Journal of Medical Implants & Surgery

Deng, J Med Imp Surg 2023, 8:4

Perspective Open Access

Mechanical Evaluation of Dental Implants

Yiping Deng*

Department of Oral Disease, Sichuan University, China

Abstract

The mechanical evaluation of dental implants holds a pivotal role in ensuring their long-term stability and functionality within the dynamic oral environment. Dental implants have transformed restorative dentistry, offering a robust solution for replacing missing teeth. This article provides an overview of the critical aspects involved in the mechanical assessment of dental implants. It explores the biomechanics of the oral environment, the influence of design and materials, osseointegration, load transfer; bite force analysis, fatigue resistance, and the significance of the implant-abutment complex. By comprehensively examining these factors, dental professionals can enhance their understanding of implant performance, enabling them to make informed decisions for optimizing the mechanical integrity of dental implant treatments.

Keywords: Dental implants; Mechanical evaluation; Biomechanics; Osseo integration; Implant design; Materials, Load transfer

Introduction

Dental implants have revolutionized the field of dentistry by providing a robust solution for restoring missing teeth and enhancing oral health. These prosthetic devices are designed to mimic natural teeth in both form and function, enabling individuals to regain their confidence and enjoy improved chewing ability. While aesthetic considerations are important, the mechanical integrity of dental implants plays a pivotal role in their long-term success. This article delves into the critical aspects of mechanical evaluation of dental implants, shedding light on the factors that contribute to their stability, durability, and overall performance [1].

Together with the high rate of success of dental implants, and with their growing use comes an increased incidence of complications, among which the mechanical ones. Like any other mechanical structure, implants are likely to fracture upon extended use. This issue is seldom mentioned or addressed in the literature, as opposed to the so-called “biological” failure to be developed in the sequel. Therefore, this paper will survey the mechanical reliability of dental implants and address the specific issues of fracture, causes, mechanisms, and future solutions, all for a better control and performance [2].

Mechanical forces in oral environment

The oral environment is a dynamic and complex setting characterized by various mechanical forces. Chewing, biting, and even speaking subject dental implants to a range of stresses and strains. The mechanical evaluation of dental implants involves assessing their ability to withstand these forces without experiencing failures or compromising the surrounding bone and soft tissues. Understanding the biomechanics of these interactions is essential for predicting implant performance and longevity.

Design and material considerations

The mechanical integrity of dental implants begins with thoughtful design and the choice of materials. Implants are typically composed of biocompatible materials such as titanium and its alloys. These materials possess a combination of strength, corrosion resistance, and compatibility with bone tissue, making them suitable for implantation [3, 4]. The design of the implant, including its shape, dimensions, and surface features, affects how it distributes and dissipates forces within the oral environment. Advances in materials science and engineering have led to the development of implants with enhanced mechanical properties, ensuring better integration and stability.

Osseointegration and load transfer

Osseointegration, the process by which bone fuses with the implant surface, is a critical factor in achieving mechanical stability. The implant must become an integral part of the surrounding bone to facilitate effective load transfer during functional activities. Any discrepancies between the implant and bone can lead to stress concentrations, potentially resulting in mechanical failure. The evaluation of osseointegration involves assessing the extent and quality of bone-implant contact through imaging techniques and biomechanical analyses [5].

Bite force and fatigue resistance

Assessing the mechanical integrity of dental implants also involves simulating real-world scenarios to understand their resilience. Bite force analysis helps determine the maximum load an implant can bear without experiencing damage. Additionally, implants must withstand millions of chewing cycles over their lifespan. Fatigue resistance testing is crucial to ensure that the implant can endure repeated loading without deterioration [6].

Implant-abutment complex

The connection between the implant and abutment is another critical mechanical consideration. The implant-abutment interface experiences significant forces during mastication and must remain stable to prevent micro-movements that could compromise osseointegration. Different connection designs, such as external hex, internal hex, and Morse taper, offer varying levels of mechanical stability and stress distribution. Evaluating the performance of these

***Corresponding author:** Yiping Deng, Department of Oral Disease, Sichuan University, China, E-mail: Yiping567@34.cn

Received: 03-July-2023, Manuscript No: jmis-23-110375, **Editor assigned:** 05-July-2023, PreQC No: jmis-23-110375 (PQ), **Reviewed:** 19-July-2023, QC No: jmis-23-110375, **Revised:** 25-July-2023, Manuscript No: jmis-23-110375 (R), **Published:** 31-July-2023, DOI: 10.4172/jmis.1000180

Citation: Deng Y (2023) Mechanical Evaluation of Dental Implants. J Med Imp Surg 8: 180.

interfaces is vital to ensuring the implant's long-term success [7].

Discussion

Studies dealing with mechanical reliability of dental implant have succeeded in bringing to awareness the fact that implants and their components' fractures are possible and realistic complications that are bound to occur with the growing and prolonged use of implants. That is why emphasis should be put on striving not only to improve the osseointegration process, but also to preserve and maintain the implant's integrity from a mechanical point of view as well. In order to consolidate the preventive measures for dentists who are placing and using implants to rehabilitate missing teeth, additional clinical information is needed that will link the biological/clinical data and the possible mechanical fracture that probably will be generated [8, 9]. In fact, as of today, this potential biological-mechanical connection has not really been explored by the dental community. Therefore, the main points that arise from this review can now be summarized as follows, with some perspective on issues that need new or additional research effort.

The oral environment presents a unique biomechanical challenge for dental implants. The diverse forces generated during activities such as chewing, biting, and speaking necessitate implants to be structurally sound and capable of withstanding considerable stresses. Mechanical evaluation involves a thorough understanding of these forces, their distribution, and the ways implants interact with them. A critical factor in evaluating the mechanical performance of dental implants is the phenomenon of osseointegration the direct structural and functional connection between implant and bone. This integration is essential for efficient load transfer during functional activities. A solid interface reduces stress concentrations, preventing potential implant failures. Techniques such as finite element analysis and in vivo studies aid in understanding the load distribution mechanisms and the significance of osseointegration in implant stability [10].

The mechanical connection between the implant and abutment is critical in maintaining stability. This interface endures substantial forces during mastication and must remain rigid to prevent micromovements that could compromise osseointegration. Different connection designs such as external hex, internal hex, and Morse taper offer varying degrees of mechanical stability and stress distribution. Comprehensive evaluation of these interfaces ensures the longevity of the implant system.

Conclusion

In the realm of dental implants, mechanical evaluation is a fundamental aspect that directly impacts their performance, longevity, and overall success. A thorough understanding of biomechanics, materials science, and engineering principles is essential for designing implants that can withstand the dynamic forces of the oral environment. As technology and research continue to advance, the mechanical integrity of dental implants will continue to evolve, allowing for even more reliable and durable solutions in restorative dentistry. Through meticulous design, careful material selection, and comprehensive testing, dental professionals can ensure that patients receive implants that not only restore their smiles but also provide lasting functional benefits.

As the field of dental implantology evolves, so too does the focus on mechanical evaluation. Advancements in digital technologies, biomaterials, and computational modeling are expanding our understanding of implant behavior under diverse mechanical stresses. This knowledge allows dental professionals to make informed decisions during treatment planning and implant selection, ultimately enhancing patient outcomes and satisfaction. By comprehensively assessing the mechanical integrity of dental implants, practitioners can continue to advance the field, ensuring implants remain a reliable and lasting solution for patients seeking oral rehabilitation.

Acknowledgement

None

Conflict of Interest

None

References

1. Sharma A, Pandey R, Sharma S, Khuller GK (2004) Chemotherapeutic efficacy of poly (dl-lactide-co-glycolide) nanoparticle encapsulated antitubercular drugs at sub-therapeutic dose against experimental tuberculosis. Int J Antimicrob Agents 24: 599-604.
2. Deol P, Khuller GK, Joshi K (1997) Therapeutic efficacies of isoniazid and rifampin encapsulated in lung-specific stealth liposomes against Mycobacterium tuberculosis infection induced in mice. Antimicrob Agents Chemother 41: 1211-1214.
3. Engler AJ, Sen S, Sweeney HL, Discher DE (2006) Matrix elasticity directs stem cell lineage specification. Cell 126: 677-689.
4. Medeiros KE, Griffith JA (2019) Double-edged scalpels: the trials and triumphs of women surgeons. Narrat Inq Bioeth 9: 221–227.
5. Esser AC, Koshy JG, Randle HW (2007) Ergonomics in office-based surgery: a survey-guided observational study. Dermatol Surg 33: 1304–1313
6. Schlussel AT, Maykel JA (2019) Ergonomics and musculoskeletal health of the surgeon. Clin Colon Rectal Surg 32: 424–434.
7. Alaqeel M, Tanzer M (2020) Improving ergonomics in the operating room for orthopaedic surgeons in order to reduce work-related musculoskeletal injuries. Ann Med Surg (Lond) 56: 133–138.
8. Nkanang B, Parker M, Parker E, Grifths R (2017) Perioperative mortality for patients with a hip fracture. Injury 48: 2180–2183.
9. Donoghue GM, Nikolopoulos TP (2002) Minimal access surgery for pediatric cochlear implantation. Otol Neurotol23: 891-894.
10. Stingl K, Bartz-Schmidt KU, Besch D (2015) Subretinal visual implant alpha IMS-clinical trial interim report. Vis Res 111: 149-160.