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Prosthodontics update

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ABSTRACT

Prosthodontics should always update their knowledge as there are many advanced techniques and improved materials are constantly being introduced into the market that improves the quality of treatment and reduces the chairside time. This is a short note providing information regarding some of the advanced materials and procedures related to Prosthodontics.

Keywords— *Impression materials, Denture base materials, Resins*

1. INTRODUCTION

A number of new materials and procedures have been recently introduced to the practice of Prosthodontics. As chair side time and office overhead have become more crucial issues to the practitioner, new techniques and procedures have been designed with these problems in mind.

2. RECENT ADVANCES IN IMPRESSION MATERIALS

2.1 Improvements in alginates

(a) Flavour Added alginate - Spearmint / Mango / Mint
(b) Rapid Set alginate
(c) Dust free alginate
(d) Chromatic Alginate
(e) Paste form alginate - (Catalyst + Base)
(f) Alginate containing antimicrobials
  – Chlorhexidine
  – Quaternary Aluminium (Components)
(g) 7. Alginates reinforced with silicones- to improve tear strength.

2.2 Impression material mixing instrument

It's a system for automatic mixing and dispensing.

Advantages

(a) Top quality mix in less time
(b) More flexible mix
(c) Homogenous void free mix
(d) Direct filling of syringes and Trays

2.3 Carbon-free, phosphate bonded investment

A carbon-free phosphate bonded investment for castings of precious, semi-precious and Pd base alloys for use in both quick heating and slow heating procedure.

Advantages:

(a) Carbon-free creamy consistency
(b) High fluidity and wettability
(c) Very smooth surface
(d) Controllable expansion

2.4 Flasking stone

Specially designed for flashing techniques in denture fabrication

Advantages:

(a) Minimal Setting Expansion
(b) Comfortable Working Time
(c) High compressive strength
(d) Excellent Accuracy

2.5 Denture base materials

(a) High impact strength materials:
- Carbon fibres are incorporated to increase rigidity and impact strength
- Disadvantage: gives black color

(b) Recent developments:
- Translucent organic fibres with high modulus are used in the form of a woven mat or as cut fibres mixed with acrylic dough.

2.6 Rapid heat polymerized resins

These are hybrid acrylics that are polymerized in boiling water for 20 minutes after being packed into denture flask.

2.7 The use of microwave energy for processing acrylic resins

(a) Microwaves are a form of electromagnetic radiation mainly used in radar &telecommunications

(b) Microwaves are reported as a means of curing dentures and listed the following advantages

- Greatly reduced curing time (3 minutes)
- Shortened dough forming time
- Minimal color changes
- Less fracture of artificial teeth &resin bases
- Superior denture base adaptability

2.8 Visible light activated denture base resins

- The material consists of a matrix of urethane dimethacrylate, microfine silica, and high molecular weight acrylic resin monomers, acrylic resin beads are included as organic filler.
- Visible light is the activator; camphoroquinone serves as the initiator for polymerization.
- The single component denture base resin is supplied in sheet and rope forms& is packed in light-proof pouches to prevent inadvertent polymerization.
- Teeth are arranged and the denture base is sculpted using light-activated resin
- The denture base is placed into a light chamber and polymerized according to manufacturers recommendations

Disadvantages

(a) When the resin is being adapted to a stone cast entrapment of air results in voids on the tissue side

(b) To reduce the voids, vacuum pressure is applied to the adapted resin through a sheet of rubber dam before curing.

2.9 Acetal resin

(a) Exceptional traction and impact resistance
(b) The optimum combination of rigidity-tenacity
(c) Optimum resilience and creep resistance
(d) The low static and dynamic friction coefficient
(e) Optimum dimensional stability
(f) High abrasion/wear resistance
(g) High elastic memory
(h) Proven Biocompatibility
(i) Nonallergic, non-toxic
(j) Proven clinically

2.10 Indicated for a wide range of clinical applications

(a) Aesthetic claps
(b) Space Maintainers
(c) Removable partial prosthesis
(d) Temporary bridges
(e) Orthodontic appliances

2.11 Radio-opaque acrylics

A copolymer containing 36- 40% poly 2-3 dibromopropyl methacrylate is incorporated.

3. PEEK

- PEEK is a member of the Polyaryletherketone Family (PAEK).
- A common synthesis route for PEEK is the reaction between 4, 4-difluorobenzophenone and the disodium salt of hydroquinone in a polar solvent such as diphenyl sulphone at 300°C.
- It is a semi-crystalline polymer.
- It's melting point is around 335 °C.
- PEEK has an elastic modulus (3-4 GPA) close to human cortical bone, suggesting the potential for a more homogenous stress distribution to bone compared to titanium.
- PEEK is a radiolucent material.
- Chemically and physically stable and resistant to radiation damage.
- Wear-resistant.
- Biocompatible in vivo and in vitro, does not cause toxic or mutagenic effects.
- Compatible with many reinforcing agents such as glass and carbon fibres.

3.1 PEEK as dental implants

- The major beneficial property for PEEK as a dental implant material remains its low Young's (elastic) modulus (3–4 GPA) being close to the human bone(14 GPA) while titanium's elastic modulus is about (102- 110 GPA).
- In contrast to titanium, PEEK has very limited inherent osteoconductive properties. Hence, a considerable amount of research has been conducted to improve the bioactivity of PEEK implants.

3.2 PEEK as dental implant abutments

- Unmodified PEEK is used as a provisional abutment because this material has been demonstrated to reduce stress shielding around the implant.
- Unmodified PEEK is not used as a definitive abutment material because its fracture resistance is lower than that of titanium.
- However, the introduction of ceramic reinforced PEEK (Bio-HPP) made its use as a permanent abutment an advantage.
- PEEK as removal partial dentures

Advantages:

(a) High biocompatibility
(b) Good mechanical properties
(c) High-temperature resistance
(d) Chemical stability
(e) Due to a 4 GPA modulus of elasticity, it is as elastic as bone and can reduce stresses transferred to the abutment teeth
(f) The retentive force of biohpp clasps could be a matter of concern. PEEK clasps offer a lower retentive force than metal clasps.
(g) However, properly designed PEEK clasps with an undercut of 0.5 mm could provide adequate retention for clinical use.
(h) Biohpp clasps are gentler to the enamel and porcelain restorative materials than conventional Cr-Co clasps are.

One disadvantage of PEEK in prosthetic dentistry is a difficulty to achieve adequate bond strength to composite resin materials owing to its low surface energy and resistance to surface modification by different chemical treatments.

Surface treatment of PEEK to increase its bond strength to veneering composites:

(a) Acid etching with 98% sulfuric acid for 1 min and careful rinsing with deionized water for 1 min.
(b) Air abrasion with alumina with a mean particle size of 50 µm or 100 µm for 10 s at a pressure of 2 bar and at a distance of 10 mm between the nozzle and the surface.
(c) Silica coating for 10 s and subsequent application of silane

for 5 min.

3.3 PEEK-Dentin bond strength

- To increase the bond strength between PEEK and dentin, the inner surface of crowns and bridges must be treated either by Sulfuric acid or air abrasion with alumina.
- Etching the dentin with 37% phosphoric acid and applying a two-step self-priming adhesive system achieves good bond strength between PEEK and dentin after surface treatment by sulfuric acid.

3.4 Artificial denture teeth

Teeth with large molecular weight cross-linking agent (urethane dimethacrylate), 27% microfill silica – abrasion resistance are intermediate between porcelain and conventional acrylic teeth.

3.5 Bite registration material

Polyvinyl siloxane silicone impression material with properties specially adjusted to the requirement of Bite Registration

Advantages

(a) Fast reliable mixing and application directly from catridges
(b) Thixotropic properties with the ideal balance between
(c) stability and fluidity

3.6 Resin reinforced glass-ionomer luiting cement

To overcome moisture sensitivity this is indicated for luiting all kinds of metal and Acrylic/Resin crowns, inlays, onlays and bridges as well as lutting of Porcelain ceramic inlays.

Advantages

(a) Easy mixing and handling like conventional cement.
(b) Similar mechanical properties to Resin cement.
(c) Elimination of complex and moisture sensitive bonding procedure.
(d) Good adhesion to metal, resin and silanated porcelain.
(e) No post operative sensitivity.
(f) Optimal Marginal Seal.
(g) Radiopacity.

3.7 Resin cement

- Flowable composites of low viscosity
- Composition: a resin matrix with silane treated inorganic fillers
- Most resin cements require dentin bonding agents to promote adhesion to the tooth structure

Advantages

(a) Insoluble in oral fluids, good initial strength
(b) Compressive strength-180 mpa,tensile strength-45 mpa

Available as

(a) Chemically activated(thicker than 2.5 mm),
(b) Light curable (thin restorations of 1.5 mm thickness.),
(c) Dual cure cement (used for – up to 2.5 mm)

3.8 Fit checker

It has easy flowing white silicone material for the location of pressure points of dentures and for checking the accuracy of Crown and Bridges.

Advantages

(a) Minimal film thickness
(b) Easy to remove from metal and resin surfaces
(c) Clearly visible colour contrast to denture resins and metals.

3.9 Nano dentistry

Nanotechnology has induced the generation of innovative and cost-effective dental materials and devices, enabled the understanding of biomechanical properties of enamel (e.g., Fracture behavior and crack propagation), and contributed to the improvement of bone-tissue regeneration as well as the diagnosis and prevention of pathologies [1]

4. ADVANCED DENTAL LABORATORY TECHNIQUES

4.1 CAD / CAM technology in dentistry

1985 is the key year to the introduction of CAD / CAM technology in dentistry.
CAD: Computer Aided Design.
CAM: Computer Aided Manufacturing.

CAD/CAM systems are composed of three major parts:

(a) Intra-oral or extra-oral scanners
(b) Software for designing (CAD)
(c) Milling device for manufacturing the restoration (CAM)

4.1.1 Scanners

- In some systems, a light powder, usually titanium oxide in a carrier medium, is applied to all the surfaces to be recorded to provide contrast.
- Maintaining homogeneity and even the thickness of this layer was a source of possible variation. (Disadvantage)
- The use of powderless scanners has removed this source of inaccuracy with no limitation of scan accuracy.

Advantages of a digital Impression

- Uncomfortable experience of making a physical impression avoided.
- Tooth preparation can be checked and corrected in real time.
- Disinfection of Impression is not an issue.
- Data stored indefinitely, recordkeeping.
- Virtual models obtained.

4.1.2 Milling (CAM)

Milling/machining technology is a type of restoration fabrication that utilizes subtraction manufacturing technology from large solid blocks.
The milling units are categorized into two classifications:

(a) Dry or wet milling
(b) A number of axes:
- 4 axes : x,y,z +rotation around X-axis
- 5 axes : x,y,z + rotation around X-axis and Y-axis

4.2 Uses of CAD/CAM

1. Inlays
2. Onlays
3. Veneers
4. Crowns
5. Bridges
6. Dentures
7. Implant abutments
8. Space Maintainers
9. Orthodontics

4.3 Advantages of CAD/CAM

(a) Speed.
(b) Ease of use
(c) Quality.
(d) Digital scans have the potential to be faster and easier than conventional impressions because casts, wax-ups, investing, casting, and firing are eliminated (a full-contour crown takes

just 6 minutes to mill).
(e) No second appointment.
(f) No provisional restorations.
(g) Scans can be stored on the computer; whereas, standard stone models take up space and can chip or break if stored improperly.

4.4 Disadvantages of CAD/CAM

(a) The cost of the equipment and software is high.
(b) The practitioner needs to spend time and money on training.
(c) A large amount of raw material is wasted because of unused portions of the mono-blocks
(d) Milling tools are prone to heavy abrasion and wear which shortens their cycling time.
(e) Due to the brittle nature of ceramic microscopic cracks can be introduced during the process of machining.[2,3]

5. 3D PRINTING

It is the process in which multiple layers of material are added one by one under computer control to create a three-dimensional object.

5.1 Materials

(a) Metals like silver, steel, titanium.
(b) Resins like PLA, polyamide (nylon), glass filled polyamide, epoxy resins, photopolymers, and polycarbonate.
(c) Organic materials such as cells, wood, and chocolate.

5.2 Mechanism

(a) It all starts with the creation of a virtual design (CAD) of the object.
(b) The most common and universal file formats for 3D printing are STL and VRML.
(c) The scanner may be used to produce a 3D model.
(d) The 3D model is sliced and then it is ready to feed into the 3D printer of compatible brand and type.
(e) The 3D printer reads every slice (2D image) and creates a three-dimensional object.

5.3 Fused deposition modeling

A thermoplastic filament material is extruded through a nozzle controlled by temperature and the material hardens immediately (within 1 sec) after extrusion.

5.4 Selective laser sintering

(a) A fine material powder is fused by scanning laser, to build up structures incrementally.
(b) Stereo lithography
(c) Involves successive printing of thin layers of UV laser curable liquid photopolymer layer by layer.

5.5 Uses

(a) Dental implants surgical guides
(b) Maxillofacial surgery
(c) Dental models
(d) Prosthodontics
(e) Orthodontics
(f) Endodontics

6. NANO-ROBOTS FOR LOCAL ANAESTHESIA

(a) Typically 0.5-2 microns large with 1-10 nm parts made of chemically inert forms of carbon, sensors, external controller
(b) A colloidal suspension containing, millions of active analgesic micron-size nano-robots, reach the pulp via gingival sulcus, lamina propria and dentinal tubules.
(c) After reaching pulp they may be directed by the dentist to shut down the sensitivity of that particular tooth. Via Acoustic signalling.
(d) After the procedure, they are signalled to restore all sensations and effuse themselves via usual human excretory channels.

7. HYBRID AIR-ELECTRIC HANDPIECE

(a) Adaptive torque control (ATC).
(b) Has a sensor in the hand piece which operates a valve (continuously regulates the amount of air pressure to the turbine).
(c) As soon as the bur contacts the tooth, instead of losing power and slowing, the valve opens and sends more pressure to the turbine (compensation).
(d) Has the power of electric hand piece but the size and weight characteristics of air driven handpiece.

8. TECHNOLOGICAL SHADE SYSTEM [4]

8.1 Spectrophotometers

It measures and records the amount of visible radiant energy reflected or transmitted by an object one wavelength at a time for each that is Hue, value and chroma, present in the entire visible spectrum.

8.2 Colorimeteres

(a) Colorimeters provide measurements in CIELAB units that can compare the color parameters of different objects when analyzed mathematically.
(b) Microcolor colorimeter (a photoelectric tri-stimulus colorimeter) is a self-contained measuring system that requires no external power source
(c) Filter Colorimeter (A silicon photodiode array requiring both an external power source and a standard light source); has spectral correction filters limiting the spectral characteristic of light reaching detector surface. Inadequate sensitivity for low light levels, absolute accuracy inferior to the spectrophotometer.

8.3 Digital Cameras

(a) Instead of focusing light upon film to create a Chemical Reaction, they capture images using CCDs
(b) Factors such as illumination and the angle of the photograph will alter how color is perceived by the camera, therefore appropriate calibration protocols to be applied.
(c) To get full color image, most sensors use filtering to look at the light in 3 primary colors. Highest quality sensors use 3 separate sensors with a different and separate color filter over it.[5]

9. RECENT ADVANCES IN ETCHED CAST RESTORATIONS

9.1 Indications

(a) As retainers for a fixed partial denture if the abutments provide enough tooth structure for bonding (caries free abutments or teeth with lesions that do not limit enamel available for retention are acceptable)
(b) Post-orthodontic fixed stabilization

9.2 Contraindications

(a) Abutments with large carious lesions, extensive restorations, severely abraded teeth
(b) Where aesthetics can't be improved by bonding from the lingual surface
(c) Patients with known sensitivity to nickel or other metals in the non-precious alloys

10. REINFORCED FIXED PROVISIONAL RESTORATIONS

(a) Extensive Prosthodontic treatment often requires fabrication of long term provisional restorations.
(b) Reinforced heat processed provisional restorations reduce flexure, which minimizes progressive loss of cement &diminished the possibility of recurrent decay
(c) Occlusal stability and vertical dimensions were maintained because of greater wear resistance.
(d) Provisional restorations may be reinforced with various materials to avoid fracture.

11. REFERENCES

[1] Thomas B, Mathew CA, Muthuvignesh j Nanotechnology-Applications in Prosthodntics: A Literature Review. J Orofac Res 2014; 4(2):103-10.
[2] Kim Li RW, Matinlinna JP, Ceramic dental Biomaterials and CAD/CAM technology: state of art, J. Prosth Research, Oct 2014; 58(4): Pg- 208-16.
[3] Mantri SS, Bhasin AS. CAD/CAM in dental restorations: an overview. Annals and Essences of Dentistry. 2010 Jul 13; 2(3):123-8.
[4] Smitha AJ, Savitha PN. Shade matching in aesthetic dentistry–from past to recent advances. J Dent Oral Care Med. 2017; 3(1):102.
[5] Tam WK, Lee HJ. Dental shade matching using a digital camera. Journal of dentistry. 2012 Dec 1; 40:e3-10.

