INTRODUCTION

A. Overview:

1. RPD Acrylic portions = denture teeth (DT), denture base (DB) (and veneering)

2. Potential problems
   a. DT wear
   b. DT bonding to DB
   c. PMMA porosity
   d. DB distortion
   e. DB staining
   f. DB bonding to alloy framework
   g. Acrylic-metal leakage

B. Biomechanics of acrylic portions of RPDs:

1. Wide variation in moduli of materials

2. Avoid stress concentrations in denture portion:
   a. Allow at least a minimum of 1 mm of denture base between tooth and alloy
DENTURE TEETH (DT)

A. Classification:

1. Porcelain (high fusing ceramic)
2. PMMA (acrylic) – lightly crosslinked with TEGDMA
3. IPN (Interpenetrating Network) – 2-phase polymer
4. Isosit (composite; crosslinked acrylic) – heavily crosslinked
5. (Experimental [fiber-reinforced])

B. Attachment mechanisms of DT to DB:

1. Gross mechanical retention (diatoric holes, undercuts)
2. Micromechanical retention (Bur roughening, grinding, sandblasting)
3. Pseudo-chemical bonding (DB monomer penetration into DT)
   a. Minimizes interfacial leakage and staining (hygienic and esthetic problem)
   b. Facilitates stress-transfer preventing cracks or crazes near interface with base
4. NO CHEMICAL BONDING

C. Denture tooth wear

1. Denture tooth vs natural teeth wearing surfaces -- designed to minimize wear
   a. [Porcelain] x [Porcelain]
   b. [Gold] x [enamel, gold, or other restorative materials (not porcelain)]
   c. [Acrylic] x [enamel, acrylic]
**DENTURE BASE (DB) MATERIAL**

**A. Classification:**

1. High-Impact Acrylic (PMMA = Lucitone 199; Lightly crosslinked with TEGDMA)
2. Experimental (polyethylene fiber-reinforced)
3. Other (polystyrene, nylon, polycarbonate, epoxy)

**B. Attachment mechanisms of DB to RPD framework:**

1. Gross mechanical retention (interpenetration of framework holes; undercuts)
2. Micromechanical retention (roughened surface -- sandblasting)
   a. Alloys generally single phase -- and cannot preferentially etch with one phase
   b. Roughening with alumina particle sandblasting is best
3. NO PSEUDO-CHEMICAL BONDING
4. **Chemical bonding via coupling systems** (4-META; silicoating+silane; Rocatec)
   a. Produce about 15-20 MPa bond strengths (similar to enamel/dentin bonding)
   b. Sufficient to discourage leakage at interface and distribute stresses

**C. DB fabrication:**

1. **Design considerations:** avoid thin sections of acrylic around RPD alloy
2. **Curing considerations:**
   a. [MMA → PMMA] = chain reaction polymerization, fast, exothermic
   b. Chain Rx = activation (heat/BPO), initiation, propagation, termination
3. **Composition:**
   a. Liquid = MMA, EGDM, HQ (Inhibitor)
   b. Powder = PMMA / PS / BMA / EGDMA, BPO, colorants, fibers (mimic arteries)
4. **Manipulation of acrylic dough:**
   a. Mixing of P/L: **Dissolution/penetration of monomer into surface of powder**
   b. Thermal decomposition of BPO on heating; Polymerization of monomers
   c. Newly forming polymer becomes **pseudo-chemically bonded** to old polymer.

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MMA Liquid
PMMA Powder
Heat and pressure
Old and new polymer chains intertwined at the molecular level.
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5. **Flasking options with acrylic dough:**
   a. Trial-packing, trimming, repacking
   b. Packing-only
   c. Poured resin (e.g., Lucitone Fas-Por)
6. **Heat and pressure control:** avoids porosity and maximizes reaction conversion
   a. **MMA:** \( T_{bp} = 100^\circ C \) (P= 1 atm); \( 140^\circ C \) (P= 2 atm)
   b. Reaction is thermally activated and generates heat as well
   c. Reaction conversion is about 98 to 99.5% for heat processed conditions
7. Flask processing conditions:
   a. **40-30 Cycle** = cure at 71-72°C for 40 min + 100°C for 30 min
   b. **Fast Cycle** = cure at 71-72°C for 30-90 min + 100°C for 30 min.
   c. **Slow Cycle** = cure at 71-72°C for 10 hrs.
      [A slow cycle is better for complete dentures with larger amounts of material.]
      [Generally, slow cures result in better dimensional accuracy.]

8. Analysis of porosity problems:
   a. Internal porosity: P/L heterogeneity and air incorporation (spherical pores)
   b. **Internal porosity**: localized MMA boiling (common in thicker portions)
   c. External porosity: insufficient pressure or dough (surface blisters and pores)

9. Dimensional changes on processing: expansion on heating flask; expansion on polymerization exotherm; contraction on MMA polymerization (21vol.%); contraction on cooling to room temperature; expansion on swelling in water; expansion on thermal change to 32°C.

10. Cracks and crazes created by thermal and mechanical cycling

D. **DB reprocessing:**

1. Hard and soft tissue changes **every 5-8 years** require modifying denture base:
   a. Relining ≡ resurfacing of the tissue surface with new material
   b. Rebasing ≡ replacement of entire denture base with new material

2. Soft-liners generally not practical

E. **DB hygiene:**

1. Clean with toothbrush and warm soap-and-water (or mild dentifrice)
2. Avoid oxidizing or Cl-containing materials that may attack base metal alloy
3. Diligently clean both the top surface and tissue borne surfaces
MULTIPLE CHOICE STUDY QUESTIONS:

1. Which type of denture teeth pseudo-chemically bonds best to a denture base?
   a. IPN
   b. Porcelain
   c. Acrylic
   d. Isosit
   e. Fiber-reinforced

2. Which type of denture teeth is more likely to produce interfacial acrylic crazing and cracking?
   a. Porcelain
   b. IPN
   c. Acrylic
   d. Isosit
   e. Fiber-reinforced

3. Which type of denture teeth involves a composite occlusal surface?
   a. Porcelain
   b. IPN
   c. Acrylic
   d. Isosit
   e. Fiber-reinforced

4. Which adhesion mechanism does NOT occur with acrylic resin teeth?
   a. Gross mechanical retention (diatoric holes)
   b. Micromechanical retention (surface roughening or grinding)
   c. Pseudo-chemical bonding
   d. Chemical bonding

5. What is pseudo-chemical bonding of acrylic resin teeth?
   a. Chelation bonding
   b. Dissolution/penetration of acrylic tooth surfaces by unset denture base monomer
   c. Formation of occasional covalent bonds between tooth and denture base acrylic
   d. Crosslinking of denture base resin near tooth surfaces
   e. Ionic attractions between tooth and denture base polymer chains

6. What is the predominant type of denture base material in use?
   a. Epoxy
   b. PMMA
   c. Polystyrene
   d. Polycarbonate
   e. Composite

7. What is the formula for methyl methacrylate?
   a. \( \text{H}_2\text{C} = \text{C} \left( \text{CH}_3 \right) \left( \text{COOCH}_3 \right) \)
   b. \( \text{H}_2\text{C} = \text{C} \left( \text{CH}_3 \right) \left( \text{COOCH}_2\text{CH}_3 \right) \)
   c. \( \left( \text{H} \right) \left( \text{CH}_3 \right) \text{C} = \text{C} \left( \text{CH}_3 \right) \left( \text{COOH} \right) \)
   d. \( \left( \text{H} \right) \left( \text{CH}_2 \right) \text{C} = \text{C} \left( \text{CH}_3 \right) \left( \text{COOCH}_3 \right) \)
   e. \( \left( \text{CH}_3 \right)_2\text{C} = \text{C} \left( \text{H} \right) \left( \text{COOCH}_3 \right) \)

8. Which one of the following properties is NOT correct for methyl methacrylate?
   a. Boiling point = 100°C at 1 atmosphere
   b. Boiling point = 140°C at 2 atmospheres
   c. Reaction mechanism = chain reaction polymerization
   d. Monomer molecular weight = 100 gms/mole
   e. MMA polymerization shrinkage = 11%

9. What type of adhesion mechanism does NOT occur between acrylic denture base and an RPD framework alloy?
   a. Gross mechanical retention (undercuts or holes in framework)
   b. Micromechanical retention (sandblasted framework surface)
   c. Pseudo-chemical bonding
   d. Chemical bonding
10. Without pressure, what is the boiling point for MMA monomer?
   a. 50°C
   b. 60°C
   c. 80°C
   d. 100°C
   e. 120°C

11. What is the maximum fast processing temperature using controlled heat and controlled pressure for a denture base?
   a. 50°C
   b. 72°C
   c. 85°C
   d. 100°C
   e. 120°C

12. What is the major reason for initially processing all dentures at 71-72°C rather than at 100°C in the dental laboratory?
   a. The flask pressure is insufficient to elevate the T_bp of the monomer
   b. MMA polymerization causes an exotherm and raises the temperature above 100°C
   c. High temperatures interfere with denture base bonding to acrylic resin teeth
   d. High temperatures distort the acrylic resin teeth
   e. High initial temperatures produce excessive contraction on cooling and misfit

13. What is the evidence of MMA problems from improper denture base processing?
   a. Porosity
   b. Internal stresses that cause denture base distortion
   c. Misfit of the denture base to soft tissues
   d. Interfacial separation of the acrylic from the RPD alloy surfaces
   e. Interfacial separation of the acrylic from the porcelain teeth

14. What makes a craze different from a crack?
   a. Much smaller in size
   b. Reversible condition with proper thermal treatment
   c. Water can not penetrate
   d. Occur from compressive rather than tensile stresses
   e. Cannot be seen with the naked eye

15. What is the main reason for relining or rebasing an RPD about every 5-8 years?
   a. Wear of the acrylic resin in contact with soft tissues
   b. Misfit due to soft or hard tissue changes over long times
   c. Increased surface roughness after extensive number of cleaning procedures
   d. Water and food bolus absorption into the acrylic denture base
   e. Surface hardening with staining from beverages and food

**DISCUSSION STUDY QUESTIONS:**

- Your RPD patient complains of irritation during the first day of wearing the prosthesis. How do you determine whether the irritation is due to misfit, nickel sensitivity, or monomer elution from the denture base material?
- A new denture base material is advertised that is twice as strong as PMMA and much more stiff. Is this an advantage? Why?
- Under what circumstances would you prescribe using cast alloy or porcelain teeth as portions of the denture base?
- Explain why soft denture liners generally are not practical for treatment of tissue irritation with RPD patients.