int J Periodontics Restorative Dent 2016; 34:713–718.
12. Fawzy El-Sayed KM, Cosgarea R, Sculean A, Doerfer C. Can vitamins improve periodontal wound healing/regeneration? Periodontol 2000. 2024 Feb;94(1):539-602. doi: 10.1111/prd.12513.
13. Nastri L, Moretti A, Migliaccio S, Paoletta M, Annunziata M, Liguori S, Toro G, Bianco M, Cecoro G, Guida L, Iolascon G. Do Dietary Supplements and Nutraceuticals Have Effects on Dental Implant Osseointegration? A Scoping Review. Nutrients. 2020 Jan 20;12(1):268. doi: 10.3390/nu12010268.
14. Werny JG, Sagheb K, Diaz L, Kämmerer PW, Al-Nawas B, Schiegnitz E. Does vitamin D have an effect on osseointegration of dental implants? A systematic review. Int J Implant Dent. 2022 Apr 11;8(1):16. doi: 10.1186/s40729-022-00414-6.
15. Bezerra AP, Gama LT, Pereira LJ, van der Bilt A, Peyron MA, Rodrigues Garcia RCM, Gonçalves TMSV. Do implant-supported prostheses affect bioavailability of nutrients of complete and partially edentulous patients? A systematic review with meta-analysis. Clin Nutr. 2021 May;40(5):3235-3249. doi: 10.1016/j.clnu.2021.02.018.
16. Cenzato N, Khijmatgar S, Carloni P, Dongiovanni P, Meroni M, Del Fabbro M, Tartaglia GM. What is the use of nutraceuticals in dentistry? A scoping review. Eur Rev Med Pharmacol Sci. 2023 Jun;27(11):4899-4913. doi: 10.26355/eurrev_202306_32607.
17. Ferrari DS, Piattelli A, Iezzi G, Faveri M, Rodrigues JA, Shibli JA. Effect of lateral static load on immediately restored implants: histologic and radiographic evaluation in dogs. Clin Oral Implants Res 2015 Apr;26(4):e51-6.
18. Pessoa RS, Sousa RM, Pereira LM, Silva TD, Bezerra FJB, Spin-Neto R. Avaliação da estabilidade dos tecidos duros e moles em implantes imediatos com carga imediata em área estética: estudo clínico. Dental Press Implantol. 2015 Apr-Jun;9(2): 100-9.
19. Coelho PG, Jimbo R. Osseointegration of metallic devices: current trends based on implant hardware design. Archives of biochemistry and biophysics. 2014; 561: 99-108.
20. Coelho PG, Jimbo R, Tovar N, Bonfante EA. Osseointegration: hierarchical designing encompassing the macrometer, micrometer, and nanometer length scales. Dent Mater. 2015; 31(1): 37-52.
21. Bezerra F, Pessoa RS, Zambuzzi WF. Carregamento funcional imediato ou precoce de implantes com câmara de cicatrização e nano-superfície: estudo clínico prospectivo longitudinal. Innov Implant J, Biomater Esthet. 2015; 9(2/3): 13-7.

22. Sculean A, Gruber R, Bosshardt DD. Soft tissue wound healing around teeth and dental implants. J Clin Periodontol 2014. Apr; 41 Suppl 15: S6-22.

23. Camacho FMT, Sakamura CE, Munhoz MF, Esteves JC, Ribeiro FS, Pontes AEF. Avaliação clínica em curto prazo do sistema de Cone Morse e plataforma reduzida em prótese sobre implantes do tipo protocolo: estudo piloto randomizado. Ver Odontol Unesp. Araraquara SP. 2012; 41(4):247-53.

24. Consolaro A. Mecanismo da saucerização nos implantes osseointegrados. Rev Dental Press Periodontia Implantol. 2009;3(4):25-39.

25. Consolaro A., Carvalho, RS, Francischone Jr.CE, Francischone, CE. Mecanismo da saucerização nos implantes osseointegrados. Rev. Dental Press Periodont Implantol. 2010;4(1):137-54.

MetaScience Press
The Best Science

https://zotarellifilhoscientificworks.com/