Principles of tooth preparation

Objectives of tooth Preparation:-

The main objectives of tooth preparation
1-To eliminate undercuts from the axial surface of the tooth.
2-To provide enough space for the crown restoration to withstand the forces of mastication. This space depends on the material used. So the metal material needs little space while the plastic material needs more space.
3- Not to enlarge the size of the tooth.
4- To provide good esthetics

Biomechanical principles of preparations:

The design and preparation of a tooth for a cast metal or porcelain restorations are limited by five principles:-

1- Preservation of tooth structure.
2- Retention and resistance form.
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. The minimal amount of tooth structure must be removed, and excessive amount of the tooth structure in addition to be destructive phenomenon it has many harmful effects: -

A- Excessive reduction lead to thermal hypersensitivity, pulpal inflammation and necrosis may result from approaching to the pulp closely.
B- 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: is the ability of the preparation to resist the crown restoration from removal along its path of insertion.
Resistance: is the ability of the preparation to resist the dislodgment of the restoration by forces directed obliquely or horizontally to the restoration.
Path of insertion: An imaginary line along which the restoration can be inserted and removed without causing lateral force 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 crown restorations is parallel to the long axis of the tooth (this is not a role) except in ¾ 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).

By Limiting the path of withdrawal ret. is improved. A prep. with unlimited freedom of displacement is much less retentive.

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 mean.

1- Taper of the preparation

Convergence angle: is the angle that formed between opposing axial walls of a tooth prepared to receive crown restoration, it determines the convergence (taper) of the prepared tooth. The magnitude of retention depends on the degree of this angle. The greater the taper the less the retention. The degree of the convergence angle is one of the factors that determine the amount of axial and non axial forces which can tolerated without leading to a loss of crown restoration.

*(5-6) degree convergence angle is mostly used to provide the needed retention.

The more nearly parallel the opposing walls of preparation the greater will be the retention. 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 *(5-6) degree convergence angle is mostly used to provide the needed retention.

![Diagram](image)

**Taper and Resistance:**
The more parallel the axial walls the more will be the resistance of crown restoration.

![Diagram](image)

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 increase retention

*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 cover by the crown restoration the mor will be
   the retention , thus full metal crown on molar is more retentive than 3/4 crown 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):
   Under some circumstances crown on narrow tooth can have grater
   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.

5-Texture of the preparation.
   Depending on the type of cem. Agent, tex. Of the prep. might effect 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- Structural Durability (SD):

The preparation must be designed so that it provide S.D. to the restoration i.e. the crown rest. Must be rigid enough to not flex, perforate (metal) or even fracture (plastic). For rest. To be rigid it need bulk....to provide enough bulk to the crown rest. Sufficient tooth structure must be removed from the preped tooth to create enough space. By doing so the restoration allowed to withstand the forces of occlusion, prevent wearing holes in the gold and allow proper contouring and carving of anatomy in the restoration.

Preparation features related to Structural Durability:

1- Occlusal reduction.

Enough T.S. must be removed from occ.sur. So that rest. Can built back to ideal occl.& thick enough to prevent wearing or distoration(1—1.5mm)

Occlusal clearance:

is the space between the occlusal surface of the prepared tooth and that of apposing tooth. It should be evaluated in centric and eccentric relation. Enough tooth structure must be removed occlusally so that when the restoration is built back to ideal occlusion will be thick enough to prevent wearing through or distortion.

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

Occlusal reduction must reflect the geometric inclined planes of occlusal surface. Avoid---- creating steep planes with sharp angles, because it lead to stress. Flat occlusal reduction---- lead too thin metal---this will lead to perforation of the crown restoration in future

Lowering entir occlusal surface in attempt of providing sufficient space might lead to tooth structure destruction (non conservative preparation) & shorten axial wall of prepped tooth which defiantly will effect the retention-resistance potential of the preparation.(next picture)
**Functional cusp bevel (FCB)**
Wide bevel should be placed on the functional cusps of posterior teeth. To provide Structural Durability (it allow adequate thickness of restoration at this critical area without undue scarifying of structure destruction). If FCB is omitted, the rest. Is likely to be to thin in this stress bearing area.

If restoration thickness is achieved by overtapering, this will compromise retention. **In absence of FCB ---** technician overbuild crown restoration in attempt of providing structural durability for the restoration this will lead to superocclusion or premature contact with the opposing tooth.

2- **Axial reduction.**
Sufficient reduction is important to provide sufficient space so that the restoration can build with sufficient thickness, this will prevent flexing of the crown restoration when occlusal force acting on.