

Introduction to Dentistry

lecture 4: Materials used in Dentistry

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Dental materials

- It is the study of **composition** and **properties** of materials used in dentistry and the way they interact with the oral environment.
- The oral cavity is considered to be the harshest environment for a material in the body (temperature, ph, saliva, plaque, forces...).
- Every dentist (and dental assistants) should have basic knowledge of the materials used in Dentistry
- The practice of clinical dentistry depends not only on a complete understanding of the various clinical techniques but also on an appreciation of the basic biological, chemical, and physical characteristics of the dental materials in calinical applications.

History of dental materials

- Humans have been making and using dental appliances and dental implants for thousands of years



Restoration of the dentition with the patient's teeth using gold wire ancient egypt around 2500 bc



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Characteristics of dental materials

- It should be:
 1. **Biocompatible** (non-toxic, non-irritating, non-allergic)
 2. **Mechanically stable and durable** (strong, resistant to fracture)
 3. **Resistant to corrosion** (does not deteriorate overtime)
 4. **Dimensionally stable** (little or no change to temperature and solvents)
 5. **Aesthetic** (looks like normal oral tissue)
 6. **Minimal conduction** (insulates against thermal/ electrical change)
 7. **Easy to manipulate**

Classification of Dental materials

- Dental materials can be classified as:

- 1. Preventive dental materials**

- 2. Restorative dental materials**

- Direct
- Indirect

- 3. Auxiliary dental materials**

The classification of dental materials is not very straight forward!

Preventive dental materials

- Aim: to prevent or inhibit the progression of tooth decay
- 1. Pit and fissure sealants**
 - 2. Fluoride treatment:**
 - 3. Mouthwashes and cavity varnishes**

Pit and fissure sealants

- Pits and fissures of the occlusal surfaces of the posterior teeth are more prone to caries development than the smooth surfaces due to their morphological complexity.
- The use of pit and fissure sealants provides a physical barrier that inhibits microorganisms and food particles accumulation, preventing caries initiation, and arresting caries progression .

Pit and fissure sealants



Fluoride treatment

- Professionally applied fluoride therapy to prevent and arrest caries in children and adults.
- Early childhood caries remains highly prevalent in many countries.
- Routine tooth brushing is inadequate in cleaning
- The mechanism of action of fluoride is the **inhibition of demineralization and enhancement of remineralization**
- Sodium fluoride (NaF) 5% varnish is a professional topical fluoride



Restorative dental materials

Materials used in Restorative Dentistry

- Restorative dental materials are the foundation for the replacement of tooth structure.
- **Amalgam alloys, resin composites,, glass ionomers, ceramics, cements, primers, bonding agents, noble and base metals,.**
- Can be classified to:
 1. **Direct restorations** are generally placed directly onto tooth structure and do not require laboratory preparation.
 2. **Indirect:** formed indirectly over a cast or moth model in the lab by a technician

Amalgam

- Dental amalgam is a restorative material that has been used in dentistry for many years.
- Mercury alloys mixed with other metals
- The main ingredients of amalgam alloy are silver (Ag), tin (Sn), copper (Cu) and **mercury (Hg)**. Small amounts of zinc (Zn) and palladium.
- Easy to handle, durable and cheap material
- Used in posterior teeth
- Its use has become questionable!!!!!!



Review | [Open access](#) | [Published: 13 January 2011](#)

Is dental amalgam safe for humans? Mercury : the scientific committee of the European

Review > Neurotoxicology
Epub 2020 Oct 14.
doi: 10.1016/j.neuro.2020.09.034.

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The Dental Amalgam

Review > Neurotoxicology
Epub 2020 Oct 14.

Mercury in dental amalgam: a risk analysis

[Toxicol Int.](#) 2020 Dec;81:382–386. doi: 10.1016/j.neuro.2020.09.034.

of dental amalgam and alternative dental on materials for patients and users

[Toxicol Int.](#) 2016 Aug;79:108–109. doi: 10.1016/j.yrtph.2015.12.015. Epub 2016 Jan 18.

Amalgam: a risk analysis

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Resin composites

A resin composite material is a material made from two or more substances

Aesthetics restorative material for anterior teeth

Consist of an **organic resin**, **reinforcing filler** and a **coupling agent**.

Are usually used in conjunction with acid etching , primers and bonding agents. Added as increments (layers)



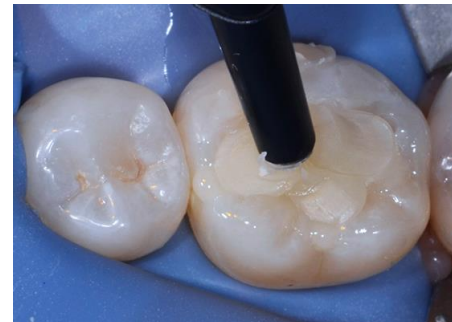
Acid etching



Bonding



Light cure



Composite filling



Light cure

Glass ionomer

- Was introduced in 1972. it sets *by* an acid-base reaction between polymers of polyacrylic acid and fluoro-aluminosilicate bases.
- **Advantages:** fluoride release and its unique ability to bond chemically to tooth structure, can be added in bulk.
- **Resin-modified Glass-ionomer:** a glass ionomer with resin composite properties. It contains a resin (like a resin composite) that allows it to be set with a curing light (this is opposite to a **compomer** which is a resin composite with glass ionomer properties)



Ceramics

- **Definition** :Materials that are part of systems designed with the purpose of producing dental prostheses that in turn are used to **replace missing or damaged dental structures (crowns and bridges)**
- Ceramics can simulate the visual character of the tooth substance successfully and are biocompatible materials.
- Porcelain-fused-to-metal (PFM) restoration
- All-ceramic crowns (aesthetics)



Temporary (provisional) restorative materials

- Temporary dental cement such as **zinc oxide eugenol cement**, temporary crown and bridge polymers.
- The traditional odor of dental clinics in the past is due to the use of eugenol or oil of cloves and eugenol containing dental materials such as Zinc oxide eugenol cement.
- **Intermediate restorative materials IRM**



Endodontic Materials Used To Fill Root Canals

- **Gutta-Percha:** Materials used to “obturate” canals after endodontic treatment
- **Sealers:** binding agents used to adapt the rigid gutta percha to canal walls and fill up the voids



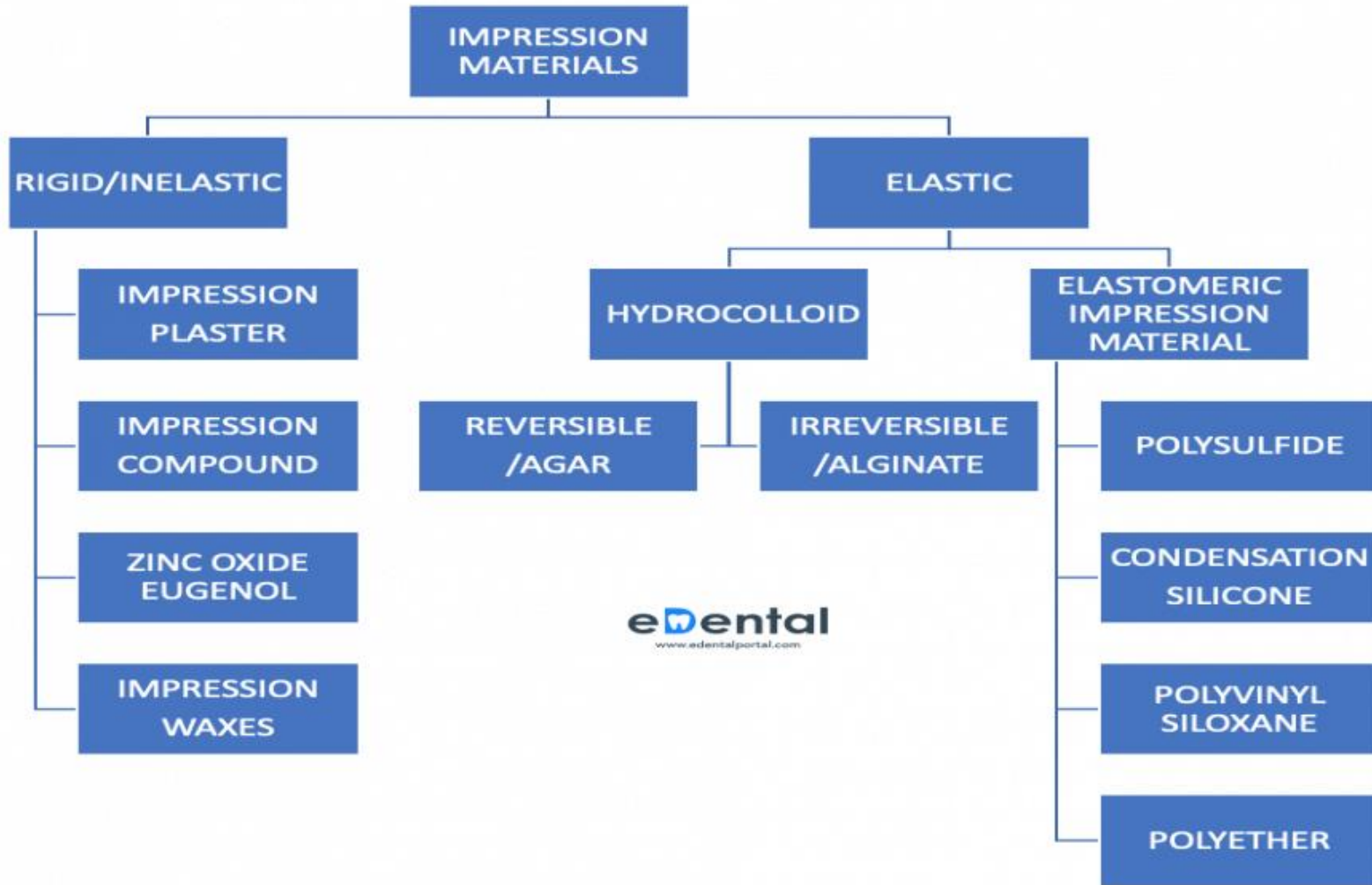
Auxiliary dental materials

- Materials used in the process of fabricating dental prosthesis.
These include:
 1. Impression materials
 2. Dental waxes
 3. Gypsum casts
 4. Finishing and polishing abrasives
 5. Acrylic resins

Impression materials

- **Impressions** are used in the dental clinics to produce accurate negative reproductions of the patients' teeth, surrounding tissues and dental arches.
- **Casts** (positive reproductions) are created from dental impressions and are used to fabricate various dental prostheses.
- **Impression trays** are used to hold the impression material, allowing the operator to place it into the patients' mouth.





Dental waxes

- Waxes have a variety of uses within dentistry and are manufactured from various materials, including plants, minerals, animals and synthetic waxes.
- They are thermoplastic materials that present as solids at room temperature; they can be softened with heat and hardened with cooling.



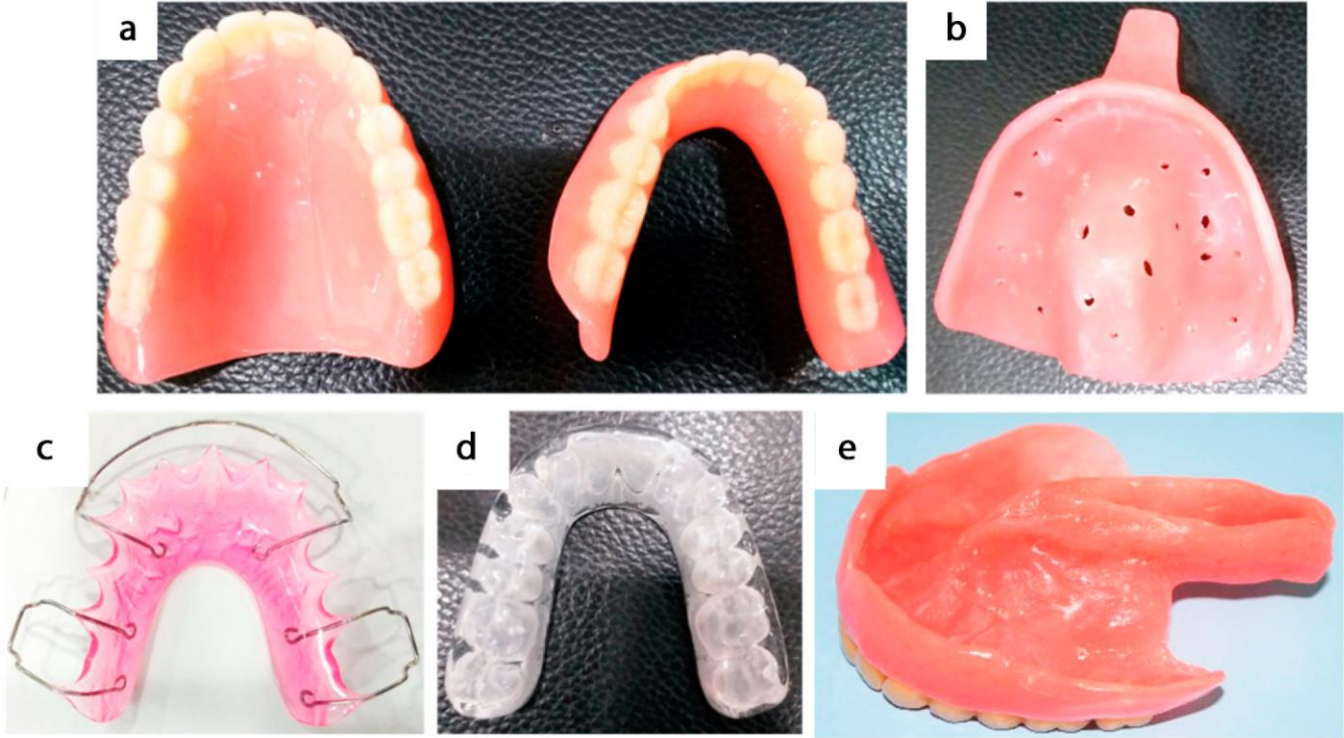
Gypsum casts

- Gypsum (calcium sulphate dihydrate) is a naturally occurring mineral used in dentistry to fabricate models
- Many dental appliances and restorations are constructed **extra-orally** using models, dies (one tooth) and casts (replicas of the patients tooth/teeth and surrounding tissues).



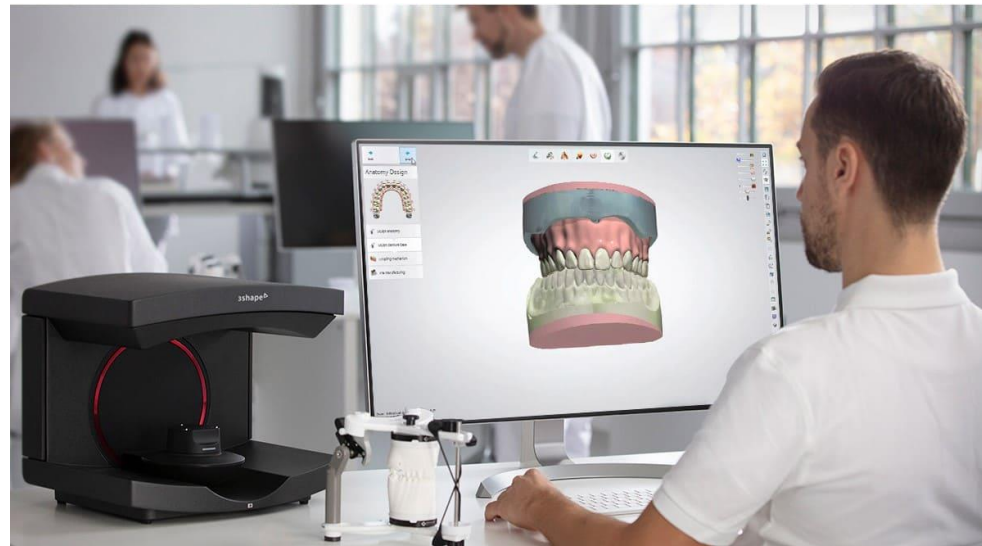
Acrylic resins

Applications of Denture Base Materials



CAD/CAM

- Computer-aided design/computer-aided manufacturing (CAD/CAM) techniques
- Due to CAD/CAM technology, patients occasionally get restorations on the same day



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