Selection of a Suitable Restorative Material

Chapter outline:
- Available restorative materials
  a) Permanent restorative materials
  b) Temporary restorative materials
- Requirements for an ideal restoration
- Assessment of restorative material behavior
- Factors influencing selection of the suitable restorative material
  I- Factors concerning the available restorative materials
  II- Factors concerning the patient
    a- Factors related to the general condition of the patient.
    b- Factors related to the oral cavity.
    c- Factors concerning the tooth to be restored.
    d- Factors related to the cavity to be restored.
  III- Factors related to the operator
Available restorative materials can be classified according to their durability and purpose of use into:

A- Permanent restorative materials:

I. Metallic:
   i. Gold.
      a. Gold foil which is pure gold.
      b. Cast gold which is gold alloy.
   ii. Silver amalgams:
      a. Zinc containing alloy.
      b. Zinc free alloy.

II. Non metallic:
   i. Castable ceramics.
   ii. Resin composites.
   iii. Glass ionomer restoratives.
   iv. Polyacid-modified composite resins.
   v. Resin modified glass ionomer

B- Temporary restorative materials such as:
   i. Zinc oxide-eugenol cement.
   ii. Zinc phosphate cement.
   iii. Zinc polycarboxylate cement.
   iv. Calcium hydroxide cement.
   v. Glass ionomer cement.
   vi. Ready-made temporary materials.

Requirements for an ideal restoration:
1. It should stop further progress of the present lesion such as caries, attrition, abrasion, erosion or fracture.
2. It should restore normal function of the affected tooth as mastication of food.
3. It should restore any speech defects due to missing parts of the hard tooth structures.
4. It should restore normal esthetic.
5. It should restore and maintain the integrity of the dental arch and its surrounding periodontium.
6. It should sustain the normal physiologic occlusal load without fracture and it should protect the remaining hard sound tooth structures from fracture.
7. It should protect and maintain pulp vitality.

In order to get successful restoration according to the previously enumerated requirements, the selected restorative material should be the most suitable one.

**Assessment of some restorative materials behavior:**

1. **Indestructible and/or insoluble in the oral fluids:**

   It should be indestructible or insoluble in fluids such as saliva, water, soft or hot drinks and juices. These fluids may alter the pH of saliva according to their chemical contents. Metallic, ceramic and resinous restorative materials can resist solubility in oral fluids. However, **glass ionomer** and **silicate cement** restorations cannot resist solubility. Moreover, luting cements such as **zinc phosphate** or **zinc polycarboxylate** cements are relatively soluble in the oral fluids particularly in acidic media while **resin cements** are insoluble.

2. **Bond chemically to hard tooth structure:**

   It should bond chemically to the surrounding hard tooth tissues, or at least, it should maintain constant adaptation with the surrounding cavity walls at the tooth-restoration structure interface.

   The importance of adhesion or adaptation is to provide marginal seal to prevent or minimize the ingress of
oral fluids and bacteria to the dentin-pulp organ. Thus, post restorative hypersensitivity of dentin, recurrent caries, pulp affection and discoloration of both restorations and tooth structures will be minimized.

Glass ionomer whether restoration or luting cement has the ability to bond chemically with the hard tooth structure. Direct gold provides satisfactory adaptation with the surrounding cavity walls because it depends on the frictional grip of viscoelastic dentin. Amalgam has a self sealing property due to the release of the corrosion products.

Cast restorations suffer from marginal leakage due to the solubility of the luting cement. Acrylic resin and resin composite restorations do not adhere or adapt to the cavity walls due to their polymerization shrinkage and their different coefficient of thermal expansion and contraction. This behavior encourages marginal percolation through the space created at the tooth- restoration interface which will negatively affect the pulp. Loss of adaptation of silicate cement restorations can be due to their solubility, particularly in acidic media.

3. **Withstand functional forces:**

It should withstand functional forces without fracture, permanent deformation or wear and protects the surrounding hard tooth structures from fracture. Moreover, it should have high surface hardness to retain its smooth shiny surface. Ceramic and gold restorations fulfill this property. Amalgam restorations suffer from tension, shear, flow and creep. Silicate cement has low strength properties and low shear resistance. Glass ionomer and resinous restorations cannot resist wear.

4. **Dimensionally stable:**
It should maintain its dimensional stability inside the cavity. The restoration should be free from any volumetric changes after its placement inside the cavity. If it expands, it will result in overhanging margins or formation of premature contact, which may fracture due to stress concentration. Furthermore, it may exert pressure on dentin and create discomfort for the patient and may lead to pulp hyperemia or pulpitis. On the other hand, contraction or shrinkage of the restoration inside the cavity may cause marginal leakage with its subsequences or it may lead to looseness and displacement of the restoration.

Ceramic and gold restorations are stable inside their cavities. Amalgam restorations may expand due to either excess mercury or moisture contamination. They may contract inside their cavities during their hardening. Resin composite restorations shrink less than acrylic resins during their polymerization. Glass ionomer restorations show some contraction during their setting but they do not create marginal leakage due to their chemical bonding ability with the hard tooth tissue and their matching coefficient of thermal expansion and contraction.

5. Biologically compatible:

It should be biologically compatible with the pulp and adjacent soft tissues. The biologic reaction of the restoration depends on many factors such as; pulp condition, thickness of dentin bridge, reparative power of the pulp, chemical composition of the restorative materials, restorative technique and behavior of the restoration inside the oral cavity.

Normal pulp response to irritation is the formation of secondary reparative dentin. However, large and bulky
metallic restorations can conduct thermal shocks to the pulp due to its high thermal conductivity. The acid contents of some restorative materials and luting cements may cause chemical irritation to the dental pulp particularly in deep cavities. Moreover, the volumetric contraction of some restorations such as resin composite can create leakage space at the tooth-restoration interface and leads to bacterial irritation for the pulp.

**Glass ionomer** restorations are the best regarding the biological compatibility. This can be attributed to their chemical bonding ability with the adjacent tooth structures and to the high molecular size of the polyacrylic acid. **Castable ceramic** restorations are biologically compatible due to their thermal insulating property and their highly smooth glazed surfaces. **Direct gold** cause thermal and/or traumatic irritation to the pulp. Moreover, it may lead to chipping or crazing of enamel.

Large **amalgam** restorations conduct thermal shocks to the pulp in addition to their metallic corrosion products which penetrate the dentinal tubules. Most of the previously mentioned irritational factors can be controlled by using suitable cavity linear and/or base material. These materials can protect the pulp from both chemical and thermal irritation of the restorations.

6. **Harmonious color:**

It should have harmonious color simulating the affected tooth. The selected color should be very close to the combined color of the enamel and dentin. The restoration should have the ability to reflect the light similar to the surface of the tooth.
Porcelain restorations can provide perfect color matching to that of the affected tooth. They can maintain their color unchanged because they do not absorb fluids nor retain any surface deposits. Resin composite restorations are very satisfactory during their early placement. However, by time, surface, marginal and bulk discoloration was observed. The rate of discoloration is changeable from a person to another according to the type of the composite material, technique of application and patient habits i.e. drinks and smoking habits.

Glass ionomer restorations cannot maintain their color for long time. Their surfaces change to the chalky appearance as a result of their solubility in the oral fluids. Unfilled resins restorations change their color faster than filled types. Both gold and amalgam restorations have poor esthetic due to their metallic colors.

7. Reasonable cost:

The restoration should be inexpensive either in its price or in its techniques for production or manipulation. Amalgam is relatively cheaper than gold as a metallic restoration. Construction of each gold restoration through the indirect technique needs more costs than its construction with the direct technique.

Porcelain restorations are the most expensive tooth colored restorative materials. Resin composite restorations come next to ceramic restorations regarding their price. Glass ionomer restorations have costs similar or near to that of composite restorations.

8. Convenient and easy in its manipulation:
It should be convenient and easy in its manipulation. The restorative material should not be sensitive to the human variables of the operator. It should be produced easily without detailed procedures or expensive special equipment.

**Amalgam** restorations satisfy this property. Dental technician participates in the production of **cast gold** restorations. Some participation can be observed in case of castable ceramics. **Direct gold** restorative procedures need skillful operator.

The foregoing discussion indicates that none of the available restorative materials is ideal. For this reason, we have to select the most suitable material for a particular case. The selection depend on the scientific evaluation of the properties of the each material and only after thorough analysis of all factors presented in that individual case as to their influence on this selection.

**Factors influencing selection of the suitable restorative material:**

I. Factors concerning the available restorative materials.

II. Factors concerning the patient:
   a- Factors related to the general condition of the patient.
   b- Factors related to the oral cavity.
   c- Factors concerning the tooth to be restored.
   d- Factors related-to the cavity to be restored.

III. Factors related to the operator.

**I- Factors concerning the available restorative materials:**

The operator should have full knowledge about all available restorative materials. This knowledge should include physical, chemical and biological properties of each
material as discussed before.

II- Factors related to the patient:

A. Factors related to the general condition of the patient:

a. Patient’s age:
   1. Young patients cannot stay for long time on the dental chair. They cannot follow post-restorative instructions carefully. They prefer esthetic restorations wherever indicated.
   2. Middle aged patient prefers ideal restorations.
   3. Old patients cannot withstand long operations on the dental chair. He prefers strong permanent restorations.

b. Patient’s sex:
   1. Male patients prefer strong permanent restorations.
   2. Female patients advocate or prefer esthetics.

c. Patient’s occupation:
   1. Regular patients ask for restorations of reasonable price. They prefer ideal restoration if possible.
   2. Public personalities like esthetic restorations. Those are; politicians, professors and teachers, spokesmen, television and movie stars, diplomats and artists etc…
   3. Few technicians, butchers, fruit sellers, shoemakers and mechanics advocate gold color in esthetic areas.

d. Physical condition of the patient:
   1. Patients with normal physical fitness can stay on the dental chair for the required time without creating any troubles.

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2. Debilitated patients cannot tolerate long work on the dental chair. They prefer indirect restorations.
3. Handicapped patients prefer short term restorations.

e. Educational and social conditions of the patient:
1. Educated patient advocate the most suitable restoration according to their satisfaction.
2. Less educated persons prefer esthetic restoratives.
3. Uneducated patients agree with the operator selection for the suitable restoration.

f. Mental condition of the patient:
1. Normal persons can easily be satisfied with the most suitable restoration according to the knowledge introduced by the dentist.
2. Psychic patients cannot withstand treatment for long time and prefer esthetic restorations.

g. Patient's habits:
1. Patients with smoking habit suffer from staining and from acidic saliva.
2. Alcoholics always suffer from solubility of dental cements.
3. Persons with bruxism need strong restorations with high surface hardness.

h. Economic condition of the patient:
1. Wealthy persons select the best restoration whatever it costs.
2. Ordinary people should be informed about the expenses before starting the restorative procedures.
3. Poor patients prefer amalgam in posterior teeth and resin composite for esthetic restoration.
SELECTION OF A SUITABLE RESTORATIVE MATERIAL
Objective of the Chapter

(1) Types of available restorative materials.
(2) Requirements of ideal restorative materials.
(3) Assessment of restorative material behavior.
(4) Factors influencing selection of the suitable restorative materials.
What are the types of the available restorative materials?

- Restorative materials
  - Permanent
    - Metallic
  - Temporary
    - Non-Metallic
I– Metallic Materials:

i. Gold:
   a. Gold foil which is pure gold.
   b. Cast gold which is gold alloy.

ii. Silver amalgams:
   a. Zinc containing alloy.
   b. Zinc free alloy.
II. Non metallic Materials:

i. Castable ceramics.

ii. Resin composites.

iii. Glass ionomer restoratives.


v. Resin–modified glass ionomer.
B- Temporary Materials such as:

i. Zinc oxide–eugenol cement.

ii. Zinc phosphate cement.

iii. Zinc polycarboxylate cement.

iv. Calcium hydroxide cement.

v. Glass ionomer cement.

vi. Ready made temporary materials.
Requirements for an ideal restoration:

1. Stop the progress of the lesion.
2. Restore normal function.
3. Restore any speech defects.
4. Restore normal esthetic.
5. Restore and maintain the integrity of the dental arch.
6. Sustain the normal physiologic occlusal load.
7. Protect and maintain pulp vitality.
Assessment of some material behavior

1- Indestructible and insoluble
   In the oral fluids such as saliva, water, soft drinks and juices. These fluids may alter the pH of saliva according to their chemical contents.

- Glass ionomer
- Silicate cement
- Zinc phosphate
- Zinc polycarboxylate
- Resin cements.
2. It should **bond chemically** with the surrounding hard tooth tissues, or at least, it should maintain its **adaptation** with the surrounding cavity walls at the restoration - tooth structure interface.

- **Glass ionomer.**
- **Direct gold.**
- **Amalgam.**
- **Cast restorations.**
- **Acrylic resin.**
- **Resin composite.**
3- It should **withstand the functional forces without fracture, permanent deformation or wear**. Moreover, it should have **high surface hardness to retain high surface polish**.

- **Gold.**
- **Ceramic restorations**.
- **Amalgam.**
- **Silicate cement.**
- **Glass ionomer.**
- **Resin restorations.**
4. It should maintain its **dimensional stability** inside the cavity. The restoration should be free from any volumetric changes after its placement inside the cavity.

- Ceramic restorations
- Gold
- Amalgam
- Resin composite
- Glass ionomer
5. It should be biologically compatible with the pulp and adjacent soft tissues. The biologic reaction of the restoration depends on factors such as; pulp condition, thickness of dentin bridge, reparative power of the pulp, chemical make up of the R.M., restorative technique and behavior of the restoration inside the oral cavity.

- Glass ionomer
- Castable ceramic
- Direct gold
- Amalgam
- Resin composite
6. It should have harmonious color simulating the affected tooth. The selected color should be very close to the combined color of the enamel and dentin.

- Porcelain
- Resin composite
- Glass ionomer
- Gold
- Amalgam
7. It should have **reasonable cost**. The restoration should be inexpensive either in its price or in its techniques for production or manipulation.

- Amalgam
- Gold
- Porcelain
- Resin composite
- Glass ionomer
8. It should be convenient and easy in its manipulation. The restorative material should not be sensitive to the human variables of the operator.

- Amalgam
- Cast gold
- Ceramic restorations
- Direct gold
Factors influencing selection of the restorative materials

I. Factors concerning the available restorative materials.

II. Factors concerning the patient:
   a– Factors related to the general condition of the patient.
   b– Factors related to the oral cavity.
   c– Factors concerning the tooth to be restored.
   d– Factors related to the cavity to be restored.

III. Factors related to the operator.
Factors concerning the patient

Factors related to the general condition of the patient

a. *Patient’s age:*

1. Young patients cannot stand prolonged procedures cannot follow instructions prefer esthetic restoratives

2. Middle aged patient prefers ideal restorations

3. Old patients cannot withstand long operations prefer strong permanent restorations
Factors related to the general condition of the patient

b. Patient’s sex:
1. Male patients prefer strong permanent restorations.
2. Female patients advocate esthetic.
Factors related to the general condition of the patient

c. Patient’s occupation:

1. Regular patients ask for restoration of reasonable price. They prefer ideal restoration if possible.

2. Public personalities like esthetic Restorations as politicians, professors teachers, movie stars, and artists.

3. Few technicians, butchers, fruit sellers, shoemakers and mechanics advocate gold color in esthetic areas.
Factors related to the general condition of the patient

d. Physical condition of the patient:
1. Fit patients → Stay on dental chair for the required time
2. Debilitated patients → Cannot tolerate long procedures prefer cast restorations.
3. Handicapped patients → Prefer short term restorations.
Factors related to the general condition of the patient

e. **Educational and social conditions of the patient**

1. Educated patient → the most suitable restoration

2. Less educated persons → prefer esthetic restoratives

3. Uneducated patients → agree with operator selection
Factors related to the general condition of the patient

**f. Mental condition of the patient:**

1. Normal persons can easily be satisfied with the most suitable restoration according to the knowledge introduced by the dentist.

2. Psychic patients cannot withstand treatment for long time and prefer esthetic restorations.
Factors related to the general condition of the patient

**Patient's habits:**

1. Patients with smoking habit suffer from stains and acidic saliva.

2. Alcoholics always suffer from solubility of dental cements.

3. Persons with bruxism need strong restorations with high surface hardness.
Factors related to the general condition of the patient

h. Economic condition of the patient:
1. Wealthy persons select the best restoration whatever it costs.
2. Ordinary people should be informed about the expenses first.
3. Poor patients prefer amalgam in posterior teeth composite for esthetic restoration.
Thank You