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Comparative Analysis of Natural Tooth Wear against Various Prosthetic Crown Materials

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Abstract

Natural tooth wear is an inevitable physiological process that occurs due to mastication, parafunctional habits, and aging. However, the introduction of prosthetic crowns in dental rehabilitation has led to concerns regarding the wear of opposing natural teeth. This review explores the comparative analysis of natural tooth wear caused by different prosthetic crown materials, emphasizing recent advancements, advantages, and future directions in this domain. The discussion highlights how the hardness, surface roughness, and material composition of crown materials impact tooth wear. Furthermore, advancements in materials science, such as the development of monolithic ceramics and hybrid materials, have significantly improved the biocompatibility and wear resistance of dental prosthetics. A future perspective focuses on the need for clinical trials and advanced in vitro testing to optimize material properties for minimal wear of natural teeth while maintaining functional efficiency.

Keywords: natural tooth wear, prosthetic crowns, ceramics, hybrid materials, wear resistance, dental rehabilitation

Introduction

The interaction between natural teeth and prosthetic materials has been a critical area of focus in restorative dentistry. Natural tooth wear is influenced by factors such as occlusal forces, diet, and parafunctional habits like bruxism. When prosthetic crowns are introduced into the oral environment, the biomechanical dynamics change, often resulting in accelerated wear of the opposing natural teeth. Prosthetic crowns are essential in restoring function, esthetics, and structural integrity to compromised teeth, but the choice of material significantly affects their interaction with the natural dentition. Materials such as metals, ceramics, and resin-based composites have been widely used in crown fabrication, each with distinct properties influencing wear. [1-5]

Metal-based crowns, including gold and base metal alloys, have long been considered the gold standard for their biocompatibility and wear characteristics. However, their esthetic limitations have led to the growing preference for ceramic and resin-based materials. Ceramics, particularly zirconia and lithium disilicate, are favored for their superior esthetics and mechanical properties, although they are often associated with increased wear of opposing teeth due to their hardness. In contrast, resin-based composites, while more forgiving in terms of opposing tooth wear, exhibit lower durability and higher susceptibility to surface degradation. The evolution of dental materials, including the advent of hybrid ceramics and nanocomposites, has aimed to address these challenges by balancing durability, esthetics, and wear resistance. Understanding the wear dynamics between natural teeth and prosthetic materials is essential for optimizing material selection and improving long-term clinical outcomes. [6-11]

Discussion

Recent advancements in material science have significantly influenced the design and performance of prosthetic crowns, leading to a deeper understanding of their interaction with natural teeth. Hardness and surface roughness are critical parameters determining the wear potential of prosthetic materials. For instance, monolithic zirconia crowns have gained popularity due to their excellent strength, fracture resistance, and esthetic properties. However, their high hardness can lead to excessive wear of opposing enamel, especially in cases of bruxism or malocclusion. To mitigate this, surface treatments such as glazing and polishing have been developed, reducing the abrasive effect of zirconia. [12-16]

Lithium disilicate ceramics, another widely used material, strike a balance between strength and esthetics. Their wear characteristics are more favorable compared to zirconia, making them suitable for anterior and posterior restorations. Meanwhile, hybrid ceramics and nanocomposites, which combine the properties of ceramics and resin, have emerged as promising alternatives. These materials offer lower hardness and superior shock absorption, reducing the risk of opposing tooth wear without compromising durability. [17-20]

One significant advancement in recent years is the development of CAD/CAM (computer-aided design and manufacturing) technologies. These technologies enable precise fabrication of crowns with controlled surface topography, minimizing irregularities that could exacerbate tooth wear. Additionally, biomimetic materials, designed to mimic the mechanical and structural properties of natural teeth, are being extensively researched. These materials aim to replicate the enamel's wear behavior while maintaining long-term durability and esthetics. [21,22]

The advantages of these advancements are multifold. Improved wear resistance and biocompatibility not only enhance the longevity of prosthetic crowns but also protect the opposing natural dentition. The aesthetic appeal of newer materials, coupled with their functional efficiency, has expanded their clinical applications.

Moreover, the introduction of materials with tunable properties has allowed for personalized dental solutions, catering to the unique needs of individual patients. [23]

Future Perspectives [24,25]

As material science continues to evolve, the future of prosthetic crown materials lies in the development of bioinspired and smart materials. These materials will integrate properties such as self-healing, wear adaptability, and antimicrobial activity, further enhancing their interaction with natural teeth. Advanced simulation models and machine learning algorithms are expected to play a pivotal role in predicting wear patterns and optimizing material selection. Furthermore, long-term clinical trials and standardized in vitro testing protocols are needed to validate the performance of new materials and establish guidelines for their use in diverse clinical scenarios.

The focus on sustainability and environmental impact in dentistry is another area of interest. The development of eco-friendly materials and manufacturing processes will contribute to the global effort toward sustainable healthcare. Moreover, interdisciplinary research involving material scientists, engineers, and clinicians is essential to address the multifactorial nature of tooth wear and prosthetic material performance.

Conclusion

The interaction between natural teeth and prosthetic crown materials is a complex phenomenon influenced by the material's mechanical properties, surface characteristics, and clinical application. While significant advancements in materials science have improved the wear resistance and esthetics of prosthetic crowns, challenges remain in minimizing the wear of opposing natural teeth. The emergence of hybrid and biomimetic materials, along with innovations in CAD/CAM technology, holds promise for achieving optimal balance in crown performance. Future research should focus on developing smart materials and predictive models to further enhance clinical outcomes and ensure the long-term preservation of natural dentition.

References

1. Davidowitz G, Kotick PG. The use of CAD/CAM in dentistry. Dent Clin North Am 2011;55(3):559–570. DOI: 10.1016/j.cden.2011.02.011
2. Wiley MG. Effects of porcelain on occluding surfaces of restored teeth. J Prosthet Dent 1989;61(2):133–137. DOI: 10.1016/0022-3913(89) 90360-0
3. Rupawala A, Musani SI, Madanshetty P, et al. A study on the wear of enamel caused by monolithic zirconia and the subsequent phase transformation compared to two other ceramic systems. J Indian Prosthodont Soc 2017;17(1):8–14. DOI: 10.4103/ 0972-4052.194940
4. Mahalick JA, Knap FJ, Weiter EJ. Occusal wear in prosthodontics. J Am Dent Assoc 1971;82(1):154–159. DOI: 10.14219/jada.archive.1971.0018
5. Lee A, Swain M, He L, et al. Wear behavior of human enamel against lithium disilicate glass ceramic and type III gold. J Prosthet Dent 2014;112(6):1399–1405. DOI: 10.1016/ j.prosdent. 2014.08.002
6. Seghi RR, Rosenstiel SF, Bauer P. Abrasion of human enamel by different dental ceramics in vitro. J Dent Res 1991;70 (3): 221–225. DOI: 10.1177/ 00220345910700031301
7. Stawarczyk B, Keul C, Eichberger M, et al. Three generations of zirconia: from veneered to monolithic. Part II. Quintessence Int 2017; 48(6):441–450. DOI: 10.3290/j.qi.a38157

8. Della Bona A, Corazza PH, Zhang Y. Characterization of a polymer-infiltrated ceramic-network material. Dent Mater 2014;30(5):564–569. DOI: 10.1016/j.dental.2014.02.019
9. Fasbinder DJ. Material matters: a review of chairside CAD-CAM restorative materials. J Cosmet Dent 2018;34(3):64–74.
10. Coldea A, Swain MV, Thiel N. Mechanical properties of polymer-infiltrated-ceramic-network materials. Dent Mater 2013;29(4):419–426. DOI: 10.1016/j.dental.2013.01.002
11. Harsono M, Simon JF, Stein JM, et al. Evolution of chairside CAD/CAM dentistry. Tex Dent J 2013;130(3):238–244. PMID: 23734548.
12. Elsayed A, Yazigi C, Kern M, et al. Mechanical behavior of nano-hybrid composite in comparison to lithium disilicate as posterior cement-retained implant-supported crowns restoring different abutments. Dent Mater 2021;37(8):e435–e442. DOI: 10.1016/j.dental.2021.03.015
13. Marchesi G, Piloni AC, Nicolin V, et al. Chairside CAD/CAM materials: current trends of clinical uses. Biology (Basel) 2021;10(11):1170. DOI: 10.3390/ biology10111170
14. Oh WS, DeLong R, Anusavice KJ. Factors affecting enamel and ceramic wear: a literature review. J Prosthet Dent 2002;87(4):451–459. DOI: 10.1067/ mpr.2002.123851
15. Smith BG, Bartlett DW, Robb ND, et al. The prevalence, etiology and management of tooth wear in the United Kingdom. J Prosthet Dent 1997;78(4):367–372. DOI: 10.1016/s0022-3913(97) 70043-x
16. Bajraktarova-Valjakova E, Korunoska-Stevkovska V, Kapusevska B, et al. Contemporary dental ceramic materials, a review: chemical composition, physical and mechanical properties, indications for use. Open Access Maced J Med Sci 2018;6(9):1742–1755. DOI: 10.3889/ oamjms. 2018. 378
17. Kunzelmann KH, Jelen B, Mehl A, et al. Wear evaluation of MZ100 compared to ceramic CAD/CAM materials. Int J Comput Dent 2001;4(3):171–184. PMID: 11862884.
18. Bayne SC, Taylor DF, Heymann HO. Protection hypothesis for composite wear. Dent Mater 1992;8(5):305–309. DOI: 10.1016/0109-5641(92) 90105-l
19. Lawson NC, Bansal R, Burgess JO. Wear, strength, modulus and hardness of CAD/CAM restorative materials. Dent Mater 2016;32(11):e275–e283. DOI: 10.1016/j.dental.2016.08.222
20. Kamel MA, Hasan MR, Hashem RM. Assessment of wear of three CAD/CAM ceramics against natural tooth structure in a chewing simulator (in vitro study). Egypt Dent J 2019;65(1):403–416.
21. Ludovichetti FS, Trindade FZ, Werner A, et al. Wear resistance and abrasiveness of CAD-CAM monolithic materials. J Prosthet Dent 2018;120(2):318.e1–318.e8. DOI: 10.1016/ j. prosdent. 2018.05.011
22. Xu Z, Yu P, Arola DD, et al. A comparative study on the wear behavior of a polymer infiltrated ceramic network (PICN) material and tooth enamel. Dent Mater 2017;33(12):1351–1361. DOI: 10.1016/ j.dental.2017.08.190
23. Mörmann WH, Stawarczyk B, Ender A, et al. Wear characteristics of current aesthetic dental restorative CAD/CAM materials: two-body wear, gloss retention, roughness and Martens hardness. J Mech Behav Biomed Mater 2013;20:113–125. DOI: 10. 1016/j.jmbbm.2013.01.003

24. Chun KJ, Choi HH, Lee JY. Comparison of mechanical property and role between enamel and dentin in the human teeth. J Dent Biomech 2014;5(1): 1758736014520809. DOI: 10.1177/ 1758736014520809
25. Duarte S, Sartori N, Phark JH. Ceramic-reinforced polymers: CAD/CAM hybrid restorative materials. Curr Oral Health Rep 2016;3(3):198–202. DOI: 10.1007/s40496-016-0102-2