

Principles of Tooth Preparation

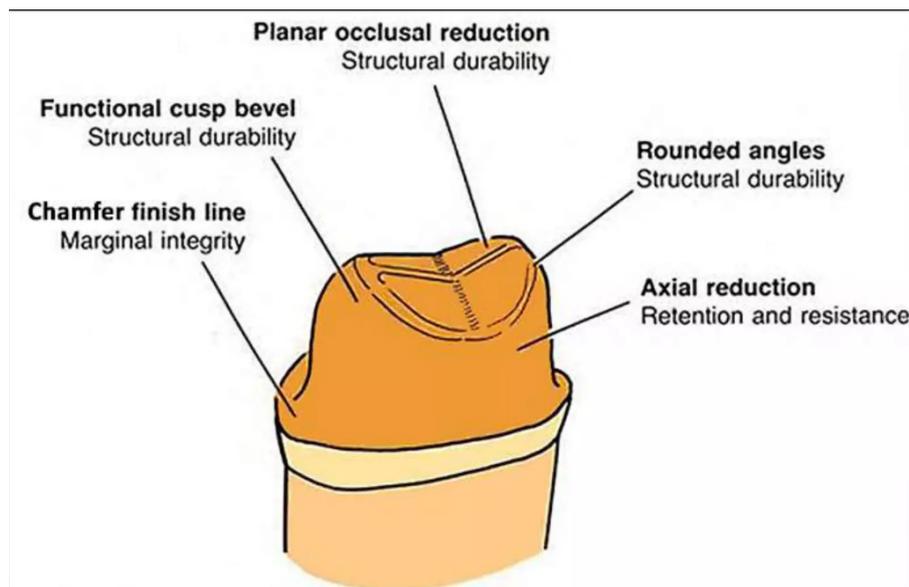
The design of the preparation of a tooth for cast metal or porcelain restorations is limited by five principles:

- 1- Preservation of tooth structure.
- 2- Retention and resistance from.
- 3- Structural durability of the restoration.
- 4- Preservation of periodontium.
- 5- Marginal integrity.

1. Preservation of the tooth structure

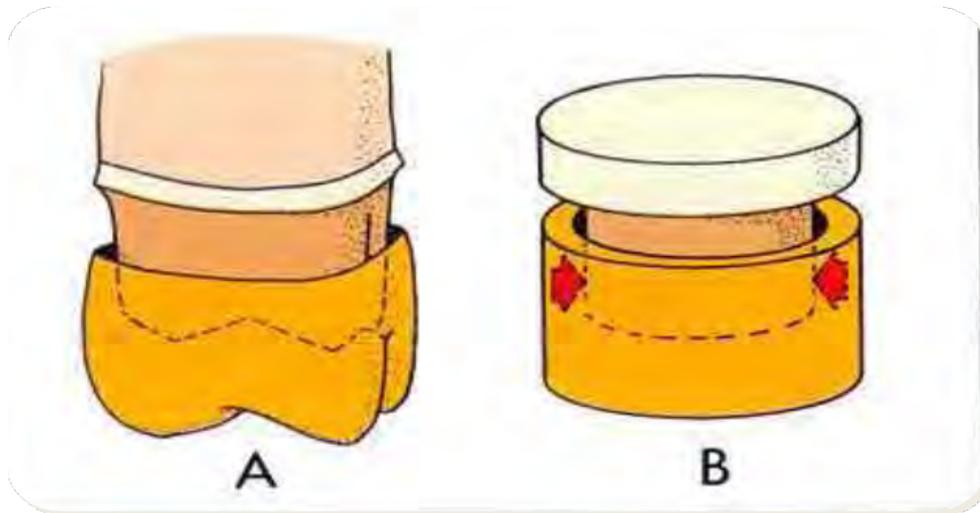
The preparation of the tooth must be conservative, minimal amount of tooth structure must be removed. Excessive amount of tooth structure removal, in addition to be destructive phenomenon, it has many harmful effects:

- Excessive reduction will lead to thermal hypersensitivity, pulpal inflammation and necrosis may result from approaching to the pulp closely.
- The tooth might be over tapered or shortened and this might affect the retention and resistance of the prepared tooth.

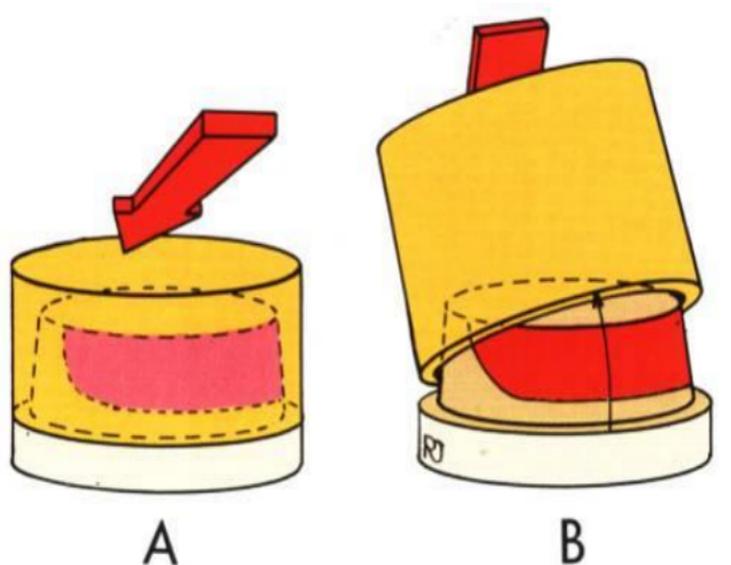


2. Retention and resistance form

Retention prevents removal of the restoration along the path of insertion or long axis of the tooth preparation.

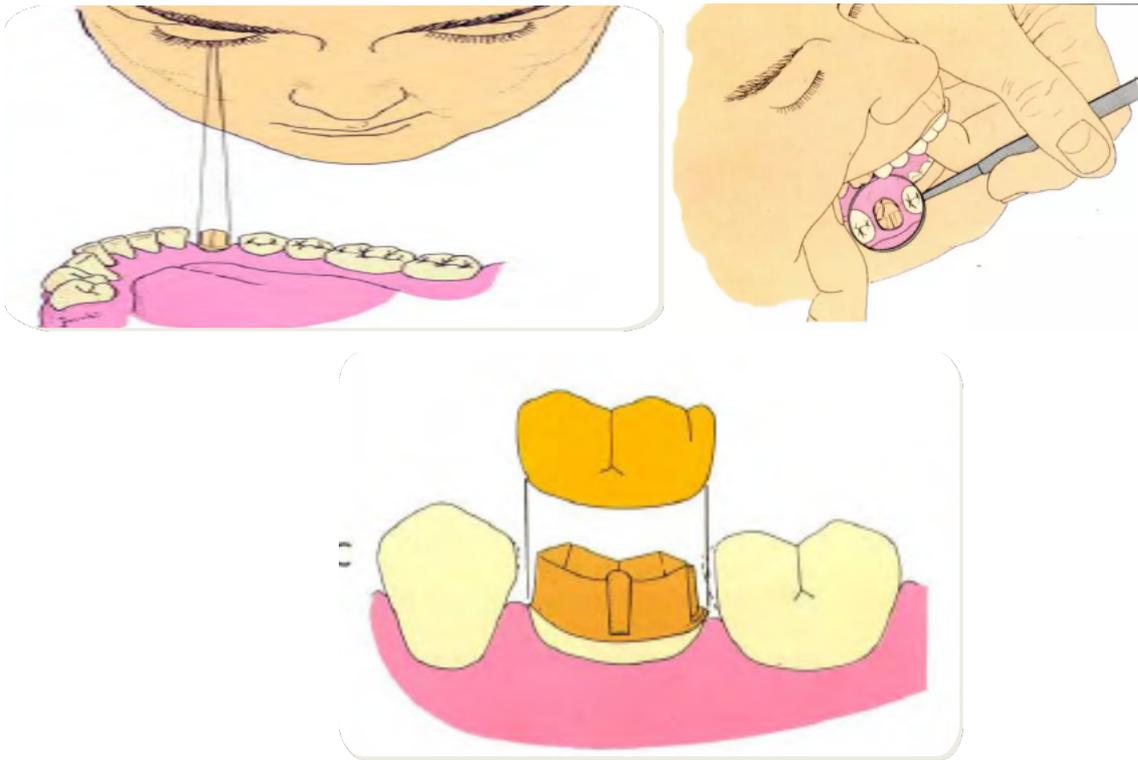


Resistance prevents dislodgement of the restoration by forces directed in an apical or oblique direction and prevents any movement of the restoration under occlusal forces.

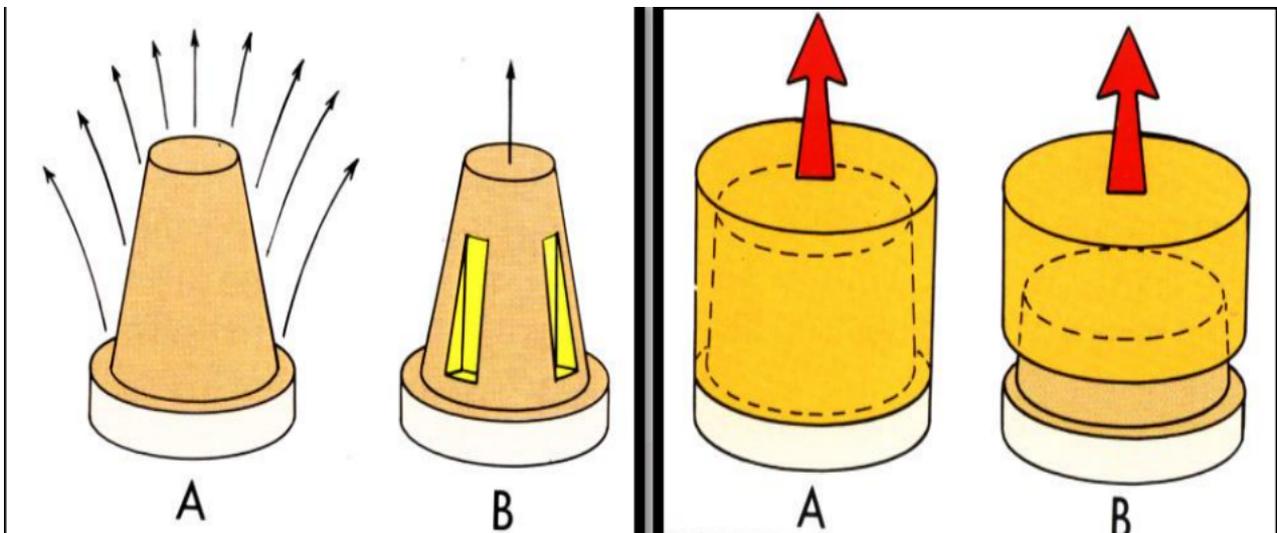


Retention and resistance are interrelated and often inseparable qualities.

Path of insertion is 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. Most of the time, the path of insertion of the crown restoration is parallel to the long axis of the tooth, but this is not a rule as in three-quarter crown for the anterior teeth where the path of insertion should be parallel to the incisal two-thirds of the crown not to the long axis.



Retention is improved by limiting the number of paths along which a restoration can be removed from the tooth preparation.

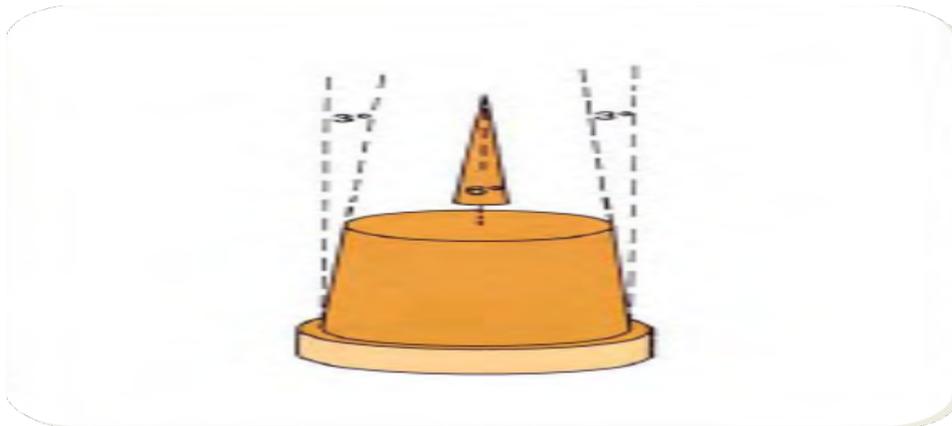


Factors affecting retention and resistance

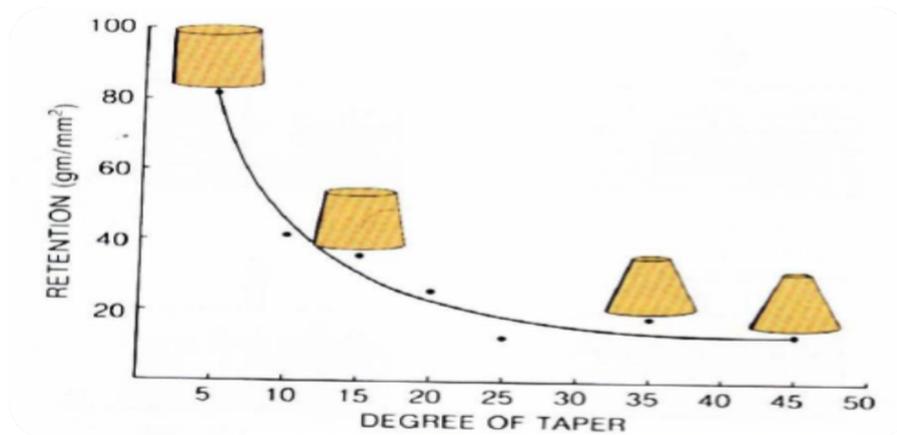
1. Taper of the preparation.
2. Surface area of the preparation.
3. Length and height of the preparation.
4. Diameter of the tooth (tooth width).
5. Texture of the preparation.
6. Accessory means.

1. Taper of the preparation

Convergence angle is the angle that is formed between each two opposing axial walls of a tooth prepared to receive a crown restoration.



Retention of the crown depends on this angle, 5-6 degree convergence angle is mostly used to provide the needed retention. Theoretically, the more nearly parallel the opposing walls of a preparation, the greater is the retention, but parallel walls are difficult to be obtained inside the patient's mouth without creating undercuts and might lead to difficulty in seating of the crown restoration.

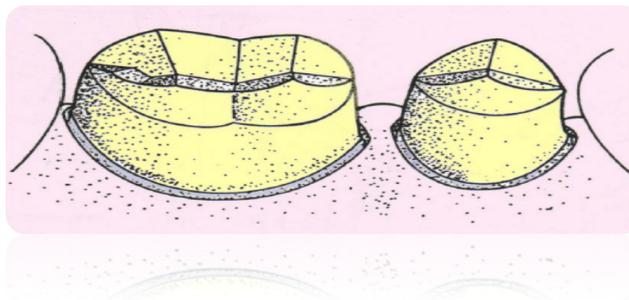


Taper and Resistance: The more parallel the axial walls of the preparation, the more will be the resistance of crown restoration. The walls of a short wide preparation must be kept nearly parallel to achieve adequate resistance from.

2. Surface area of the preparation

Increasing the surface area will increase the retention. The factors that influence the 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, and thus the more will be the retention. In this issue, a full metal crown on a molar tooth will definitely be more retentive than that on a premolar tooth.

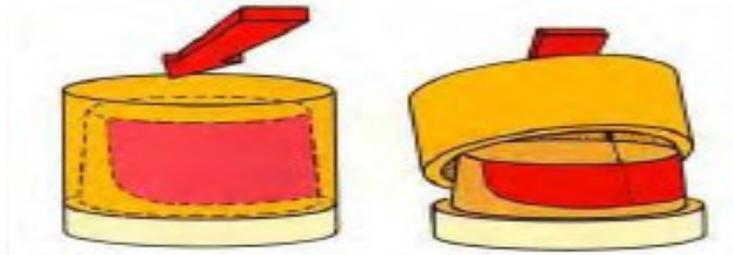


(b) **Extent of tooth coverage by the restoration:** The more the area that will be covered by the crown restoration, the more will be the retention. Thus full metal crown on a molar tooth is more retentive than a three-quarter crown on the same tooth.

(c) **Accessory features:** The retention of the preparation can be greatly enhanced by the addition of grooves, pin holes or boxes.

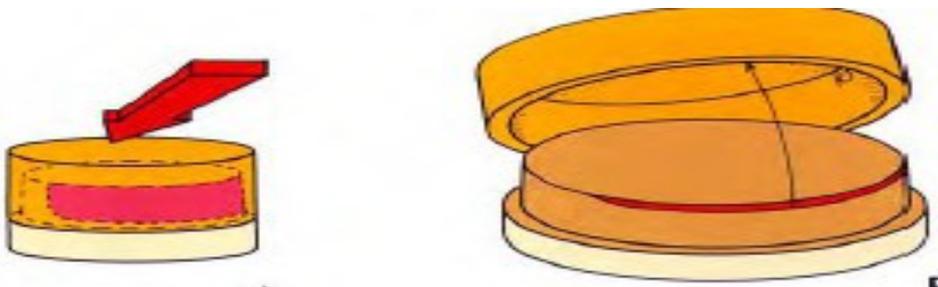
3. Length (height) of the preparation

Increasing the length of the preparation will increase the retention and resistance and vice versa.



4-Diameter of the tooth (tooth width)

Under some circumstances, a crown on a narrow tooth can have greater resistance to tipping than the one on a wider tooth. This occurs because the crown on the narrower tooth has a shorter radius for rotation resulting in a lower tangent line and a larger resisting area.

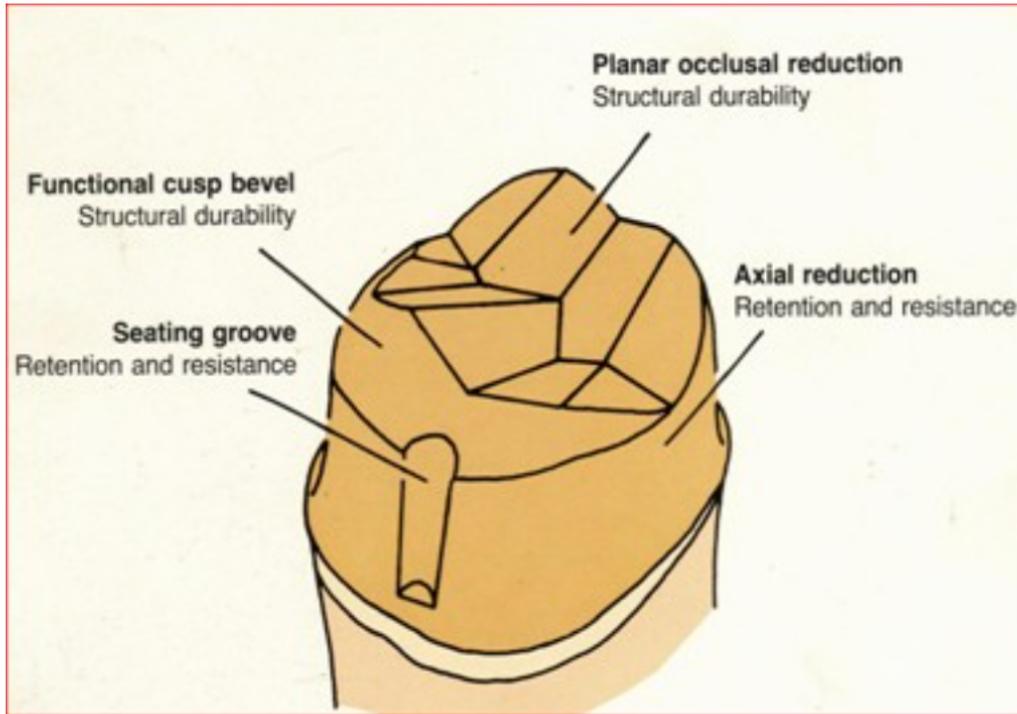


5. Texture of the preparation

The texture of the preparation might affect the retention of cast crown. Smooth surfaces are less retentive than the rough (mechanical interlocking).

6. Extra retention means

Grooves, pinholes and boxes lead to increase retention.

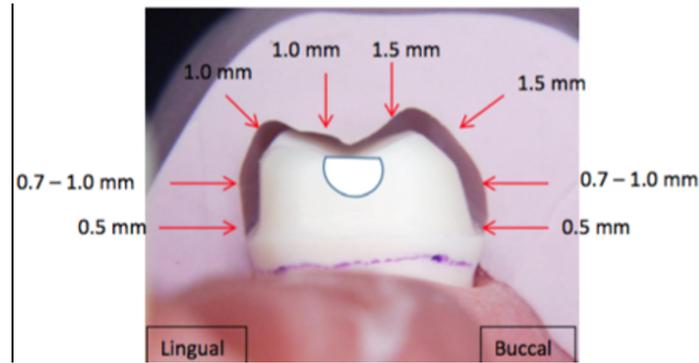


3. Structural Durability

A restoration must have sufficient strength to prevent permanent deformation during function. In other words, the ability of a restoration to withstand destruction due to external forces. The preparation must be designed so that it can provide structural durability to the restoration. By doing so, the restoration will be allowed to withstand destruction due to external forces, The preparation features related to structural durability are:

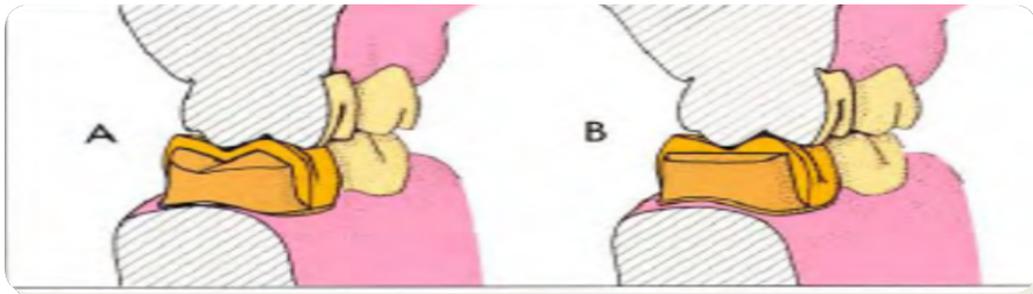
(1) Occlusal reduction: Enough tooth structure must be removed from the occlusal surface so that the restoration can be built back to ideal occlusion and thick enough to prevent wearing or distortion (1-1.5mm). The placement of inclined planes on occlusal surfaces of a crown preparation rather than flat surface increases resistance form



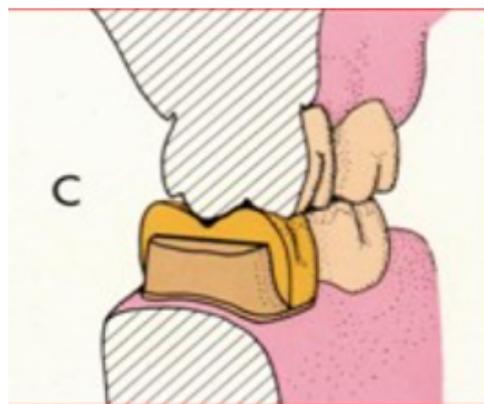


Occlusal reduction must reflect the geometric inclined planes of the occlusal surface (the so called "planar occlusal reduction" or "anatomical occlusal reduction").

We should avoid creating steep planes with sharp angles because it will lead to stress. On the other hand, flat occlusal reduction will lead to too thin metal and this will lead to perforation of the crown restoration in the future.



Meanwhile, lowering the entire occlusal surface in an attempt to provide sufficient space might lead to tooth structure destruction (non-conservative preparation) which interferes with the first principle of tooth preparation which is the conservation of tooth structure. In addition, lowering the entire occlusal surface will shorten the axial walls of the prepared tooth which definitely will affect the retention-resistance features of the preparation.



Occlusal clearance: is the space between the occlusal surface of the prepared tooth and that of opposing tooth. It should be evaluated in centric and eccentric relation. This clearance is crucial to prevent interference and ensure proper function of the restoration.



Here's how occlusal clearance is evaluated in centric and eccentric relations:

1. Centric Relation (CR): is the relationship of the mandible to the maxilla when the condyles are in their most superior and anterior position within the glenoid fossa. It is considered the most stable position of the mandible.

Evaluation: Occlusal clearance is evaluated in centric relation by assessing the space between the prepared tooth and the opposing tooth when the mandible is in centric relation. This is often done using materials like articulating paper, which leave marks on the occlusal surfaces when the patient bites down in centric relation.



2. Eccentric Relations: Refer to any mandibular position other than centric relation, such as protrusive, lateral, or any other functional movement.

Evaluation:

- A. Protrusive Movement: Occlusal clearance is evaluated during protrusive movements by observing the space between the prepared tooth and the opposing tooth as the mandible moves forward.

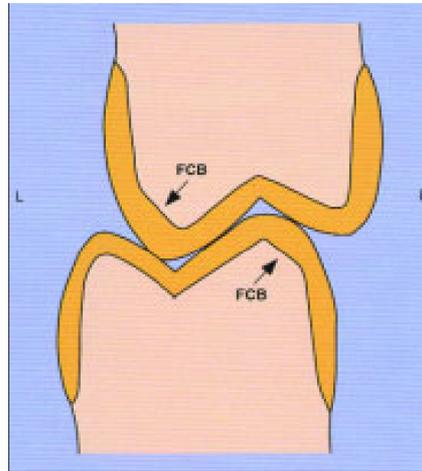


- B. Lateral Movement: During lateral excursions or movements to the side, occlusal clearance is assessed similarly by observing the space between the prepared tooth and the opposing tooth.

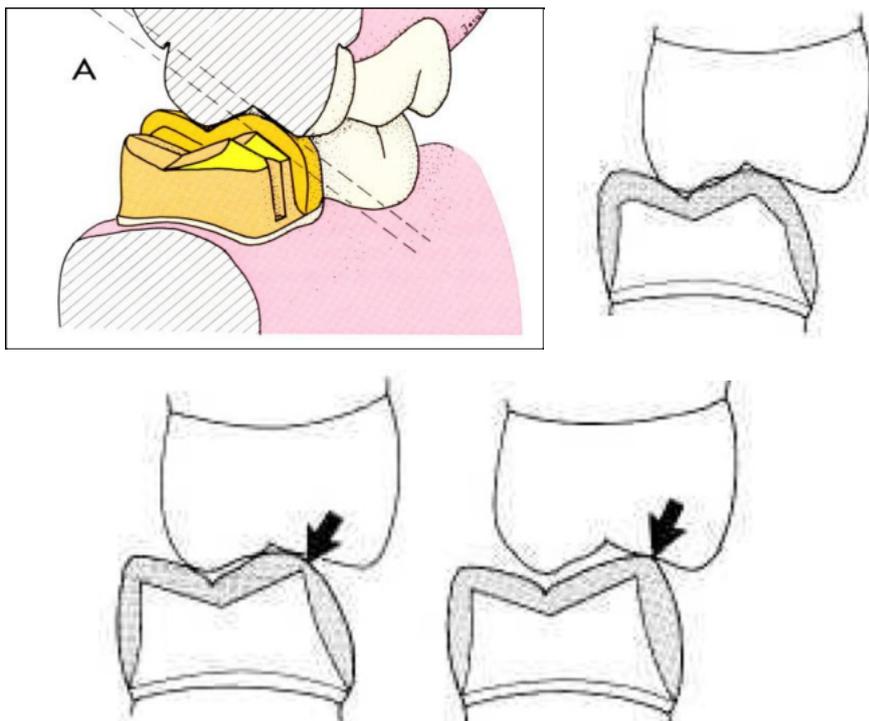


- C. Excursive Movements: These include any movements of the mandible that deviate from centric relation. Evaluating occlusal clearance during excursive movements helps ensure that the restoration does not interfere with normal jaw function.

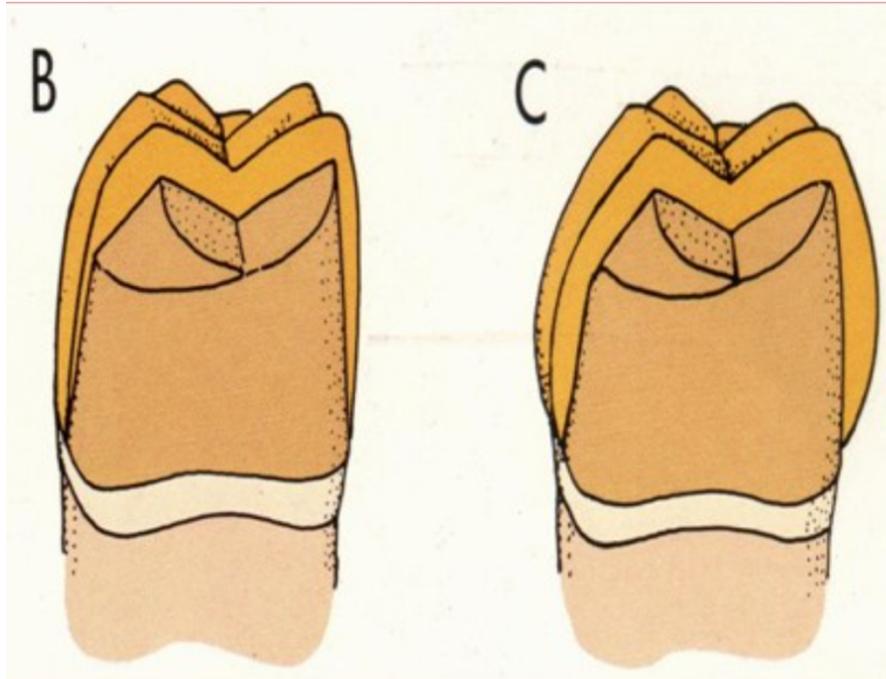
Functional cusps: are the cusps that give centric stops of occlusion (Palatal of upper posterior teeth and buccal of lower posterior teeth).



Functional cusp bevel (FCB): is a wide bevel placed on the functional cusps of posterior teeth to provide structural durability. It allows adequate thickness of restoration at this critical area without undue scarfing of tooth structure. If FCB is omitted, the restoration is likely to be too thin in this stress bearing area. In the absence of FCB, the laboratory technician overbuilds the crown restoration in attempt to provide structural durability for the restoration; this will lead to premature contact with the opposing tooth.



(2) Axial reduction: Plays an important role in securing space for an adequate thickness of the restorative material. Inadequate axial reduction will have thin walls subject to distortion or result in over contouring the axial surface which could lead to periodontal problems.



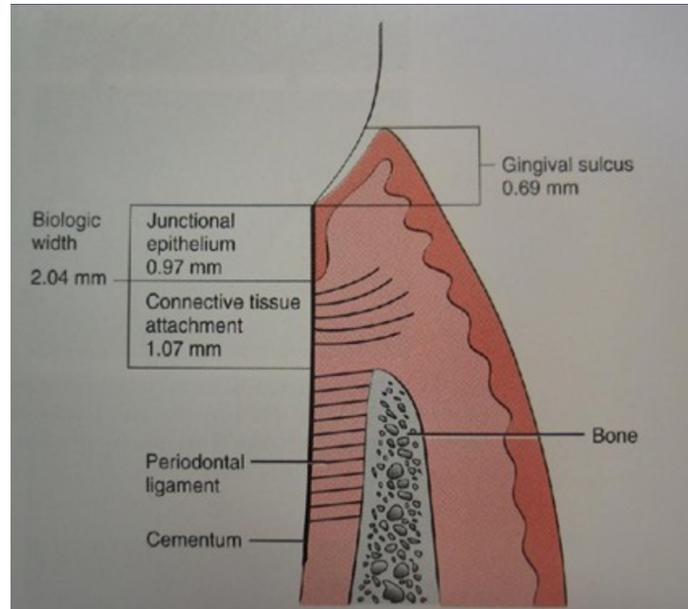
4. Preservation of the periodontium

For the preservation of the periodontium, the following points should be considered:

- (a) Whenever possible, the margin of the preparation should be placed supra-gingivally.
- (b) The crown restoration should have proper contact, embrasure form, occlusion and a healthy occluso-gingival contour.

Biologic width: It is the dimension of space that the healthy gingival tissues occupy above the alveolar bone. It refers to the combined connective tissue-epithelial attachment from the crest of the alveolar bone to the base of the sulcus (2mm; connective tissue-1.07mm and epithelium-0.97mm). Evaluation of the biological width by radiographs, probing, and sounding of bone.

The biologic width is a critical factor in maintaining the health and stability of the periodontium. Any dental procedures that may impact the biologic width should be carefully planned and executed to avoid compromising the integrity of the periodontal tissues.



Margin placement (finishing line placement): The finishing line of the preparation can be placed either supra-gingivally, sub-gingivally, or equi-gingivally (with the level of the gingiva).

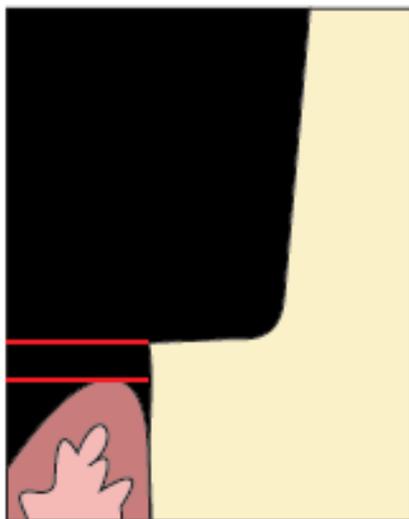


Fig. 4.12: Supra-gingival margin

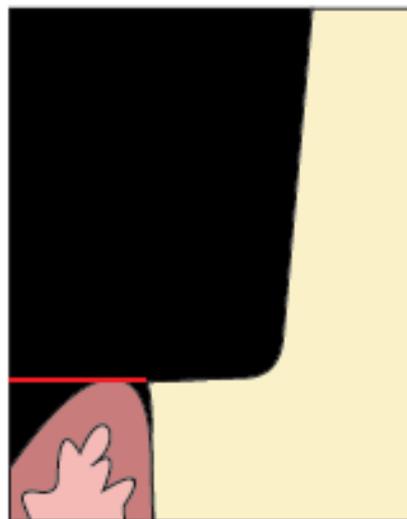


Fig. 4.13: Equi-gingival margin

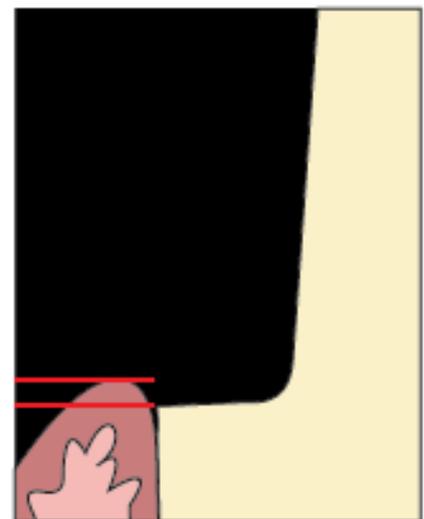


Fig. 4.14: Sub-gingival margin

Placing the margin above the gingival tissue (supra-gingivally) for the following reasons:

- a- can be easily prepared and finished by the operator.
- b- to provide good vision for the operator during preparation.
- c- the impression can be easily made.
- d- the patient can keep the area clean more easily.
- e- most of the time such a position is situated on hard enamel.
- f- less destructive

Placing the margin below the gingival tissue (sub-gingivally) for following reasons:

- a- for esthetic.
- b- when we need extra retention as in teeth with short crowns.
- c- when there is caries or filling at the area of finish line (the preparation margin should be placed on sound tooth structure).

5. Marginal Integrity

The restoration can survive in the biological environment of the oral cavity only if the margin is closely adapted to the preparation margin. The configuration of the finishing line determines the shape and bulk of the restoration margin that will affect both marginal adaptation and the degree of seating of the restoration. The restoration margin should have the following requirements:

- (a) it must fit as closely as possible against the finishing line of preparation.
- (b) it must have sufficient strength.
- (c) whenever possible, it should be placed in an area where the dentist can finish easily and the patient can clean properly.

