Advances in biomaterials for dental restorations and implants.

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Introduction

Advancements in biomaterials have significantly enhanced the efficacy and longevity of dental restorations and implants. These developments aim to improve biocompatibility, mechanical strength, and aesthetic outcomes, thereby offering patients more reliable and natural-looking dental solutions.

Titanium and its alloys

Titanium has long been the gold standard for dental implants due to its excellent biocompatibility and mechanical properties. Recent innovations include the development of titanium alloys, such as Roxolid—a combination of titanium and zirconium—that offer enhanced strength and osseointegration capabilities. These alloys allow for the use of narrower implants without compromising structural integrity, making them suitable for patients with limited bone volume [1-5].

Zirconia implants

Zirconia-based ceramics have gained popularity as metal-free alternatives to titanium implants. They exhibit excellent biocompatibility, aesthetic appeal due to their tooth-like color, and resistance to corrosion. Advancements in zirconia implants have focused on improving their mechanical properties and surface modifications to enhance osseointegration. Studies have shown that zirconia implants can achieve comparable success rates to titanium implants, with the added benefit of superior aesthetics, especially in patients with thin gingival biotypes.

Surface modifications

Enhancing the surface characteristics of dental implants is crucial for promoting osseointegration. Techniques such as sandblasting, acid etching, and laser treatments have been employed to increase surface roughness, thereby facilitating better bone-implant contact. Additionally, coatings with bioactive materials like hydroxyapatite and bioglass have been developed to further improve the integration process. These surface modifications not only accelerate healing but also enhance the long-term stability of the implants.

Bioceramics in dental restorations

Bioceramics, including materials like hydroxyapatite and calcium phosphates, have been extensively used in dental restorations due to their similarity to natural bone and tooth structures. Recent advancements have led to the development of bioactive glass-ceramics that can bond chemically with bone and dental tissues, promoting regeneration and repair. These materials are particularly beneficial in endodontic treatments and as fillers in bone defects, offering improved sealing properties and biocompatibility [6-10].

Polyetheretherketone (PEEK)

PEEK is a high-performance polymer that has emerged as a promising material for dental implants and frameworks. It offers advantages such as a modulus of elasticity similar to that of bone, radiolucency, and resistance to wear and corrosion. Recent developments have focused on reinforcing PEEK with carbon fibers and incorporating bioactive fillers to enhance its mechanical properties and osseointegration potential. These modifications aim to overcome the inert nature of PEEK and promote better integration with the surrounding bone tissue.

Nanotechnology and biomimetic approaches

The application of nanotechnology in dental biomaterials has led to the development of nanostructured surfaces and coatings that mimic the natural extracellular matrix. These biomimetic approaches facilitate cellular adhesion, proliferation, and differentiation, thereby enhancing tissue integration. Nanoparticles of silver, zinc oxide, and titanium dioxide have also been incorporated into dental materials to impart antimicrobial properties, reducing the risk of peri-implant infections.

Additive manufacturing (3d printing)

Additive manufacturing has revolutionized the fabrication of dental restorations and implants by allowing for the production of patient-specific designs with high precision. This technology enables the creation of complex geometries and porous structures that can enhance osseointegration and reduce stress shielding. Recent advancements include the use of biocompatible materials in 3D printing, such as custom root-analogue implants, which replicate the natural tooth root morphology, offering improved aesthetics and function.

Conclusion

The continuous evolution of biomaterials in dental restorations and implants has significantly improved patient outcomes by enhancing biocompatibility, mechanical performance, and aesthetic results. Ongoing research and technological advancements promise further innovations, paving the way for more effective and durable dental treatments in the future.

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References

1. Dinleyici EC, Borrow R, Safadi MA, et al. Vaccines and routine immunization strategies during the COVID-19 pandemic. Hum Vaccin Immunother. 2021;17(2):400-7.
2. Sellars MC, Wu CJ, Fritsch EF. Cancer vaccines: Building a bridge over troubled waters. Cell. 2022;185(15):2770-88.
3. Geckin B, Föhse FK, Netea MG, et al. Trained immunity: implications for vaccination. Curr Opin Immunol. 2022;77:102190.
4. Ma J, Li Z, Sun Y, et al. Improving innovation and access to combination vaccines for childhood immunization in China. Int J Environ Res Public Health. 2022;19(23):15557.
5. Ward JK, Verger P, MacDonald NE, et al. Vaccine hesitancy, acceptance, and anti-vaccination: trends and future prospects for public health. Annu Rev Public Health. 2021;42(1):175-91.
6. Primorac D, Vrdoljak K, Brlek P, et al. Adaptive immune responses and immunity to SARS-CoV-2. Front Immunol. 2022;13:848582.
7. Hill A, Beitelshees M, Pfeifer BA. Vaccine delivery and immune response basics. Methods Mol Biol. 2021:1-8.
8. Bonanni P, Steffen R, Schelling J, et al. Vaccine co-administration in adults: An effective way to improve vaccination coverage. Hum Vaccin Immunother. 2023;19(1):2195786.
9. Conklin L, Hviid A, Orenstein WA, et al. Vaccine safety issues at the turn of the 21st century. BMJ Glob Health. 2021;6(2):004898.
10. Verma SK, Mahajan P, Singh NK, et al. New-age vaccine adjuvants, their development, and future perspective. Front Immunol. 2023;14:1043109.

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