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PRINCIPLES OF TOOTH PREPARATION

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AGENDA

- Principles -
  - classification
  - Biologic
  - Mechanical
  - Aesthetics
- Finish line configurations Taper
- Path of placement Functional cusp bevel

TOOTH PREPARATION:

“The process of removal of diseased and/or healthy enamel, dentin and cementum to shape a tooth to receive a restoration”

PRINCIPLES - CLASSIFICATION

BIOLOGIC	MECHANICAL	AESTHETIC
Prevention of damage	Retention form	Partial veneer restorations
Conservation of tooth structure	Resistance form	Metal ceramic restorations
Margin integrity	Structural durability	All ceramic restorations

BIOLOGIC CONSIDERATIONS

PREVENTION OF DAMAGE

Adjacent teeth

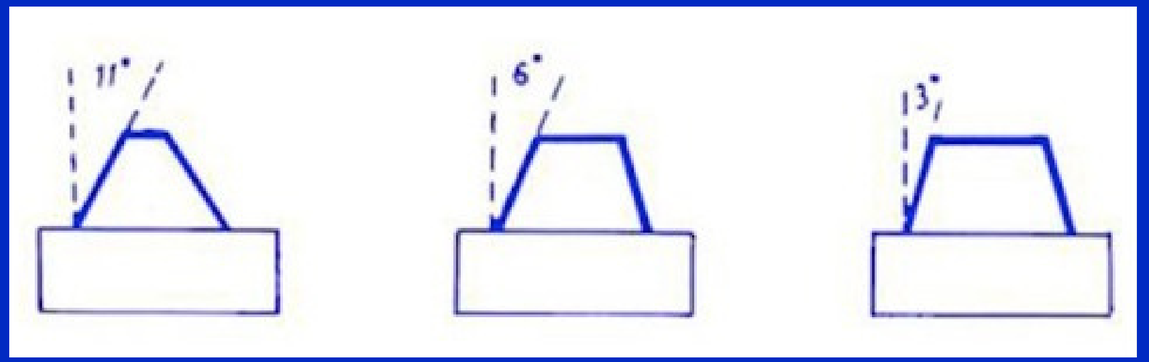
Soft tissue

Pulp

Due to over-reduction

CONSERVATION OF TOOTH STRUCTURE -

- Use of partial-coverage than complete coverage
- Prep with minimal practical taper
- Preparation of occlusal surface following the anatomic planes



MARGIN INTEGRITY

Margin - ‘The outer edge of a crown, inlay, onlay or other restoration’.
Finish line - ‘Terminal portion/peripheral extension of the prepared tooth’.

THE INTEGRITY OF THE MARGIN IS DETERMINED BY:

- *Margin placement*
- *Margin geometry*
- *Margin adaptation*

MARGIN PLACEMENT - MARGINS CAN BE PLACED;

- Supragingival - above the gingival crest
- Equigingival - margins placed at the level of gingival crest
- Subgingival - below the gingival crest

SUPRAGINGIVAL MARGINS

- Placed on enamel
- Easy to prepare without trauma to soft tissue
- Fit of the restoration can be easily evaluated
- Can be easily maintained by the patient
- Given in non-esthetic areas

SUBGINGIVAL MARGINS

- Caries, erosion or restorations extending subgingivally
- Aesthetics - when metal-ceramic is used
- In case of short crowns
- Root sensitivity
- Modification of axial contour
- Proximal contact extending to gingival crest

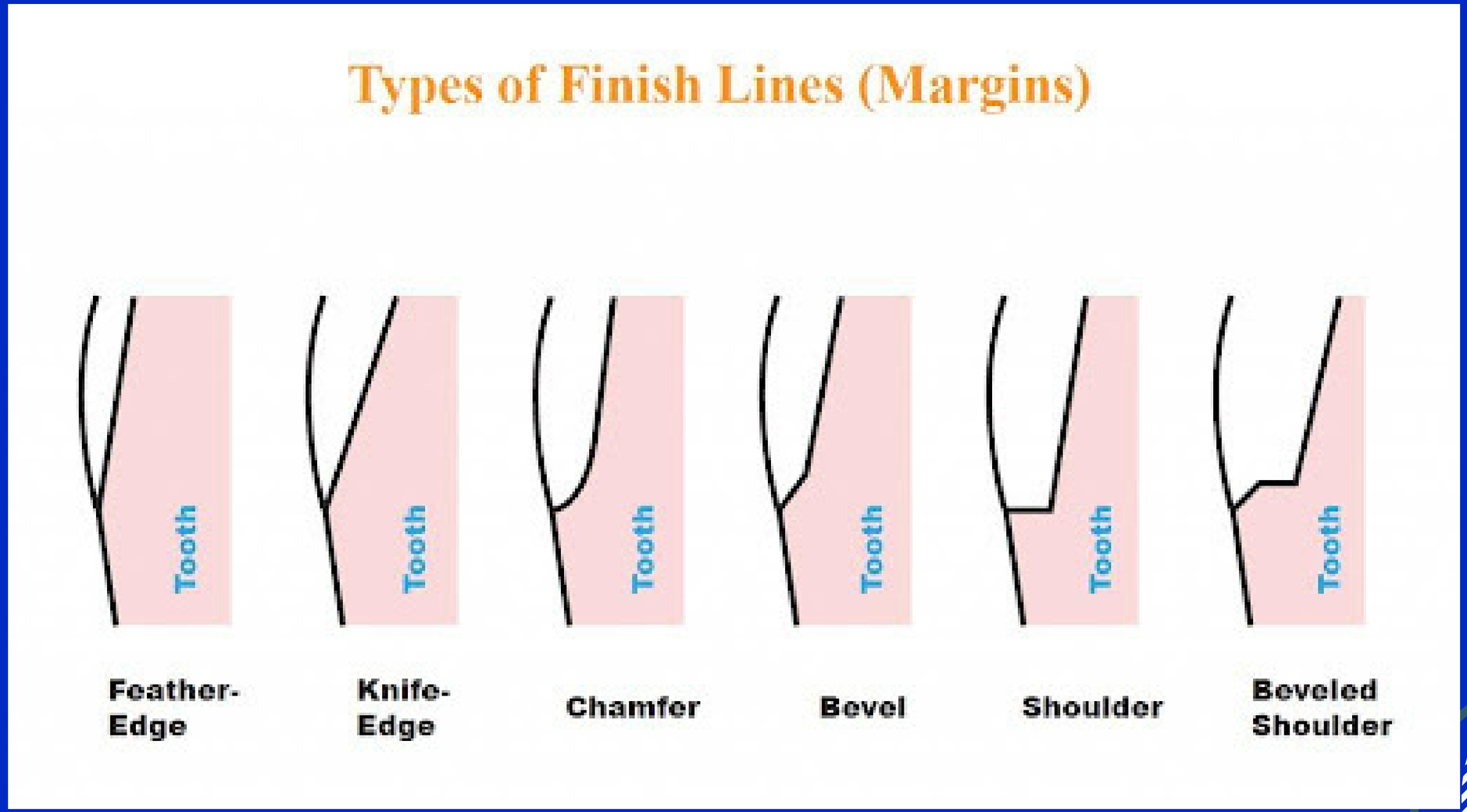
MARGIN GEOMETRY

‘The shape or configuration of the prepared finish line’.

It should possess;

- Ease of preparation
- Ease of identification
- Distinct boundary
- Sufficient strength
- Conservation of tooth structures

FINISH LINE CONFIGURATIONS



I) CHAMFER

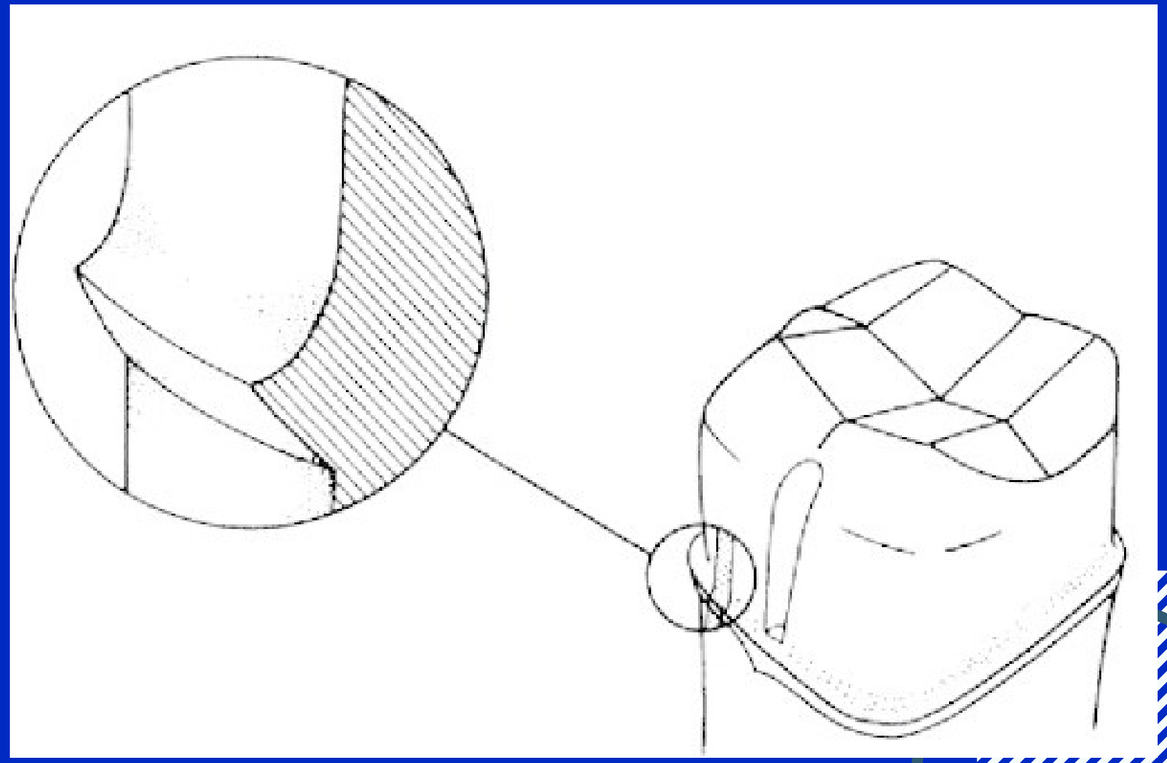
'A finish line design for tooth preparation in which the gingival aspect meets the external axial surface at an obtuse angle'.

An obtuse angled finish line
Distinct
Exhibit less stress
Most conservative

Indication:

Where metal forms the margin of a restoration.

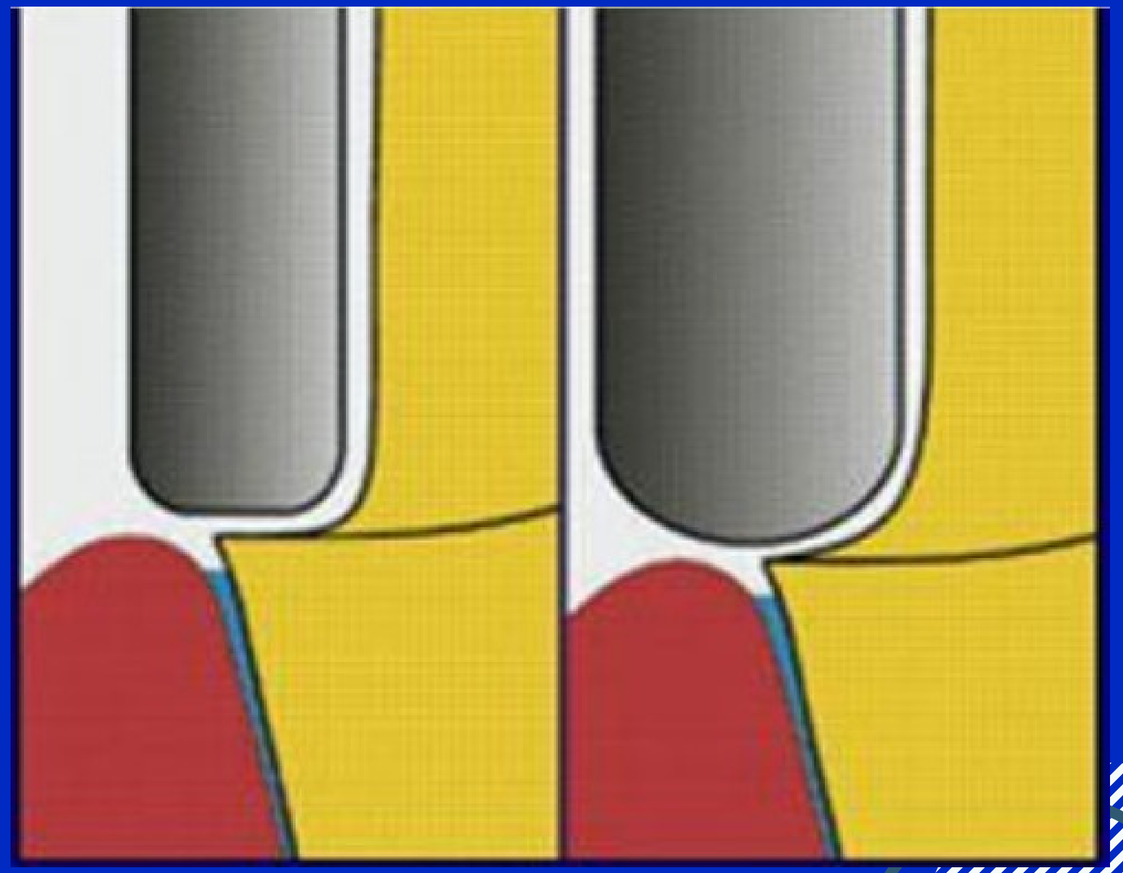
i.e., Cast metal, metal ceramic restorations



II) HEAVY CHAMFER

Similar to chamfer but prepared with a diamond of greater diameter than that used to produce the chamfer.
Indicated for all ceramic crowns

- Can produce an unsupported lip of enamel



III) SHOULDER

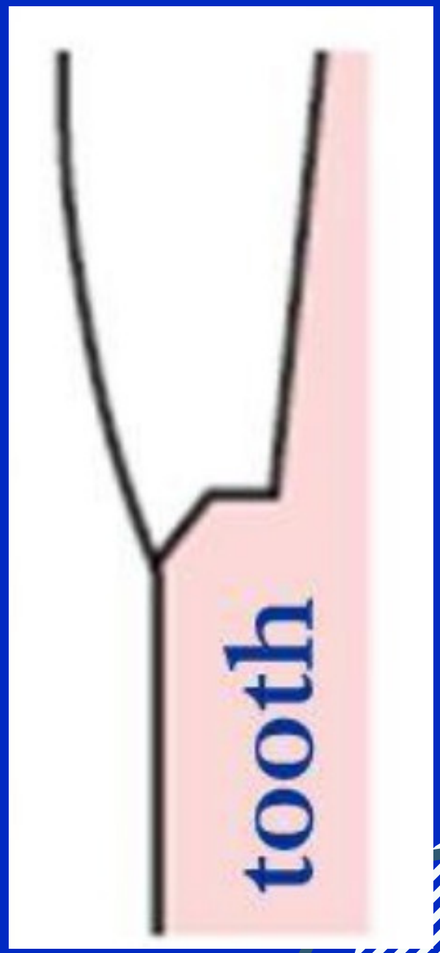
- Right angled finish line
- Produces a wide ledge which resists compressive occlusal forces
- Requires more preparation (hence not conservative).
- Indication - All-ceramic and metal-ceramic restorations

IV) SHOULDER WITH BEVEL

- A shoulder with a bevel on the external edge
- Reduces marginal discrepancy of the restoration as it can be burnished. (However, gold alloys can only be burnished).
- Protects edge of the finish line preventing chipping.

Indications -

- Indicated to hide the supragingival facial metal
- margin of metal-ceramic restorations
- As the gingival finish line on inlays, onlays
- Occlusal finish line for onlays and partial veneer crowns

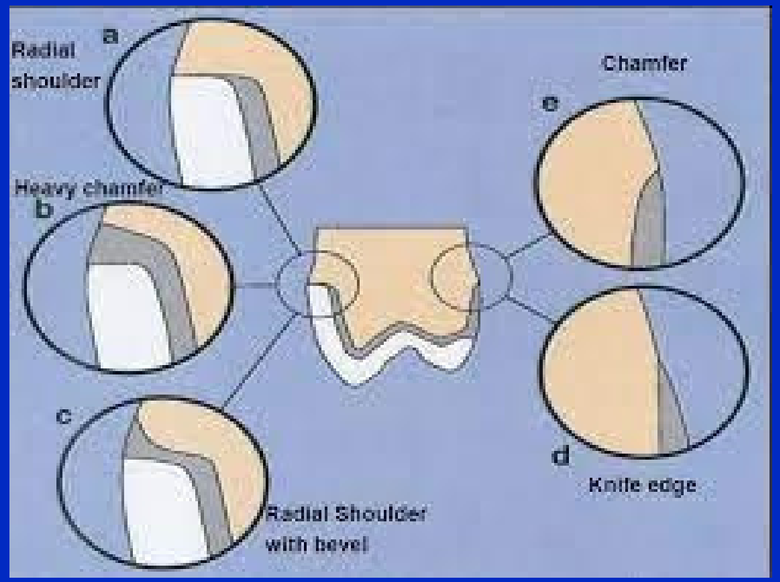


v) Radial shoulder

- A shoulder finish line with rounded internal line angle
- Indicated for all ceramic crowns

vi) Sloped shoulder

- Similar to shoulder but with an obtuse angle.
- Indicated for facial margin of metal-ceramic crowns



VII) KNIFE-EDGE

- Thin finish line
- Highly conservative
- Difficult to wax and cast; susceptible to distortion
- Can lead to over-contoured restorations

Indication-

- Metal restorations for adolescent patients
- Lingual surface of mandibular posteriors
- Very convex axial surfaces and tilted teeth

MARGIN ADAPTATION

Clinically acceptable marginal gap is 10 microns for cast metal and upto 50 microns for ceramic restorations.
The discrepancy in adaptation can have a horizontal and vertical component.

MECHANICAL CONSIDERATIONS

Principles:

1. *Retention form*
2. *Resistance form*
3. *Structural durability*

Retention form - *'The feature of a tooth preparation that resists dislodgement of a crown in a vertical direction or along the path of placement'.*

Determined by -

- Magnitude of dislodging forces
- Geometry of preparation
- Path of insertion
- Roughness of surface being cemented
- Materials being cemented
- Types of luting agent

Geometry of preparation - FPDs depend on preparation geometry rather than adhesive nature of the cement for retention.

This is because no cement has a specific adhesion to the commonly used restorative materials - metal & ceramic.

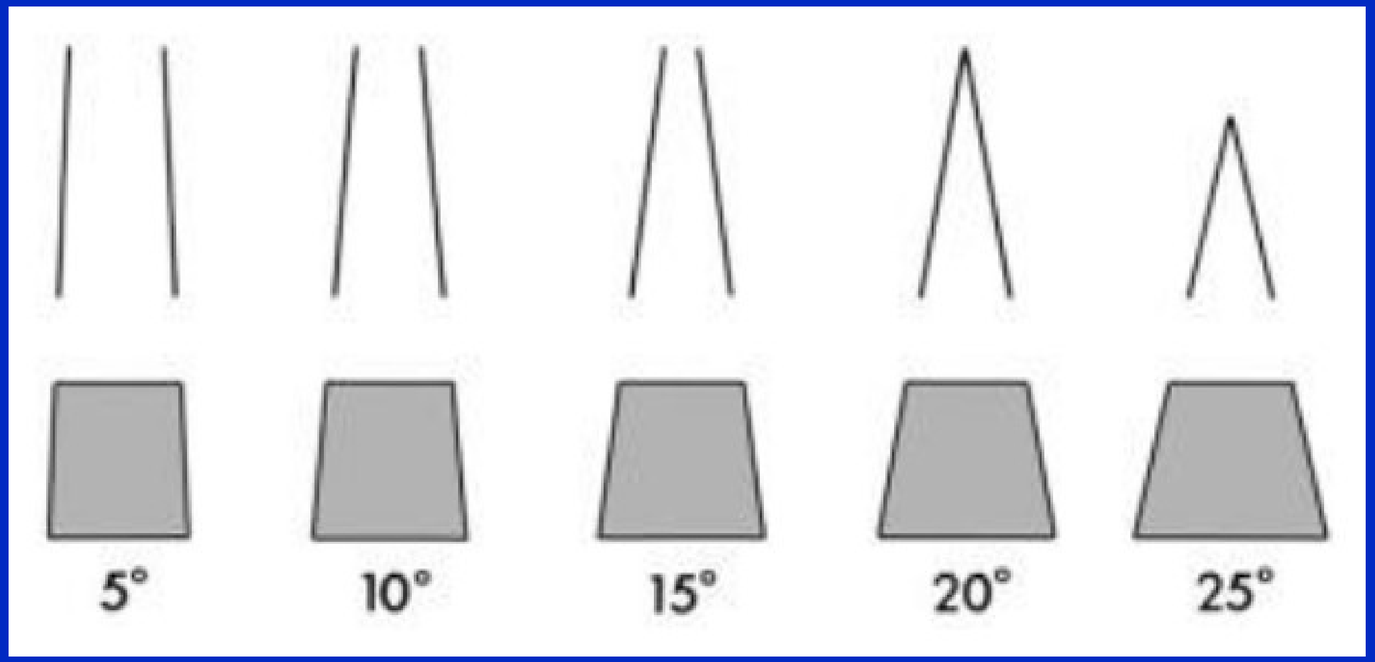
Factors affecting geometry of preparation:

1. Taper
2. Surface area
3. Freedom of displacement
4. Stress concentration
5. Type of restoration

1.TAPER

The convergence of two opposing external walls of a tooth preparation as viewed in a given plane.

‘The extension of those average lines within that plane form an angle described as the angle of convergence’.

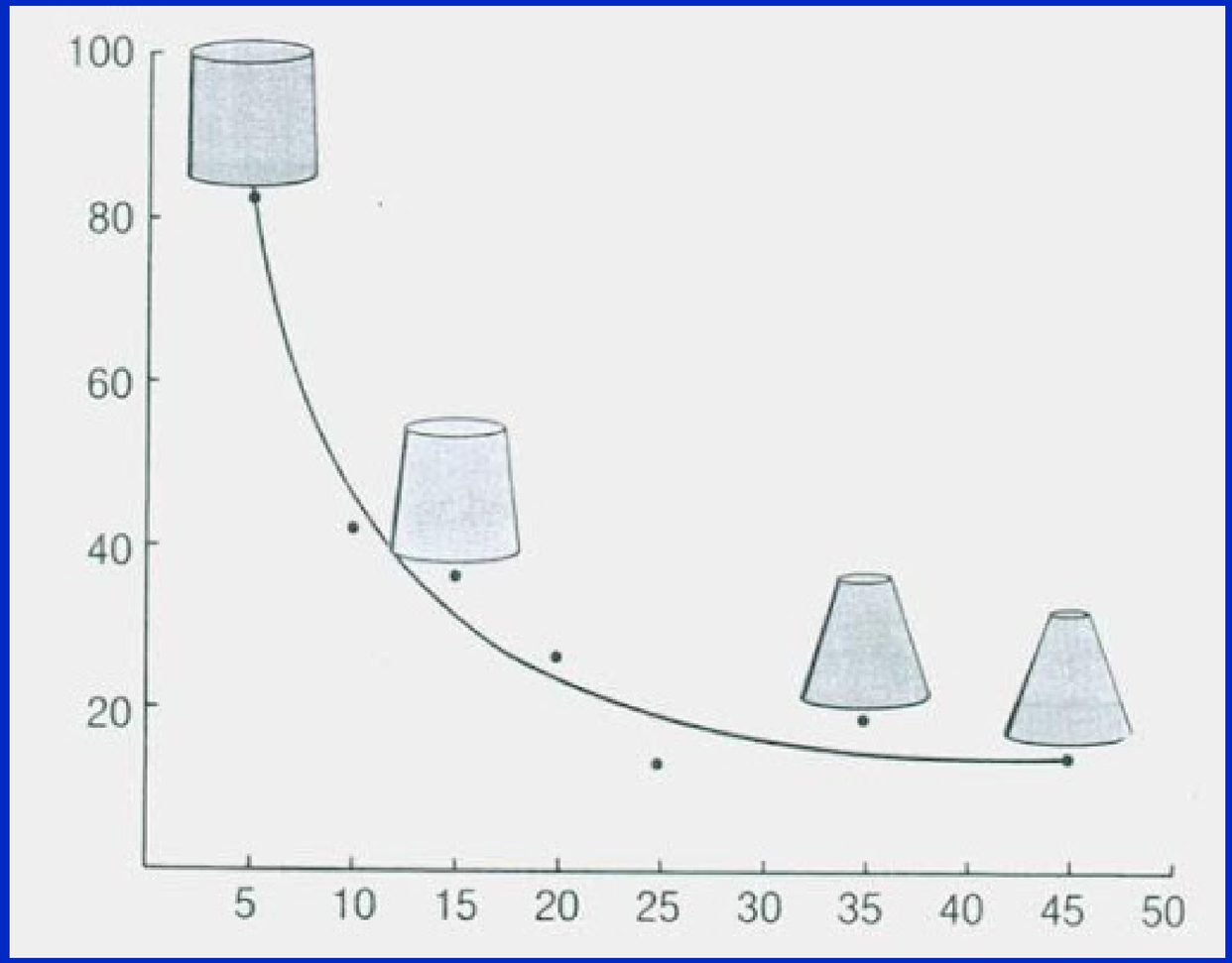


NEED FOR TAPER

- Visualize the preparation walls
- Prevent undercut
- Compensate for the inaccuracy of the fabrication procedure
- Permit more nearly complete seating of the restoration during cementation

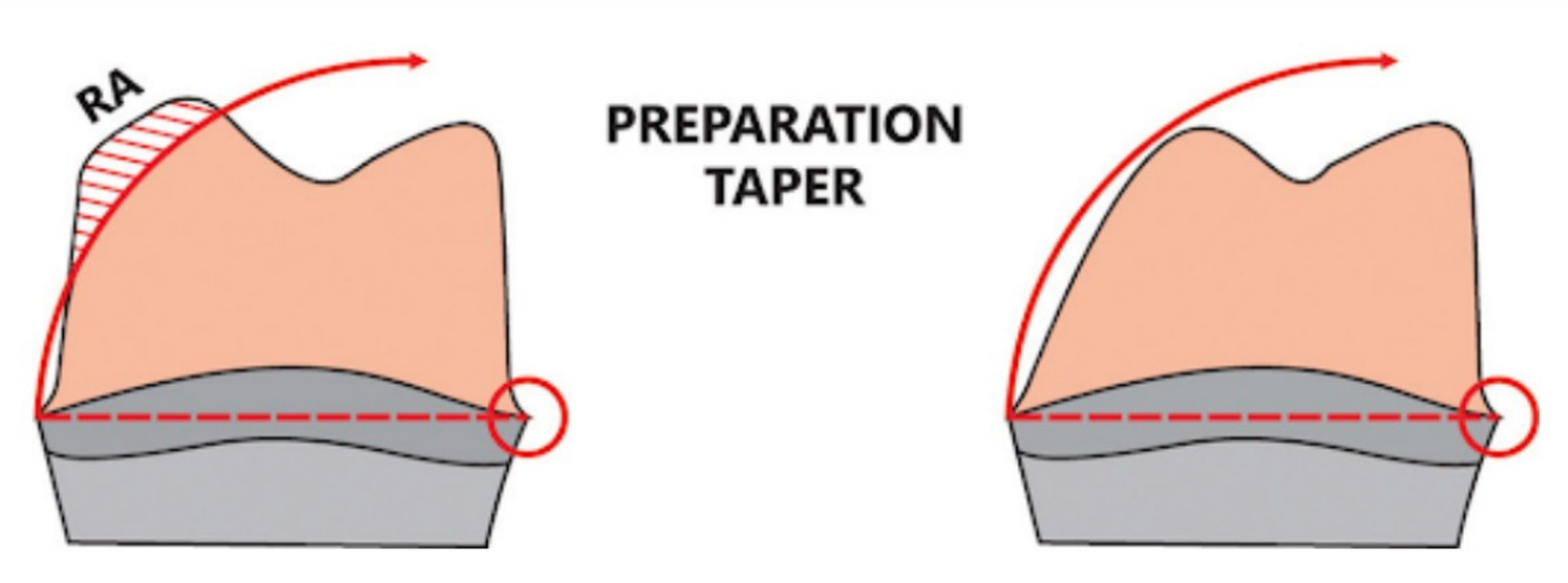
DEGREE OF TAPER

- 2.5-6.5 degrees - suggested as the optimum degree to minimize the stress in the cement interface between the preparation and restoration.
- A taper of upto 15 degrees is clinically acceptable.



THE RELATION BETWEEN THE TAPER AND RETENTION

Preparation of taper- The instrument should be held parallel to the long axis of the tooth and moved through a cylindrical path as the tooth is prepared.



B. SURFACE AREA

- Greater the surface area, greater the retention.
- Preparations on large teeth are more retentive than preparation on small teeth.
- Surface area can be increased by actually limiting the freedom of movement than increasing surface area.

C. FREEDOM OF DISPLACEMENT

- Maximum retention is achieved when there is only one/single path of removal.
- Grooves and proximal boxes can be used to increase retention by limiting the freedom of displacement in over-tapered preparation and in the absence of opposing axial wall.

D. STRESS CONCENTRATION

- Retentive failure begins at junction of axial and occlusal surfaces where stress is concentrated.
- Results in cohesive failure of the entire cemented area.
- Thus, rounding of line angles will reduce stress concentration and enhances retention.

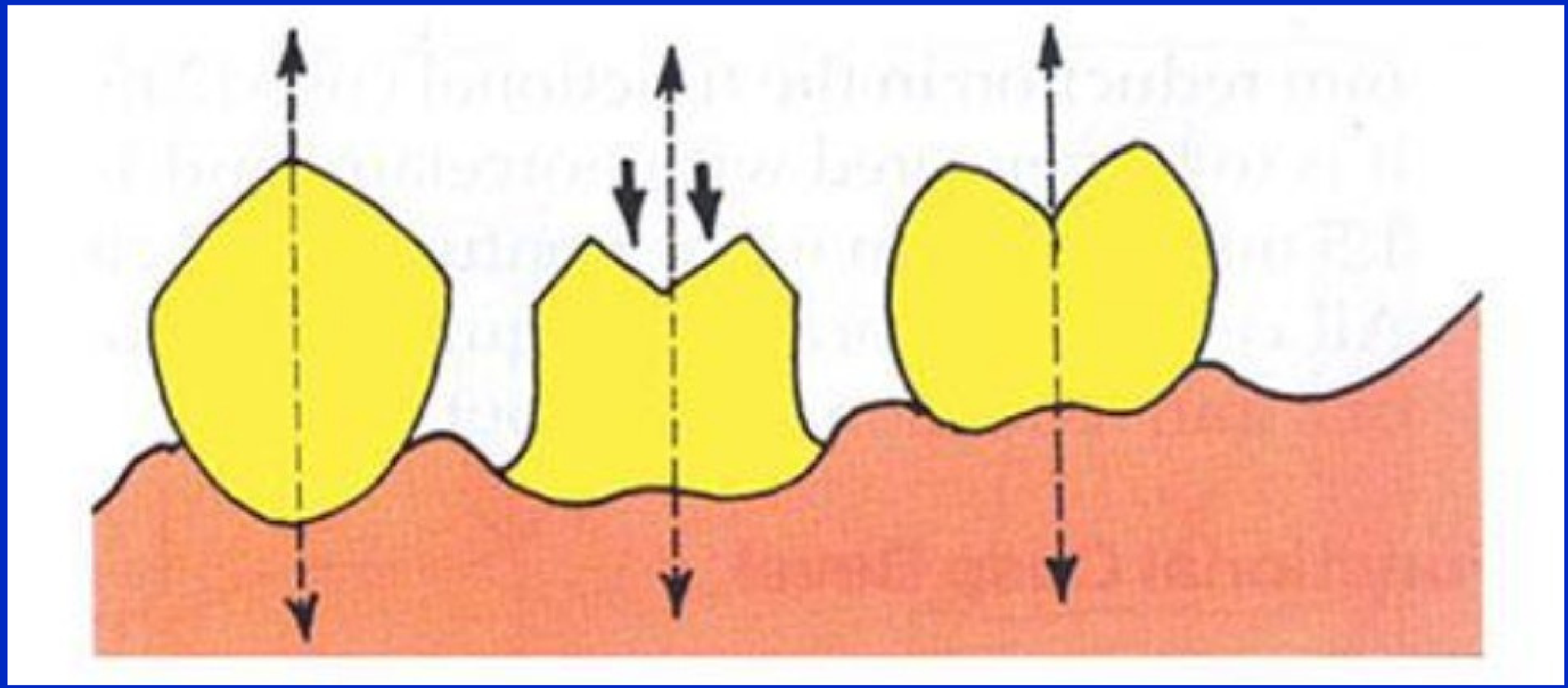
E. TYPE OF RESTORATION

- A complete crown is more retentive than partial coverage restorations.

PATH OF INSERTION (PATH OF PLACEMENT)

‘The specific direction in which prosthesis is placed on the abutment teeth’.

- Should be considered in two dimensions - faciolingually and mesiodistally.
- Mesiodistal inclination should parallel the contact areas of adjacent teeth.
- Faciolingual orientation can affect the esthetics.
- For metal-ceramic crowns, it should be parallel to the long axis of the tooth.
- For partial veneers, should be parallel to the incisal half of the labial surface.



RESISTANCE FORM

‘The feature of a tooth preparation that enhances stability of a restoration and resists dislodgement along an axis other than the path of placement’.

Factors affecting resistance form:
1.Magnitude and direction of dislodging forces
2.Geometry of tooth preparation
3.Type of luting agent

GEOMETRY OF PREPARATION

i) Occluso-gingival length:

- Short tooth preparations with large diameters were found to have little resistance form
- Teeth with short walls and short diameter have better resistance than teeth with large diameter but short walls
- The preparation on the smaller tooth will have a rotational radius for the arc of displacement, and the incisal portion of axial wall will resist displacement.
- The larger preparation allows for a gradual arc of displacement, and the axial wall does not resist removal

II) GROOVES, PROXIMAL BOXES AND PINHOLES

- Resistance to displacement for a short walled preparation on a tooth with large diameter can be improved by placing grooves, proximal boxes and pinholes in axial walls.
- This reduces the rotational radius and the portion of the groove near the occlusal surface of the preparation will resist displacement.
- Grooves and proximal boxes also limit the freedom of displacement from torquing/twisting forces in a horizontal plane and enhance the resistance of the restoration.

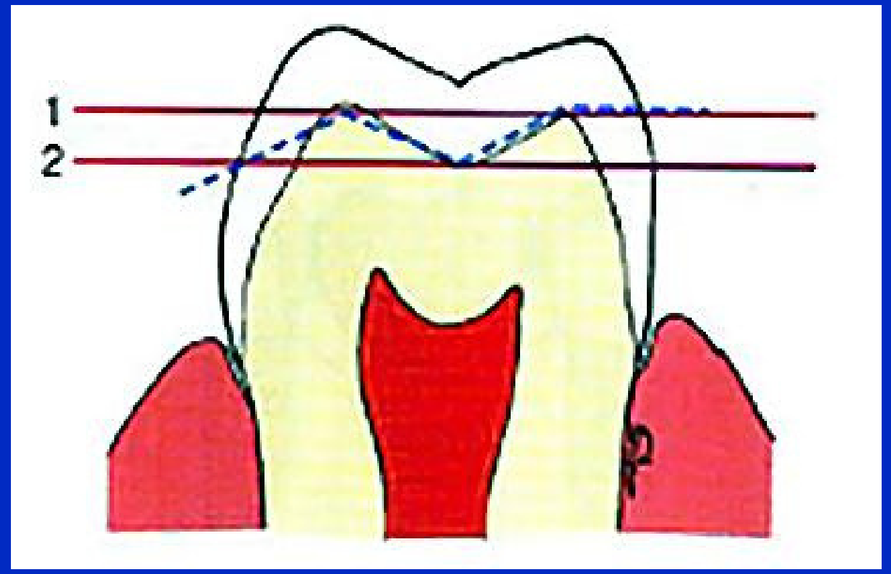
STRUCTURAL DURABILITY

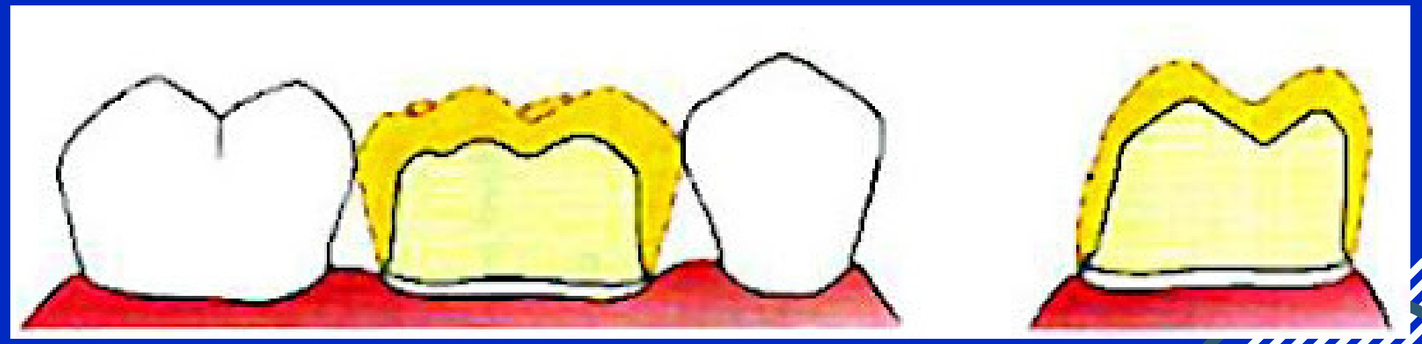
‘The ability of the restoration to last long without damage, under occlusal forces’.
Factors affecting structural durability:

- Occlusal reduction
- Functional cusp bevel
- Axial reduction

OCCLUSAL REDUCTION

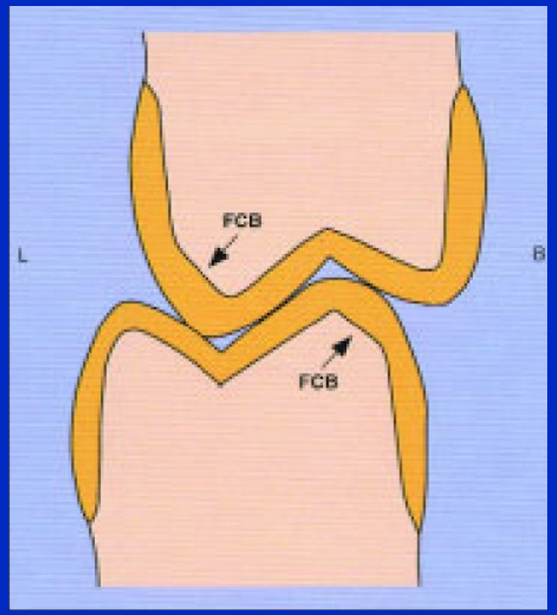
- For metal alloys, 1.5mm occlusal clearance on the functional cusps and around 1mm on non-functional cusps
- Metal ceramic, 1.5-2mm on functional cusps; 1-1.5mm on non-functional cusps 2mm clearance on preparations for all ceramic restorations

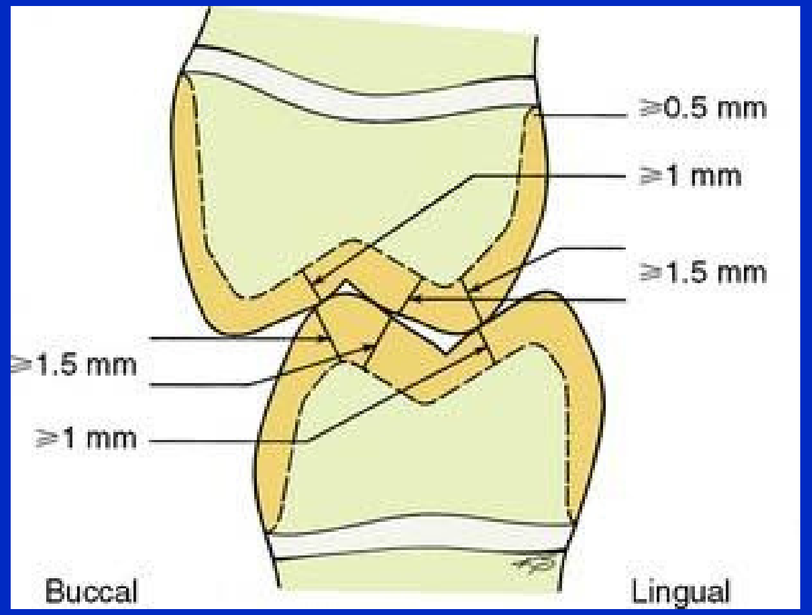




FUNCTIONAL CUSP BEVEL

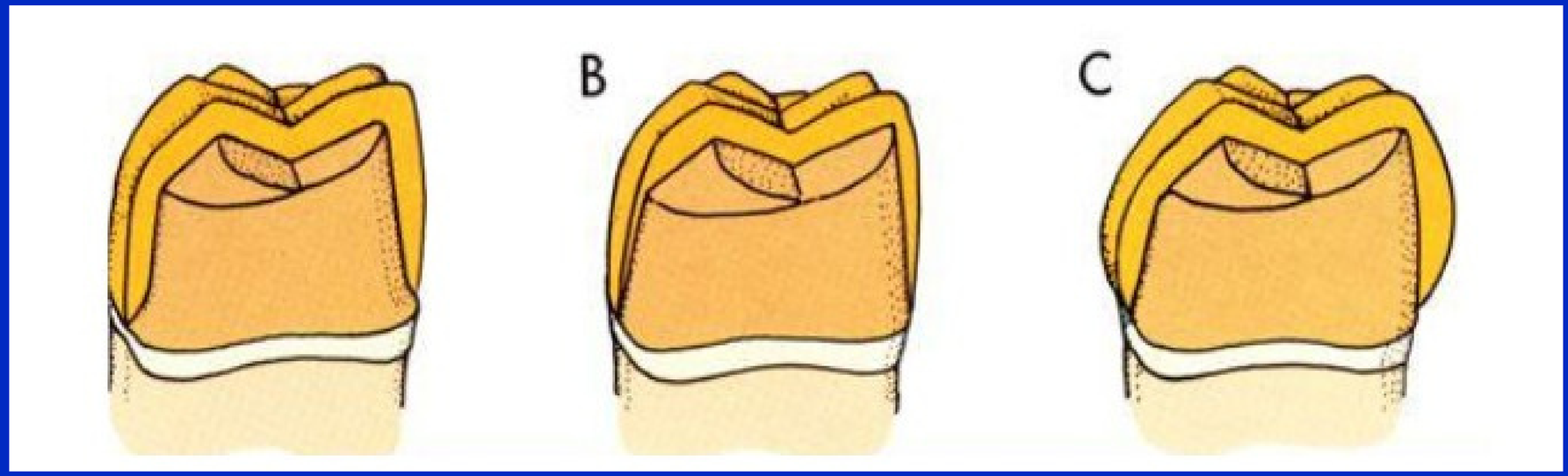
- Provides space for adequate bulk of restoration in an area of heavy occlusal contact Wide bevel placed on functional cusps - palatal cusps of maxillary posteriors & buccal cusps of mandibular posteriors
- Lack of this may lead to perforation, over-contouring with defective contact/ over inclination of axial surface





AXIAL REDUCTION

- For securing adequate thickness of restorative material.
- Other features incorporated in tooth preparations that also enhance structural durability are - offset, groove, occlusal shoulder, isthmus and proximal box.



AESTHETIC CONSIDERATIONS

Aesthetic restorations include;

- Partial veneer crowns with intact labial surface
- Metal-ceramic restorations with ceramic coverage facially
- All-ceramic restorations

SUMMARY

- Biologic, mechanical and aesthetics considerations are as follows;
- Biologic:
  - Prevention of damage
  - Conservation of tooth structures
  - Margin integrity
- Mechanical:
  - Retention form - Taper, surface area, freedom of displacement, stress
  - concentration and type of restoration
  - Resistance form - Grooves, proximal boxes, pinholes
- Structural durability
  - Aesthetic considerations:
  - Partial veneer restorations
  - Metal ceramic restorations
  - All ceramic restorations

REFERENCES

- *Contemporary fixed prosthodontics, Rosential, Land, Fujjimoto. Fifth edition Unconventional pontics in fixed partial dentures*
- *Fundamentals of fixed prosthodontics - Shillingburg H. T, 4th edition*

Thank You

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