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The New Inventory in CAD CAM Materials Used in Dentistry-A Narrative Review

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INTRODUCTION:

CAD/CAM (Computer-Aided Design and Computer-Aided Manufacturing) materials are special materials used in the manufacture of dental restorations using digital workflows. These materials are designed to be compatible with CAD/CAM technology, which means that restorations are designed using computer software and manufactured using automated milling or 3D printing machines. The usage of CAD CAM materials in dentistry taking its momentum long back in all the dental speciality treatments. This review paper aimed to discuss about various CAD CAM materials using in the dentistry and their advantages .

The adoption of CAD/CAM technology in dentistry offers several advantages over traditional materials and methods. These advantages include:

improved accuracy, efficiency, and patient outcomes. They are:

1. **Accuracy and precision**: CAD/CAM technology offers greater accuracy and precision in the fabrication of dental restorations than traditional methods. This results in better seated recovery and shorter adjustment time. [1]

2. **Consistency and repeatability**: CAD/CAM systems provide consistent and repeatable results by minimizing the variability associated with manual manufacturing processes. [2]

3. **Reduced production time**: Digital impressions and CAD/CAM production significantly reduce the time required to make dental fillings, improving efficiency for both dentists and patients. [3]

4. **Material quality and strength**: CAD/CAM materials such as zirconia and lithium disilicate offer superior mechanical properties and strength over traditional materials, resulting in longer lasting restorations.[4]

5. **Improved aesthetics**: CAD/CAM technology allows the use of high-quality ceramic materials that offer superior aesthetic results compared to traditional methods.[5]

6. **Minimized Human Error**: By automating design and manufacturing processes, CAD/CAM systems reduce the potential for human error, resulting in more accurate and reliable restorations. [6]

7. **Improved patient experience**: Patients are satisfied with CAD/CAM restorations due to shorter treatment times, fewer appointments, and better fit and comfort.[7]

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Computer Aided Design and Computer Aided Manufacturing (CAD/CAM) technology has made significant advances in dentistry, resulting in the development and use of various advanced materials.

The latest CAD CAM materials used in Prosthodontics:

A.**Zirconia**:

Monolithic Zirconia: Known for its strength and durability, it is used in crowns, bridges and implant restorations. It also offers good esthetics, especially for posterior restorations. Lyered Zirconia combines the strength of zirconia with the aesthetics of porcelain, making it suitable for anterior restorations. [8]

B.**Lithium disilicate (e.max):**This material is popular for its excellent aesthetic properties and high strength. It is often used in crowns, veneers, inlays and onlays. Lithium disilicate can be either monolithic or layered, allowing for versatility in tooth restoration.[9]

C. **Hybrid Ceramics:**these materials combine the properties of ceramics and composite resins, offering a balance between strength, aesthetics and ease and grinding. They are often used for crowns, inlays, placement, and veneers.[10]

D. **Composite Resins**:CAD/CAM dentistry utilizes effective composite materials due to their aesthetic properties and ease of use. They are particularly suitable for temporary restorations and certain types of permanent restorations. [11]

E. **Polymers**: Advanced polymers such as polyether ether ketone (PEEK) are used for frameworks and temporary restorations. PEEK offers high biocompatibility, strength and flexibility. [12]

F. **Glass-ceramics**:materials such as leucite-reinforced glass-ceramics are used for their excellent aesthetic properties. They are often used for veneers, inlays, onlays and anterior crowns. [13]

G. **PMMA (polymethyl methacrylate):**PMMA blocks used in temporary fillings are easy to mill and provide good aesthetics and functionality for temporary dental solutions.[14]

H.**Cobolt Chromium Alloys**:These metals are used in CAD/CAM dentistry to make metal frameworks for removable partial dentures, implant rods and some types of crowns and bridges. [15]

I. **Titanium**:Titanium and its alloys are used in the manufacture of implant abutments and frames due to their excellent biocompatibility and strength.[16]

These materials are designed to maximize the benefits of CAD/CAM technology and offer dentists a wide range of options to meet the needs of different patients. Ongoing research and development of dental materials continues to improve the capabilities and applications of CAD/CAM systems in modern dentistry.

CAD-CAM materials used in Endodontics:

CAD/CAM technology is increasingly used in endodontics for procedures such as custom posts, crowns, and even some endodontic procedures.The most important CAD/CAM materials in endodontics

Zirconium:Used to make endodontic posts and crowns. High strength, biocompatibility and fracture resistance.[17]

Lithium disilicate (e.max): Used in the production of endodontic crowns and inlays/overlays. Excellent esthetics, strength and ability to engage with tooth structure.[18]

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PEEK (Polyetheretherketone): Used as endodontic posts and frames. High biocompatibility, flexibility and less stress on the root structure. [19]

Fiber Reinforced Composites (FRC): Manufacture of custom endodontic posts. Good strength, flexibility and aesthetic properties.[20]

Glass-ceramic:Used for the manufacture of inlays, plates and crowns for endodontically treated teeth. Excellent aesthetics and good adhesions.[21]

Resin-based composites:Endodontically treated tooth interiors, placements and coatings. Good aesthetics, ease of use and less invasive preparations.[22]

CAD-CAM materials used in Orthodontics:

CAD/CAM technology has made significant advances in orthodontics, providing a variety of materials and techniques to improve the efficiency, accuracy and aesthetics of orthodontic treatment.Main Orthodontic CAD/CAM materials:

Transparent Alignments:Material: Thermoplastic Polymers (eg PETG, PU). Aesthetic, removable and comfortable for patients.[23]

Custom Tongue Clips:Various metals (eg stainless steel, gold alloys). Esthetic (hidden behind the teeth), customized fit for individual teeth.[24]

Custom Archwire material: Nickel Titanium (NiTi), Beta Titanium (TMA). Accuracy in force application reduces processing time and improves efficiency.[25]

Indirect Bond Pads:Material: Silicone, Vinyl Polysiloxane (VPS). Precise placement of the bracket, shortens the service life of the chair and improves the accuracy of gluing.[26]

3D printed models:Material: photopolymer resins. Precise treatment planning, custom device manufacturing and visualization of treatment results.[27]

CAD/CAM orthodontic brackets:Material: metal alloys, ceramics and polymers. Adapted to each tooth, better fit and comfortable.[28]

CAD-CAM materials used in Periodontics:

CAD/CAM technology is also used in periodontology for a variety of procedures, including surgical guides, custom abutments, and temporary and final restorations integrated into periodontal care.The most important CAD/CAM materials in periodonticsSurgical instructions:Material: photopolymer resins. Improved accuracy of implant placement reduces operative time and improves outcomes.[29]

Custom abutment surfaces:Material: titanium, zirconium oxide. Better fit, aesthetics, and soft tissue integration.[30]

Temporary restorations:Material: PMMA (polymethyl methacrylate). Good aesthetics and ease of preparation of temporary solutions during periodontal treatment.[31]

Final restorations:Material: zirconium oxide, lithium disilicate. High strength, durability and aesthetics of crowns and bridges after periodontal treatment.[32]

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Guided Intelligent Regeneration (GBR) Membranesmaterial: Proprietary resorbable and non-resorbable membranes. Precisely appropriate damaged areas, improving bone regeneration results.[33]

CAD/CAM Titanium Mesh material: Titanium. Adaptable to individual defects, providing structural support and stability to bone grafts. [34]

CAD-CAM materials used in Implantology:

CAD/CAM technology has revolutionized implantology, improving the accuracy, fit and overall success of dental implants.The most important CAD/CAM materials in implantology:

Titanium (Ti)Applications: custom implant abutments, frames and surgical guides. High strength, biocompatibility and bone integration.[35]

Zirconium oxide (ZrO2): Implant abutments, crowns and bridges. High aesthetic quality, biocompatibility and resistance to corrosion and wear.[36]

Lithium disilicate (e.max): Implanting crowns and bridges. Excellent aesthetics, high strength and good adhesions.[37]

Polyether ether ketone (PEEK)Applications: Implant abutments and frames. High biocompatibility, lightness and flexibility.[38]

Resin-based compositesAreas of use: Temporary implant restorations. Easy to handle, good aesthetics and less invasive.[39]

Ceramic materials: Implant crowns, bridges and abutments. High aesthetic quality, biocompatibility and stain resistance.[40]

CAD-CAM materials used in Oral Surgery:

CAD/CAM technology is increasingly used in oral surgery to improve the accuracy, efficiency and results of various surgical procedures.The most important CAD/CAM materials in oral surgery:

Titanium (Ti)Applications: Custom implants, plates and screws for craniofacial reconstruction. High strength, biocompatibility and excellent bone integration.[41]

Polyether ether ketone (PEEK)Applications: Custom cranial and jaw implants. Lightweight, high strength and radiolucent (does not interfere with imaging).[42]

Ceramic (zirconia)Applications: custom maxillary implants, bone graft substitutes. High biocompatibility, aesthetic properties and abrasion resistance.[43]

3D printed resinsApplications: surgical guides, custom splints. High accuracy, customization and ease of use. [44]

Biocompatible polymersApplications: custom occlusal dentures, temporary implants. Flexibility, ease of manufacture and biocompatibility.[45]

CONCLUSION:

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Dental CAD/CAM materials offer important advantages such as better accuracy, customization, efficiency, better aesthetic appearance and fewer treatment complications. These materials and technologies are revolutionizing dentistry by providing more predictable and effective treatment results.

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