Principles of tooth preparation

The principles of tooth preparation can be divided into three broad categories:

1. **Biologic consideration:** which affect the health of the oral tissues.

2.**Mechanical considerations:** which affect the retention and the resistance form and resistance to deformation.

3. **Esthetic considerations**: which affect the appearance of the patient.

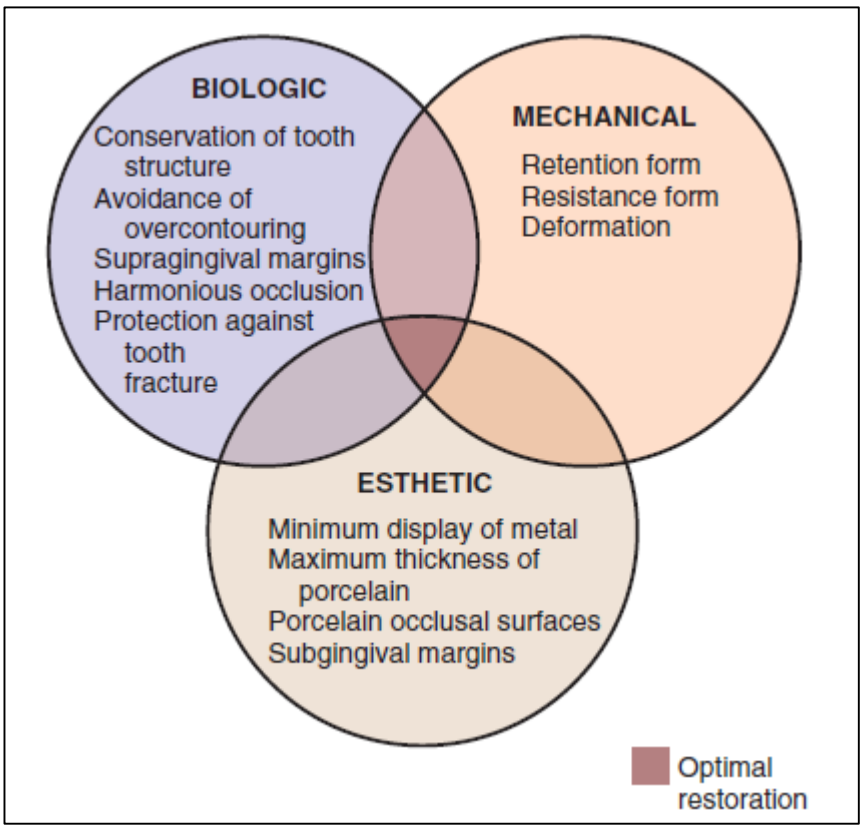

Fig.(1) The optimum restoration should satisfy biologic, mechanical, and esthetic requirements.

1) Biologic consideration

1. **Conservation of tooth structure**: One of the basic tenets of restorative dentistry is to conserve as much tooth structure as possible because the excessive cutting leads to:

a) Thermal hypersensitivity, pulpal inflammation and may be lead to necrosis.

b)The tooth might be over tapered or shortened and thus affecting the mechanical properties (retention and resistance) of the prepared tooth.

2.Prevention of damage during tooth preparation to:

a) The adjacent tooth.
b) Soft tissue.
c) The pulp.

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a) *The adjacent tooth*.

Iatrogenic damage to the proximal contact area of adjacent tooth makes it more susceptible to dental caries. Therefore, a metal matrix band put around the adjacent tooth for protection may be helpful but the preferred method is to use a fine, tapered fissure diamond bur to pass through the interproximal contact area leaving a slight lip of enamel without causing excessive tooth reduction.

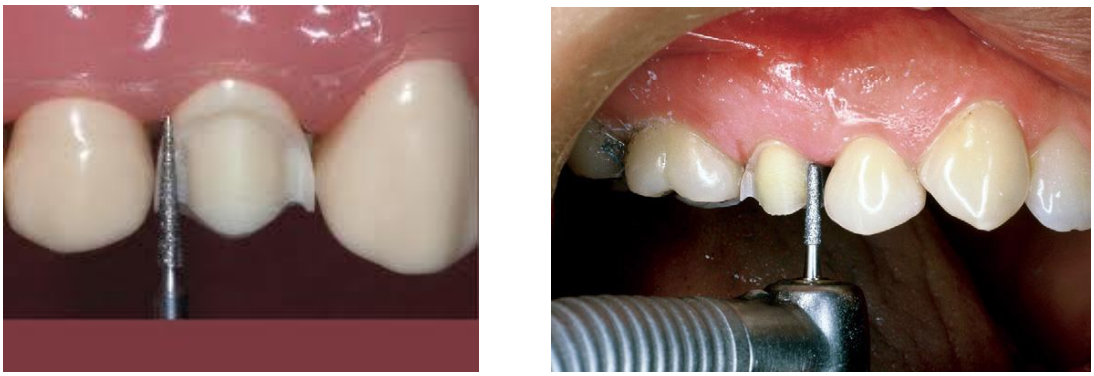


Fig. (2) Damage to adjacent teeth is prevented by making a thin "lip" of enamel as the bur passes through a proximal contact.

b) Soft tissues: Tongue and cheeks can be preserved by careful retraction with an aspirator tip, mouth mirror. Using gingival retraction cord to reflect the gingiva in case of subgingival finishing line.

c) The pulp: Tooth preparations must take into consideration the morphology and size of the dental pulp chamber.

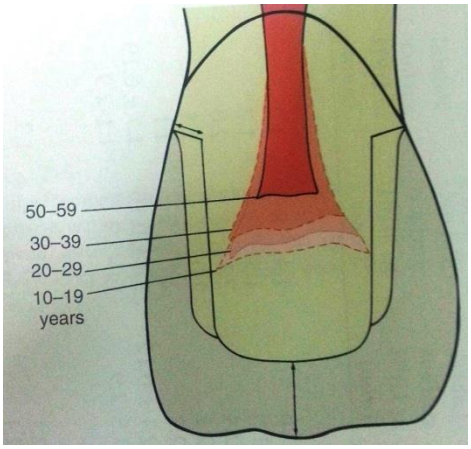


Fig.(3) Relationship between tooth preparation and pulp chamber size. The dotted lines represent pulp chamber morphology at various ages. A, Maxillary central incisor with a metal-ceramic crown preparation

Causes of pulpal damage:

☒ **Extreme temperature**: This is generated by friction between a rotary instrument and the surface being prepared, and this depends on:-

- Excessive pressure
- Higher rotational speed
- Type and condition of cutting instrument.

This heat can be minimized by the use of water coolant high speed with light touches.Water coolant is useful because it cools the tooth and the bur, and removes the tooth debris from the cutting blades because clogging reduces the cutting efficiency and generates more frictional heat.

☒ **Chemical irritation.**

Certain dental materials (bases, restorative resins, solvents, and luting agents) can cause pulpal damage when applied to freshly cut dentin. cavity varnish or dentin-bonding agents will form an effective barrier in most instances but their effect on the retention of a cemented restoration is controversial.

☒ **Bacteria irritation.**

Bacteria that either left behind or gained access to the dentin because of microleakage lead to pulpal damage. Because the vital pulp resist infection, the common use of antimicrobial agent such as consepsis after tooth preparation has not been documented in clinical trial.

3). Preservation of periodontal tissue: which is the most important considerations for the future dental health:

a) The restoration should have proper contact, embrasure form, occlusion and a healthy occluso-gingival contour otherwise a persistent gingival inflammation occur. (Difficult to maintain plaque control by the patient).

b) Whenever possible the margin of the preparation (finishing line) should be placed supragingivally.

2. Mechanical considerations

The design of tooth preparations must adhere to certain mechanical principles; otherwise, the restoration may become dislodged or may distort or fracture during service.

Mechanical considerations can be divided into three categories:

1. Providing retention form.

2. Providing resistance form.

3. Preventing deformation of the restoration.

1. Providing retention form:

Retention: is the ability of the preparation to resist the removal of the crown restoration along its path of insertion.

Path of insertion: An imaginary line along which the restoration can be inserted and removed without causing lateral forces on the abutment.

The crown restoration should have a single path of insertion to be retentive. Which is mostly parallel to the long axis of the tooth as shown in fig.(4) but sometimes not parallel for example: in 3/4 crown for anterior teeth the path of insertion should be parallel to the incisal 2/3 of the tooth crown(not to the long axis)as shown in fig.(5)

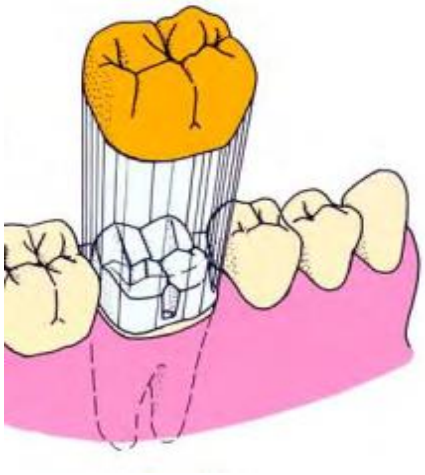


Fig.(4)

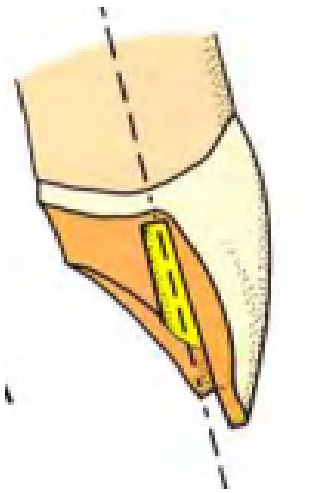


Fig.(5)

2. Providing resistance form.

Resistance: is the ability of the preparation to resist the dislodgment of the restoration by forces directed obliquely or horizontally to the restoration.

Factors affecting retention and resistance:

1- Taperness of the preparation.

2. Surface area of the preparation.

3. Length and height of the preparation.

4. Diameter of the tooth (tooth width).

5. Texture of the preparation.

6. Accessary means.

1- Taperness of the preparation: The more nearly parallel the opposing walls of preparation the greater retention will be, but parallel wall is difficult to be obtained in the patient mouth without undercuts, also parallel walls might lead to difficulty in seating of the crown restoration, thus (6°) degree convergence angle is mostly used to provide the needed retention. To produce an optimal 6°taper or convergence angle, each opposing axial wall should have an inclination of three degree to the path of insertion.(fig.6,fig.7).

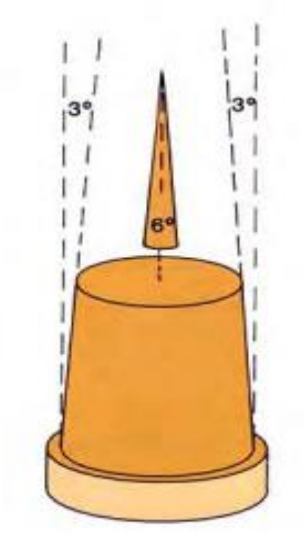
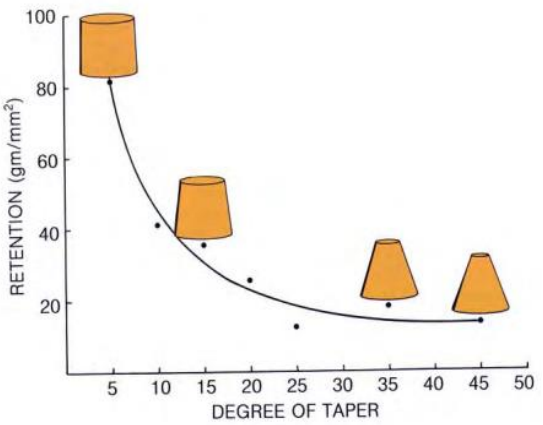


Fig.(6)



Fig(7) ↑ the degree of taper ↓ retention

Taper and Resistance: The parallel axial walls the more will be the resistant crown restoration (fig.8).

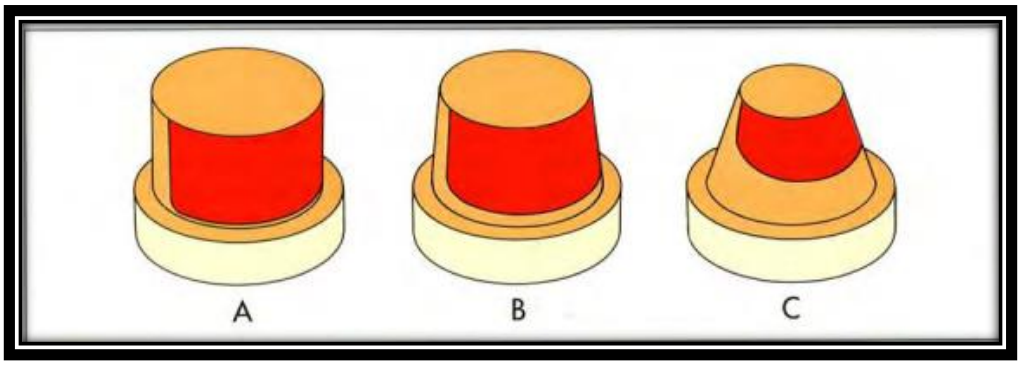


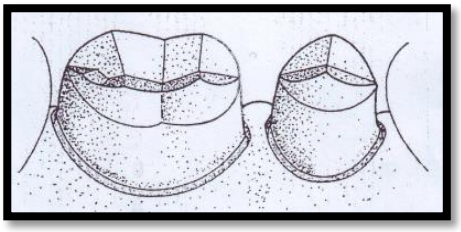
Fig.(8)

2- Surface area of the Preparation:

Increasing the surface area will increase the retention of the restoration.

Factors that influence surface area are:

a) Size of the tooth: The larger the size of the tooth the more will be the surface area of the preparation, the more will be the retention thus full metal crown on molar tooth definitely more retentive than that on premolar tooth.



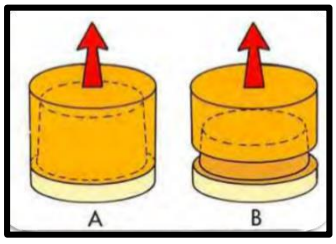
b) Extend of coverage by restoration

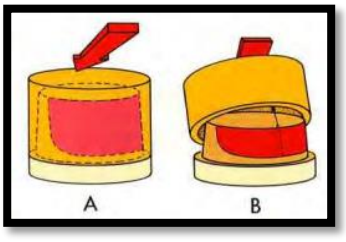
The more the area that will be covered by the crown restoration the more retention and resistance will be, thus full coverage crown is more retentive& resistant than 3/4 crown restoration on the same tooth.

c) Accessory feature: such as boxes grooves and pin hole.

3- Length (height) of the preparation:

Increasing the length increase retention and resistance and vice versa.

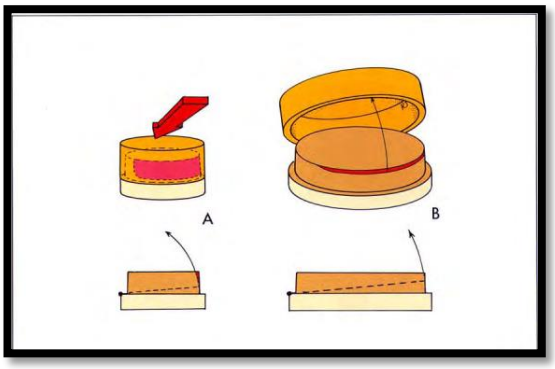




4-Diameter of the tooth (tooth width):

Wider tooth is more retentive than narrower one (increasing tooth width will increase the retention of crown restoration. Under some circumstances crown on narrow tooth can have greater resistance to tipping than one on the wider tooth, this occur because the crown on the narrower tooth has shorter radius for rotation resulting in a lower tangent line and a larger resisting area.

Ex.: The walls of a short wide preparation must be kept nearly parallel to achieve adequate resistance from.



5-Texture of the Preparation.

Texture of the preparation might affect on the retention of cast crown. Smooth surfaces less retentive than rough (mechanical interlocking).

6- Extra retention means: The retention of a preparation can be greatly enhanced by the addition of grooves, pin holes or boxes.

3. Resistance to deformation:

A restoration must have sufficient strength to prevent permanent deformation during function, so the restoration must has structural durability and marginal integrity.

a).Structural durability

The restoration must be rigid enough not to flex, perforate (metal) or even fracture (plastic) during occlusal forces. Sufficient tooth structure should be removed to create enough thickness to the ideal occlusion.

-Preparation features related to Structural durability:

1. Occlusal reduction:

Occlusal reduction must reflect the geometric inclined planes of occlusal surface with bevelling of the functional cusps (palatal cusps of the upper posterior teeth and the buccal of lower posterior) Fig. (12).

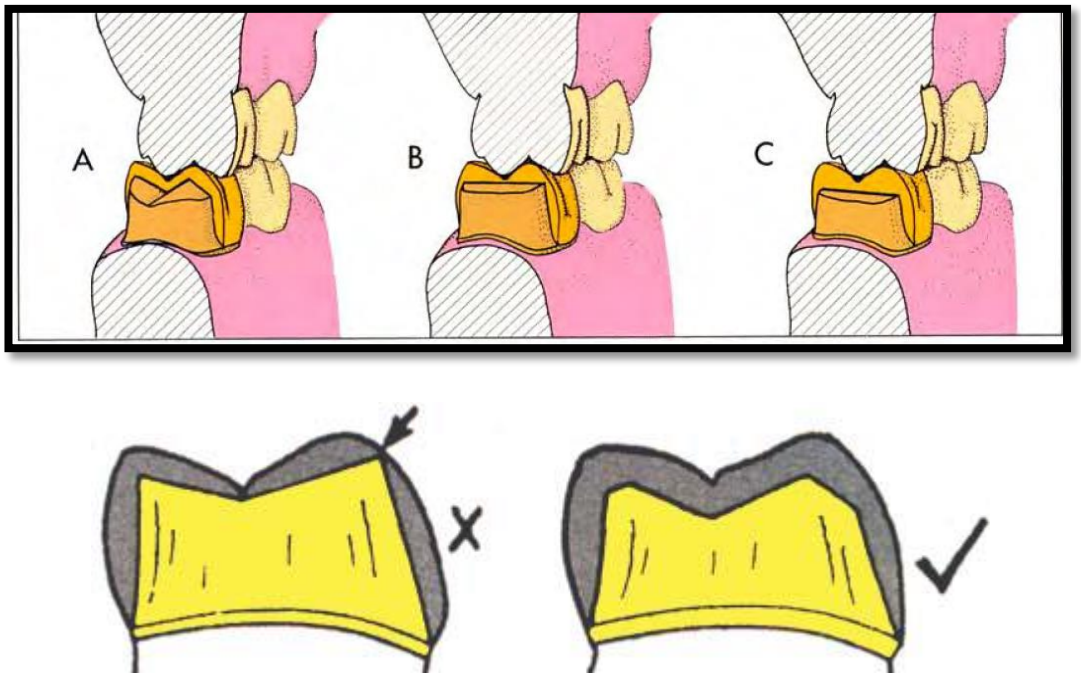


Fig.(12)Bevelling of the functional cusp

Notes

- Avoid creating steep planes with sharp angles that lead to stress concentration.
- Flat occlusal reduction leads to thin metal and perforation in the future.
- Lowering the entire occlusal surface as an attempt to provide enough space will destruct the tooth structure.

Occlusal clearance: is the space between occlusal surface of prepared tooth and that of the opposing tooth. It should evaluate in centric and eccentric relation.

2. Axial reduction: it must be sufficient to provide enough space to the restoration to duplicate the normal contour of the tooth without flexure during occlusal forces.

b).Marginal integrity:

The configuration of the finishing line determines the shape and bulk of the restoration margins. The requirements of the restoration margins:

- It must be well adapted (as fit as possible) to the finishing line of tooth preparation.
- It must have enough strength.

- Should be placed in the area that is easily polished by dentist and cleaned by the patient.

3. Esthetic consideration:

Patients prefer their dental restorations to look as natural as possible.

This can be achieved by:

1. Minimal displaying of metal collar.
2. Maximum thickness of porcelain material will enhance the shade (colour) of the restoration.
3. Correct shade selection.
4. Porcelain occlusal surfaces, aesthetically no metal appearance is more preferable by the patient.
5. Subgingival margin.