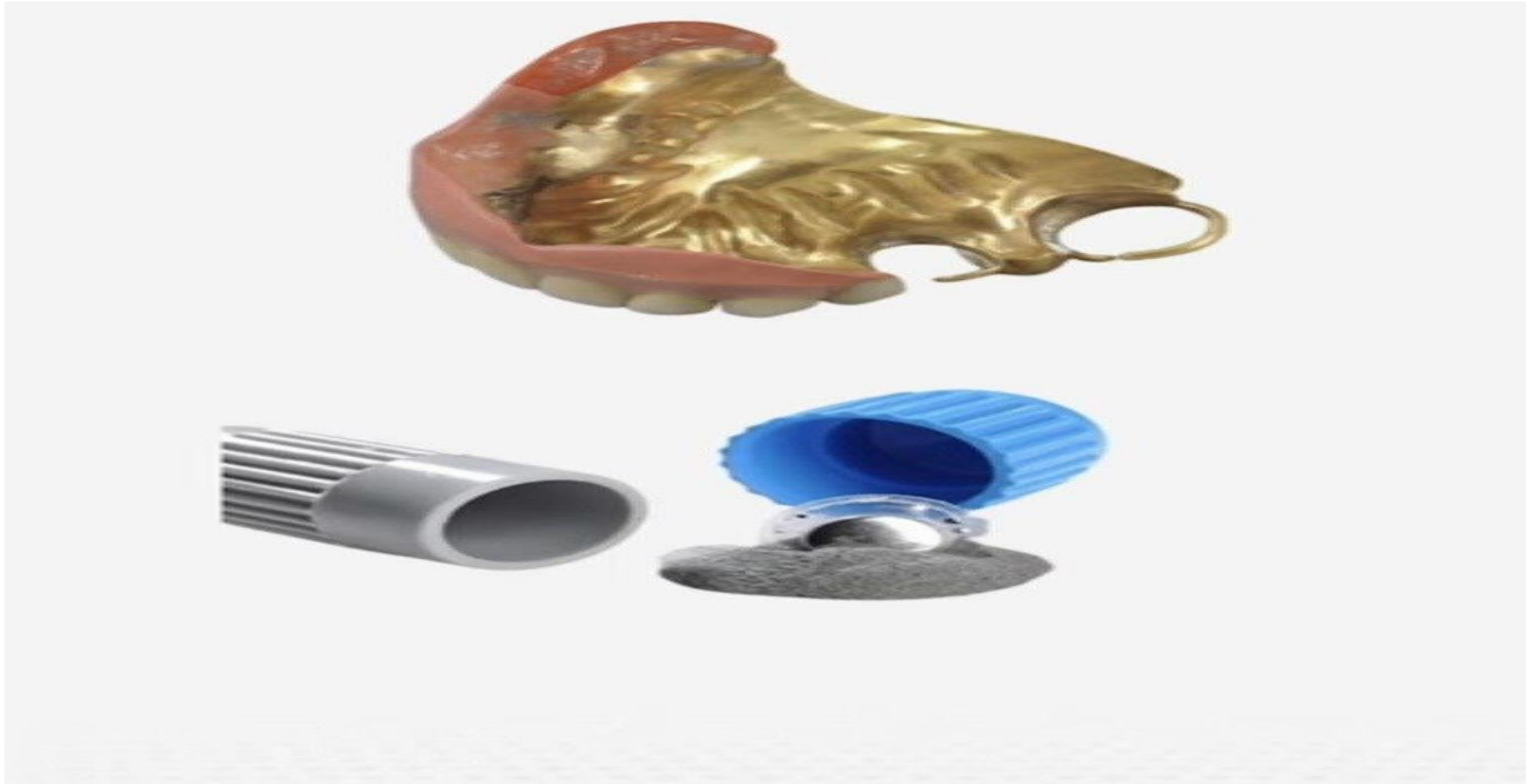


## Dental material :

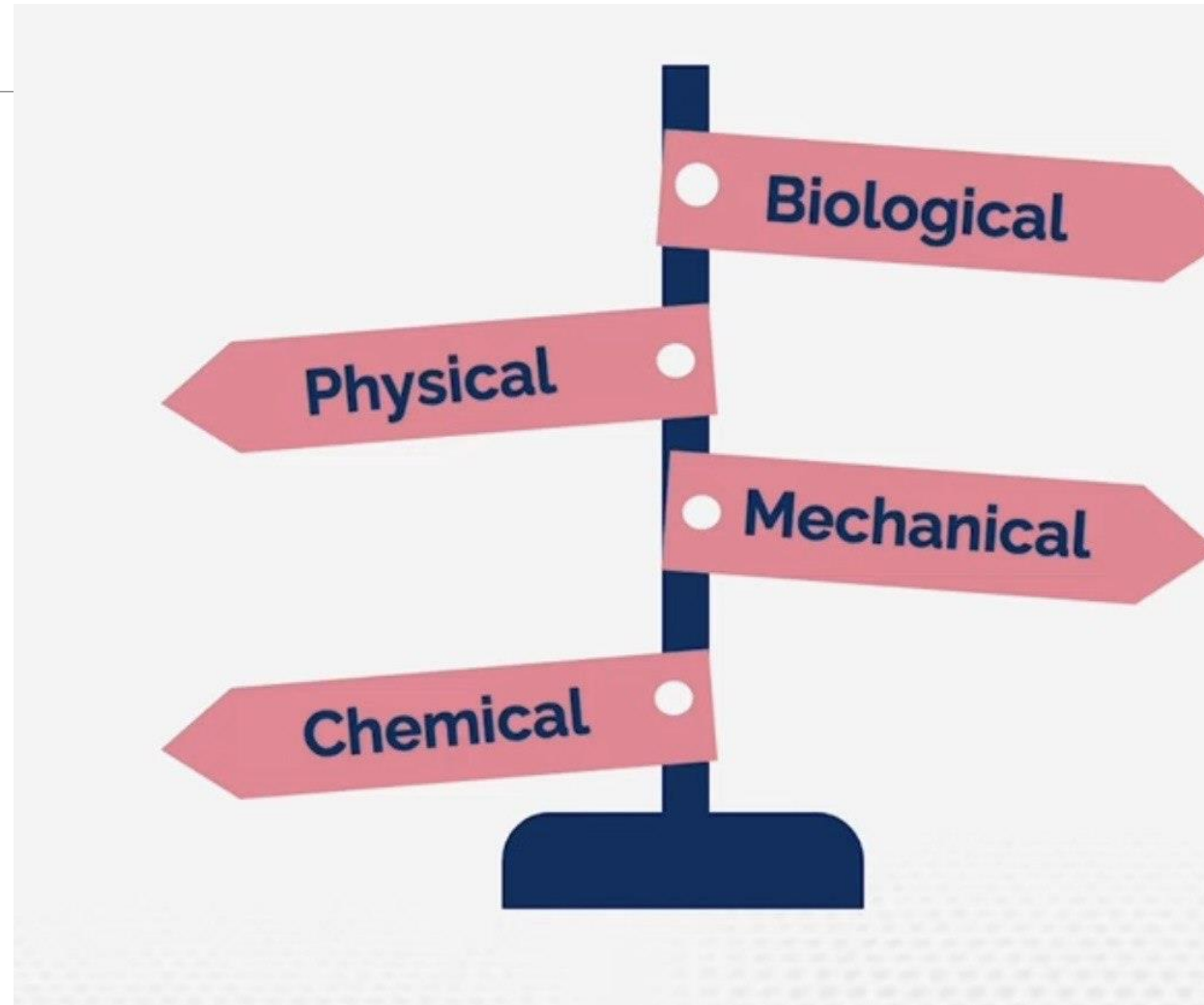
It is the science which deals with materials used in dentistry ,their physical and mechanical properties and their manipulation as such properties are related to the proper selection and use by the dentist .

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# Properties of dental materials



# Biological requirements of dental material:

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A dental material should be :

1-Be **non toxic** to the body.

2-Be **non- irritant** to the oral or other tissues.

3-**Not** produce **allergic reactions** and ,not **be mutagenic** or **carcinogenic**.

# biocompatibility

Is the ability of a material to elicit an appropriate biological response in each application in the body

Single material may not be biologically acceptable in all applications

For example, a material that is acceptable as a **full cast crown** may not be acceptable as a **dental implant**.



# Physical properties

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**1- Color**

**2- Density**

**3- Solubility**

**10- Absorption of Fluids**

**4- Dimensional Stability**

**5- Thermal Conductivity**

**6- Thermal Diffusivity**

**11- linear coefficient of thermal expansion and contraction**

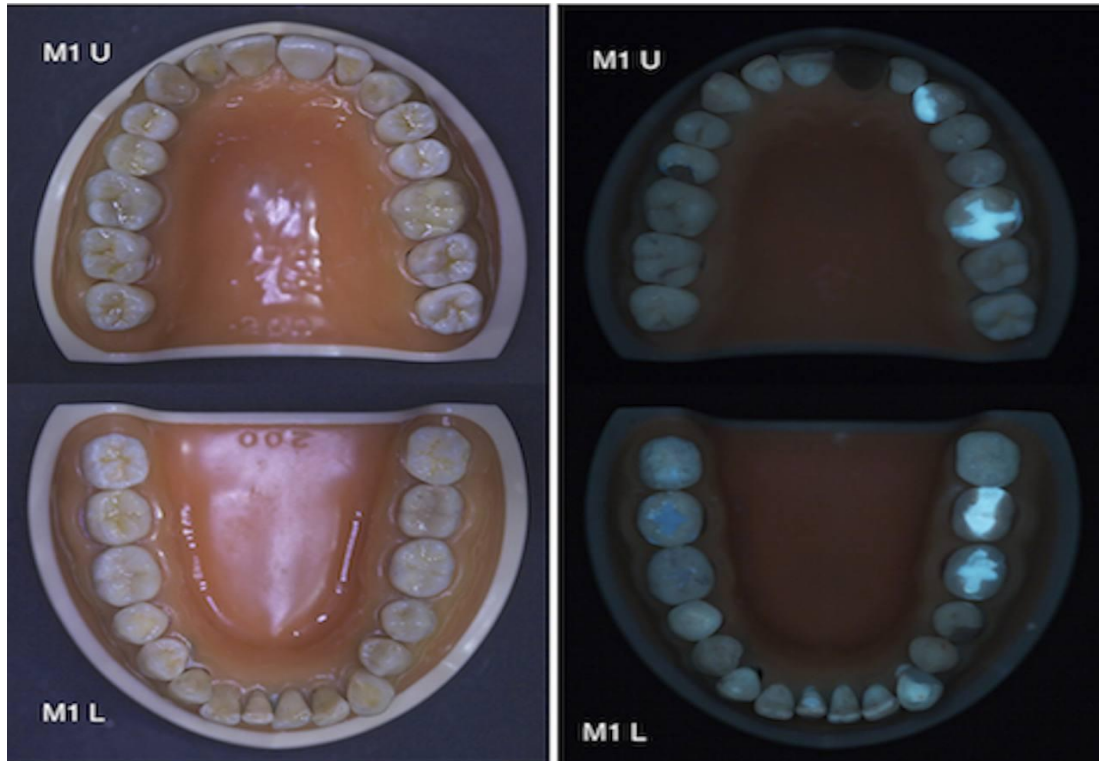
**7-Electrical Activity**

**8- Adhesion & cohesion**

**9- Tissue Reaction**

# Color: Esthetic, not stained

**For good esthetics**, the interaction of light with restorative materials must mimic the interaction of light with natural teeth. The dental restorative materials should be translucent in order to look like a natural teeth, and also should not be stained or changed the color by time ;ex anterior filling and artificial teeth.



# Color: Translucent

is the optical property that allows the light to go short way in the material before being reflected out again .Also should look like natural tooth substance at different light conditions ,such as day light and artificial light ,ex .an artificial tooth may be acceptable in ordinary light but may be discovered the relative darkness of the material in fluorescent light .For dentures ,the material should have the same appearance of natural gum .Acrylic material can be made with various shades of pink to look as normal gum



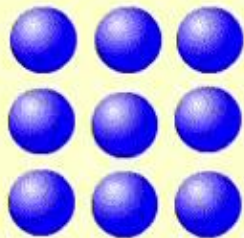


# Linear coefficient of thermal expansion and contraction:

which is the change in length per unit length for 1 C0 temperature change.

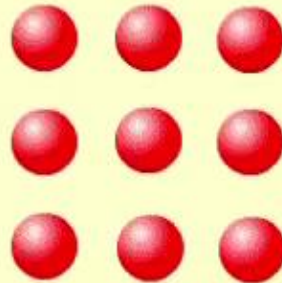
A final length- original length/original length\*temp change (cm/cm .C ).**Hard tooth structure** has the **smallest** coefficient, **metals** are **intermediate** ,and **polymers** have the **largest** .Tooth :  $11 \times 10^{-6}$  cm/cm.C ,Gold:  $14 \times 10^{-6}$  cm/cm.C ,impression compound : $250 \times 10^{-6}$  cm /cm. C , Acrylic resin:  $76 \times 10^{-6}$  cm/cm.C , Composites :  $14-50 \times 10^{-6}$  cm/cm .C .

$$\alpha = \frac{L_{\text{final}} - L_{\text{original}}}{L_{\text{original}} \times (\text{°C final} - \text{°C original})}$$



All particles in a solid vibrate - even when cold.

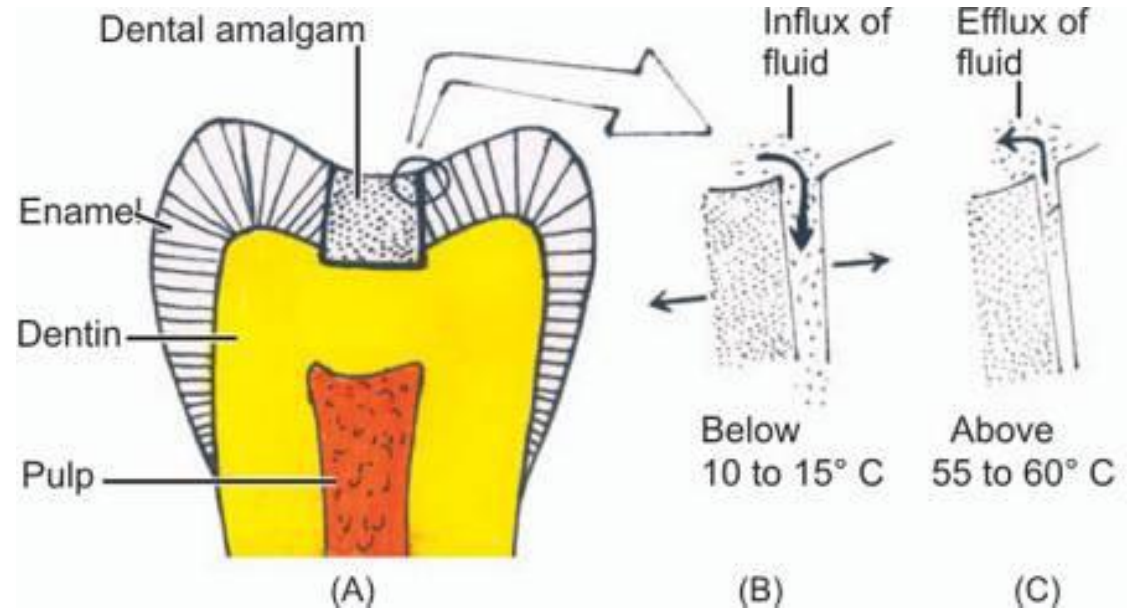
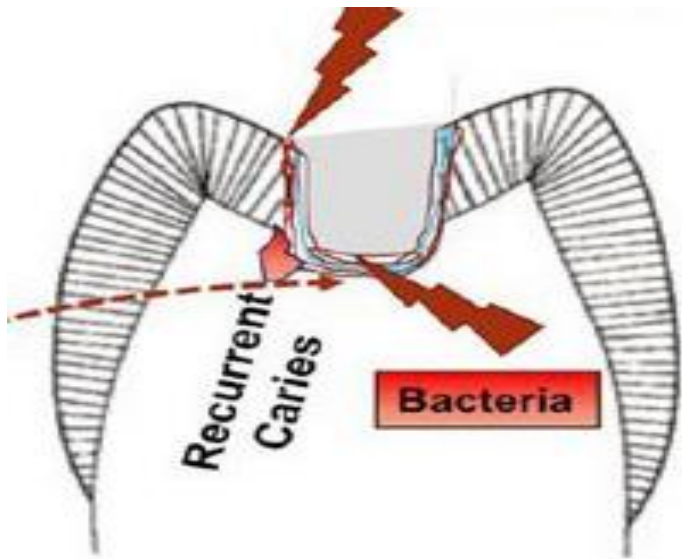
A Cyberphysics graphic 2010



At higher temperatures they vibrate faster and take up more room - expand - but the particles themselves are still the same size.

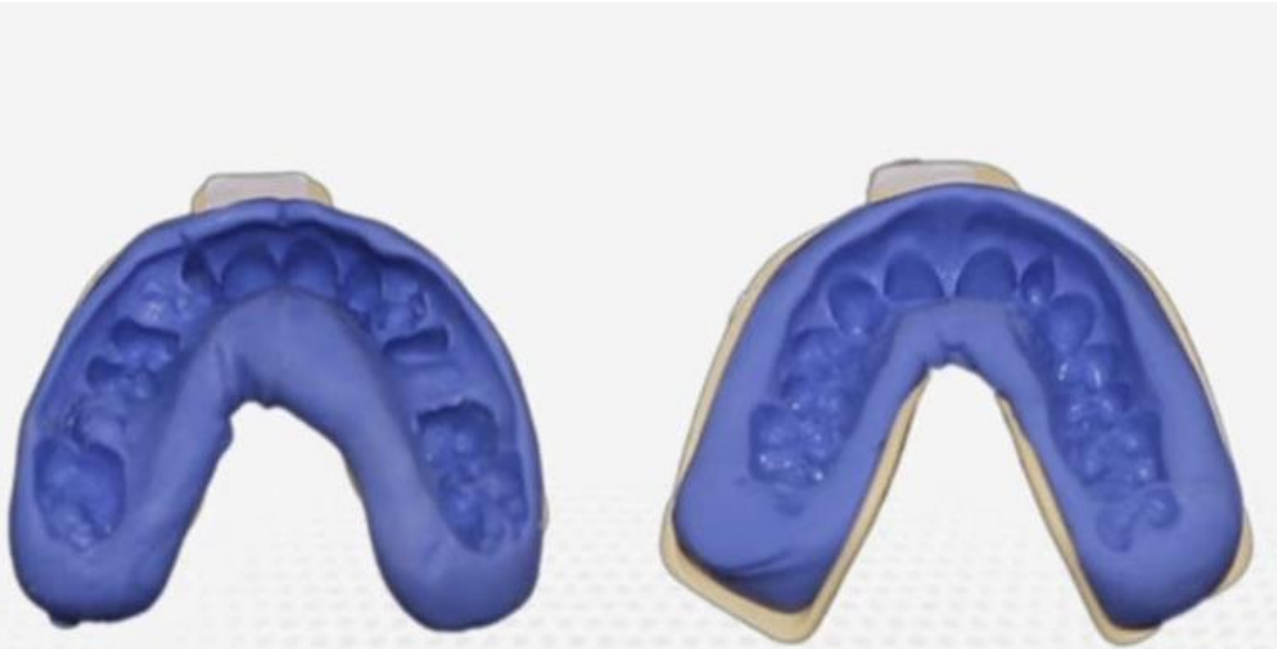


Filling materials should have the same coefficient as the tooth, if it does not, it will press too hard against the cavity wall on expansion and may cause pressure on the pulp, or pull away from the wall when chilled by cold water. The later effect will cause the filling to leak temporarily, which may lead to further caries.





**Dimensional stability:** many materials change shapes when they set or harden. Impression materials should not change dimensions when set. Also, dental materials should have no dimensional changes after setting. Amalgam is filling material for posterior teeth; it may expand or contract, depending on its manipulation. Ideally, dimensional changes should be small. **Excessive contraction** can lead to micro leakage and secondary caries. **Excessive expansion** can produce pressure on the pulp and post operative sensitivity.



**Density** :Lightness is nearly always an advantage in restorative materials, but sometimes tin or lead is used inside full lower denture to make it heavy to control its mobility .

**Density of gold:**14 gm/cm<sup>3</sup> .

**Acrylic :**1.2 gm/cm<sup>3</sup> .

**Chromium / cobalt:** 8.3 gm/cm<sup>3</sup> .

**Water :** 1gm/cm<sup>3</sup>



**Complete Denture**

- **Solubility** : Restorative materials should not dissolve in the mouth, and if it dissolves, it should not release toxic substances. It is measured in  $\text{Mg}/\text{mm}^2$ . Solubility of composite:  $0.01\text{Mg}/\text{mm}^2$ . Solubility of resin cement maximum :  $7.5\text{ Mg}/\text{mm}^2$ .

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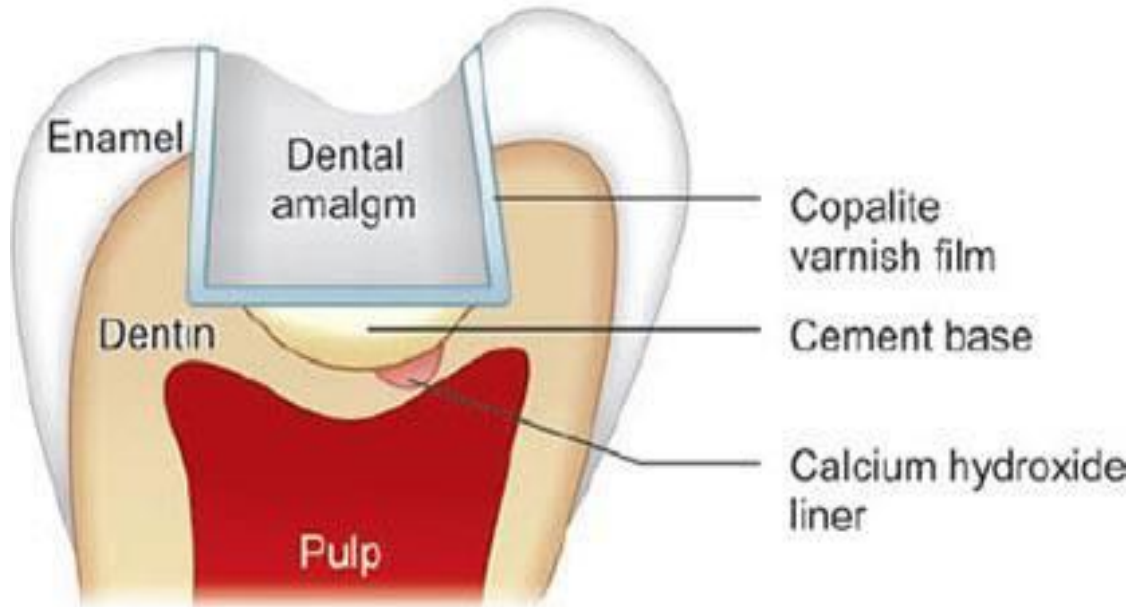
- **Absorption of fluids** : Some materials will absorb water or other fluids. If it is too much or continued for long time, this will result in serious dimensional changes and the material would also be unhygienic. On the other, some materials like acrylic will absorb water for a day and stop after that, so it is acceptable. Water absorption of composites  $40\text{Mg}/\text{mm}^2$

- **Tissue reaction** : Some restorative materials are damaging to the living tissue which is in contact with, like silicate filling and zinc phosphate cement which is acid and may kill the dental pulp unless a protective lining is used. Dental material should not show any allergic reaction to the tissue and also should not provide good culture to the growth of bacteria and *Candida albicans* to grow and cause infection, like soft lining materials.

- **Thermal conductivity** :Is the physical property that deals with heat transfer through a material by conductive flow .It is defined as the **quantity** of heat in calories per second passing through a material 1 cm thick with cross section of 1cm<sup>2</sup> having a temperature difference of 1C

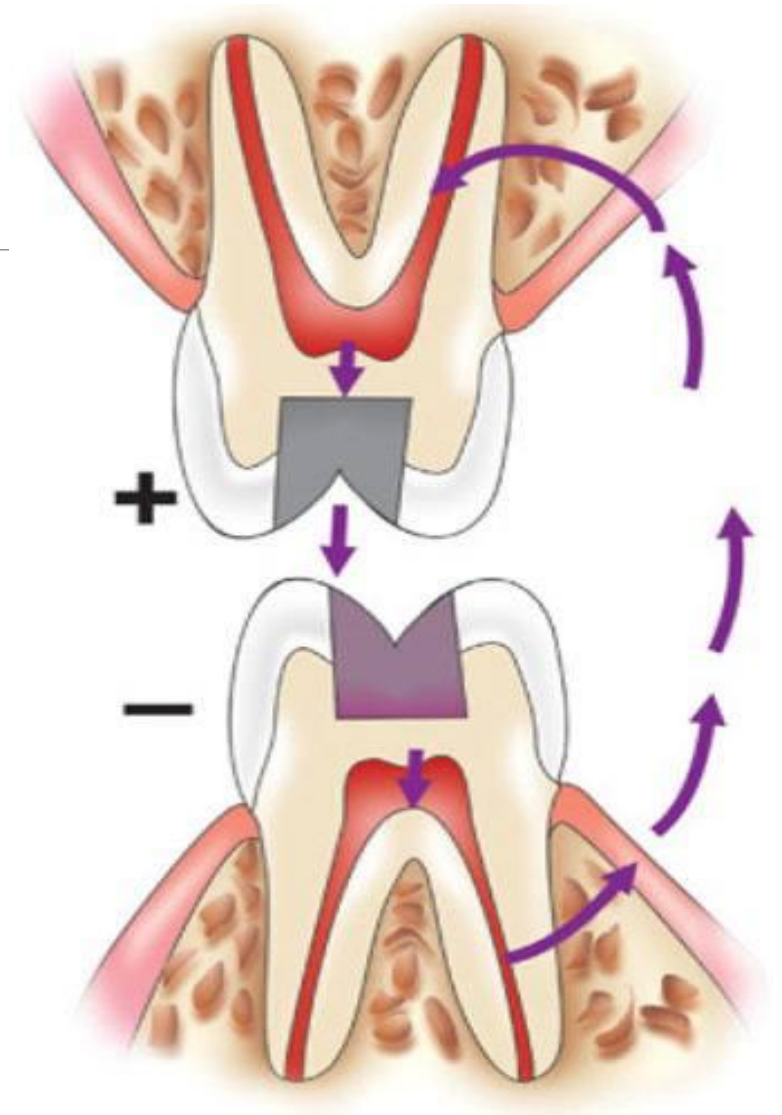
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On the other hand, the thermal conductivity of metallic denture base material is an advantage as it gives feeling closer to the normal condition and the patient will feel normal also it will protect him from drinking very hot drinks which may burn his mouth.



-**Thermal diffusivity** :is the measure of the **speed** with which a temperature change will spread through an object when one surface is heated. It is calculated from the thermal conductivity divided by the product of density and heat capacity:  $h=K/CP *$

-**Electrical Activity** : It is the ability of metals to ionize by losing electrons .If there is a high difference in the electrode potentials of two metals in contact with the same solution like gold and aluminum, an electrolytic cell may develop and the patient may feel discomfort.Enamel: $2.9*10^6$  Ohm.cm. Zinc oxide eugenol : $10^9 -10^{10}$ Ohm.cm





**Electrochemical properties:** The use of wide variety of metals for restorations and prosthetic devices the successful clinical performance and long term durability which require adequate corrosion resistance in the oral environment .

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**Corrosion** :is the electrochemical process and is dependent on the ability to conduct electrical current either by means of free electrons in metals or via ions in solutions.

**Tarnish:** is a surface discoloration on a metal or a slight loss or alteration of the surface finish or luster.

**Adhesion and cohesion** :Adhesion is the force which causes two or more different substances to attach when they are brought in contact with one another .When the molecules of the same substances hold together ,the forces are said to be cohesion