Resin based materials in prosthetic dentistry

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Resins in dentistry

- Denture base
- Crown and bridge (veneering)
- Artificial teeth
- Special tray
- Modelling
- Filling materials
- Rebase- reline
- Temporary restorations
- Luting
Requirements for dental materials

- Natural appearance
- Ease of manipulation
- High values of strength
- High surface hardness, low specific gravity
- Ease of repair, combined with dimensional stability
- Absence of odour, taste or toxic agents
- Resistance to water absorption or bacterial growth
- Good thermal conductivity
- Good retention to other materials
- Usable for all types of prosthesises
- Inexpensive
Types of resins

- Cellulose
- Phenol-formaldehyde (bakelite)
- Vinyl resin
- Vulcanite
- Acrylic resin
  - Modified materials as composite, luting resins etc.
The modern acrylic was introduced in 1937. It contains liquid monomer and powder polymer.

„Dough method”
Monomer

- Methyl-metacrilate liquid
- Can be activated by
  - heat
  - light
  - chemically (self activation)
- Join together \( \rightarrow \) large molecule: PMMA (solid)
Monomer

- Clear, colorless liquid
- Boiling point: 100,3 °C
- Gravity is: 0,945 g/cm³
- Inhibitor (stabilizer): hydroquinone 0,005%
- Dimensional stability: glycol dimetilate 1%
Properties of monomer

- Extremely volatile
- Flammable
- Special smell
- Have to prevent from heat and light
Polymer

- Transparent, glass-like resin
- Initiator: helps the polymerization
  - Benzoyl- or lauroyl – peroxide 0,02 – 1 %
- Plasticizer: be more readily moulded to shape by heat and pressure
  - Dibutyl-phthalate 2-7 %
- Colouring agents
  - Iron oxide, zinc oxide, cadmium salts
Mixing method

1. Polymer is affected by the solvent action of the monomer and hence becomes softer
2. Consistency is changing: wet sand, stringy, doughy, leathery, hard
3. Applying heat the monomer polymerizes and eventually hardens
4. There is volumetric shrinkage: 20%
5. Polymerized mass consists entirely of polymer. Soft, but hardens when the flask is cooled – thermoplasticity
6. For optimal result: slowly and under pressure
Polymerisation

- Resins solidify when they polymerise
- A repetitive intermolecular reaction
- A macromolecule, polymer is formed from large numbers of monomers
- Monomers connected by covalent bonds
Polymerisation mechanisms

1. Condensational polymerisation

- Esterification with production of water or alcohol
- Accompanied by repeated elimination of small molecules
  - $A + B = C + D$
- Functional groups are repeated in the polymer chain
- Example: polysulfide and condensation polymerized silicone impression materials
2. Additional polymerisation

- Two molecules join together to form a third larger molecule
  - $A + B = C$

- The larger molecule is capable for further reaction with the monomer

- Example: most dental resins
R+M $\rightarrow$ R-M

R-reactive species (free radicals)
M-monomer molecules

Free radical addition polymerization:
1. Activation
2. Initiation
3. Propagation
4. Termination
Molecular shape

- **Linear**: the simplest form

- **Cross-linked**: connections between linear molecules

- **Resin net/ cross net 3 dimensional molecule**
Types of resins

1. **Heat curing**
   - Dough moulding method
   - Mixing and curing
   - Components: a. powder
     - b. liquid
- mixing powder and liquid
- „dough” stage
- packing into gypsum mould (investment material)
- trial closure
- opening
- closing the flask under pressure
- curing
- cooling
„Paladon-technique“:

- chemoplastic
- Powder and liquid
- Plastic doch
- Adaptation
- Pressure
2. **Cold curing**

- Called as: cold-curing, self-curing, or autopolymerizing resins
- No need for heat
- Powder (polymer) and liquid (monomer) system
- Chemical activation
Self – curing acrylic resin for temporary appliance
3. Casted resins
- Cold and heat curing types
- Mixing powder and liquid
- Curing at room temperature
Types of resins

3. Light curing

- Activated by a certain wavelength visible light
- A single component composite having a matrix of urethane dimethacrylate, microfine silica, and high molecular weight acrylic resin monomers
- Initiator: camphoroquinone
Resin types by application:

- Baseplate of the removable denture
- Artificial teeth, gum
- Covering metal frames
- Correction: relining, rebasing
- Temporary appliances
- Ductile clay – pattern resin
- Tray-material
- Splints
- Filling materials
Baseplate, gum and teeth material - removable dentures -
Covering metal frames
Correction material
Temporary appliances
Pattern material
Processing resins

- Injection moulding
  - Pressing the preheated polymer (granulates) to the mould and let to cool down
  - Prefabricated elements
Processing resins

- Deep-drawing
  - Prefabricated thermoplastic foils
  - Applied to the cast on buckshot tray
  - Special trays, splints, bleaching
Processing resins

- **HPH**
  - Hydraulic, pneumatic heating
  - The soft polymer
  - Brush
  - Hot glycerine bath
  - Under pressure
  - 100 °C, 7-15 atm
Processing resins

- Pyroplast technique
  - Thermoplastic monomer-polymerization
  - Hot chamber
  - Under pressure
  - 140-170 C, 7 atm
Processing resins

- Wet technique
  - Acrylic dough (wet)
  - Pushed to a negative flask
  - Hot water bath
  - Under pressure
  - Partial dentures
Processing resins

- Resin „casting”
  - Pouring acrylic into a special machine
  - 6 atm
  - Acrylic elements of rpd
Thanks for Your attention!