THE UNIVERSITY OF WESTERN AUSTRALIA | Oral Health Centre of Western Australia

Lecture 1-Principles of Tooth Preparations

By Dr Cheryl Fu

Expected Reading:

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1 BOOK

Fundamentals of fixed prosthodontics ; Fourth edition.

Shillingburg, Herbert T.; Sather, David A.

Hanover Park, IL : Quintessence Pub.; 2012

Available at J. Robin Warren Library Main collection (Q 617.69 201

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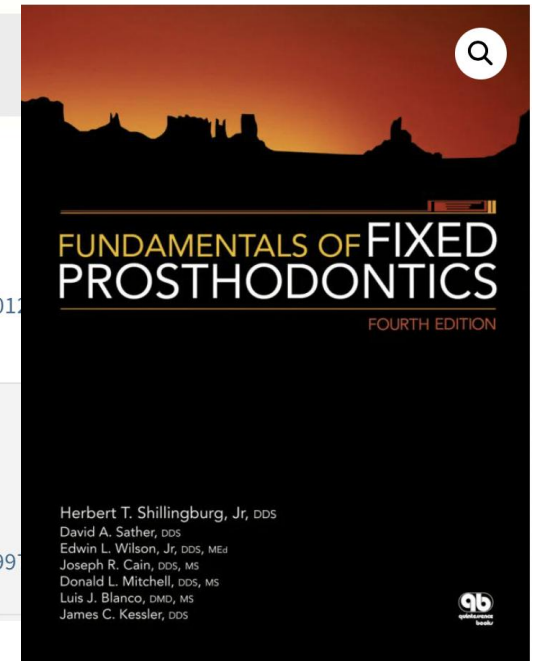
2 BOOK

Fundamentals of fixed prosthodontics ; 3rd ed.

Shillingburg, Herbert T.

Chicago : Quintessence Pub. Co.; c1997

Available at J. Robin Warren Library Main collection (Q 617.69 199



THE READING WILL BE EXAMINABLE CONTENT!

Learning Outcomes:

- Understand basic terminology for crown preparations
- Understand indications of crowns
- Understand the importance of the mechanical, biological, and aesthetic principles of tooth preparation

Reading for this lecture:

Fundamentals of Fixed Prosthodontics: Chapter 9 Principles of Tooth Preparations

Contemporary of Fixed Prosthodontics: Chapter 7 Principles of Tooth Preparations

Why Does a Tooth Need a Crown?

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As part of DMD1 and DMD2 (Semester 1) you have learnt about:

- Composite restorations
- Amalgam restorations

So why do we need crown?

Considerations for a crown:

- Destruction of tooth structure
- Aesthetics
- Plaque Control/Moisture Control
- Retention
- Finance*
- Other prosthodontic treatment (survey crowns for RPDs)

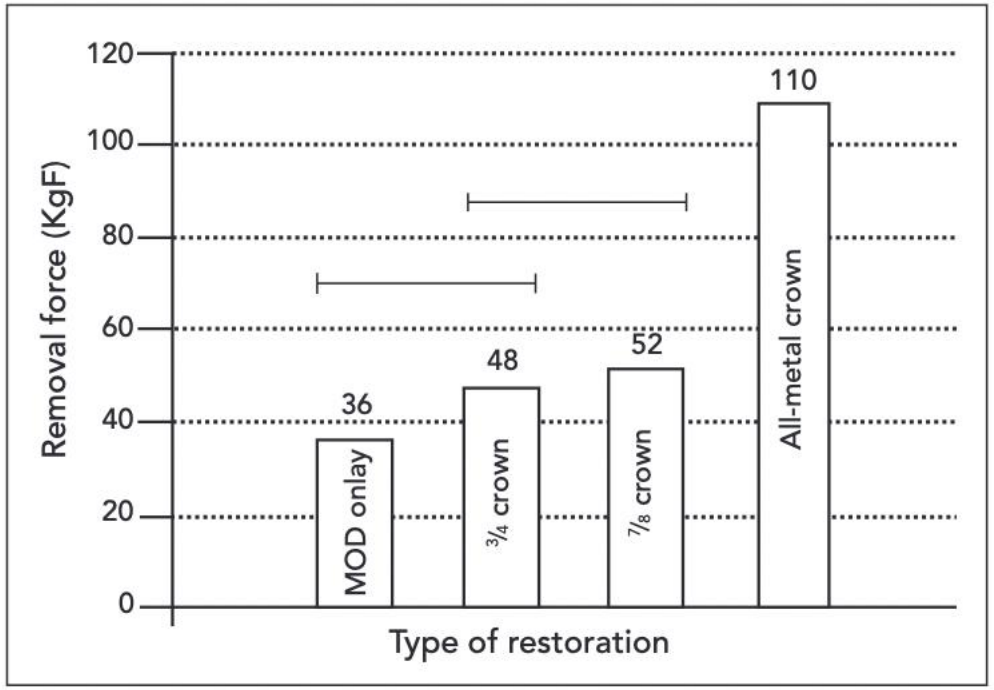


Fig 6-1 A comparison of resistance to removal forces for four types of crowns ($P = .05$).[1,2] MOD, mesio-occlusodistal.

Why Does a Tooth Need a Crown?

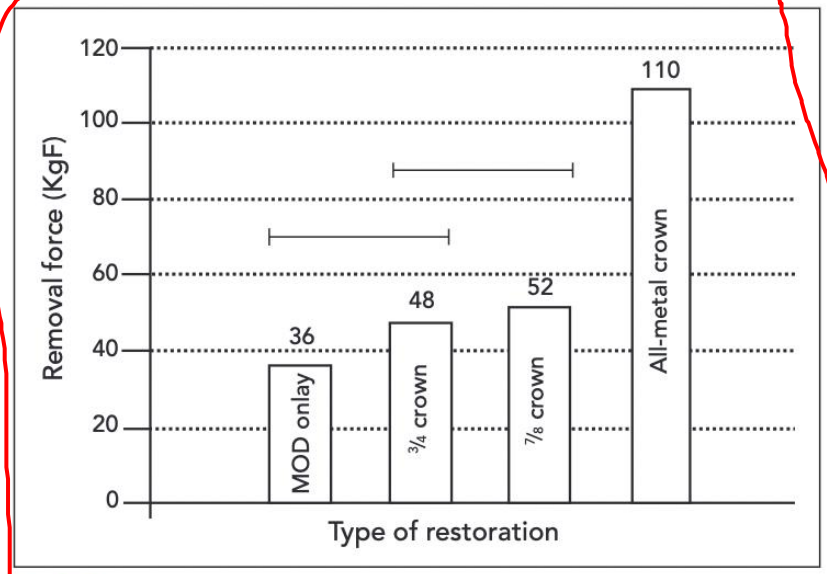
Considerations for a crown:

- **Destruction of tooth structure**
- Aesthetics
- Plaque Control/Moisture Control
- **Retention**

Figure 3a.

Figure 3b.

Figure 3. Patients abusing methamphetamine often present with rampant caries. *(Photos courtesy of Dr. Jinus Emrani)*



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Fundamental of Fixed Prosthodontics

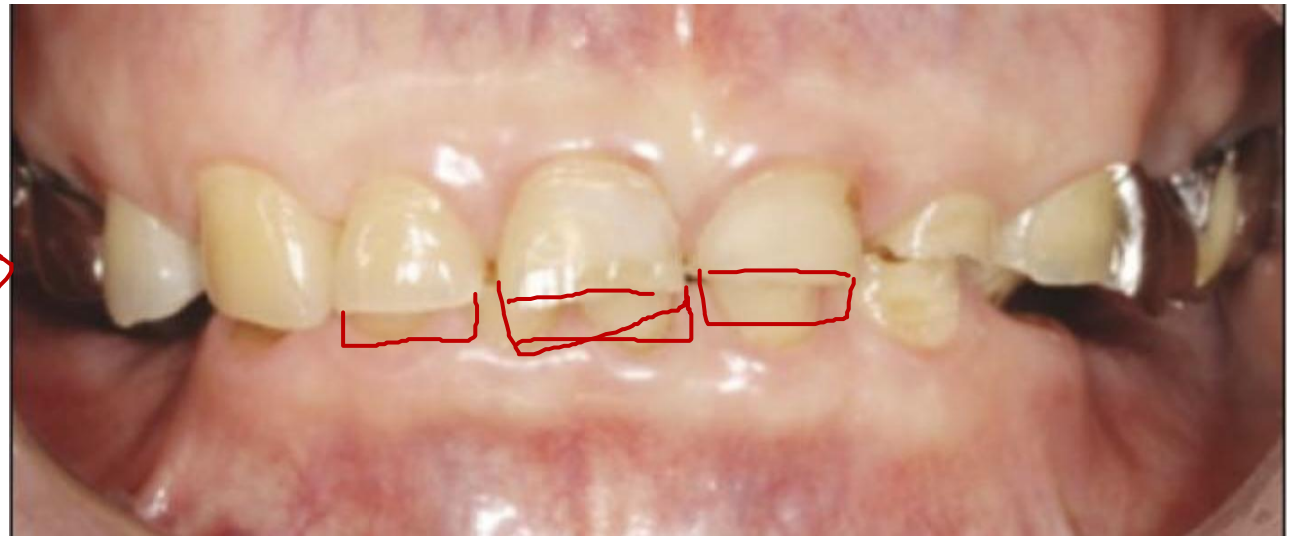
Terry E. Donovan (2006) Longevity of the Tooth/Restoration Complex: A Review

Why Does a Tooth Need a Crown?

Considerations for a crown:

- Destruction of tooth structure
- **Aesthetics**
- Plaque Control/Moisture Control
- Retention

Photo by tetracycline staining by Dr. Alessandro Martini



Song MY, Park JM, Park EJ. Full mouth rehabilitation of the patient with severely worn dentition: a case report.

Why Does a Tooth Need a Crown?

Oral Health Centre of Western Australia

Considerations for a crown:

- Destruction of tooth structure
- Aesthetics
- **Plaque Control/Moisture Control**
- Retention

Some studies report a lower annual failure rate in indirect restorations (ceramic restorations 1.9%) compared to direct (composite 2.2%, amalgam 3%) restorations.
The predominant mode of failure of ceramic restorations is bulk fracture.
The predominant mode of failure for composite restorations were reported to be marginal breakdown (secondary caries or deterioration) or fracture.

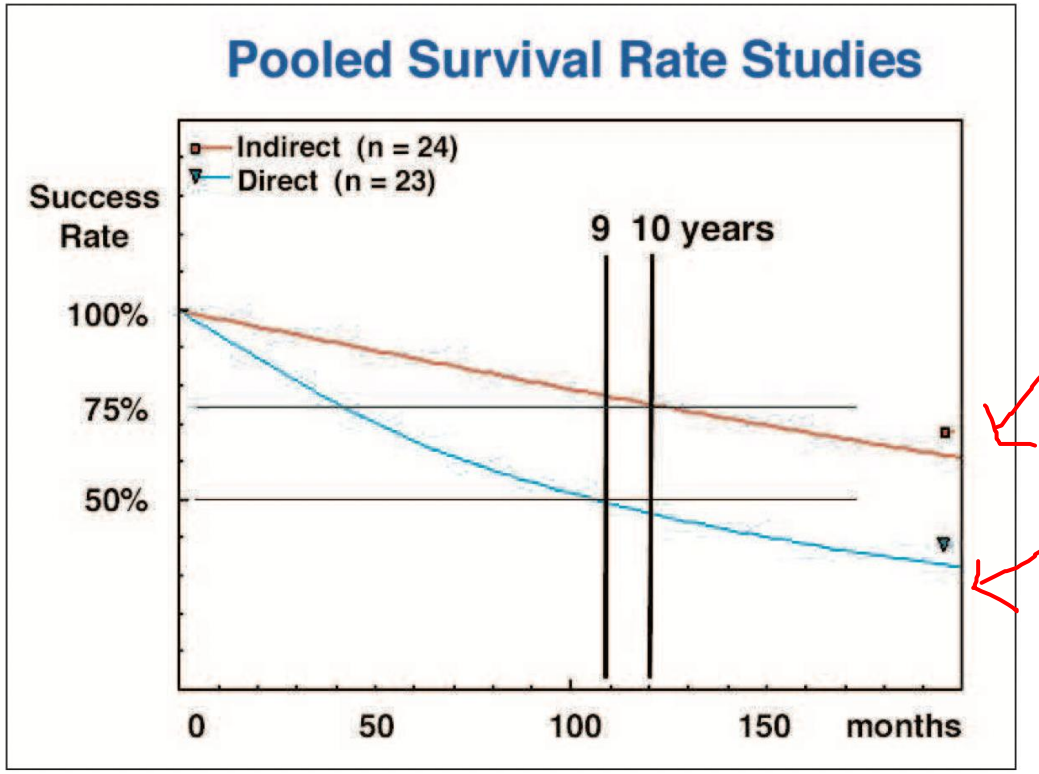


Figure 2. *Comparison of the published survival curves of direct restorations (amalgam and composite) vs indirect adhesive inlays with the 2-parameter fit.*

Manhart J, Chen HY, Hamm G, Hickel R. Review of the clinical survival of direct and indirect restorations in posterior teeth of the permanent dentition.

CLINICAL PROCEDURES

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Clinical examination

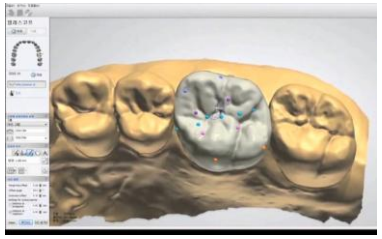
Primary Impression

Tooth preparation + Temporisation

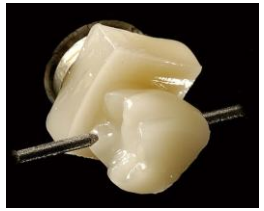
Definitive Impression

Intraoral scanning

CAD All-ceramic



Milling



Try-in

Casting and veneering

Wax up (gold crown, PFM)

Cementation

Review

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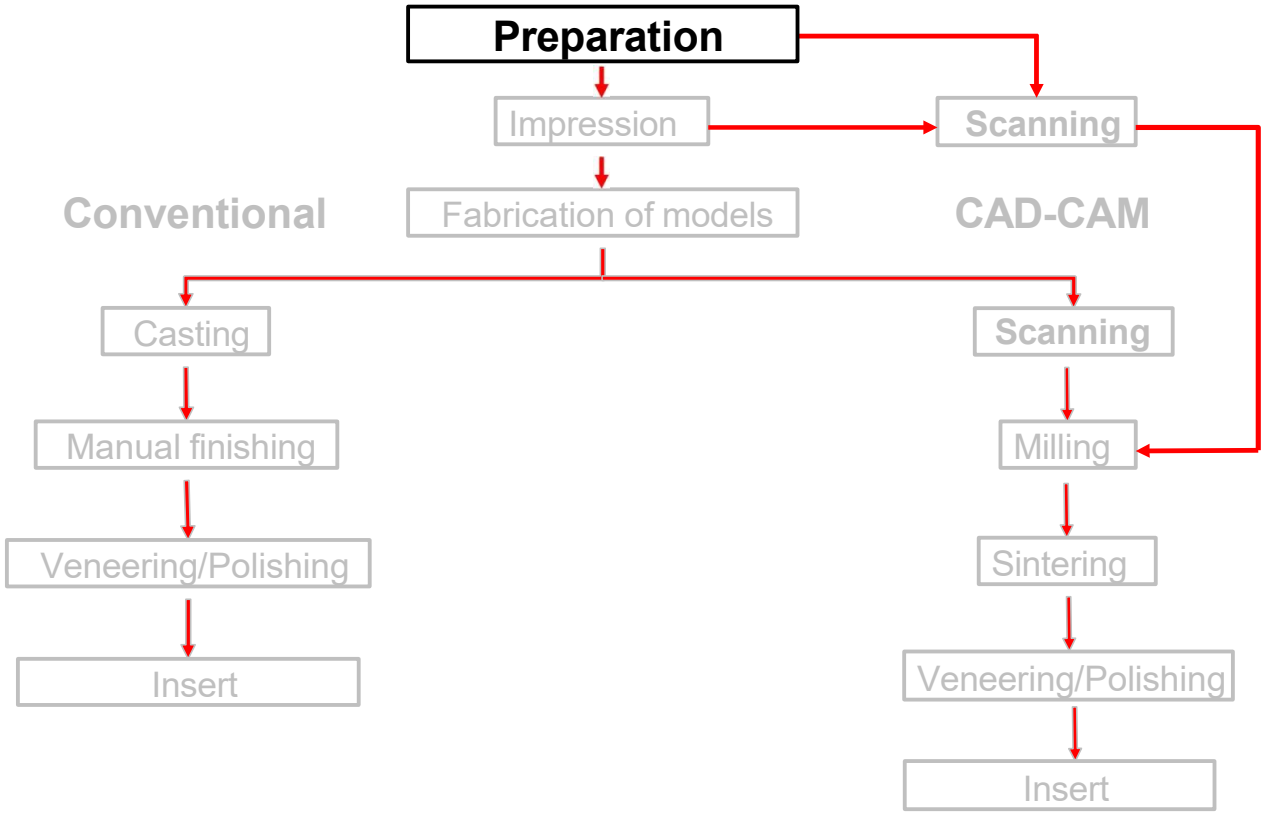

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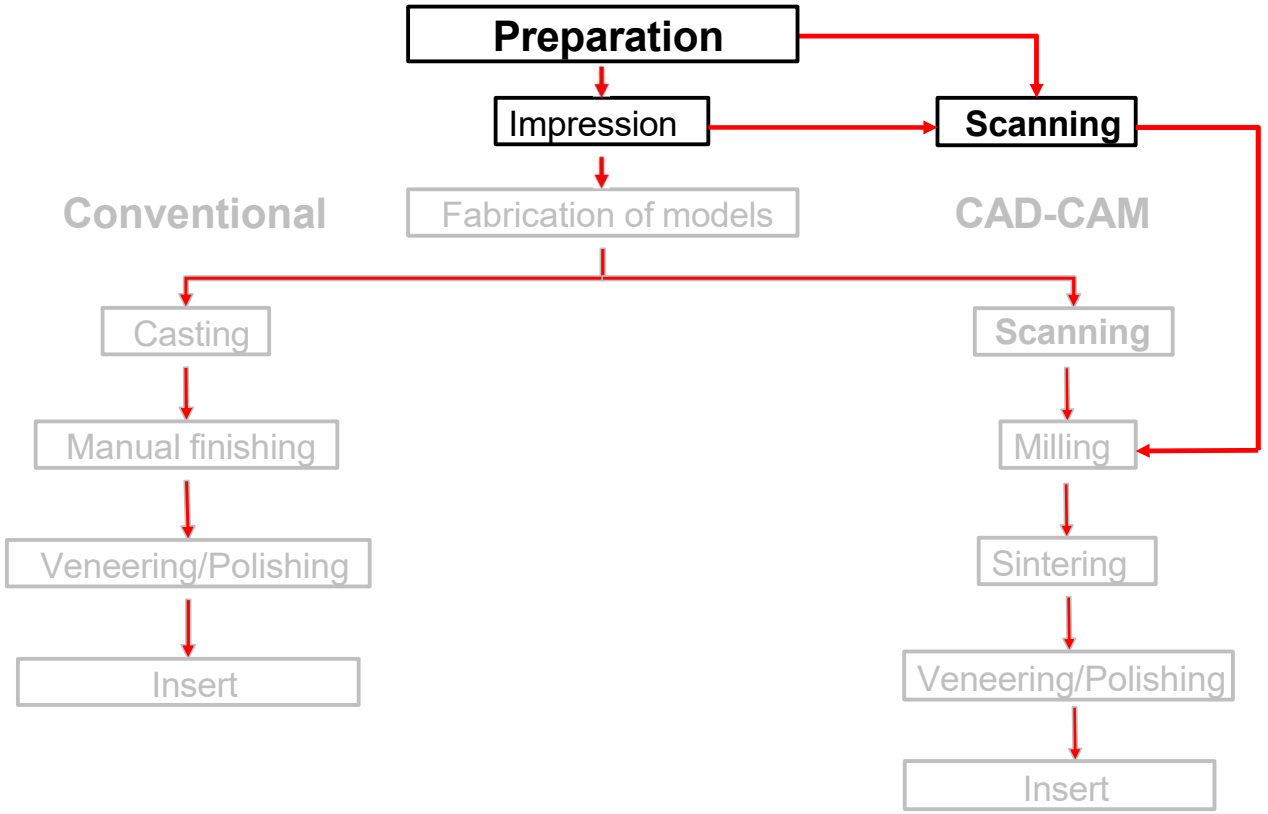

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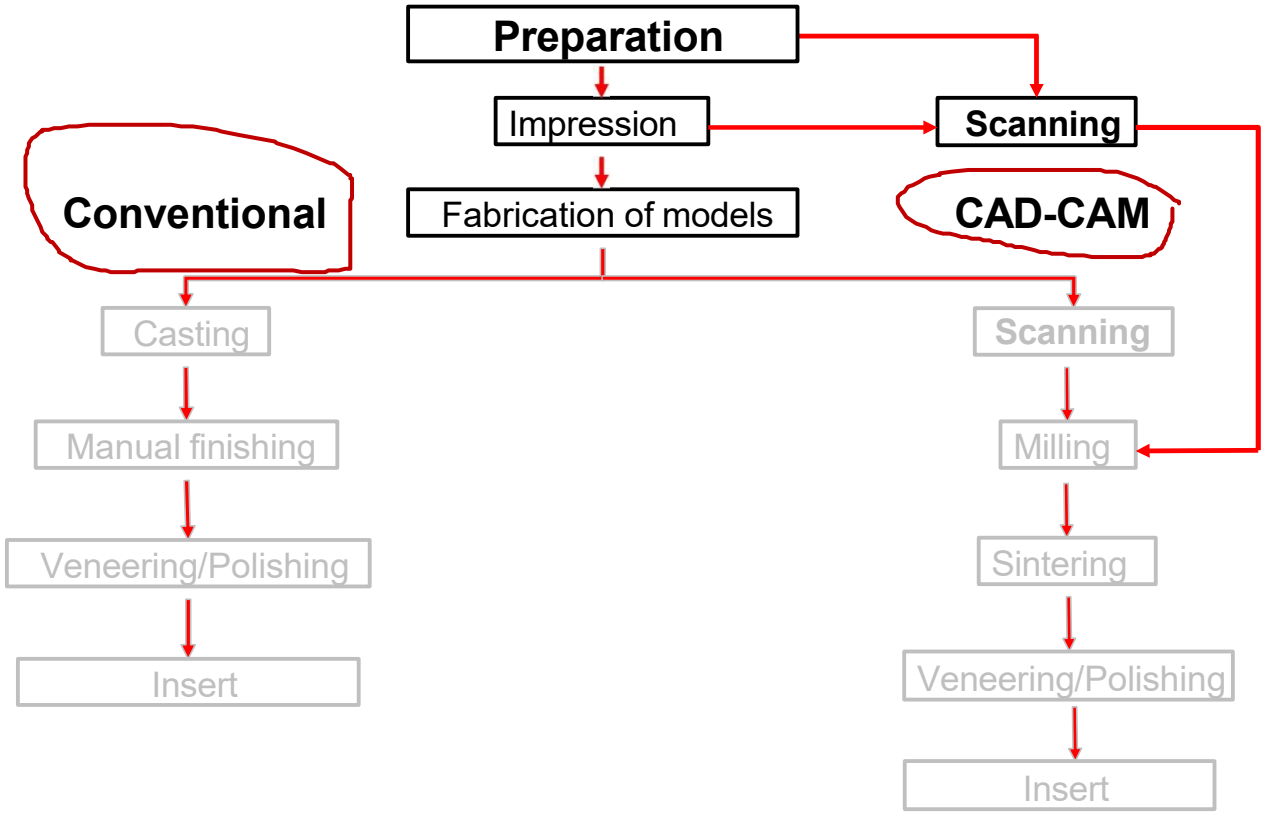

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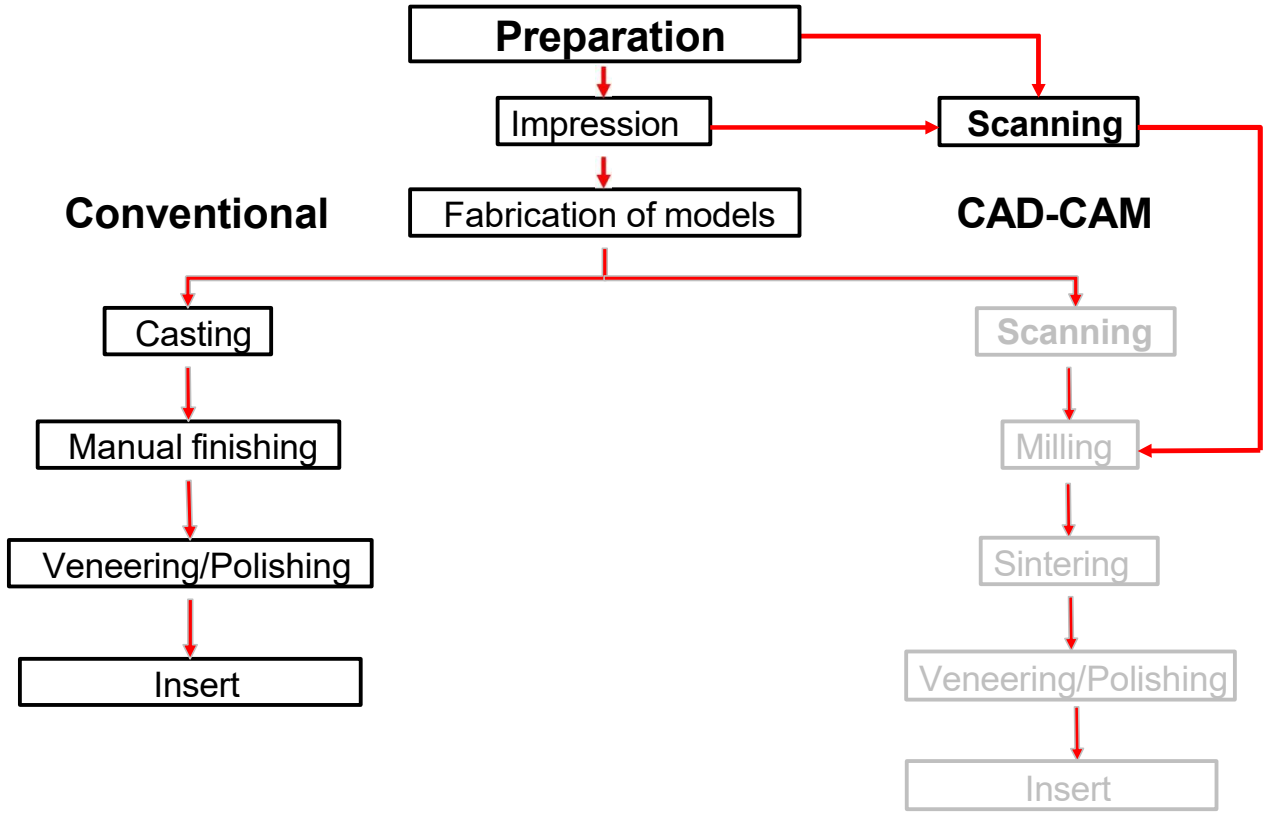

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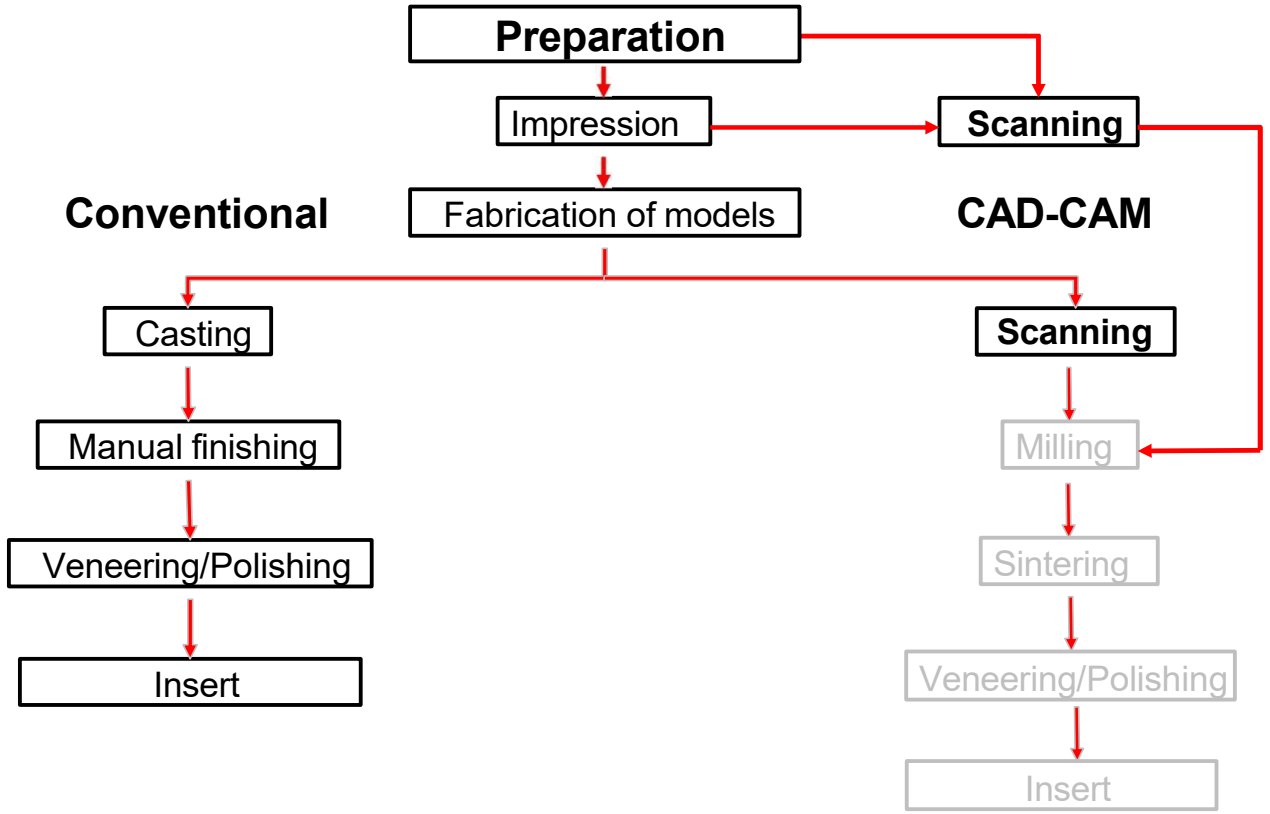

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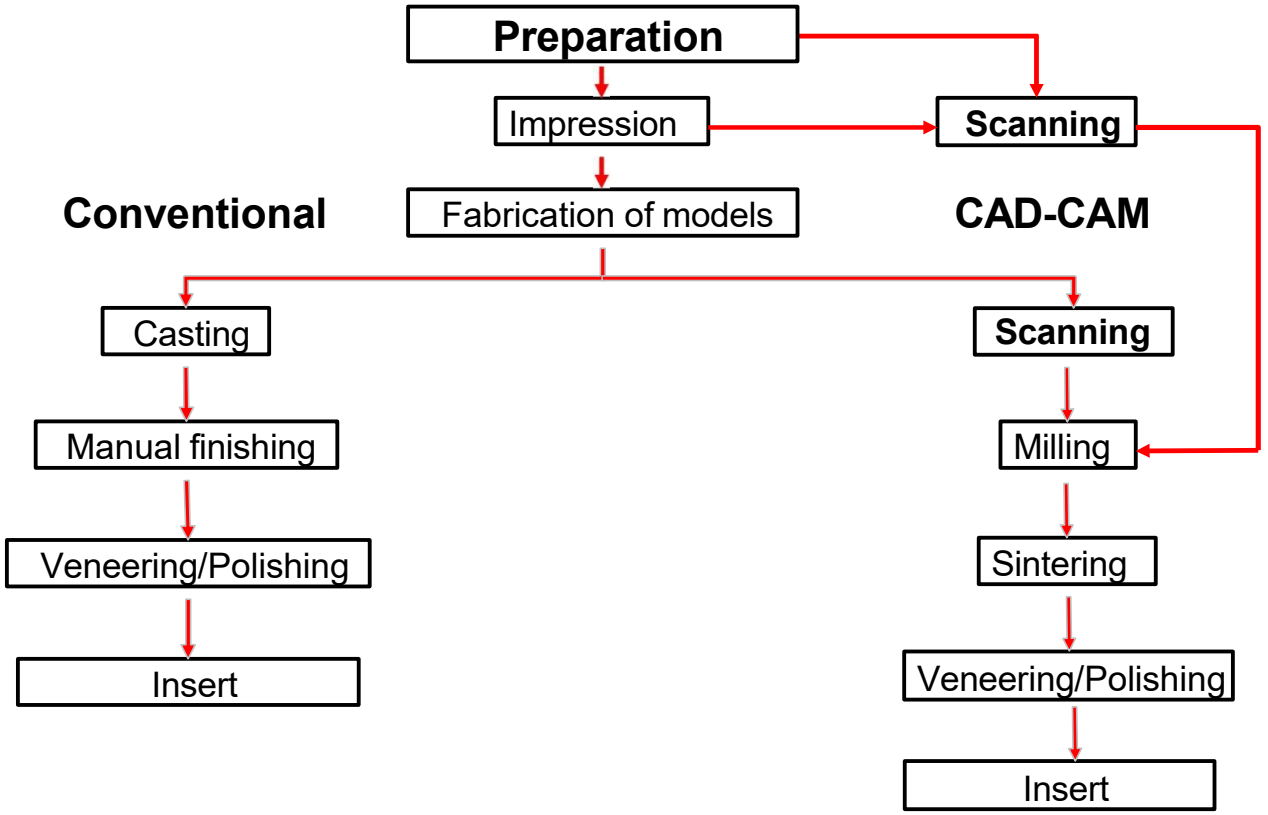
Workflow



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Crown Preparation Terminology

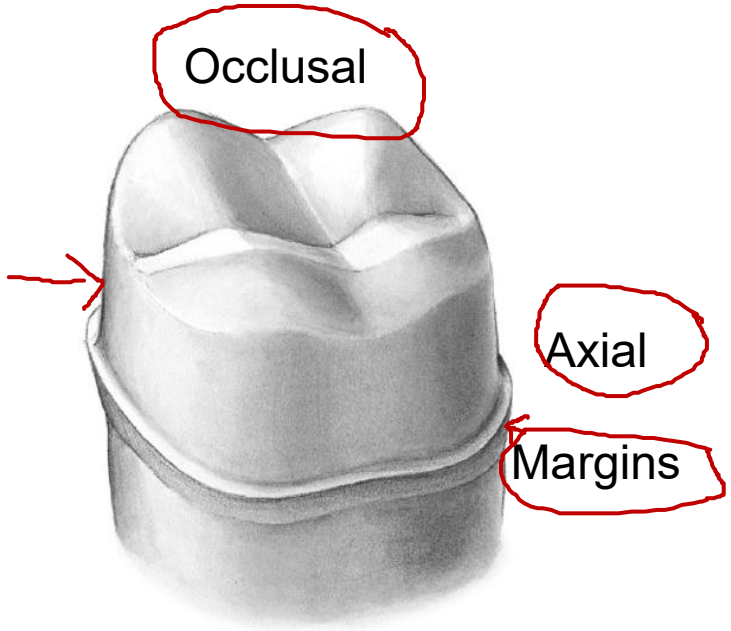

FIGURE 8-25 ■ The completed preparation is characterized by a smooth, even chamfer margin; a 6-degree taper; and gradual transitions between all prepared surfaces.

Contemporary Fixed Prosthodontics

Crowns

Materials:

- All ceramic
  - Zirconia or Glassy Ceramics (eg Lithium Sillicate or Lithium Disillicate)
- Metal
  - Varying alloys
- Porcelain Fused to Metal (PFM)

Each material may require different preparations.

Crown Preparation Terminology

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Margins:

- Supra-gingival of subgingival
- Types of margins
  - Feather edge
  - Bevel
  - Chamfer
  - Shoulder
  - Shoulder with bevel

Supragingival Margins

- Easily prepared
- Easier to take impressions
- Easily maintained by patient
- Easily evaluated at recalls
- Preserve periodontium

Subgingival Margins

Indications

- Subgingival dental caries, erosion, fracture line or restoration
- Additional retention is needed
- Aesthetic margins
- Coverage of root surface
- Modification of axial contour

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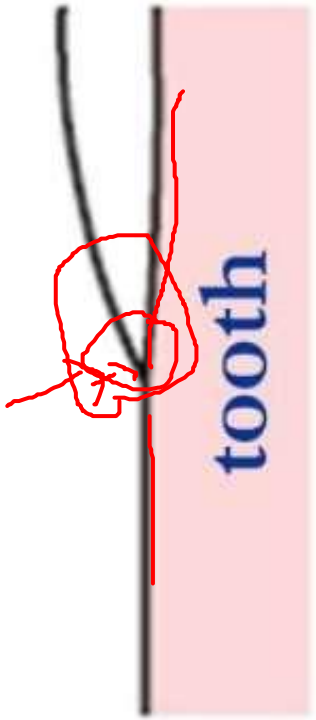

Advantages:

- Conservation of tooth structure

Disadvantages:

- Fail to provide adequate bulk at margins

CONTRA-INDICATED IN MOST CASES!

Slide by Dr Nedelcu

Margins

Margins:

- Supra-gingival of subgingival
- Types of margins
  - Feather edge
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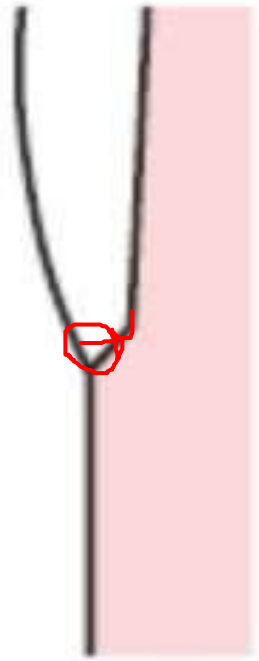


Commonly for cast restorations

Advantages:

- Allow the margin of the crown to be burnished against tooth structure
- Protect the unprepared tooth structure from chipping by removing unsupported enamel
- May reduce marginal discrepancy when complete crown fails to seat completely. (But doesn't work for oversized crown)

Disadvantages:

- Can lead to subgingival extension

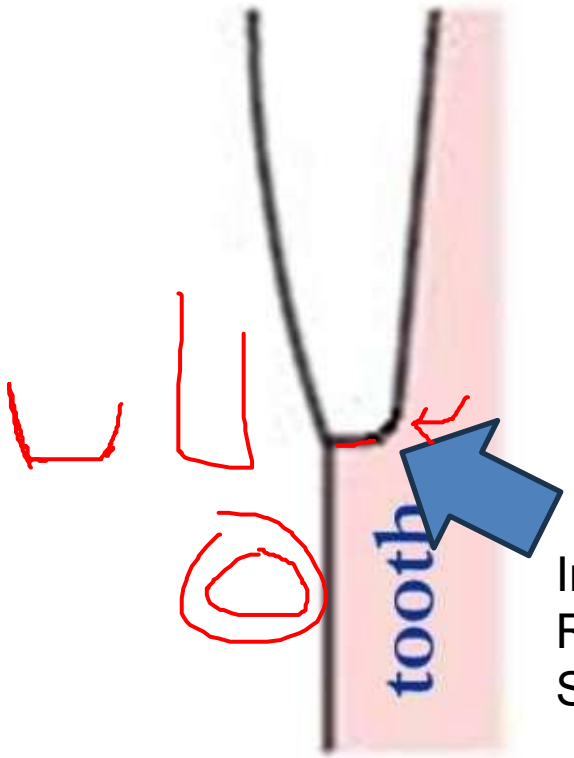
Slide by Dr Nedelcu

Margins

Margins:

- Supra-gingival of subgingival
- Types of margins
  - Feather edge
  - Bevel
  - Chamfer
  - Shoulder
  - Shoulder with bevel

Can be used for all materials.



Advantages:

- Easy to prepare and finish well
- Easy to judge on impressions

Disadvantages:

- More aggressive preparation

Internal angle is ROUNDED NOT SHARP 90 degrees.

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Margins

Margins:

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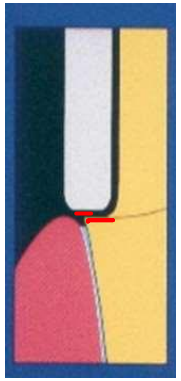
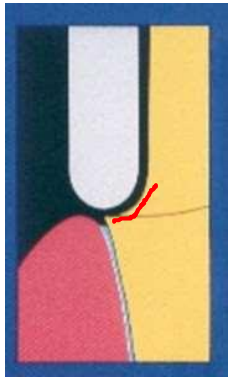


Shoulder



Chamfer

Advantages:

- Conserves tooth structure whilst providing distinct finish lines
- Easy to read in impressions

Commonly used for metal, or ceramic crowns

Use a tapered diamond bur with round tip!

Slide by Dr Nedelcu

Margins

Margins:

- Supra-gingival of subgingival
- Types of margins
  - Feather edge
  - Bevel
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  - Shoulder
  - Shoulder with bevel

Sometimes used for PFM crowns with a metal labial margin (hidden in the sulcus). But a shoulder/chamber is preferred for biologic and aesthetic considerations

Uncommonly used.

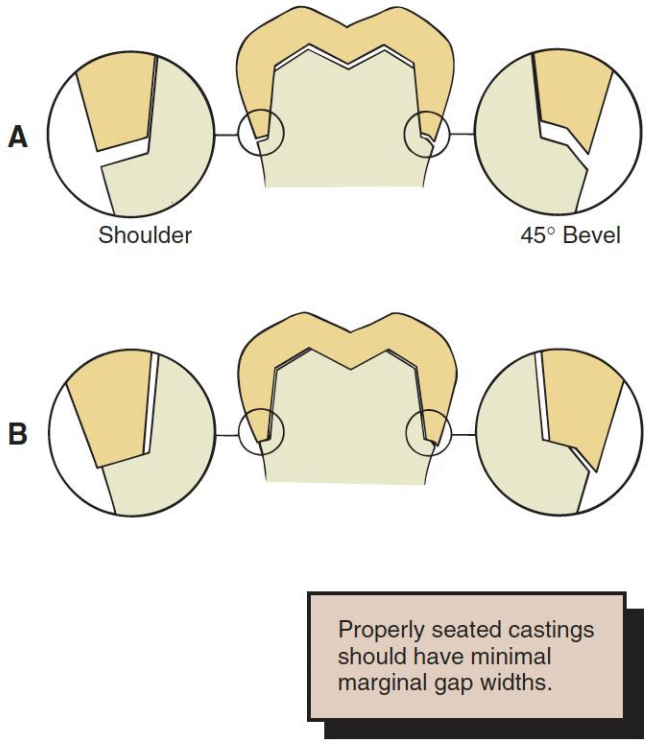
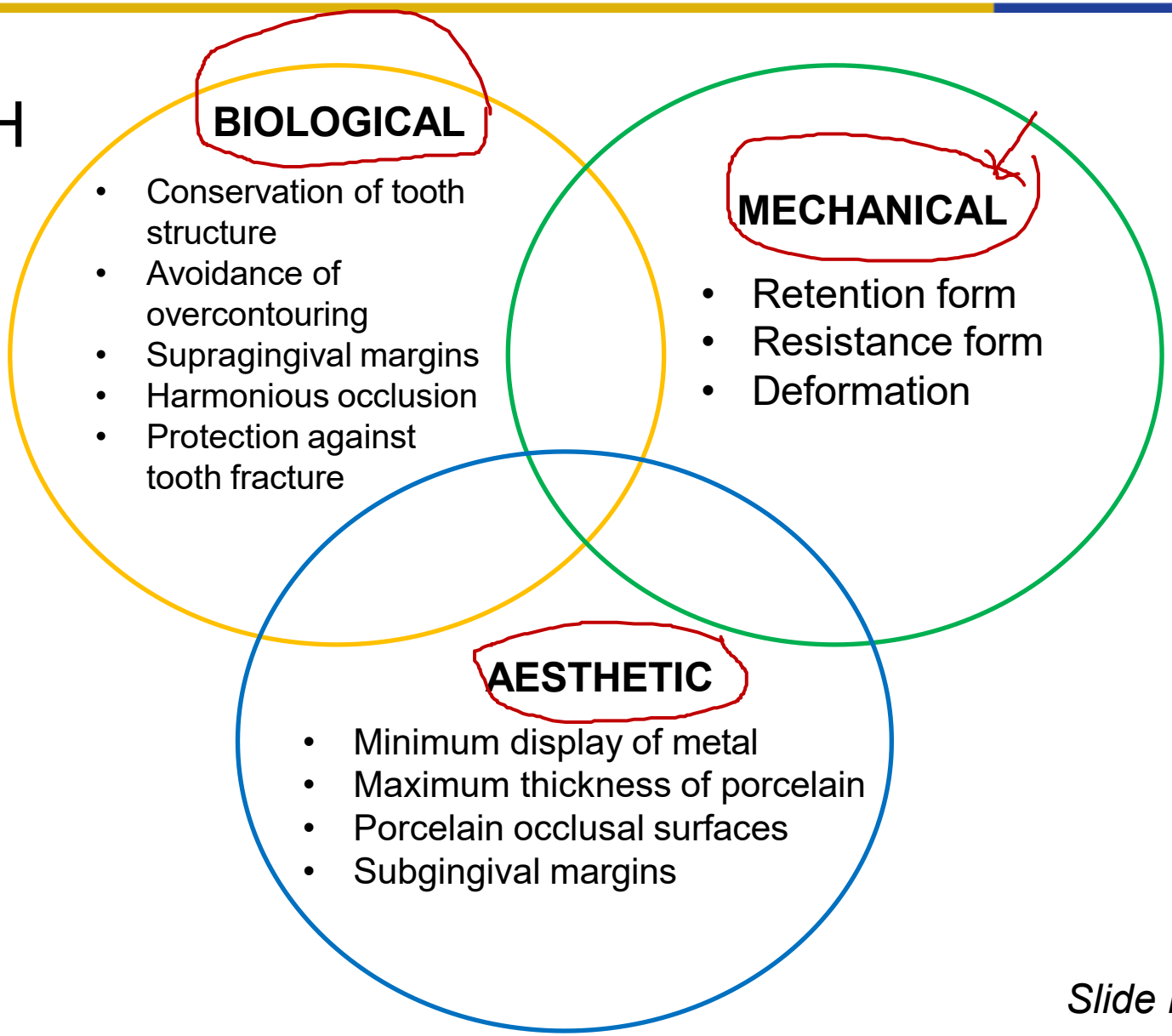


FIGURE 7-25 ■ Effect on marginal fit of beveling the gingival margin. **A,** If the internal cross section of a crown is the same as or less than that of the prepared tooth, a 45-degree bevel decreases the marginal discrepancy by 70%. **B,** If the internal diameter is slightly larger than the prepared tooth, beveling increases the marginal discrepancy. In practice, crowns are made slightly larger than the prepared tooth to allow for the luting agent.

Principles of Tooth Preparations

ABUTMENT TOOTH

- Principles of tooth preparation
- Partial or complete preparation



Slide by Dr Matsubara

Principles of Tooth Preparations

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- Partial or complete preparation

BIOLOGICAL

- Conservation of tooth structure
- Avoidance of overcontouring
- Supragingival margins
- Harmonious occlusion
- Protection against tooth fracture

MECHANICAL

- Retention form
- Resistance form
- Deformation

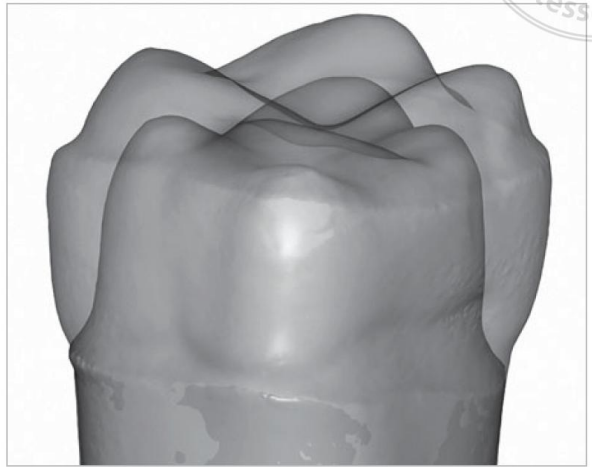

Fig 1 Approximately 70% of the volume of the clinical crown of a posterior tooth is removed for a full-crown preparation (internal contour), whereas only about 30% is lost for an occlusal onlay, unless more tissue has already been lost (see Fig 3b).

Occlusal onlays as a modern treatment concept for the reconstruction of severely worn occlusal surfaces

Article *in* Quintessence international (Berlin, Germany: 1985) · January 2018

DOI: 10.3290/j.qi.a40482

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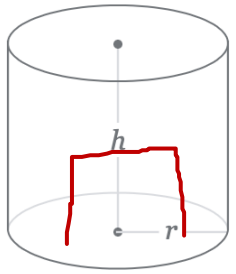
Principles of Tooth Preparations

Solve for
volume

$V \approx 785.4$

r Radius 5

h Height 10



Solution

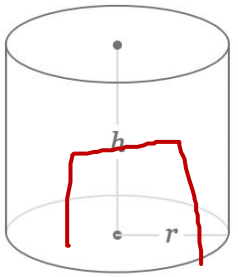
$V = \pi r^2 h = \pi \cdot 5^2 \cdot 10 \approx 785.39816$

Solve for
volume

$V \approx 402.12$

r Radius 4

h Height 8



Solution

$V = \pi r^2 h = \pi \cdot 4^2 \cdot 8 \approx 402.12386$

$$V = \pi r^2 h$$

Obvious limitations for this model such as tooth is not a cylinder shape, and tooth has a pulp chamber resulting in this simplified model giving us an underestimate.

This represents almost 50% decrease in volume!! Even worse if you include a pulp chamber space!

Principles of Tooth Preparations

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ABUTMENT TOOTH

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- Partial or complete preparation

BIOLOGICAL

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- Resistance form
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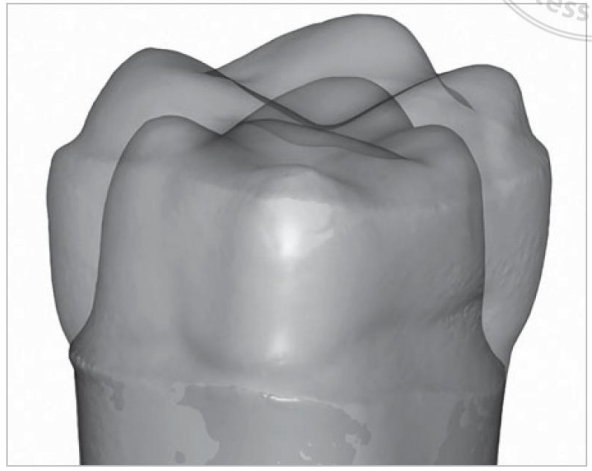

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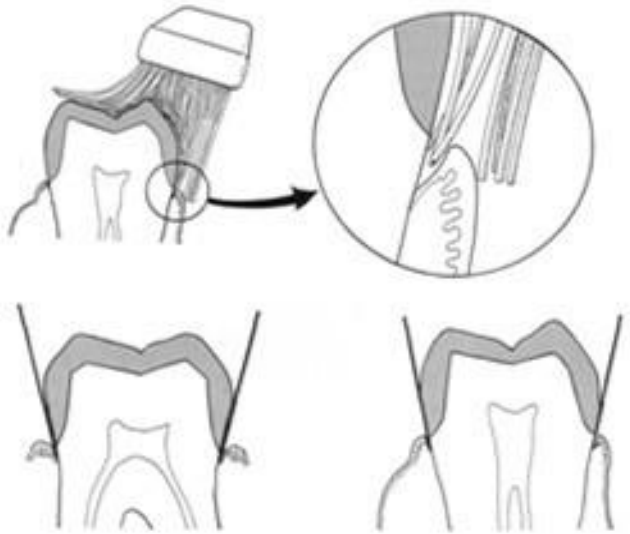

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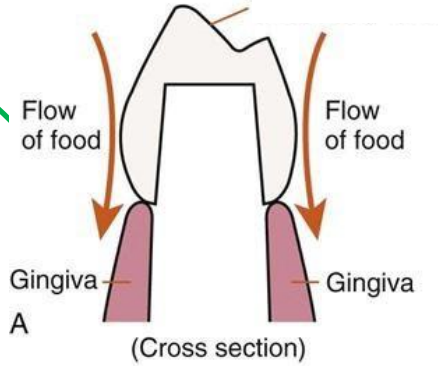
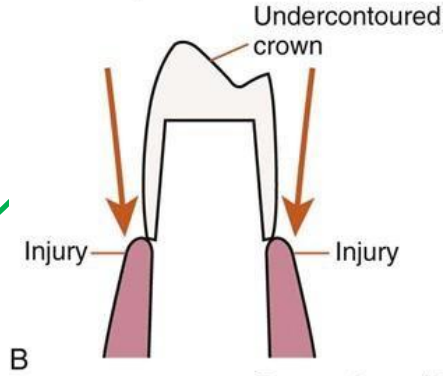
MECHANICAL

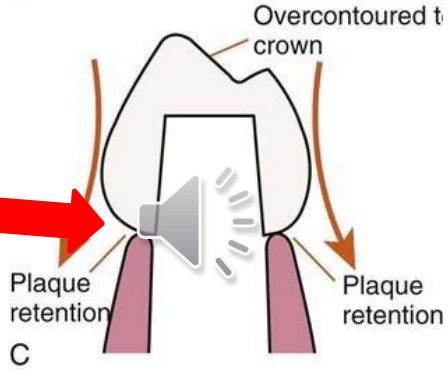
- Retention form
- Resistance form
- Deformation

AESTHETIC

- Minimum display of metal
- Maximum thickness of porcelain
- Porcelain occlusal surfaces
- Subgingival margins







Patient can't clean this!

Principles of Tooth Preparations

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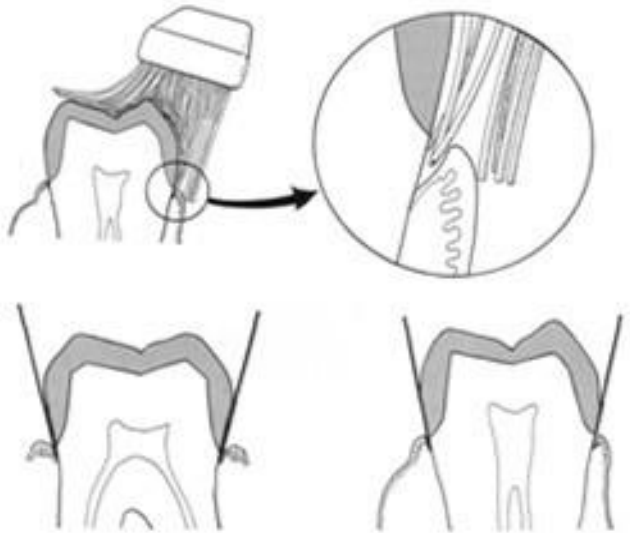

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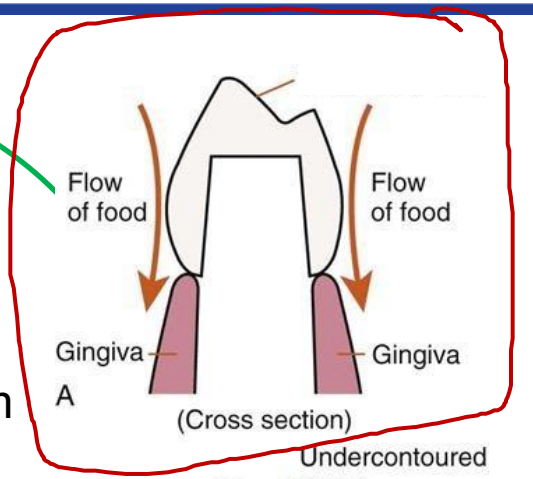

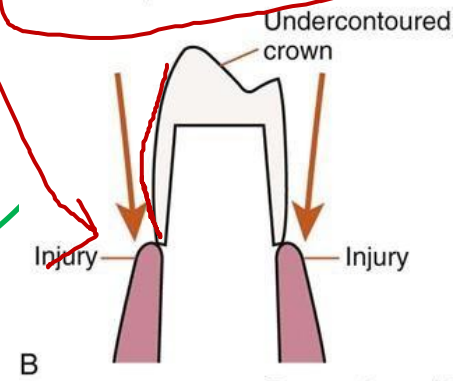

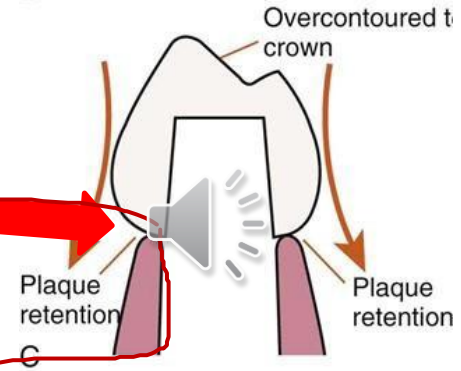

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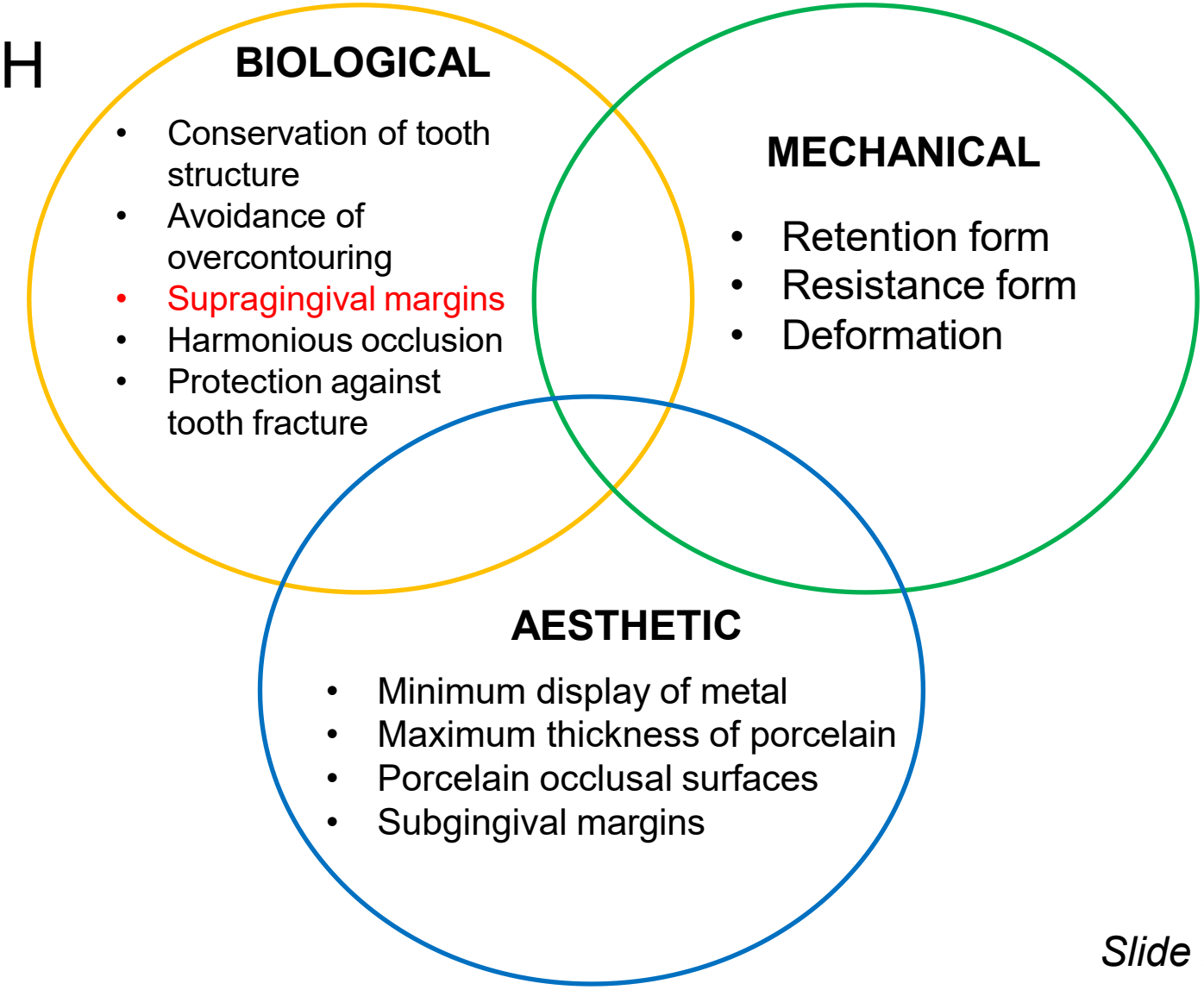

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Principles of Tooth Preparations



Sub-gingival preparation- aesthetic, BUT…..

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Principles of Tooth Preparations

We risk violation of **biologic width!** KNOW THIS WORD!

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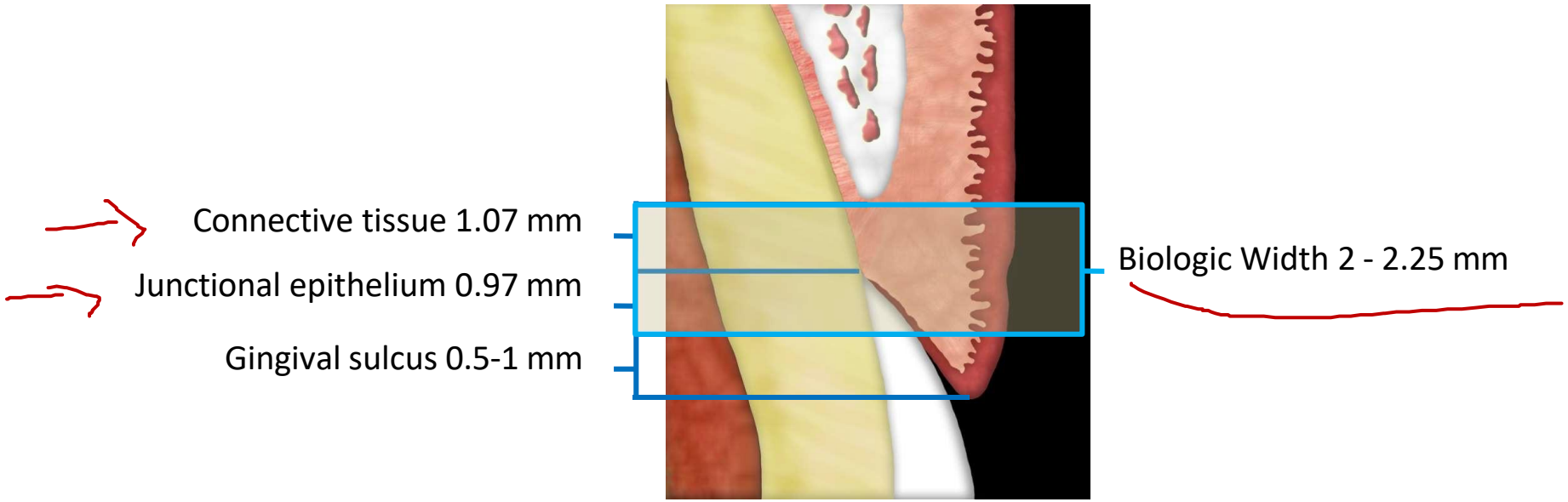
Principles of Tooth Preparations



Margin location

- ► If the margins has to be subgingival it should only be placed intracrevicularly
- ► Maximum depth around 0.7mm

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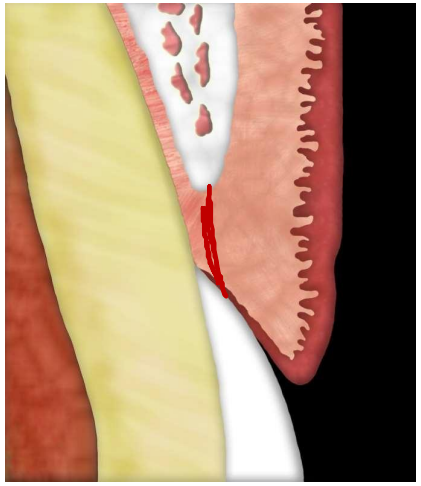

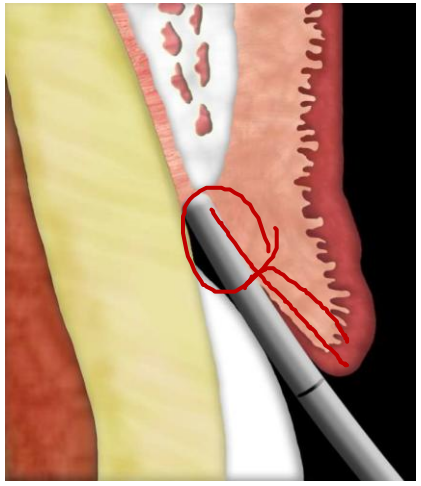

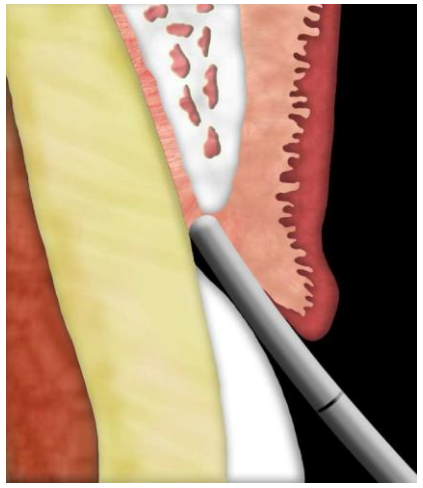

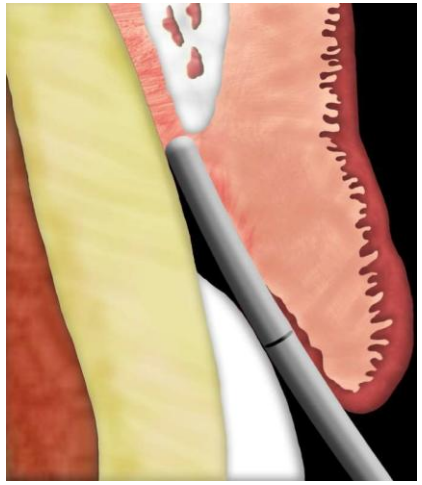

Normal Crest
3 mm (4 approx)

High Crest
< 3 mm (4 approx)

Low Crest
> 3 mm (4 approx)

Take Home Message: If you place a margin within 2mm of the crestal bone you will get inflammation, followed by bone loss as the biological width tries to re-establish itself

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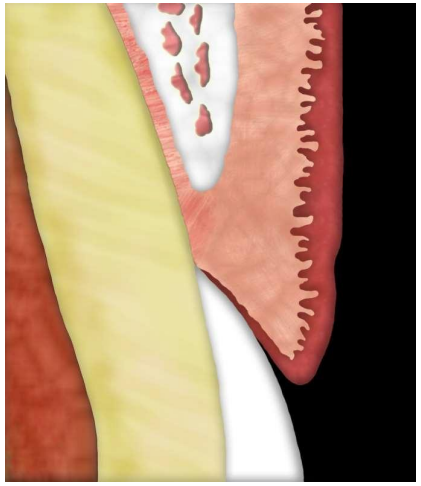

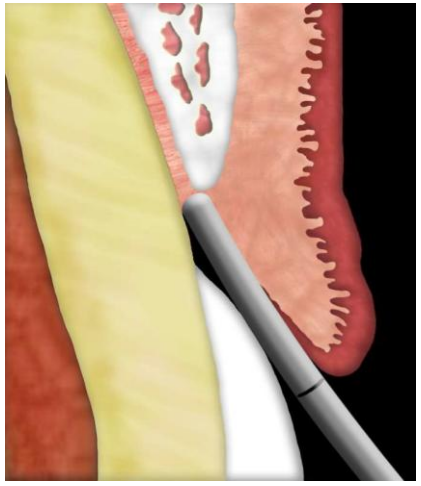

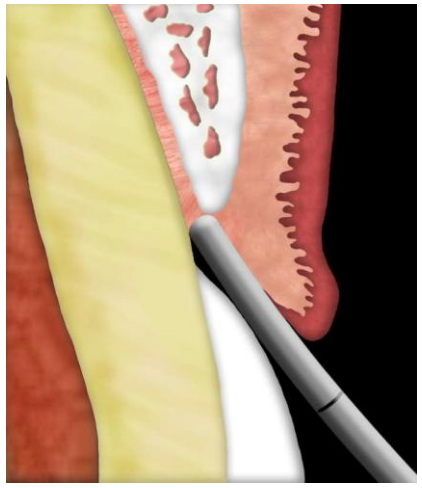

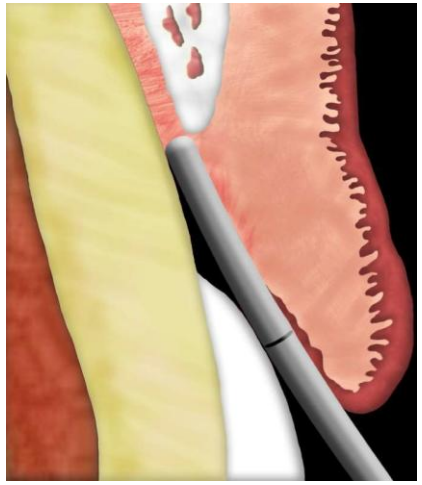

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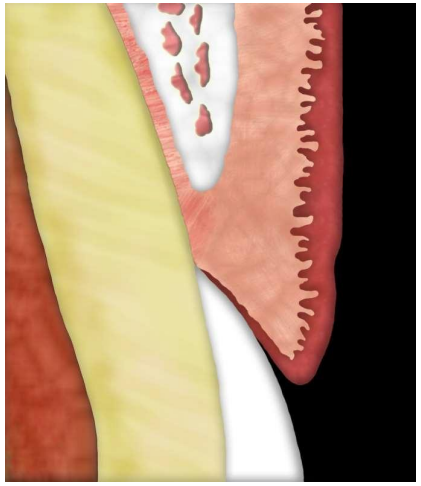

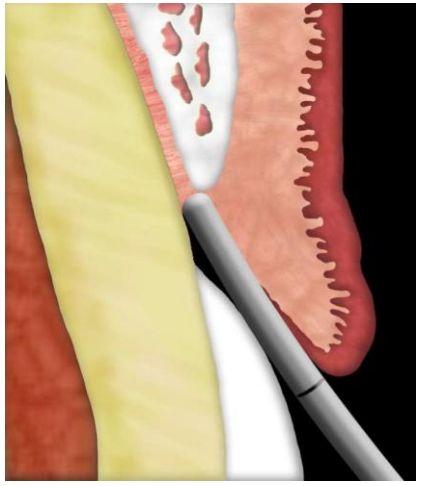

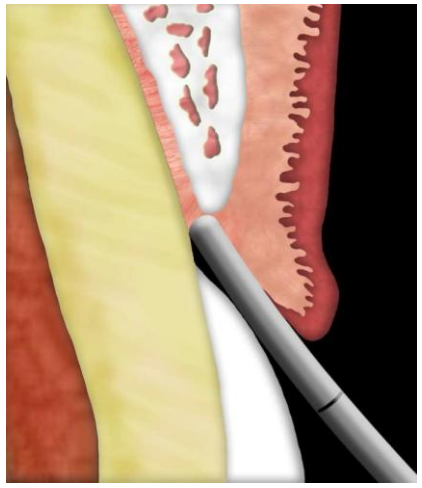

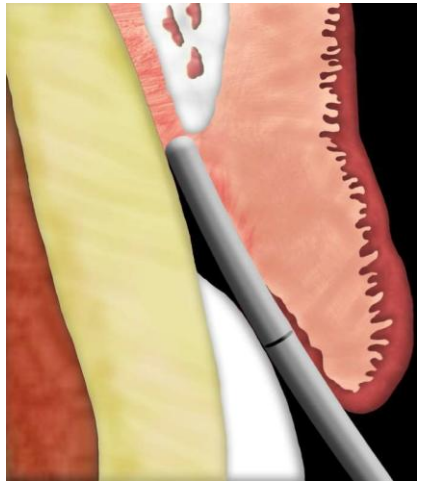

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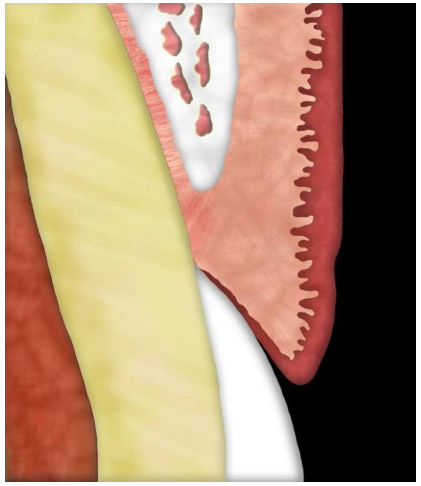
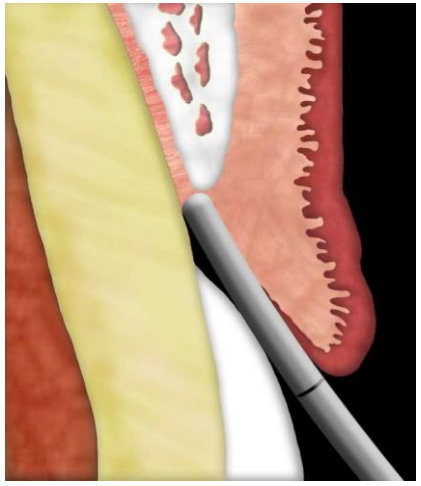
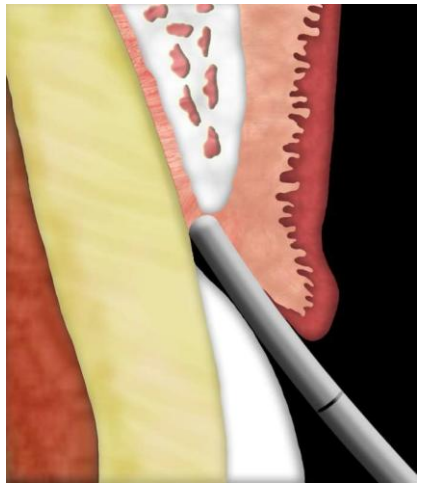
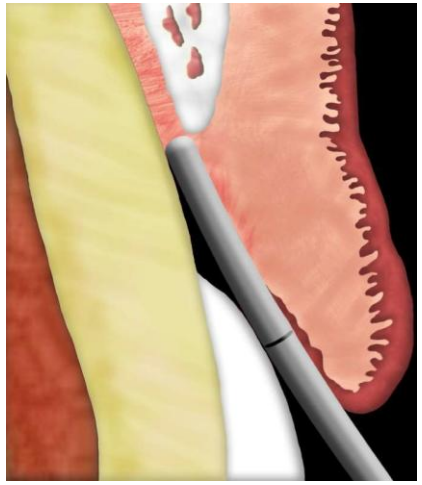
Principles of Tooth Preparations









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Principles of Tooth Preparations

The margins of the restoration can be positioned 0.5 mm below the gingival tissue crest if the probing depth of the sulcus is 1.5 mm or less. If the sulcus depth is more than 1.5mm, then the margins of the restoration should be inserted in the sulcus at a depth that is half its probing depth. Lastly, a gingivectomy may be enacted to extend the tooth and design a 1.5 mm sulcus if the probing depth of the sulcus is greater than 2 mm.

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Principles of Tooth Preparations

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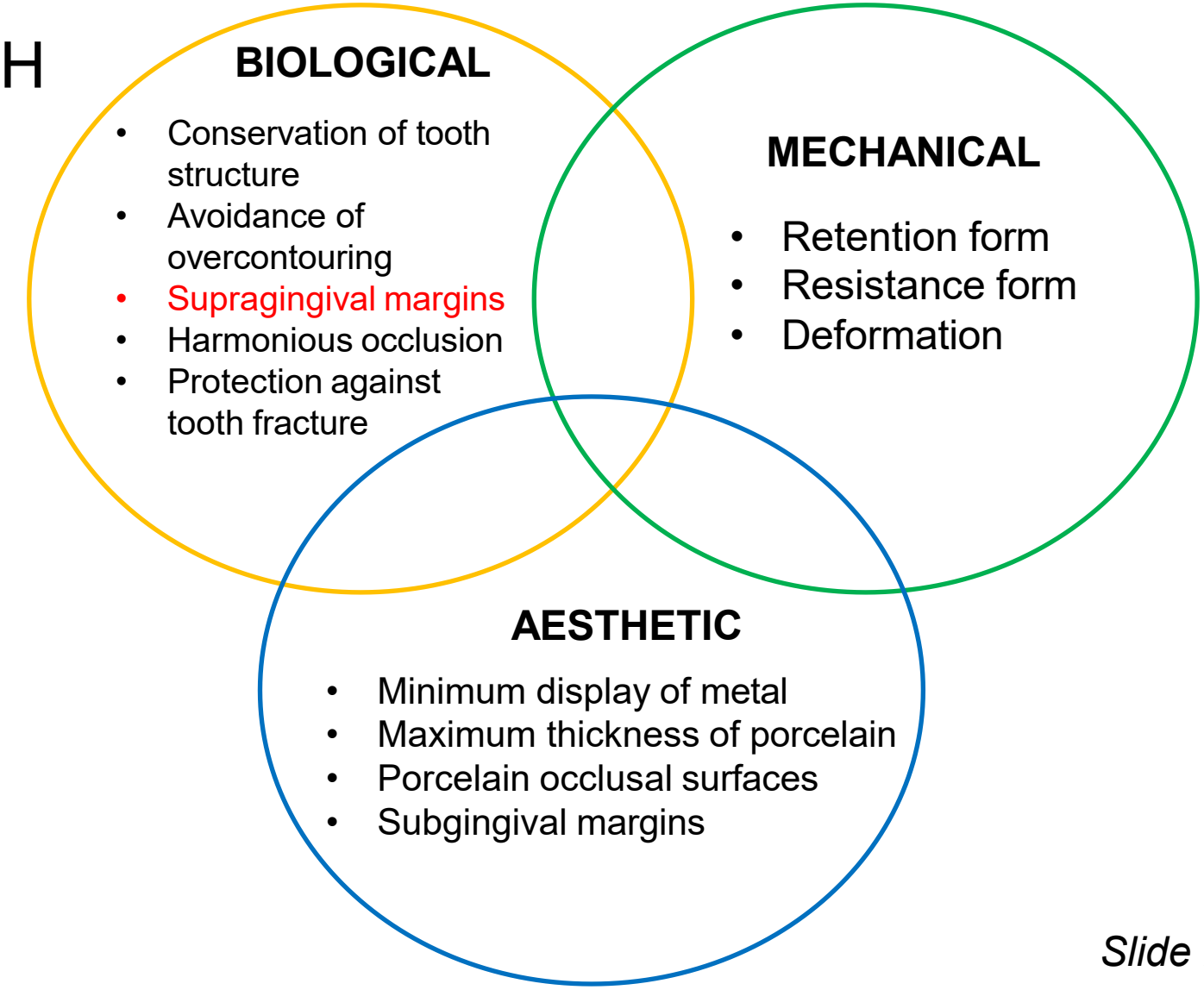
Slide by Dr Matsubara

Principles of Tooth Preparations

ABUTMENT TOOTH

- Principles of tooth preparation
- Partial or complete preparation



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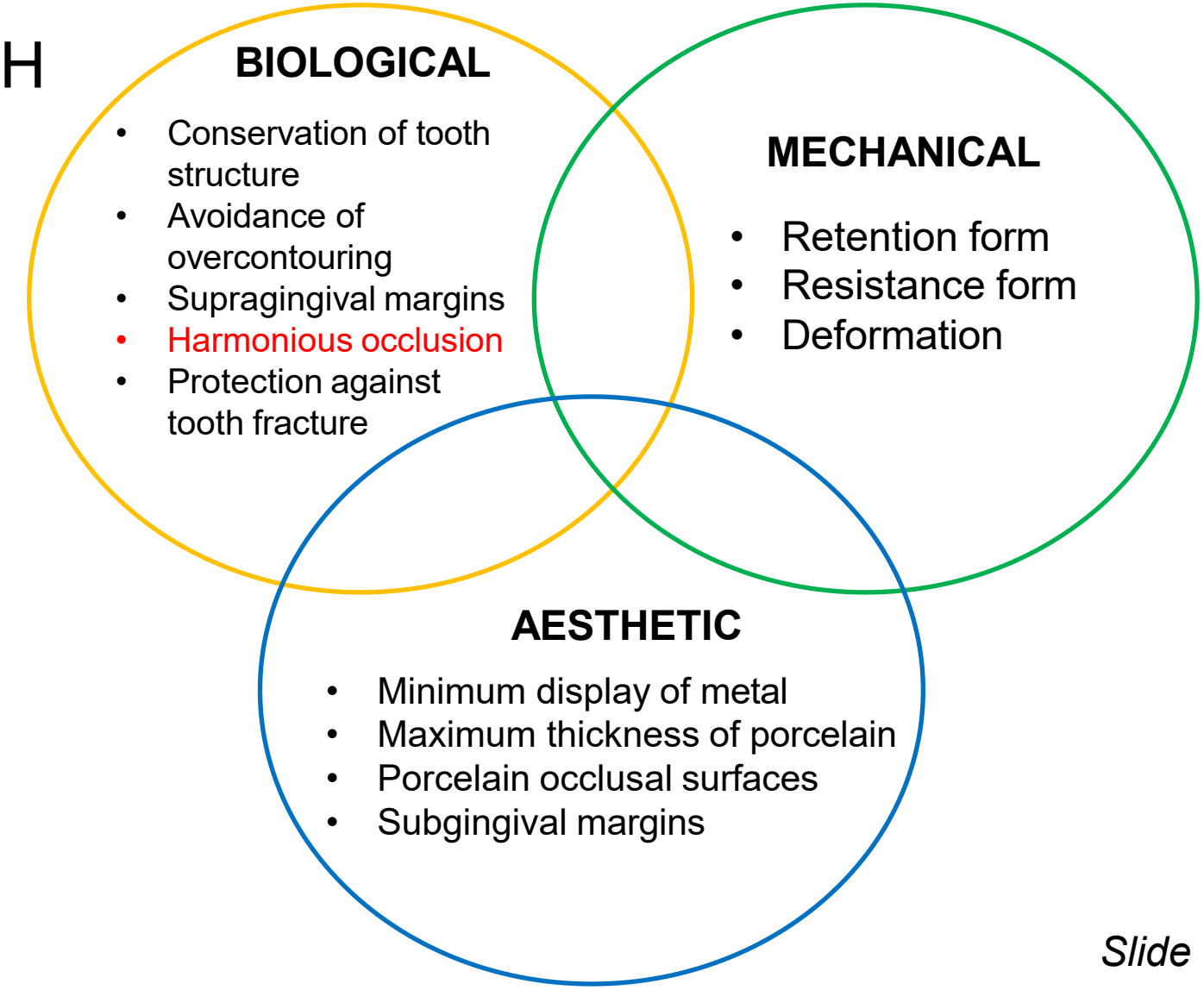

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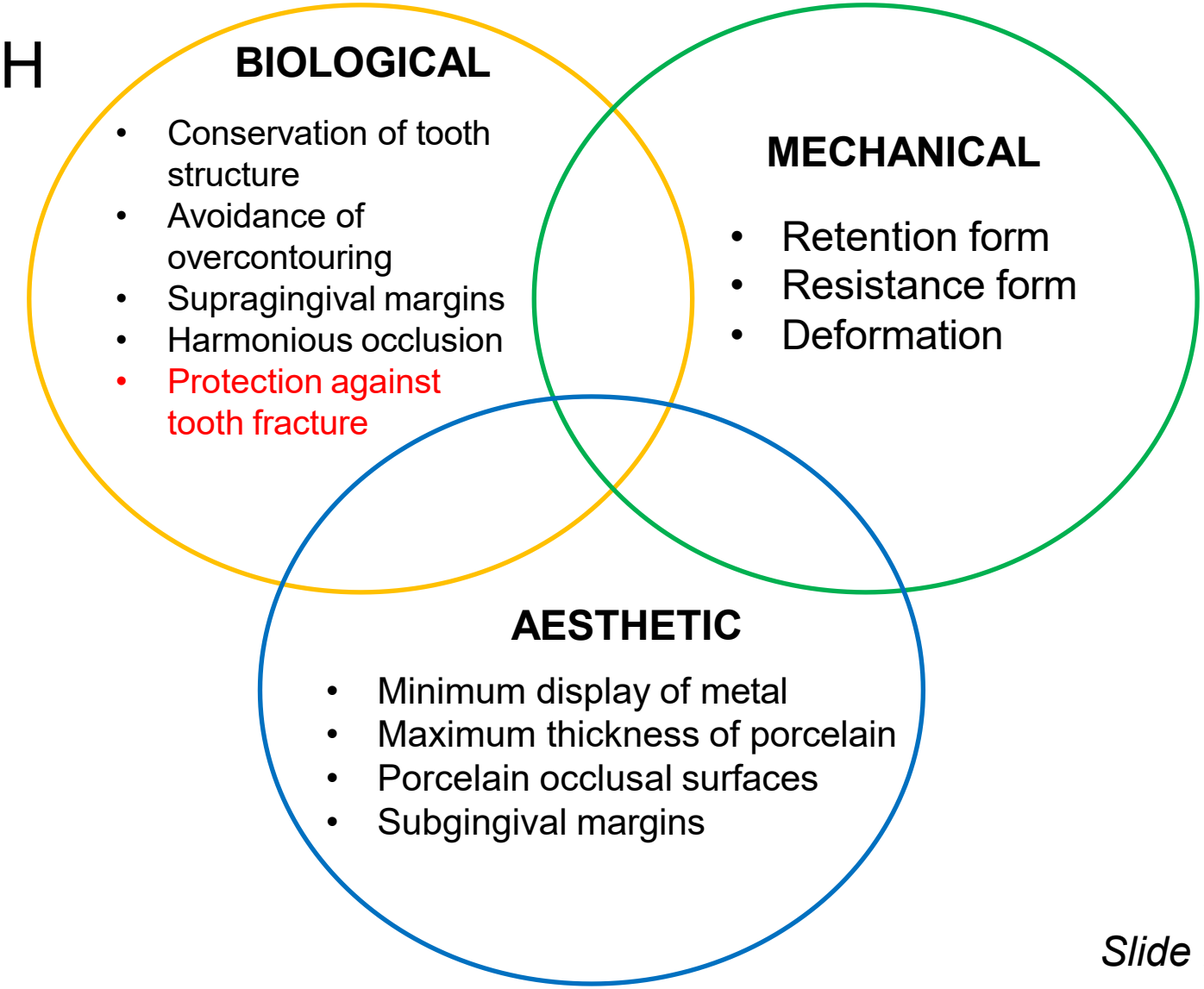

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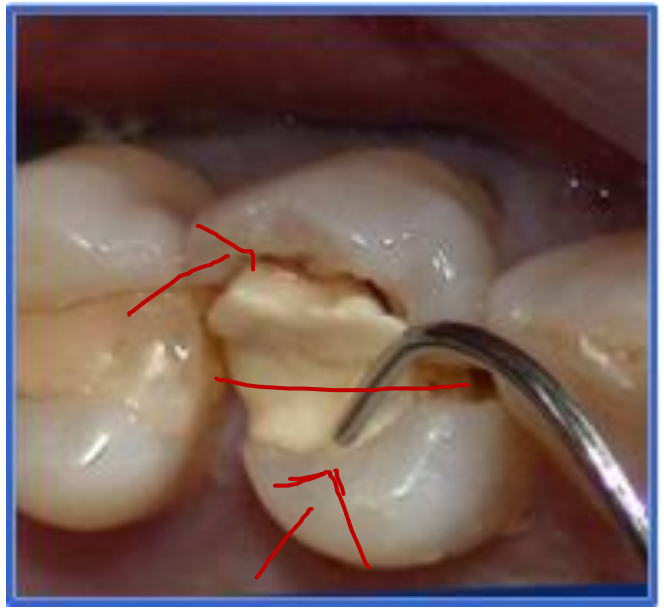
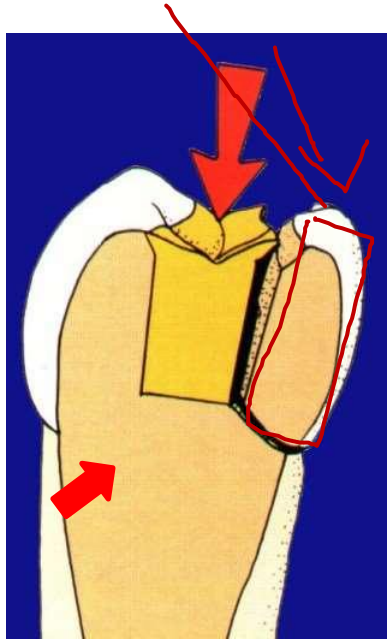
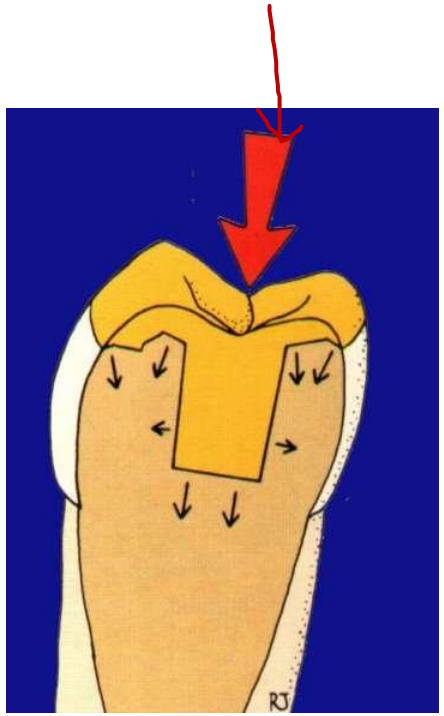
Principles of Tooth Preparations

Cuspal Protection: Coverage of one or more cusps by a indirect or direct restorative material.





Fracture/Uncontrollable tooth structure loss

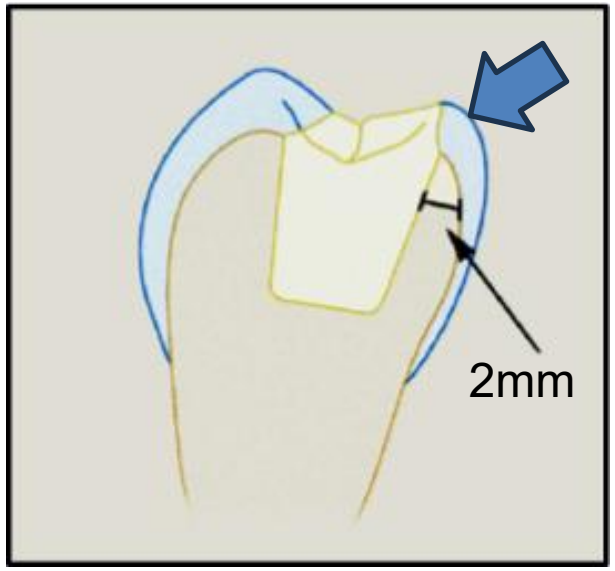


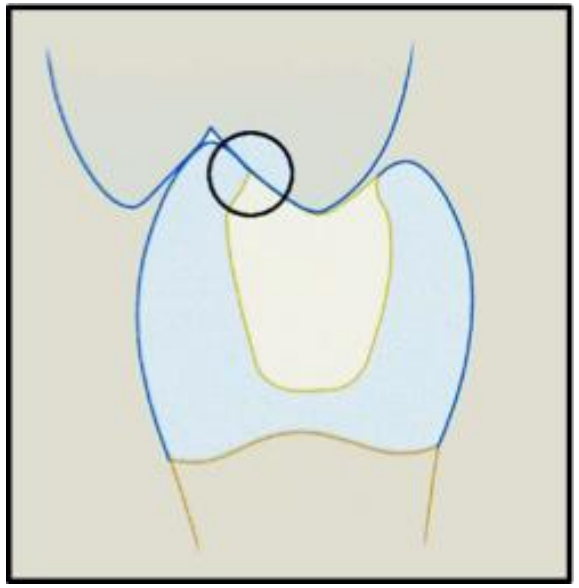
Redistribution of stresses

Slide by Dr Nedelcu

During preparation:

- Removal of tooth structure less than 2mm thick
- Removal of any low quality/undermined enamel on the cusps





Also avoid occlusal contacts on the margin of the preparations

Slide by Dr Nedelcu

Principles of Tooth Preparations

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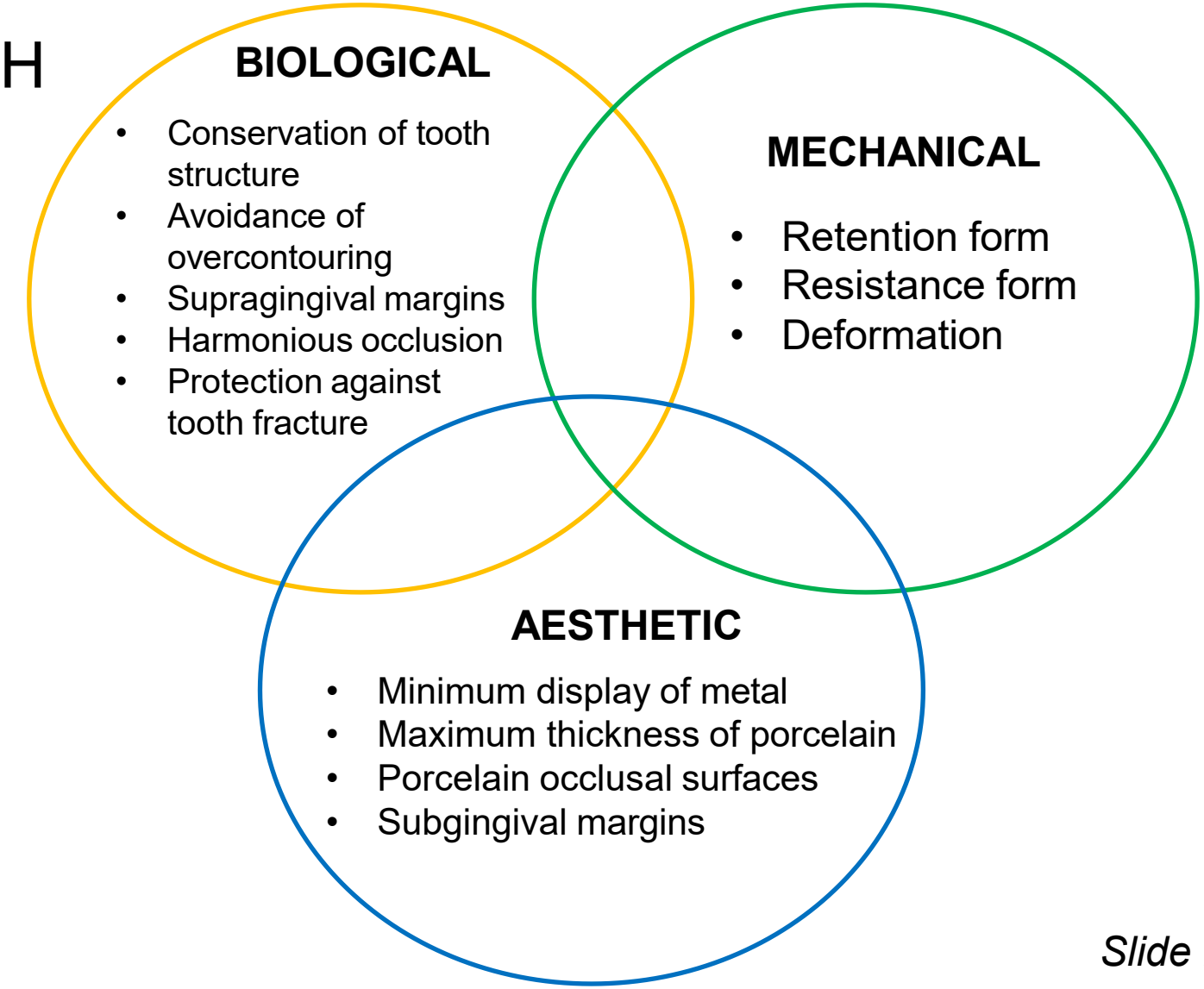

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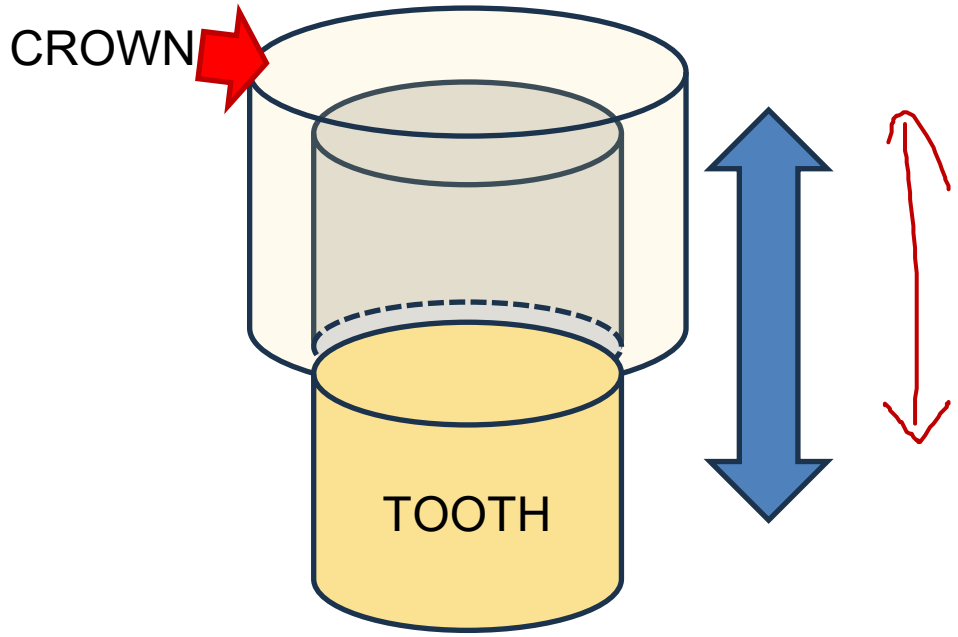
Principles of Tooth Preparations

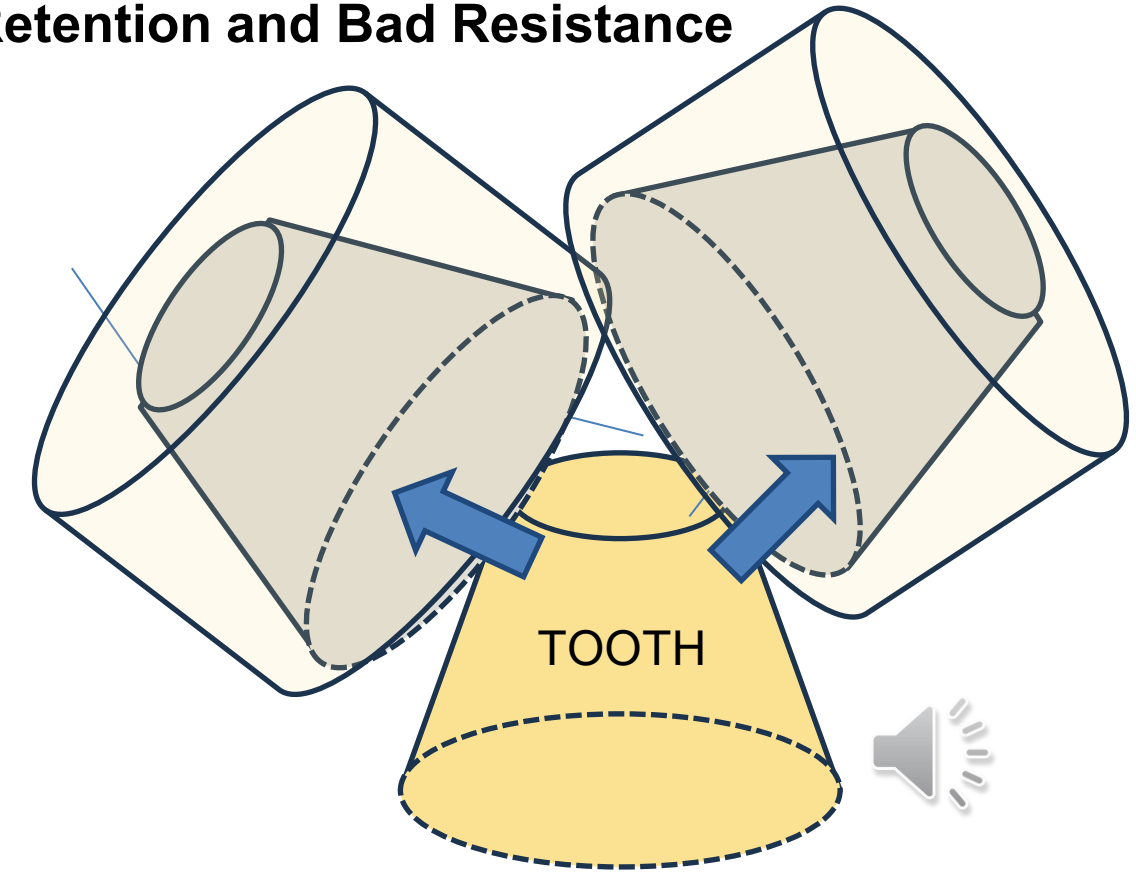
Retention: prevents removal of restoration/crown from coming off the prepared tooth when a force is applied parallel to the path of insertion.

Resistance: prevents dislodging of restoration/crown when apical or oblique forces applied, and stops movement of restoration during chewing.



Good Retention But Bad Resistance

Bad Retention and Bad Resistance



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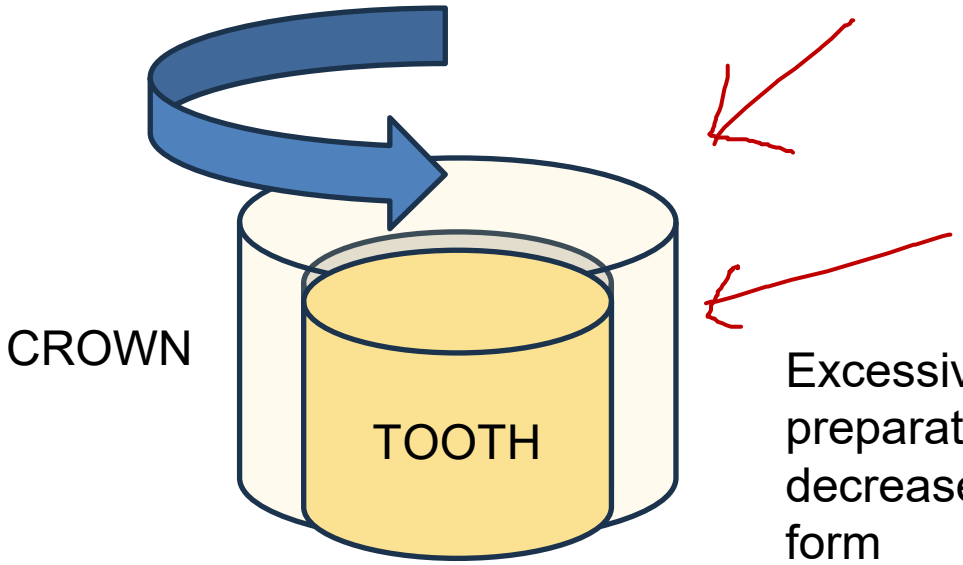
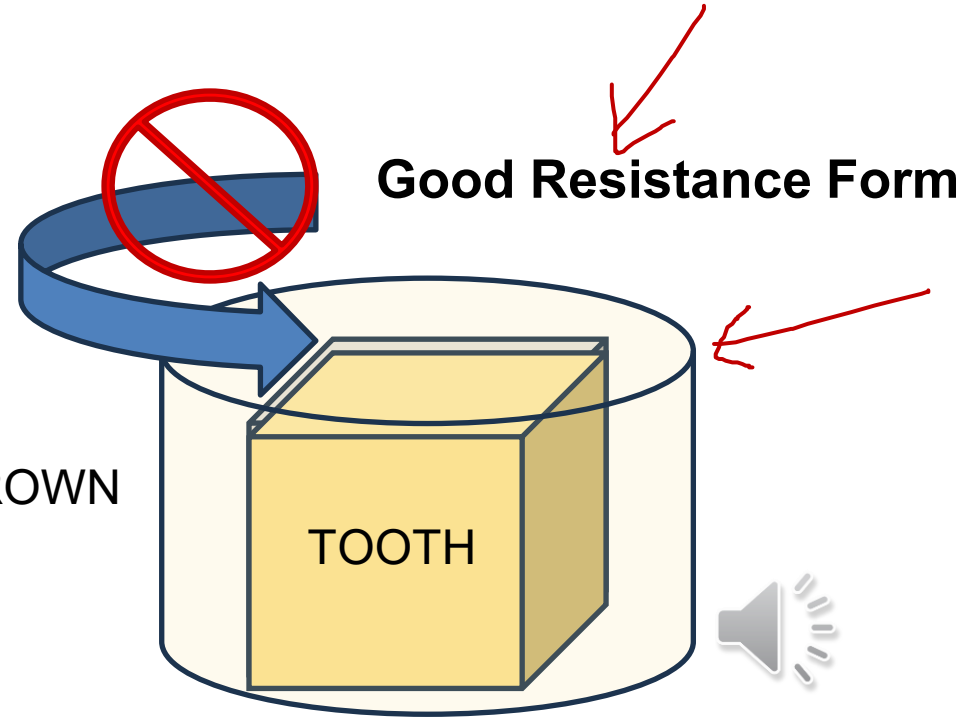


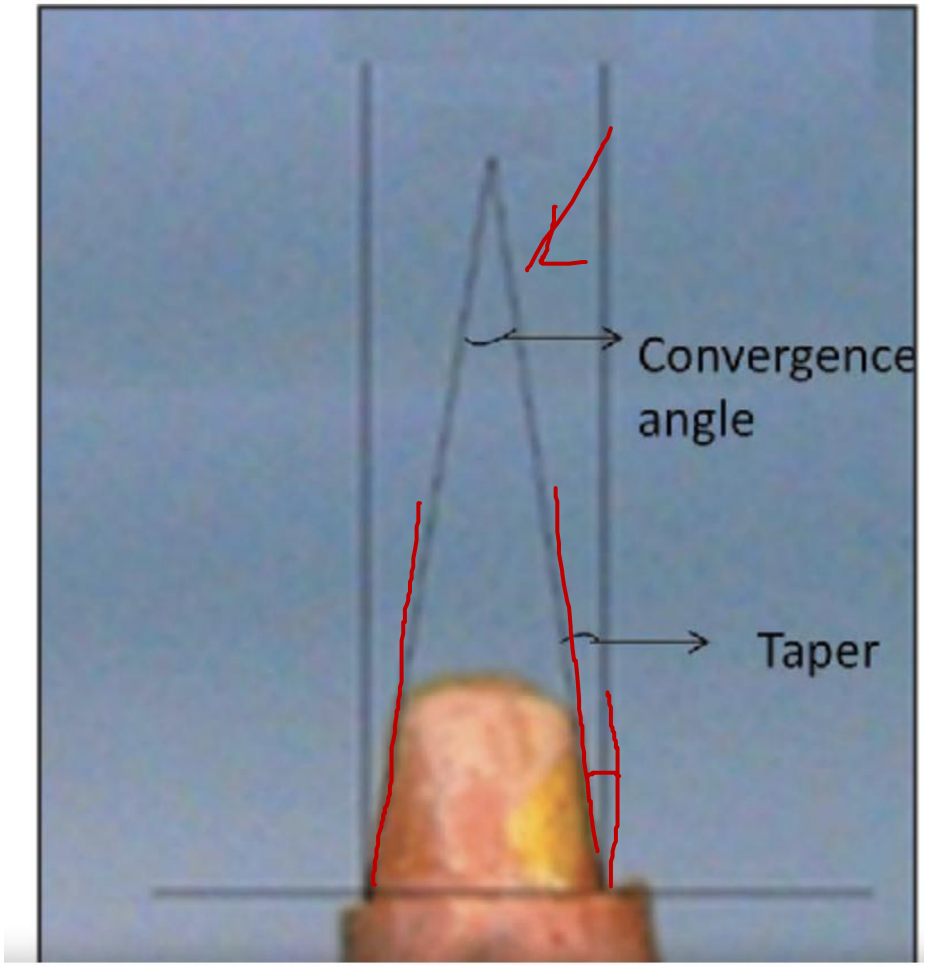
Excessive rounding of preparation can decrease resistance form

Bad Resistance Form



Principles of Tooth Preparations

Factors influencing Retention and Resistance:
Taper and Length of axial walls



Fundamental of Fixed Prosthodontics

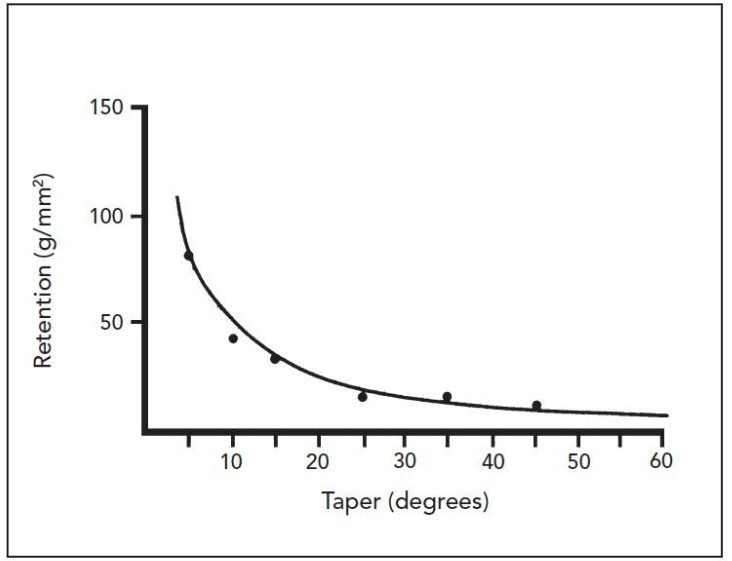


Fig 9-4 As taper increases, retention decreases. (Modified from Jorgensen[4] with permission.)

Evaluation of the degree of taper and convergence angle of full ceramo-metal crown preparations by different specialists centers at Assir Region, Saudi Arabia

Mohammed M. Al-Moaleem, M. Shariff, +2 authors S. Tikare • Published 1 September 2015 • Medicine •
Saudi Journal of Medicine and Medical Sciences

Principles of Tooth Preparations

THE JOURNAL OF PROSTHETIC DENTISTRY

THE GLOSSARY OF PROSTHODONTIC TERMS

Ninth Edition

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taper: in dentistry, the angle, measured in degrees as viewed in a given plane, formed between an external wall and the path of placement of a tooth preparation or machined surfaces on a metal or ceramic material when prepared for fixed dental prosthesis; *comp,* CONVERGENCE ANGLE, TOTAL OCCLUSAL CONVERGENCE ANGLE

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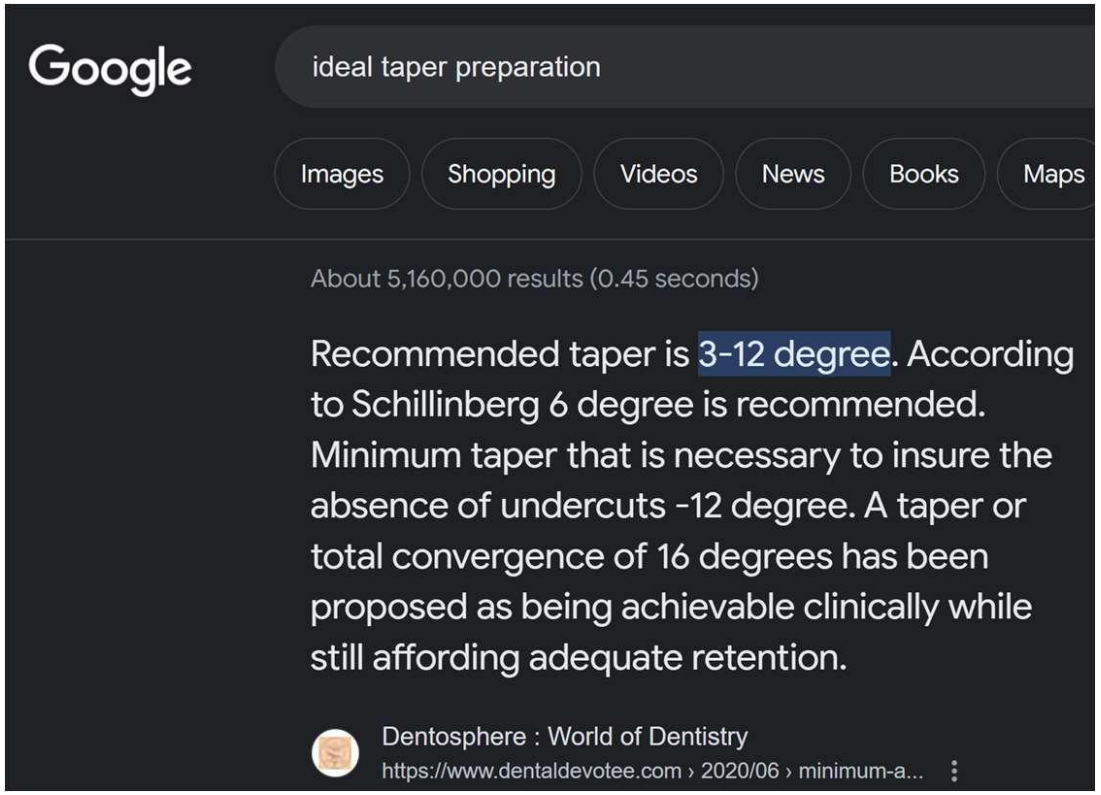
parations

THE UNIVERSITY OF WESTERN AUSTRALIA



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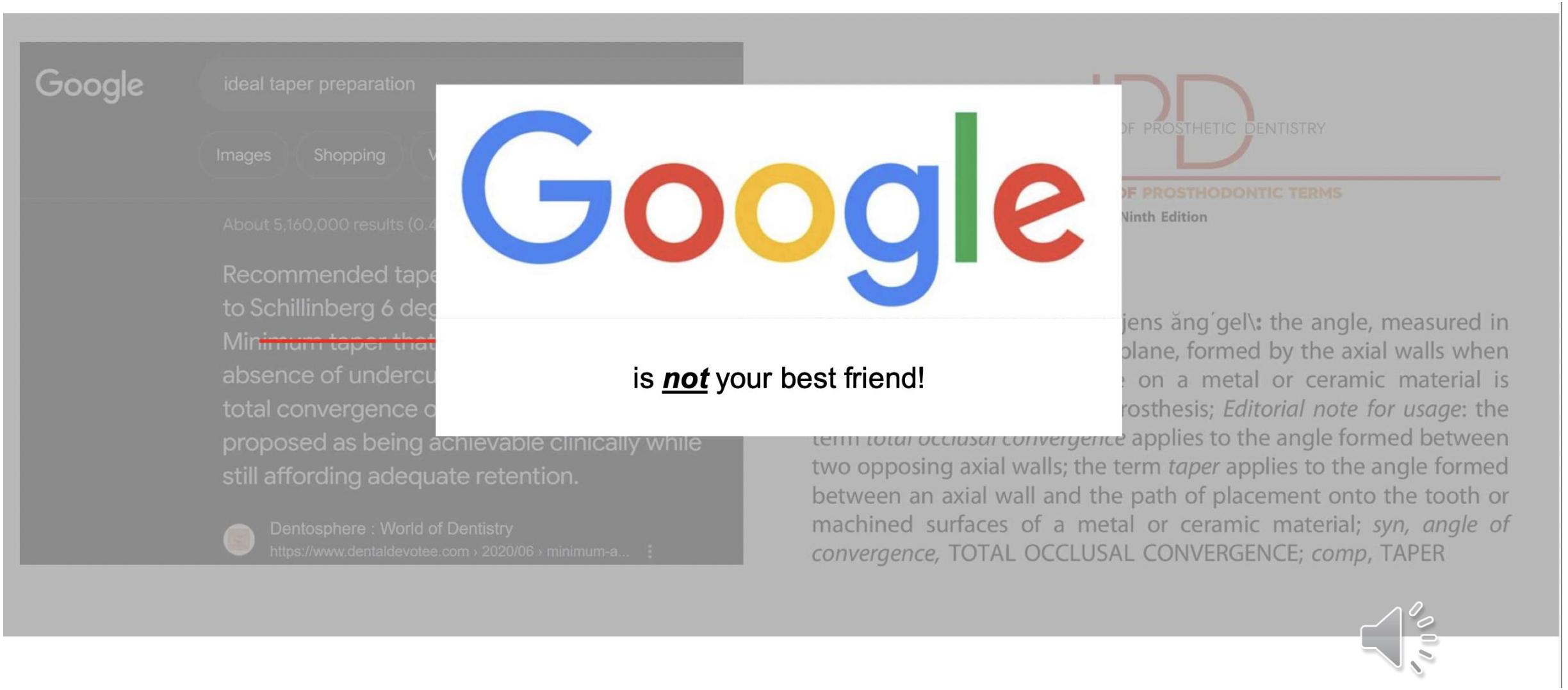
Slide by Dr Nedelcu



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Principles of Tooth Preparations

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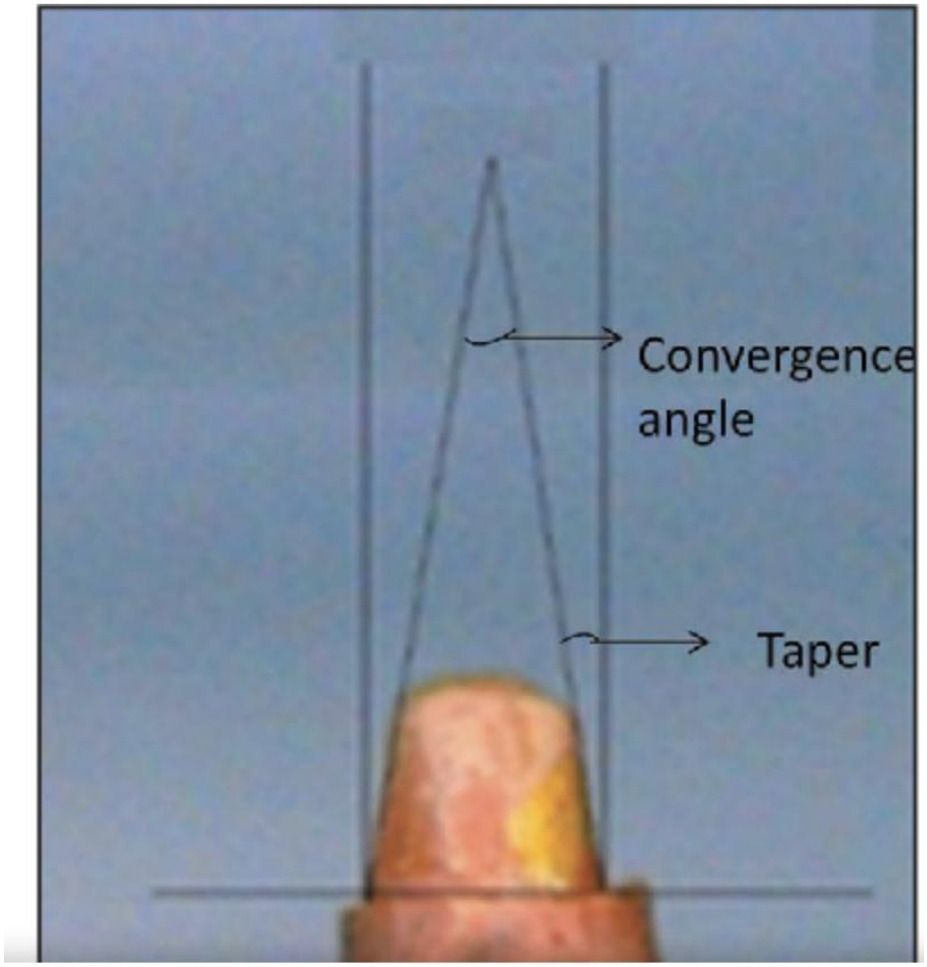

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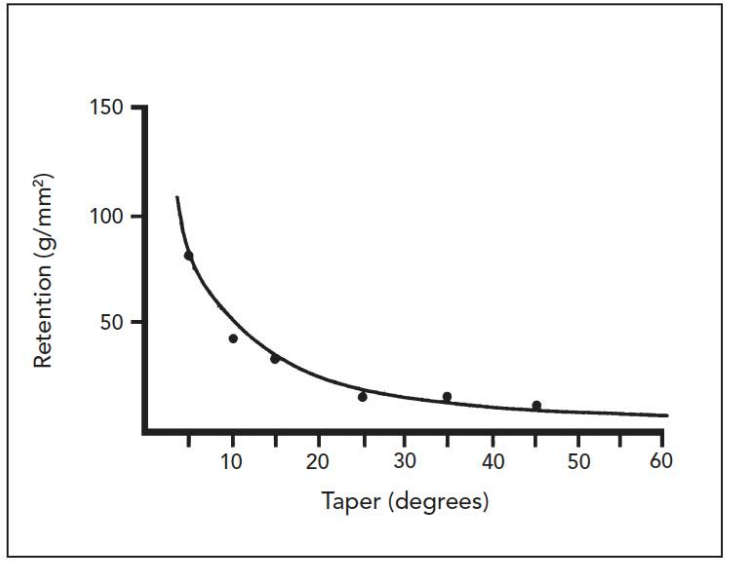

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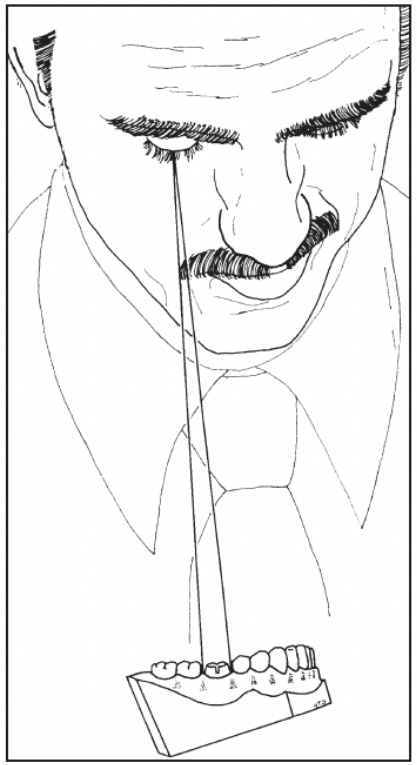

Fig 9-13 To examine a preparation for undercuts, one eye should be closed.

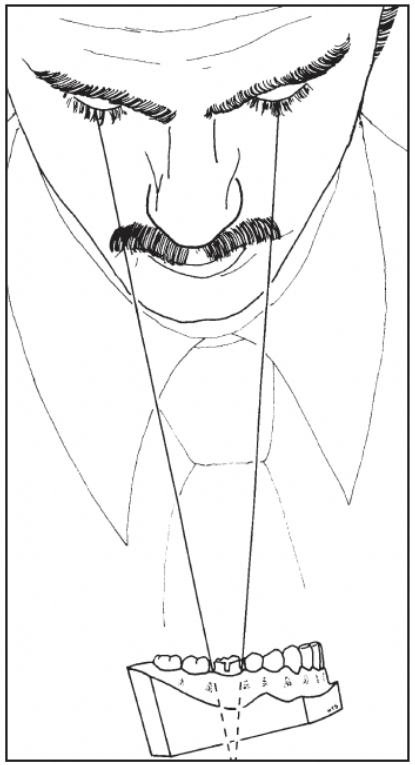

Fig 9-14 If both eyes are open when the preparation is viewed, undercuts may remain undetected.

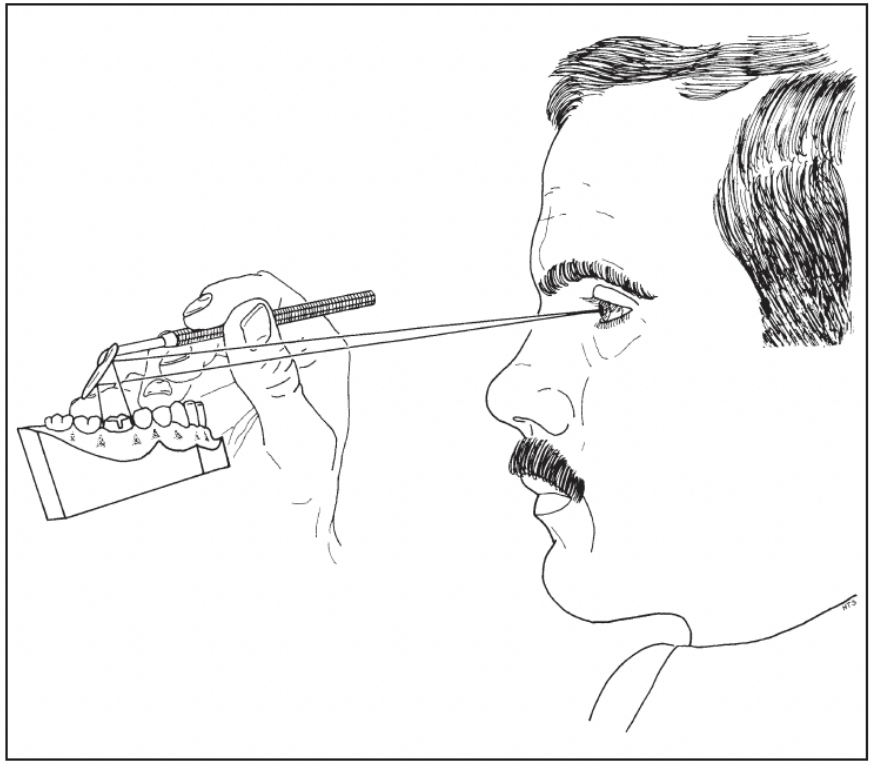

Fig 9-15 Preparations in the mouth are viewed through a mouth mirror using one eye.

Principles of Tooth Preparations

Factors influencing Retention and Resistance:
Taper and **Length of axial walls**

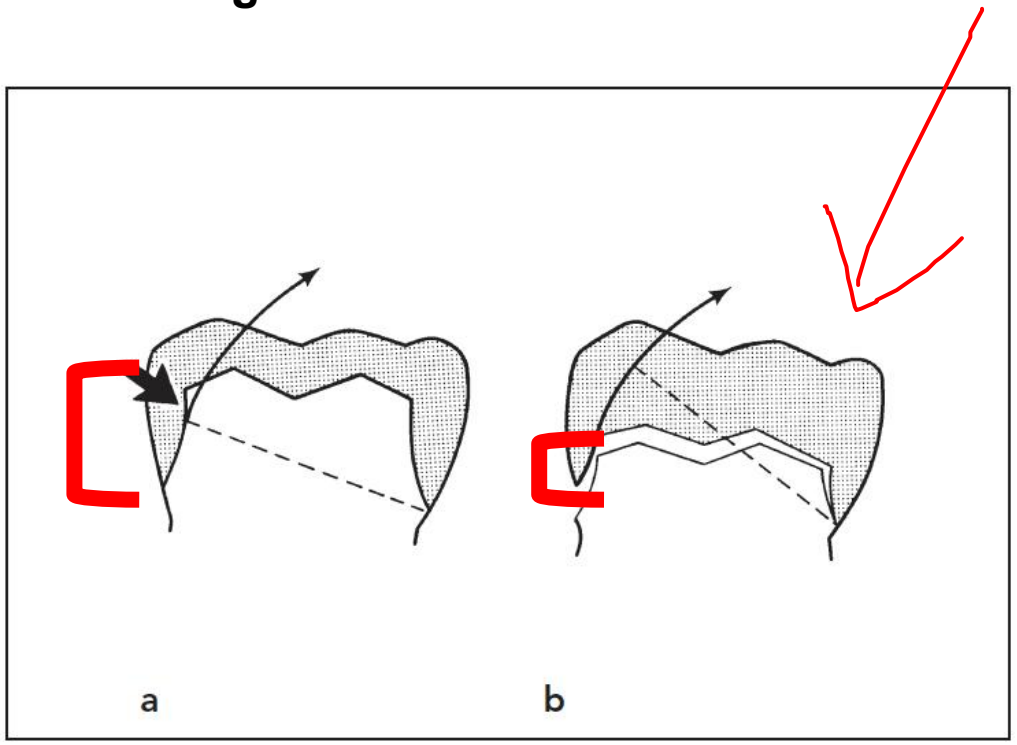

Fig 9-9 The preparation with longer walls *(a)* interferes with the tipping displacement of the restoration better than the short preparation *(b)*.

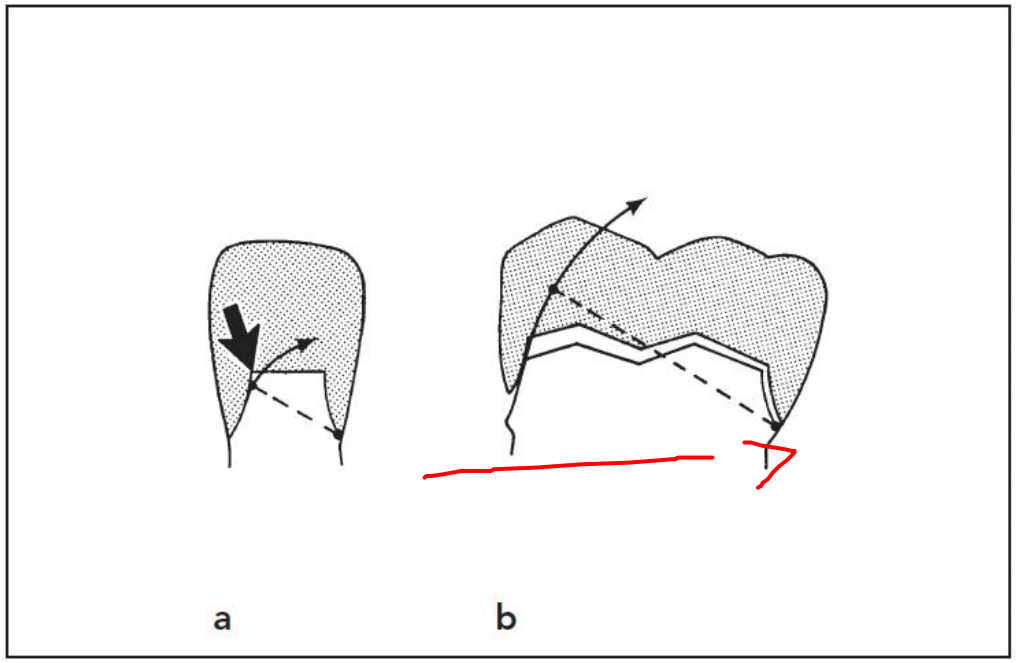

Fig 9-10 A preparation on a tooth with a smaller diameter *(a)* resists pivoting movements better than a preparation of equal length on a tooth of larger diameter *(b)*.

Principles of Tooth Preparations

Factors influencing Retention and Resistance:
Taper and **Length of axial walls**

What can we do to increase retention/resistance?

- Grooves and boxes

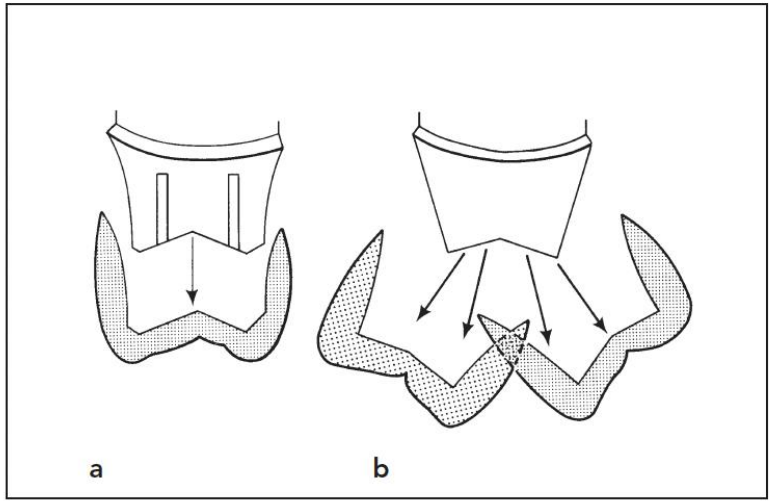

Fig 9-6 *(a)* By limiting the paths of withdrawal, retention is improved. *(b)* A preparation with unlimited freedom of displacement is much less retentive.

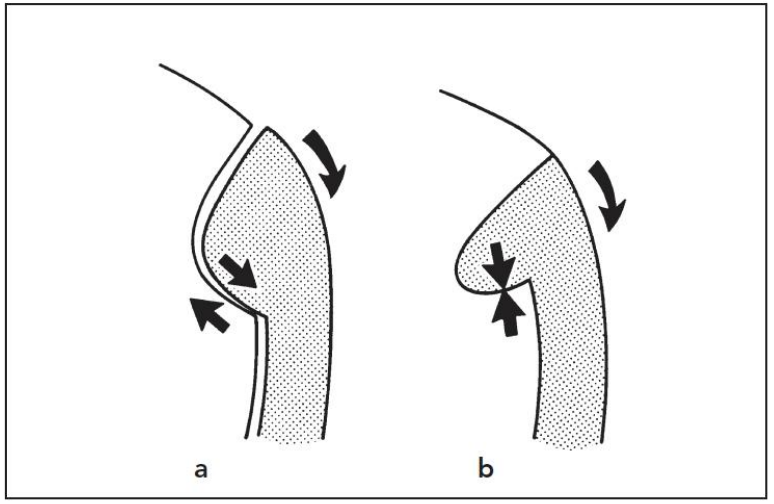

Fig 9-7 *(a)* The walls of a groove that meet the axial wall at an oblique angle do not provide the necessary resistance. *(b)* The walls of a groove must be perpendicular to rotating forces to resist displacement.

BUT USE WITH CARE!

Fundamental of Fixed Prosthodontics

Principles of Tooth Preparations

Other factors that influence retention and resistance:

a. Magnitude of the dislodging force
b. Geometry of tooth preparation (MOST IMPORTANT, YOU DIRECT IMPACT THIS)
c. Roughness of fitting surface of restoration
d. Material being cemented
e. Properties of luting agent

Principles of Tooth Preparations

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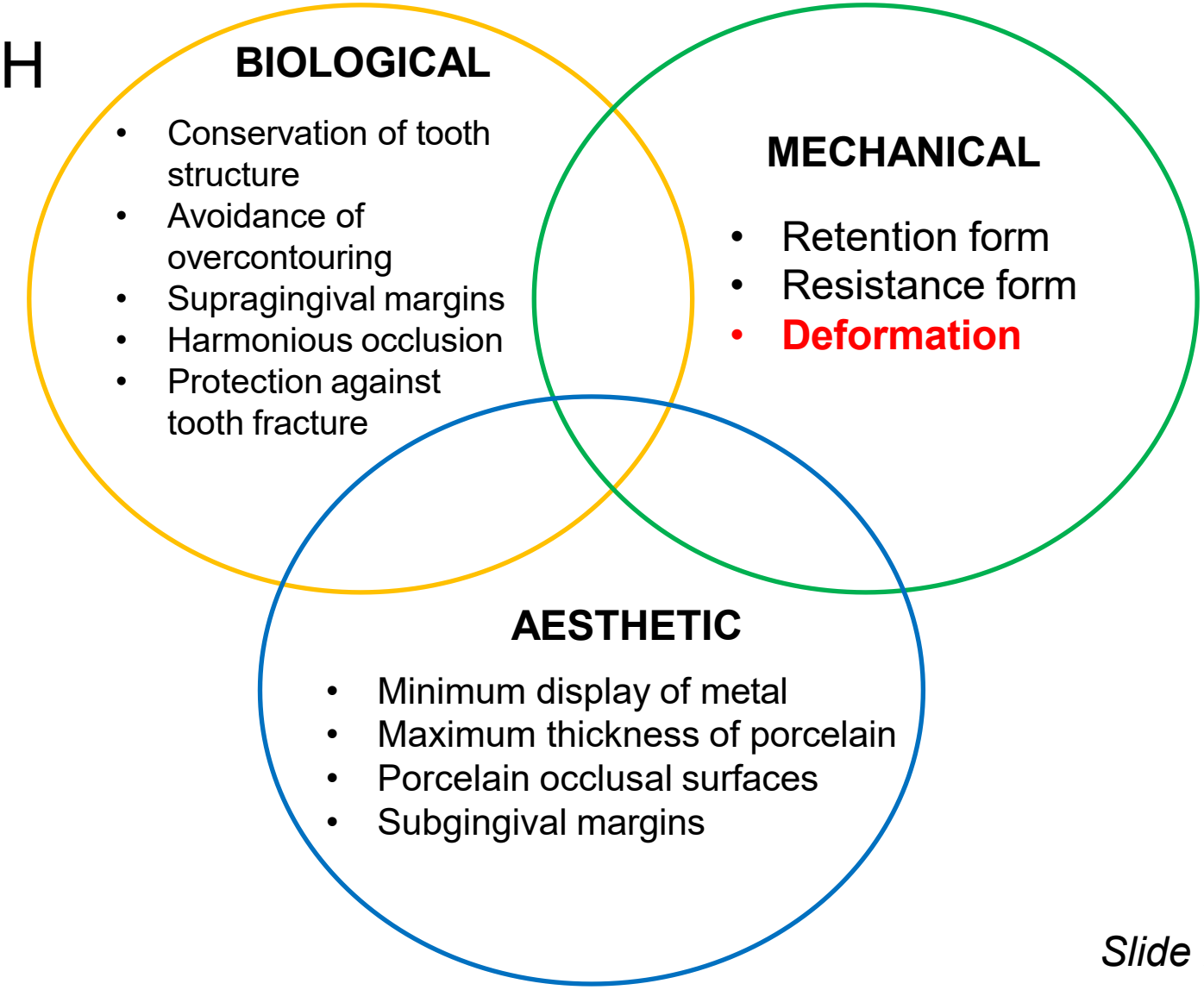
Principles of Tooth Preparations

ABUTMENT TOOTH

- Principles of tooth preparation
- Partial or complete preparation



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Principles of Tooth Preparations

ABUTMENT TOOTH

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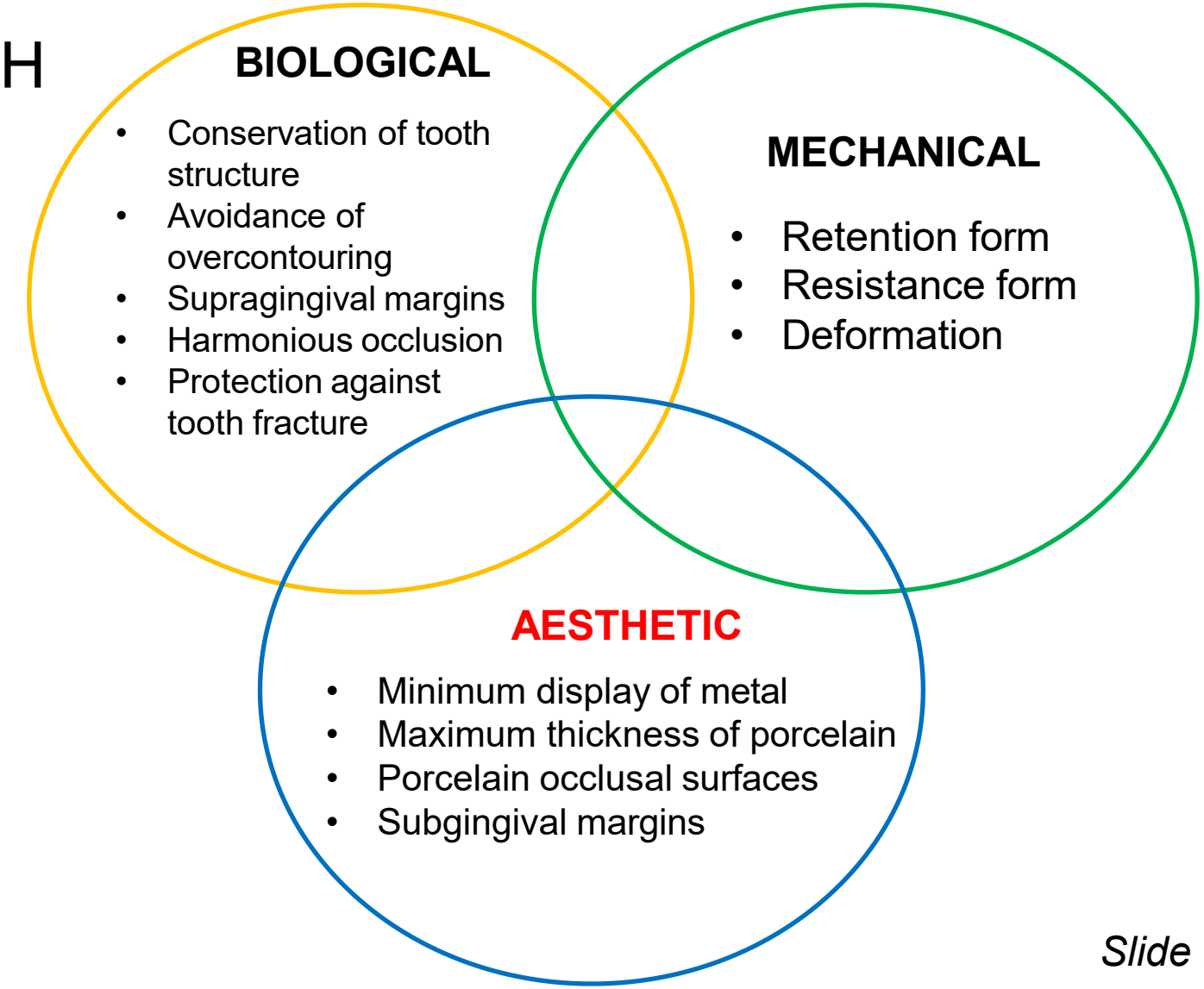

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Principles of Tooth Preparations

ABUTMENT TOOTH

- Principles of tooth preparation
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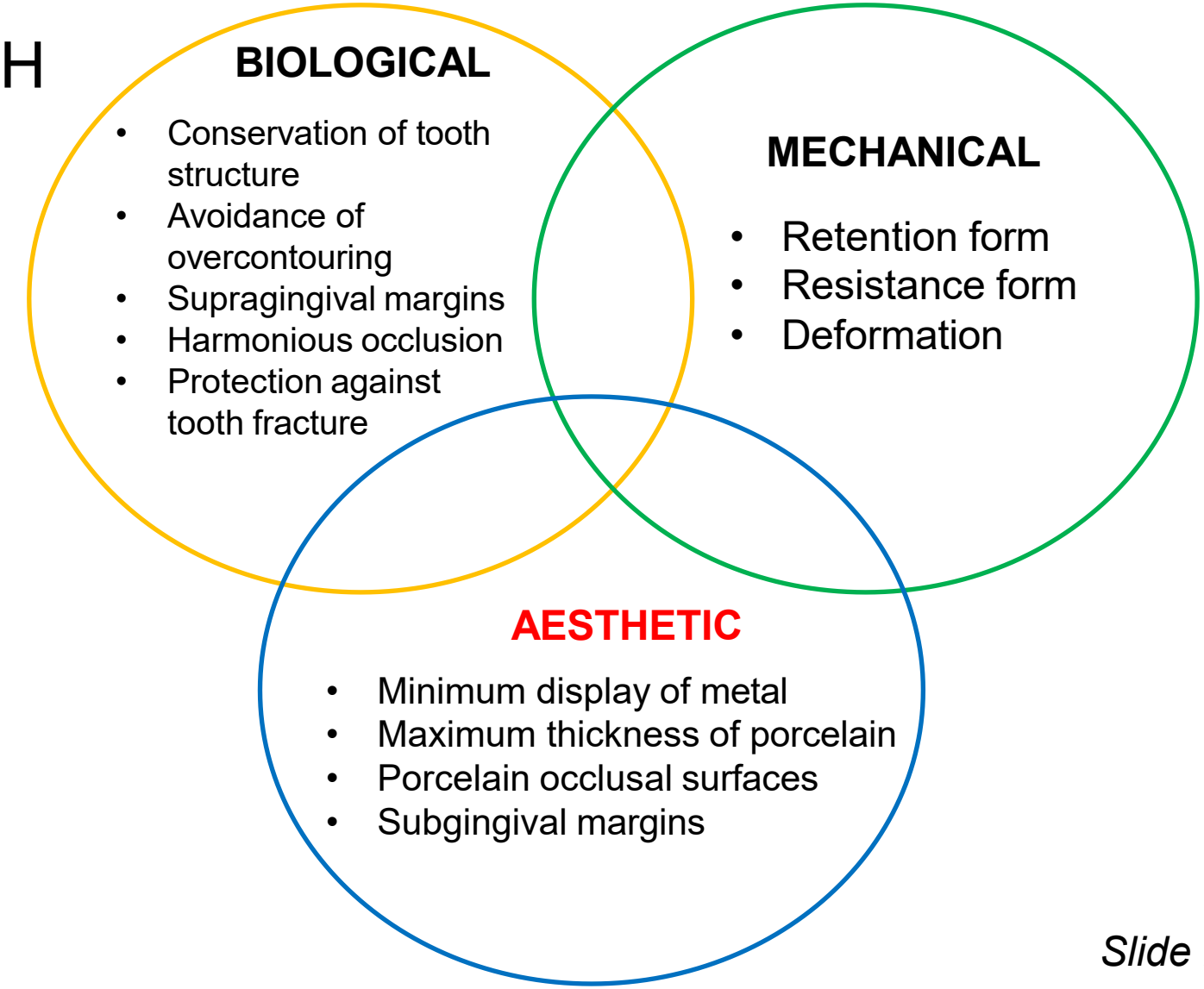

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Principles of Tooth Preparations

Any questions? Please email me,
or come up to me in CSSL.