

Principles of tooth preparation

FIVE PRINCIPLES OF TOOTH PREPARATION:

1. Preservation of tooth structure
2. Retention and Resistance
3. Structural Durability
4. Marginal Integrity
5. Preservation of the Periodontium

PRESERVATION OF TOOTH STRUCTURE

- A restoration should **replace lost tooth structure while preserving the remaining sound tooth structure**

RETENTION

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

RESISTANCE

- **prevents displacement of the restoration by apical or oblique forces and prevents movement under occlusal forces.**

VENEER OR SLEEVE RETENTION

- An extracoronal restoration (a) uses opposing external surfaces for retention

WEDGE RETENTION

- An intracoronal restoration (a) uses opposing internal surfaces for retention

TAPER

- the axial walls of the preparation must taper slightly to permit the restoration to seat
- 6-10 degrees taper
- More taper=Less Retention

External preparation:

Two opposing walls **converge occlusally**.

Internal preparation:

Two opposing walls **diverge occlusally**.

Terms:

Angle of convergence

→ relationship between opposing external walls.

Angle of divergence

→ relationship between opposing internal walls.

Inclination

→ relationship of one preparation wall to the long axis of the preparation.

Surface Area

- **Rule: Greater surface area → greater retention.**
- Therefore:

- **Large tooth preparation**
 - ◆ → more surface area
 - **greater retention**
- **Small tooth preparation**
 - ◆ → less surface area
 - **less retention**
- This is especially important when a **small tooth serves as an FPD abutment or splint.**
- Boxes and grooves can increase surface area somewhat, but their major benefit may be **limiting freedom of movement** rather than simply increasing surface area

FREEDOM OF DISPLACEMENT

- Retention improves when you **limit the number of paths through which a restoration can be removed.**
- **Maximum retention:**
 - **ONE PATH OF WITHDRAWAL**
- **Highly retentive preparation:**
 - long
 - nearly parallel axial walls
 - grooves
- **Poor retention:**
 - short
 - excessively tapered
 - many possible paths of withdrawal

LENGTH

- Occlusogingival length is an important factor in both retention and resistance.
- **Longer preparations will have more surface area for retention**
- **Preparations with longer walls interferes with the tipping displacement of the restoration better than the short preparations.**
- The walls of shorter preparations should have **as little taper as possible to increase the resistance and even this will not help if the walls are too short**

SUBSTITUTION OF INTERNAL FEATURES

- It may not always be possible to use 2 opposing walls for retention
- Groove, box form, and pinhole are interchangeable and can be substituted for an axial wall or for each other. Substitution is important, since conditions often preclude making an ideal preparation.
- In preparing these features, the much shorter distance between the walls allows the dentist to prepare them more precisely. They offer an excellent means of enhancing overall retention and resistance of an otherwise over- inclined axial wall

PATH OF INSERTION

- An imaginary line along which the restoration will be placed onto or removed from the preparation. It is determined mentally by the **dentist before the prep.**
- **Necessary when preparing teeth for FPD since all paths of abutments must be parallel to each other**
- **It must be considered in two dimensions: faciolingually and mesiodistally. The facio-lingual orientation of the path can affect the esthetics of metal-ceramic or partial veneer crowns.** For metal- ceramic crowns, the path is roughly parallel with the long axis of the teeth

STRUCTURAL DURABILITY

- A restoration must contain a bulk of material that is adequate to withstand the forces of occlusion

OCCUSAL REDUCTION

- **One of the most important features for providing** adequate bulk of metal and strength to the restoration is occlusal clearance .
- For gold & metal alloys, 1.5 mm of clearance on the functional cusps (lingual of maxillary molars and premolars and buccal of mandibular molars and premolars). On the nonfunctional cusp, 1.0 mm is **sufficient.**
- For Metal-ceramic crowns. 1.5 to 2.0 mm on functional cusps that will be veneered with porcelain and 1.0 to 1.5 mm on nonfunctional cusps to receive **ceramic coverage.**
- **There should be 2.0 mm of occlusal clearance on** preparations for all-ceramic crowns.
- **Malposed teeth may have occlusal surfaces that are not parallel with the occlusal table. Therefore, it may not be necessary to reduce the occlusal surface by 1.0 mm to achieve 1.0 mm of clearance**

AXIAL REDUCTION

- Axial reduction also plays an important role in securing space for an adequate thickness of restorative material.
- **If restorations are made with normal contours over preparations with inadequate axial reduction, they will have thin walls that will be subject to distortion.**
- **Frequently laboratory technicians attempt to compensate for this by overcontouring the axial surfaces.** While this "solution" to the problem strengthens the restoration, it can have a disastrous effect on the periodontium
- There are other features that serve to provide space for metal that will improve the rigidity and durability of the restoration:
 - the offset, the occlusal shoulder, the isthmus, the proximal groove, and the box. The isthmus connects the boxes, and the offset ties the grooves together to enhance the reinforcing **"truss effect."**

MARGINAL INTEGRITY

- The restoration can survive in the biologic environment of the oral cavity only if the margins are closely adapted to the cavosurface finish line of the preparation.

BEVEL:

- Cast metal restorations can be made to fit preparations with a high degree of precision, but even in well-fitting castings there is some discrepancy between the margin of the restoration and the preparation. Bevels have been advocated as means of diminishing marginal discrepancy

Not to BEVEL:

- Studies show that the presence of cement changes the scenario completely. The film thickness of the cement will prevent the complete seating of a casting with bevels that are nearly parallel with the path of insertion of the restoration.
- The more nearly the bevel parallels the path of insertion, the greater the distance by which the restoration fails to seat

FINISH LINE CONFIGURATIONS

- Wide, shallow bevels that are nearly parallel with the outer surface of the tooth should be avoided.
- They are likely to lead to overcontouring.
- Even if the axial surfaces of the overlying crown are not overcontoured, the resultant thin, unsupported wax at the margin potentially will break or distort when the wax pattern is withdrawn from the die and invested.
- The optimum margin for a gold alloy casting is an acute edge with a nearby bulk of metal.

CHAMFER

- The preferred gingival finish line for veneer metal restorations
- has been shown experimentally to exhibit the least stress, so that the cement underlying it will have less likelihood of failure.

HEAVY CHAMFER

- Also known as deep chamfer
- is used to provide a 90-degree cavosurface angle with a large-radius rounded internal angle
- Provides better ceramic support than a conventional chamfer

SHOULDER FINISH LINE

- has long been the finish line of choice for the all-ceramic crown
- The wide ledge provides resistance to occlusal forces and minimizes stresses that might lead to fracture of the porcelain.
- It produces the space for healthy restoration contours and maximum esthetics.
- However, it does require the destruction of more tooth structure than any other finish line.
- The shoulder generally is not used as a finish line for cast metal restorations

RADIAL SHOULDER

- The radial shoulder is a modified form of shoulder finish line.
- A radial shoulder on all-ceramic crown **preparation combines maximum support of the ceramic with a stress-reducing rounded gingivoaxial angle.**

SHOULDER WITH BEVEL

- is a finish line in a variety of situations.
- It is used as the gingival finish line on the proximal box of inlays and onlays, and for the occlusal shoulder of onlays and mandibular $\frac{3}{4}$ crowns.
- It can also be used for the facial finish line of PFM restorations where gingival esthetics are not critical.

KNIFE EDGE

- can result in overcontoured restorations when an attempt is made to obtain adequate bulk by adding to the external axial contours of the restoration.
- In spite of its drawbacks, it is sometimes necessary to use the knife edge.
- It may have to be used on the lingual surface of mandibular posterior teeth, on teeth with very convex axial surfaces, and on the surface toward which a tooth may have tilte

PRESERVATION OF PERIODONTIUM

Main principle:

Finish lines should be:

- smooth
- accessible
- cleansable
- accurately reproduced by the impression

The best results occur when margins are **fully exposed to cleansing**.