

PFM Crowns

Synonyms

- Metal ceramic
- VITA Metallic Ceramic (VMK) Crown (historical)

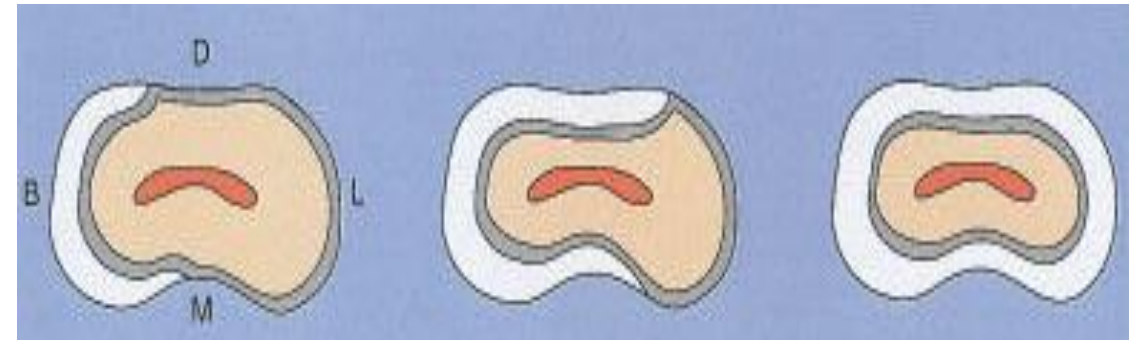
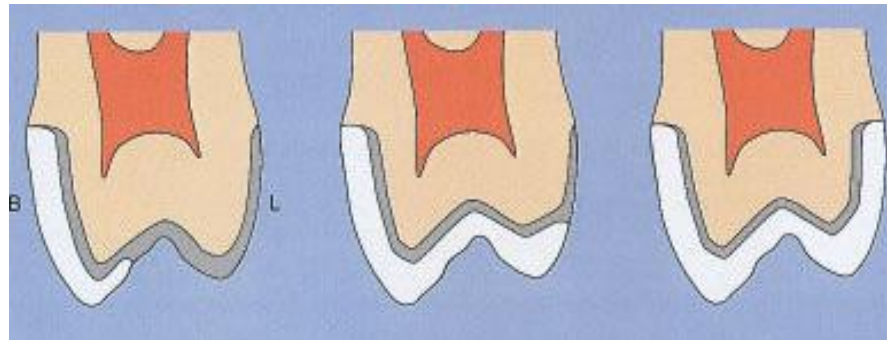
Definition

- Complete-coverage cast metal substructure (metal coping), veneered with a layer of fused porcelain to mimic the appearance of a natural tooth



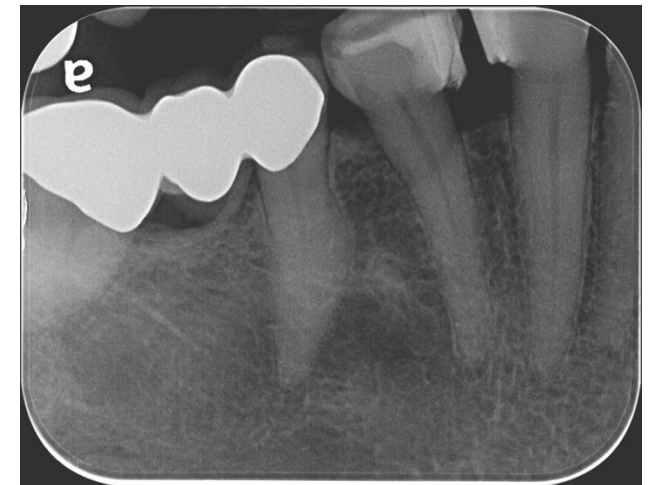
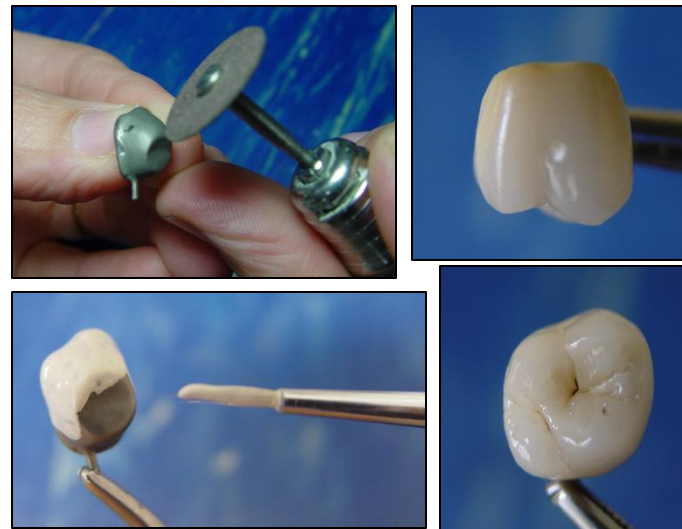
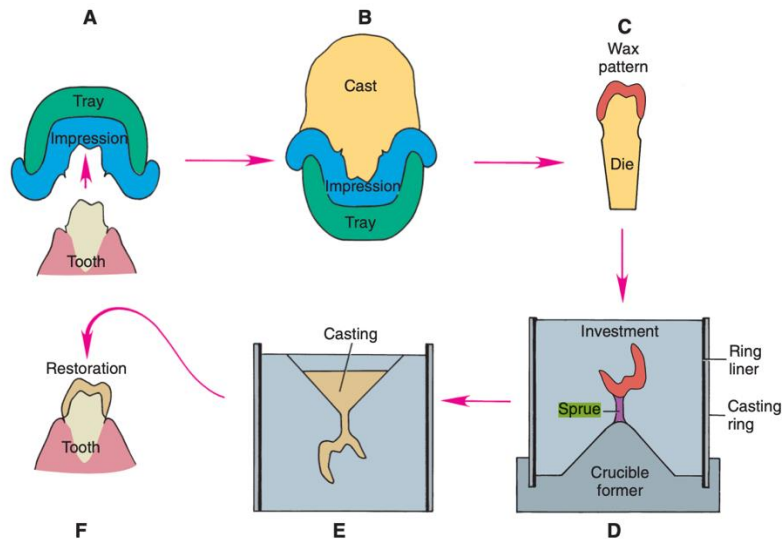
General Features

- Complete-coverage cast metal substructure with a mechanically & chemically bonded ceramic veneer
- Range of designs depending on the material coverage
- Variable extent of ceramic veneer



General Features

- One of the most widely use crown in the past.
- Long history of clinical success and have been considered the gold standard.



Indications

When both strength and aesthetic are needed :

Posterior crowns and bridges: high occlusal forces occur

Anterior crowns: When improved esthetics are desired but full ceramic is not indicated

Long-span fixed partial dentures: due to the strength of the metal substructure

Tooth preparations with reduced height: Where a full ceramic crown may not have enough support

Teeth receiving heavy load: parafunction habits.

Abutments for removable or fixed partial dentures

Contraindications

Patients with metal allergies: especially to base metals (nickel, cobalt)

Highly aesthetic cases: Where maximum translucency is required

Minimal tooth reduction cases: Requires more tooth reduction than all-metal crowns; Young patients whose pulp chambers are large

Deep bite or limited interocclusal space: Risk of porcelain fracture

Parafunctional habits without protection: Increased risk of porcelain fracture

Porcelain Fused to Metal crown - PFM

Advantages

Strong and durable: metal substructure provides excellent fracture resistance, suitable for posterior regions and bridges.

Good Aesthetics: porcelain overlay mimics natural tooth color (though not as translucent as all-ceramic).

Versatility: suitable for single crowns, multi-unit bridges, and implant-supported restorations.

Predictable Marginal Fit: especially when fabricated using traditional casting techniques and noble alloys.

Proven Clinical Track Record: well-documented long-term success.

Functional Performance: handles well heavy occlusal loads

Adjustable Shade and Contour: through layering and staining techniques.

Porcelain Fused to Metal crown - PFM

Disadvantages

Aesthetic Limitations: less translucent than all-ceramic crowns; may show dark margin

Metal Allergies: possible hypersensitivity to base metals like nickel or cobalt.

Porcelain Fracture Risk: Chipping or delamination of the veneering porcelain can occur, especially under high stress or trauma.

Tooth Reduction Requirement: requires more tooth reduction than full-metal crowns overall

Potential for Opposing Tooth Wear: porcelain can be abrasive to natural enamel if not properly polished or glazed.

Subgingival Margin Challenges: may compromise periodontal health if margins are deep or poorly contoured.

Cost: more expensive than other crowns (metal crowns or monolithic ceramic crowns)

Material Science

Metal Alloy: requirements

- Allow for casting in thin section (0.3 mm)
- Porcelain-metal compatibility
 - Thermal match between metal and porcelain: the metal should have higher melting temperature than porcelain for thermal stability while porcelain firing;
 - Colour preservation: some components of the alloy affect porcelain color;
 - Thermal contraction: if the porcelain shrinks slightly less than metal, the ceramic will be in a state of beneficial residual **compressive stress** at room temperature.
 - High alloy rigidity is required to prevent flexing (modulus of elasticity)



Material Science

Metal Alloys

Classification: Noble and Base metal

- Based on the electrochemical character of the alloys
- Gold-based alloys are the gold-standard alloys for PFM

NOBLE METAL ALLOYS:

- **High-noble metal** (gold-based):
 - Noble metal content: 60% (>40% gold)
 - e.g. Gold-Platinum-Palladium; Gold-Palladium-Silver, Gold-Palladium
- **Noble metal** (Palladium-based):
 - Noble metal content: 25% (no gold requirement)
 - e.g. Palladium-Silver, Palladium-Copper-Gallium

*Indium, tin and iron promote bonding of porcelain by the formation of stable adherent oxides

Palladium and platinum are generally added to serve as hardening elements in alloys with high gold content

Material Science

Metal Alloys

Classification: Noble and Base metal

BASE METAL ALLOYS:

- Noble metal content: <25% (no gold requirement)
- e.g. Nickel-Chromium , Cobalt-Chromium

- Casting is more technique sensitive
- Higher Hardness and Modulus of elasticity - Burnishing and finishing are more difficult
- Less flexure – long span bridge

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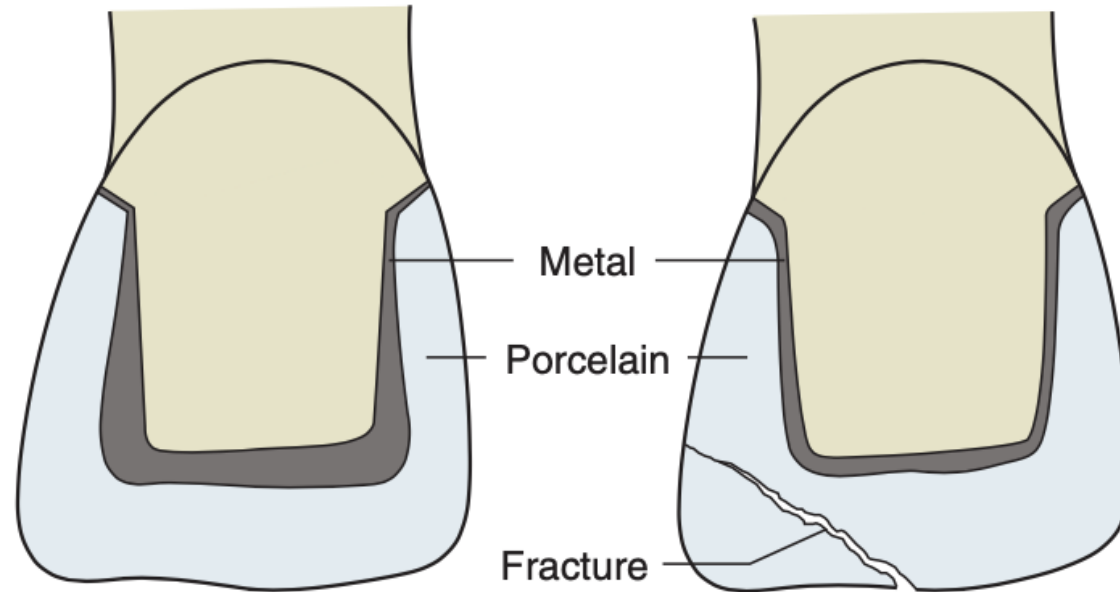
Material Science

Bonding to porcelain

- Mechanical:
 - rough metal surface (sandblasting/oxidizing) provides micromechanical retention
 - ceramic locking on cooling
- Chemical: fusion of ceramic to metal oxide layer



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Uneven
porcelain
thickness

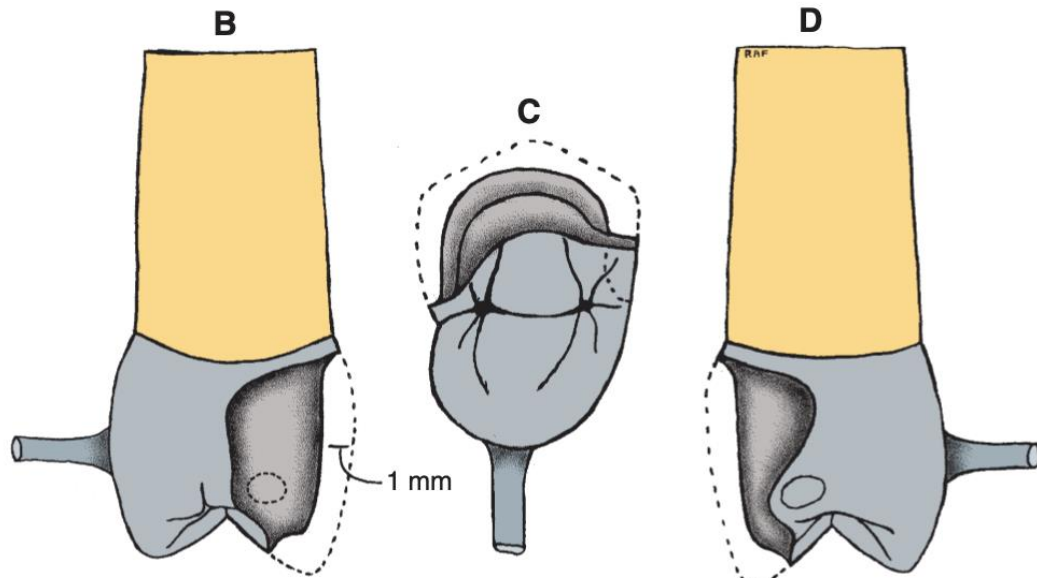


Lack of proper
support

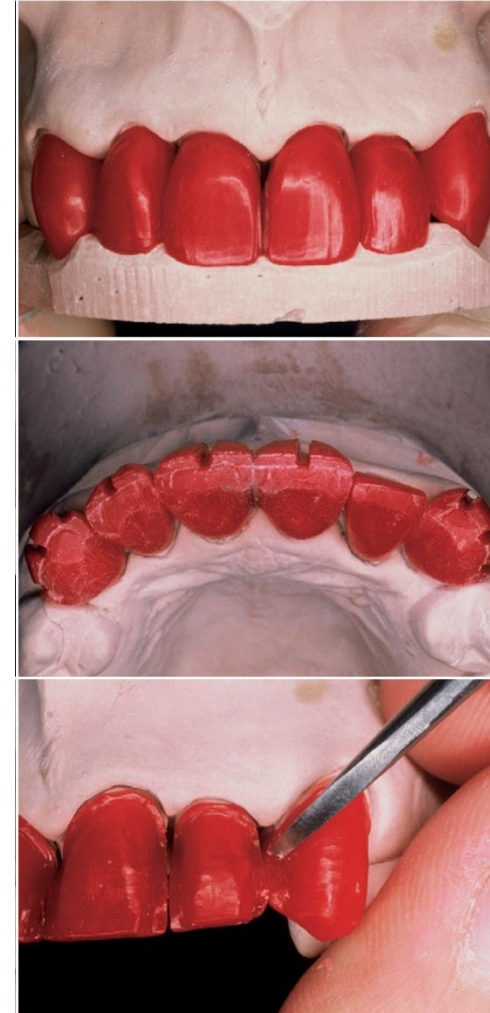


Increased
potential for
fracture

Porcelain Fused to Metal crown - PFM



**EVEN THICKNESS OF
PORCELAIN**

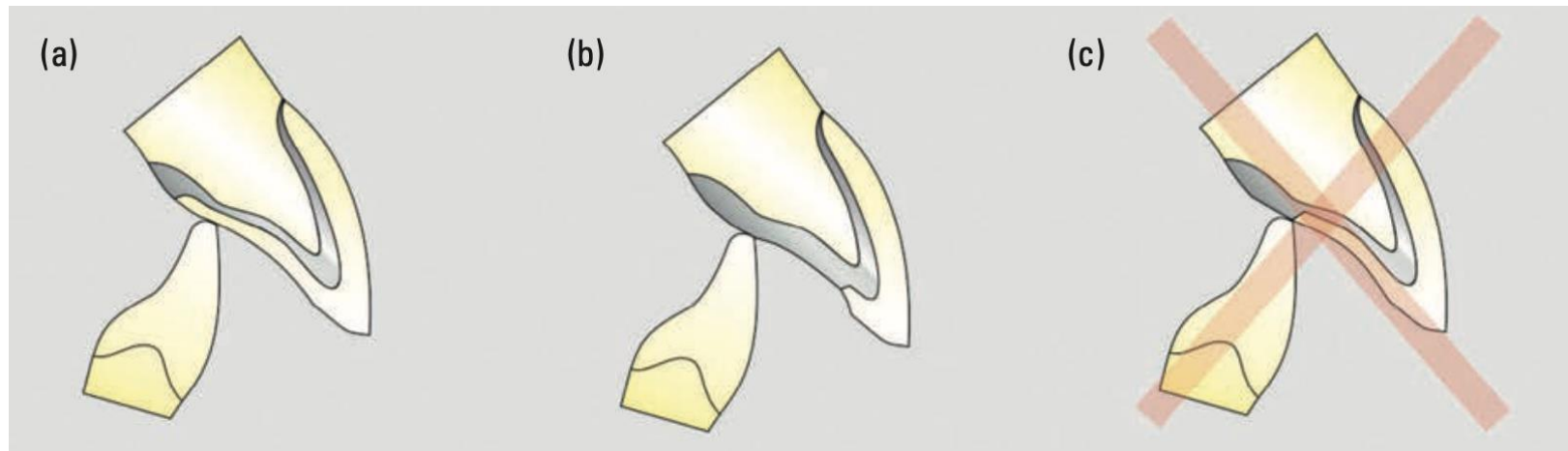


Wax-up complete
anatomical
contour

Cut back
consistent amount
for ceramic
veneer

Porcelain Fused to Metal crown - PFM

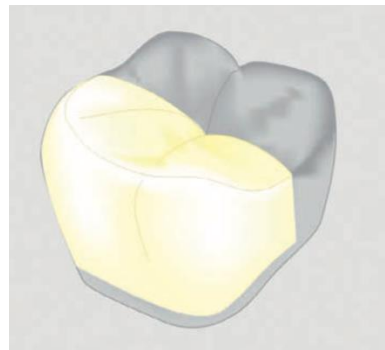
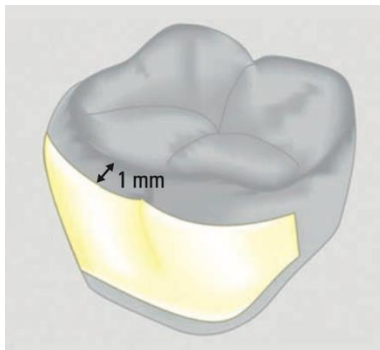
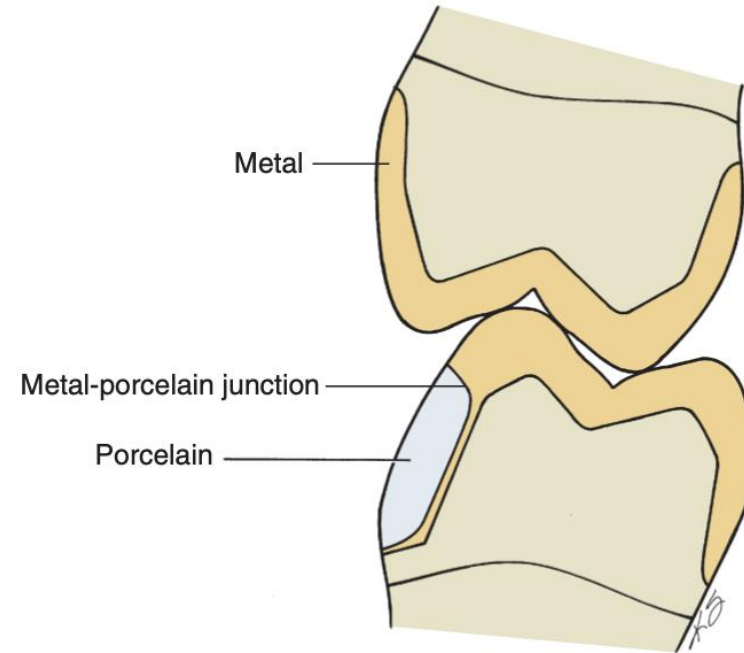
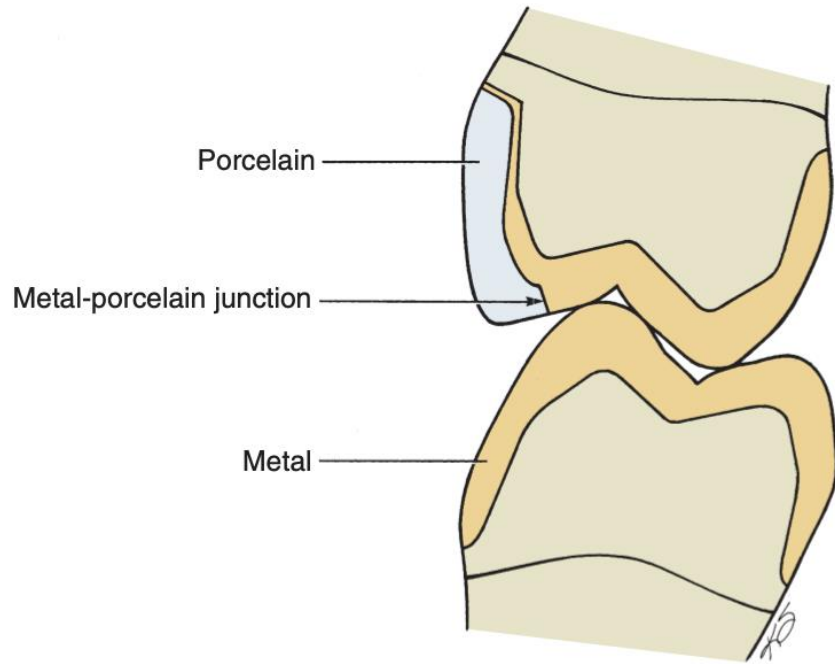
Occlusal contact in centric \neq Metal-porcelain junction



at least 1.5 mm away from the junction

Occlusal analysis is necessary to determine the PFM crown design

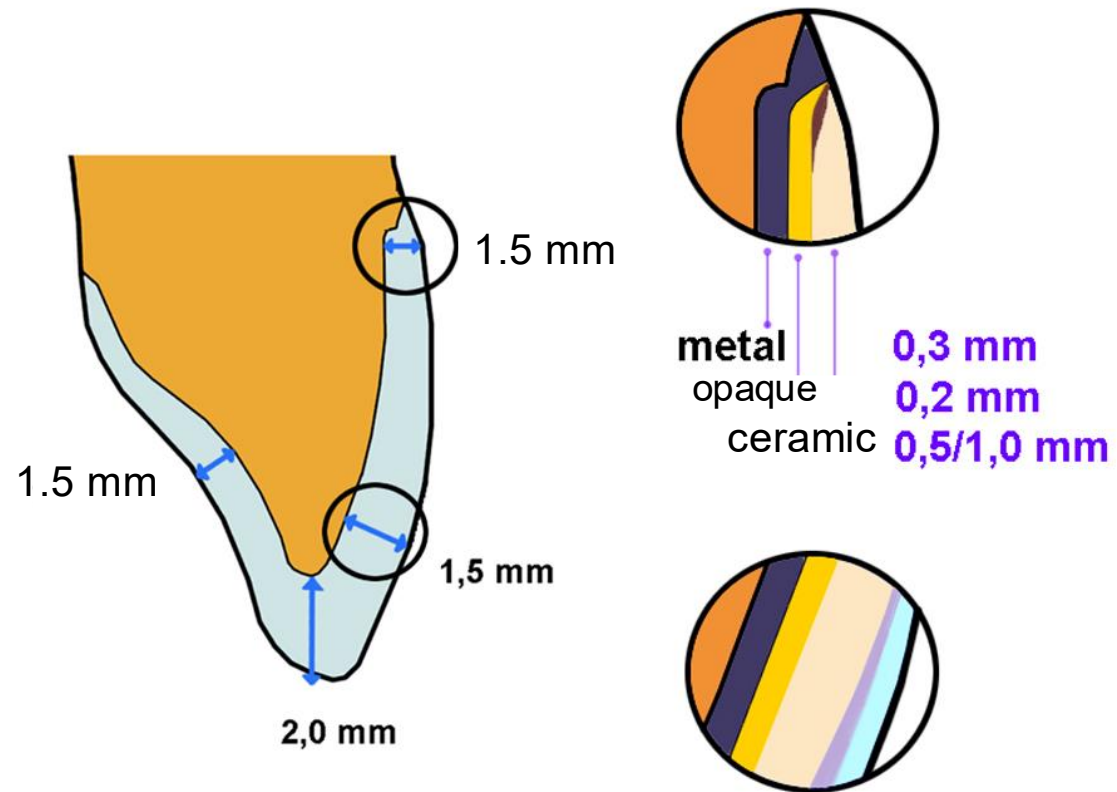
Porcelain Fused to Metal crown - PFM



Always check if the patient
accepts a compromised
aesthetic

Porcelain Fused to Metal crown - PFM

Fabrication of PFM



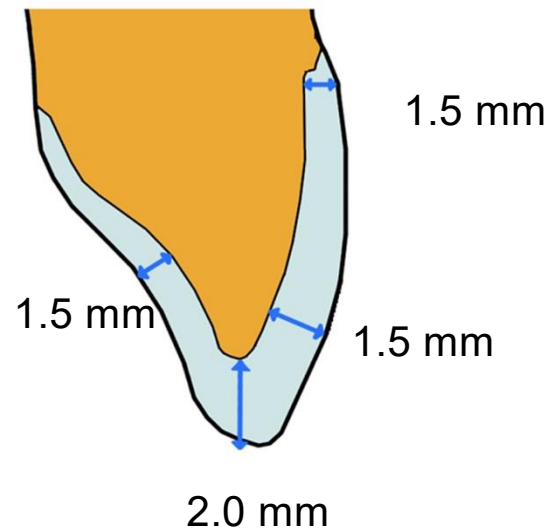
Porcelain Fused to Metal crown - PFM

Reduction depends on coverage material

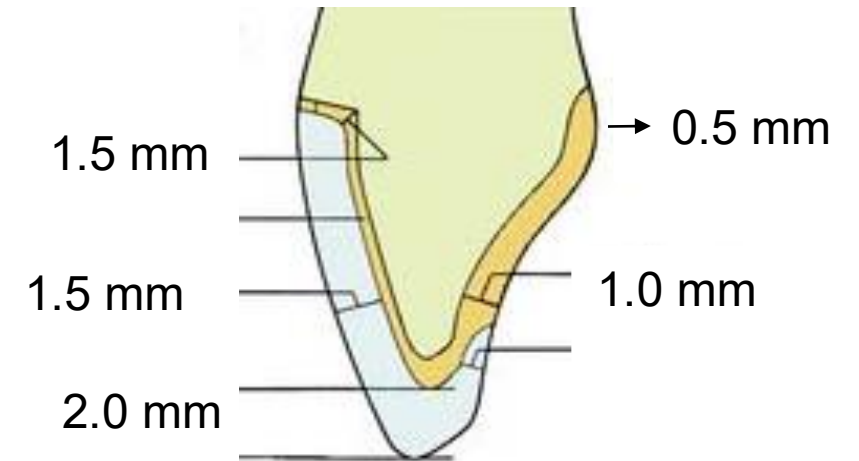
PFM: Full coverage with ceramic

Anterior:

- Incisal reduction: 2mm
- Margin: Shoulder, at least 1.0-1.5 mm
- Axial reduction (metal-ceramic): 1.5mm



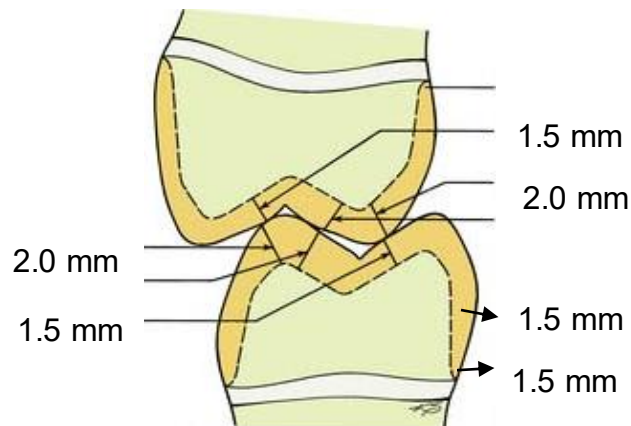
PFM: Partial coverage with ceramic



Reduction depends on coverage material

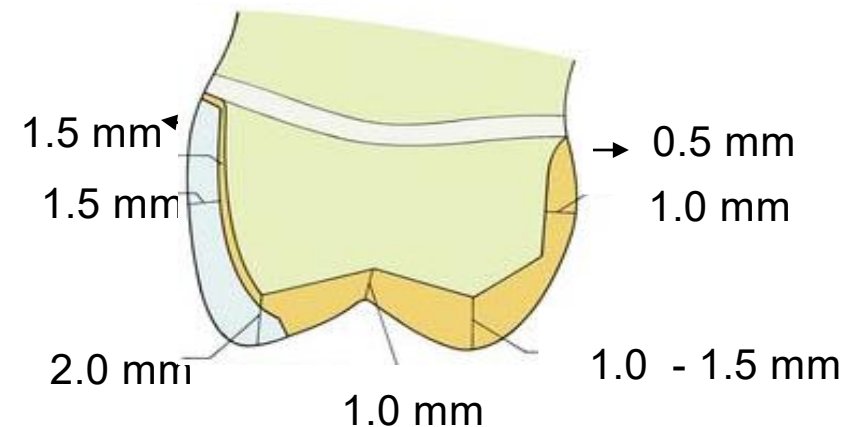
PFM: Full coverage with ceramic

- *Occlusal Surface* (metal-ceramic)
 - Non-functional cusp: 1.5 mm
 - Functional cusp: 2 mm
- *Margin*: Shoulder, at least 1.5 mm
- *Axial reduction* (metal-ceramic): 1.5 mm



PFM: Partial coverage with ceramic

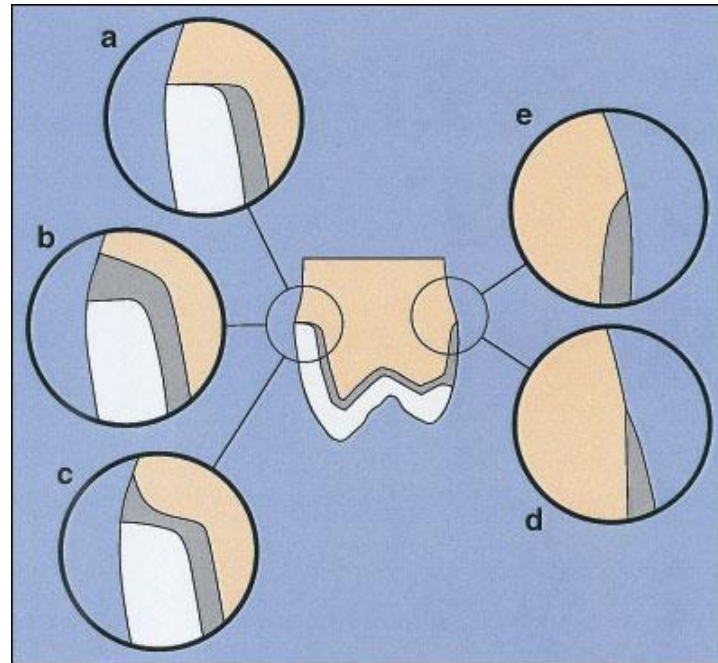
- *Occlusal Surface*:
 - Non-functional cusp: 1 mm
 - Functional cusp: 1.5 – 2.0 mm
- *Margin*: Chamfer or shoulder: 0.5 and 1.5 mm
- *Axial reduction* (metal only): 1 mm
(metal-ceramic): 1.5 mm



Margin Design

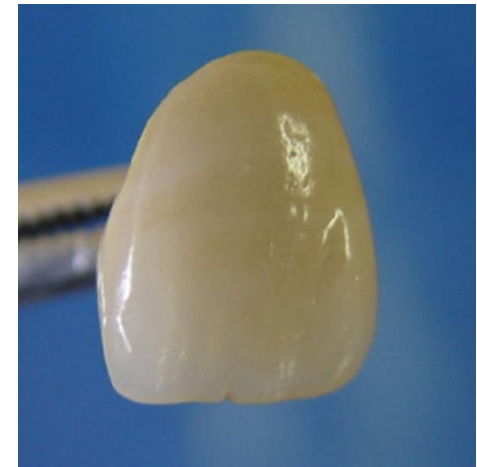
Metal collar

- Conservative
- More accurate fit
- Unaesthetic
- Subgingival placement in some cases
- More suitable posteriorly



Ceramic shoulder

- Balanced compromise of aesthetic and conservation
- Suitable for anterior teeth
- Equigingival labial margin is possible



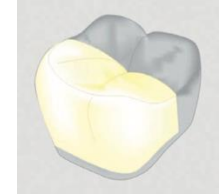
Preparation Armamentarium

- Silicone putty
- Round-end tapered diamond bur
 - course
 - Fine grid (red band)
- Football-shaped diamond
- sickle and periodontal probe



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Posterior Crown – Partial coverage with ceramic
Occlusal reduction



- Occlusal orientation grooves
- Bur: tapered carbide or diamond (1mm diameter)
- Follow anatomic configuration and cusp inclines

Porcelain Fused to Metal crown - PFM

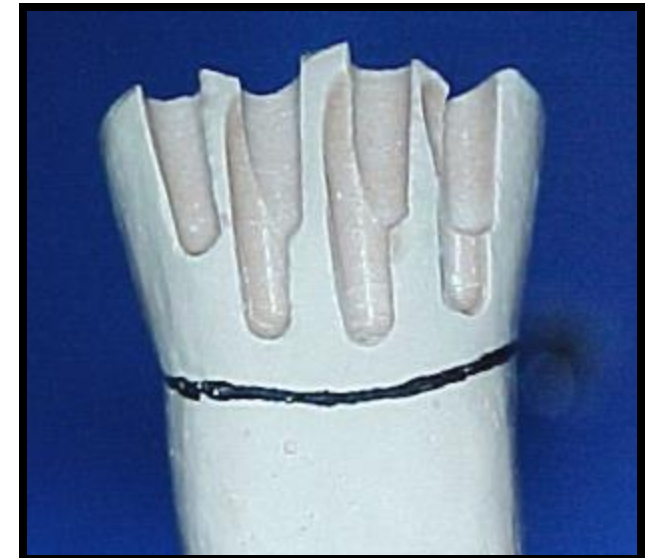
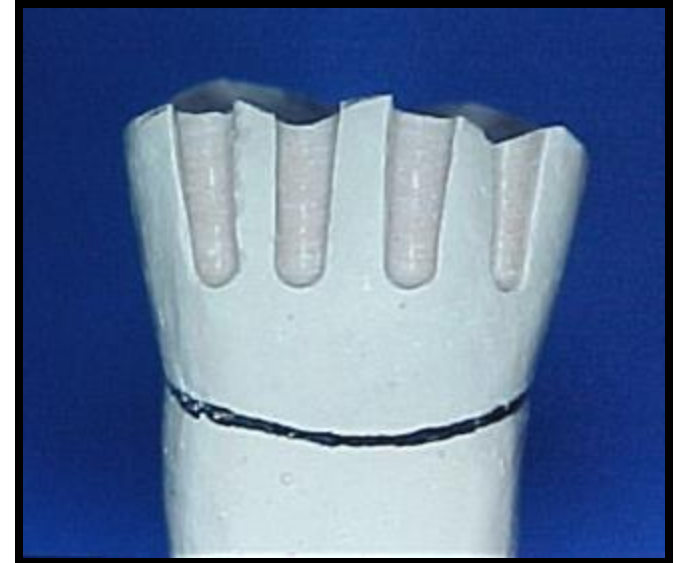
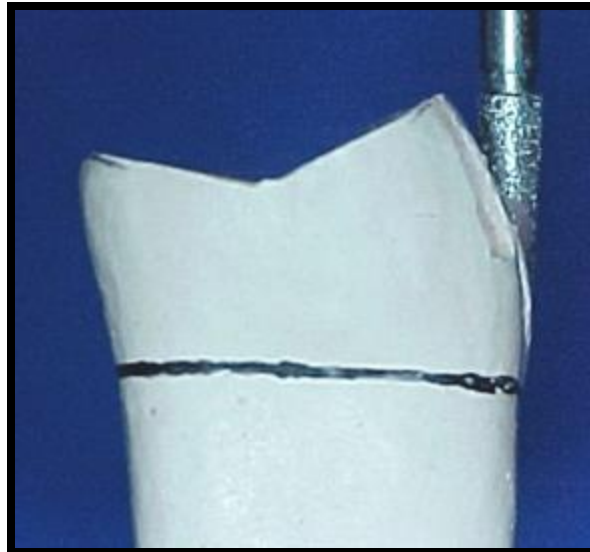
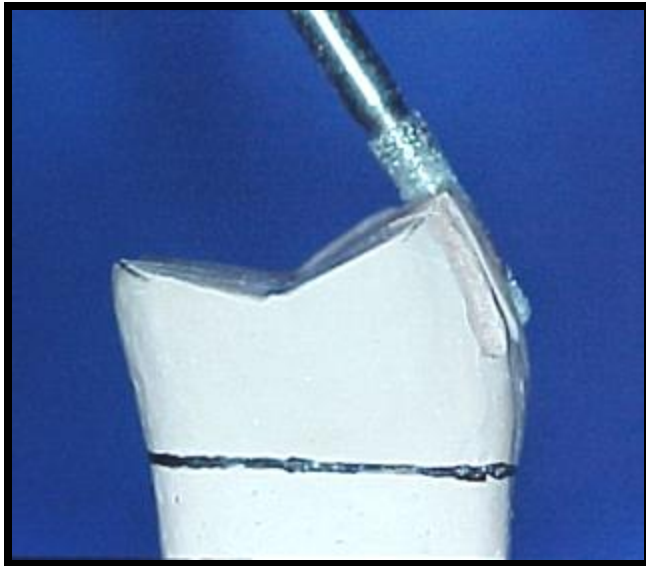
Posterior Crown
Occlusal reduction



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Posterior Crown
Buccal reduction



Porcelain Fused to Metal crown - PFM

Posterior Crown
Buccal reduction

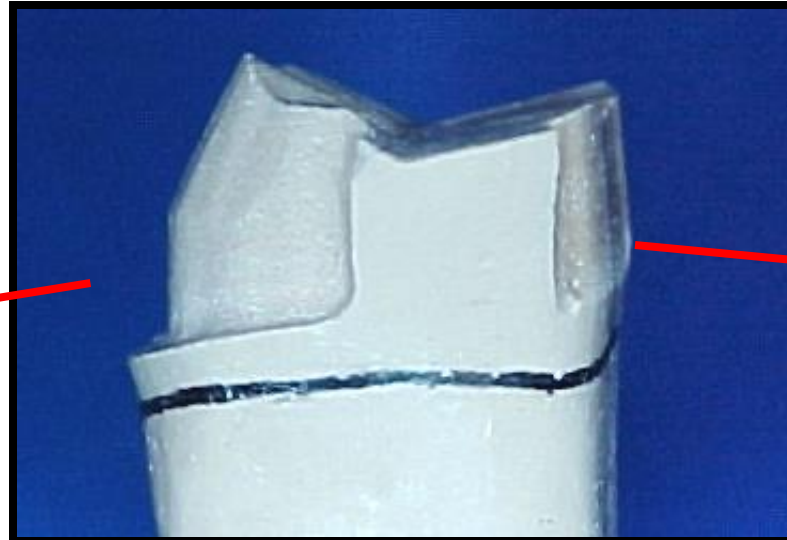


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Posterior Crown
Lingual reduction

Metal + Ceramic



Metal



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Posterior Crown
Interproximal reduction



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Posterior Crown
Interproximal reduction



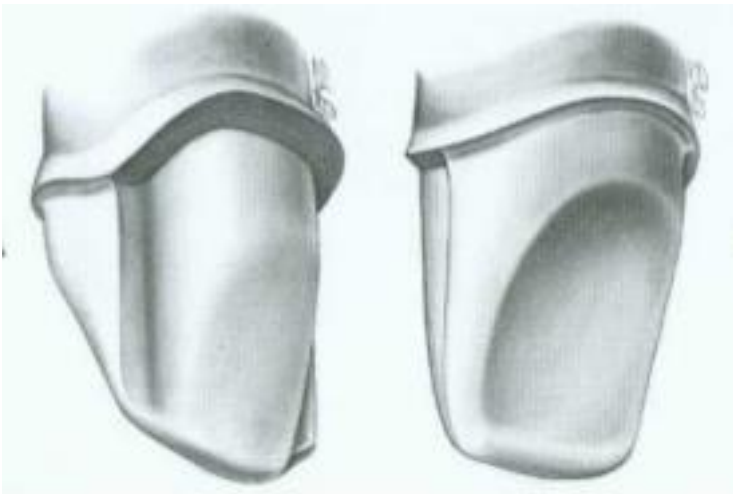
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Posterior Crown Finishing



Shoulder with bevel finishing line

Classical preparation (wing preparation)



Contemporary PFM Preparation (Wingless preparation)

- Shoulder blending interproximally from wide labial margin to narrow palatal margin
- Easier to prepare



Porcelain Fused to Metal crown - PFM

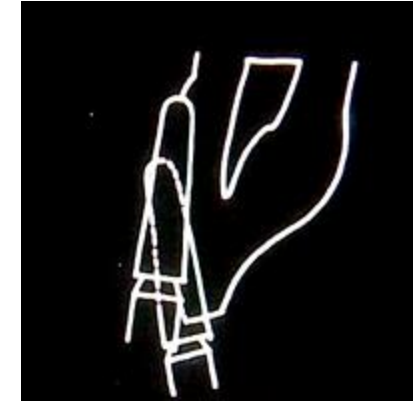
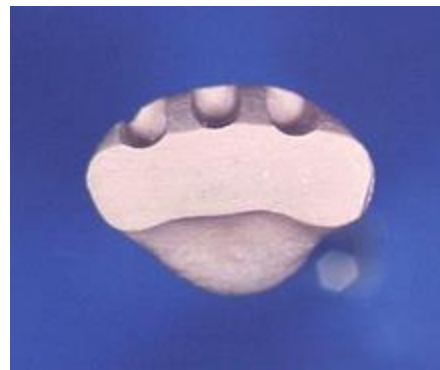
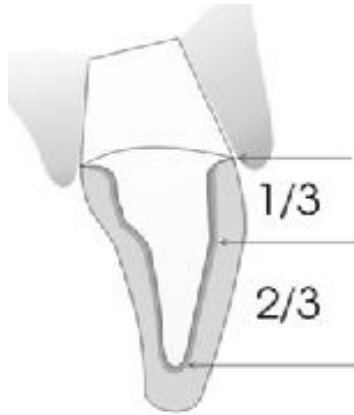


Anterior Crown – full coverage with ceramic
Incisal reduction



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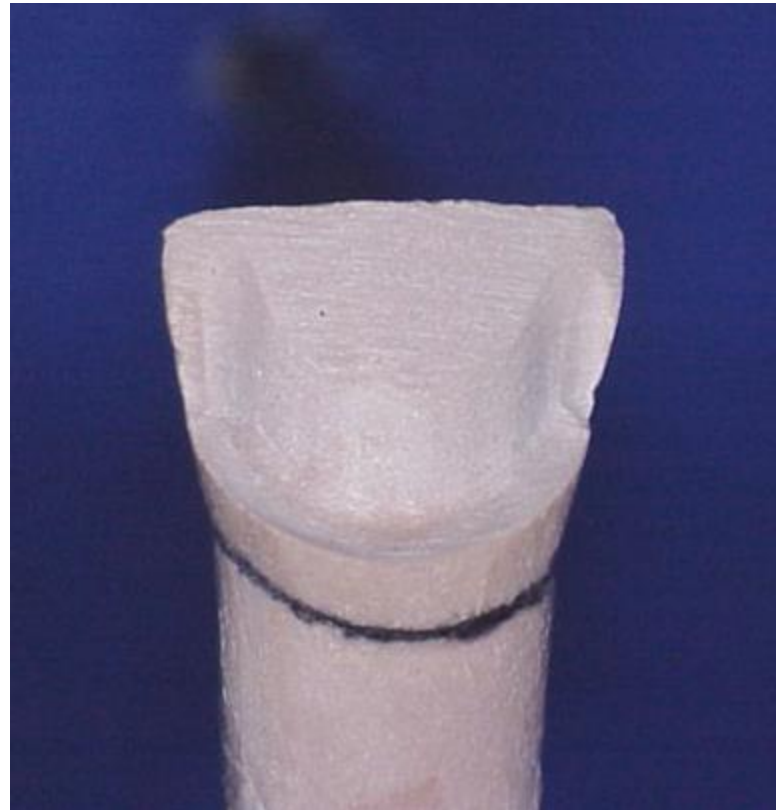
Anterior Crown
Buccal reduction



Porcelain Fused to Metal crown - PFM



Anterior Crown
Buccal reduction



Porcelain Fused to Metal crown - PFM



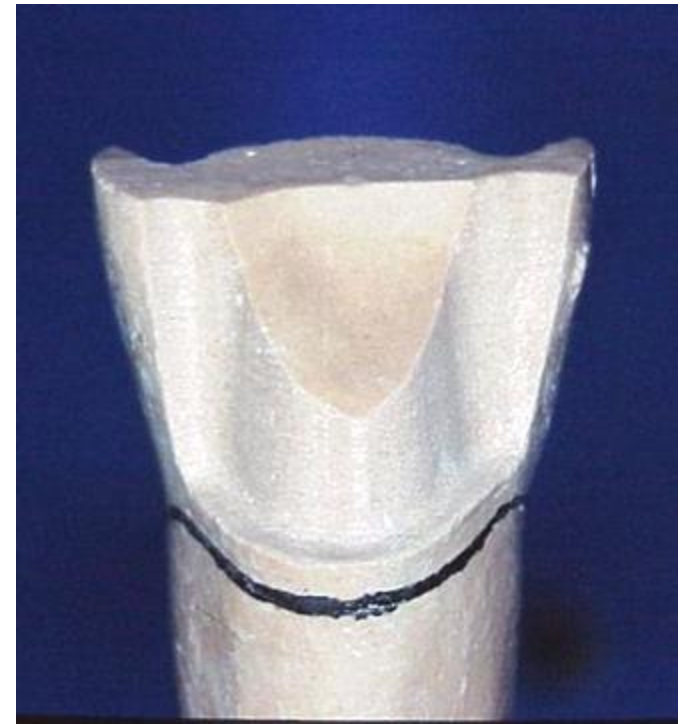
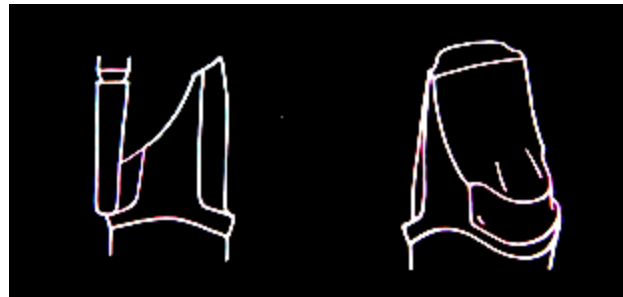
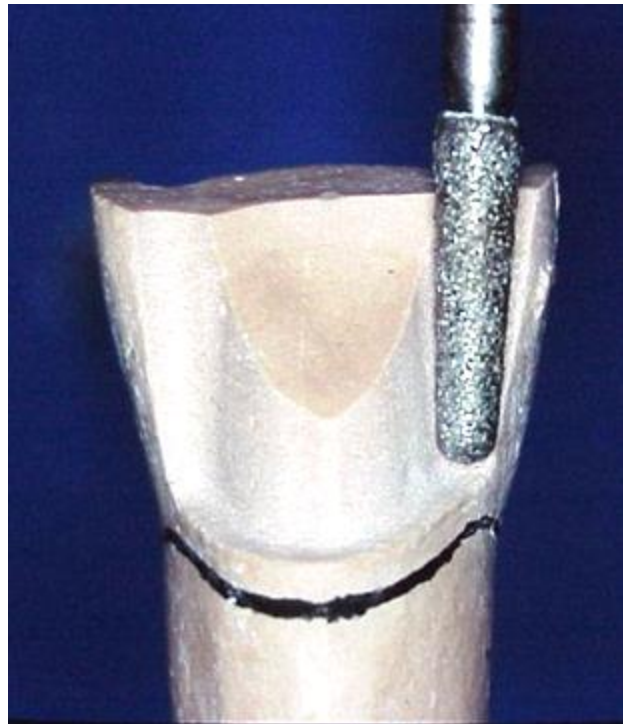
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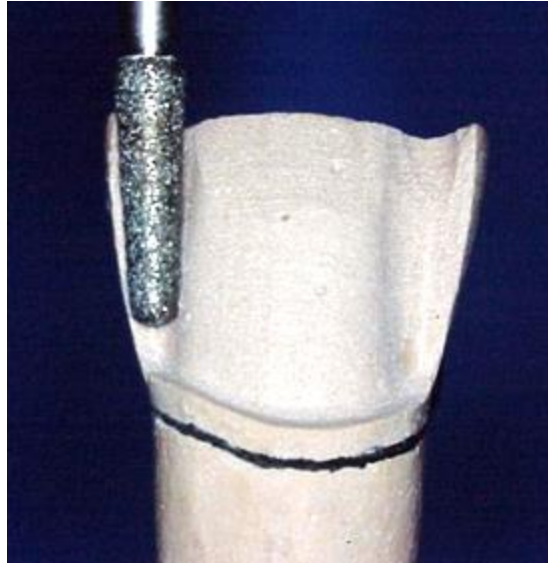
Anterior Crown

Lingual reduction 1



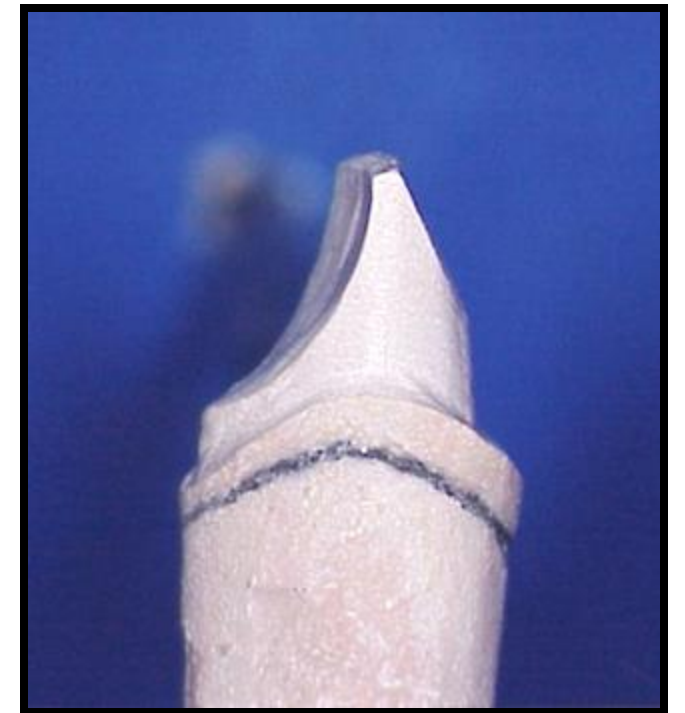
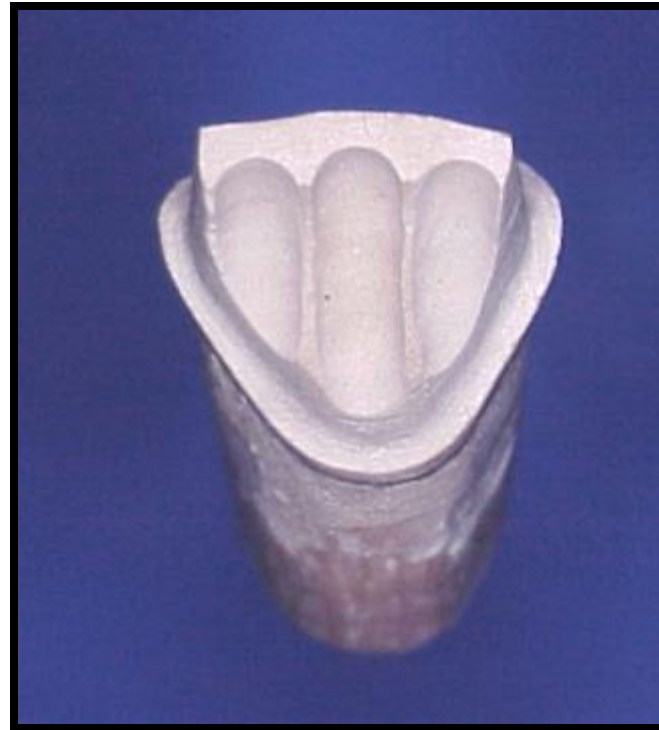
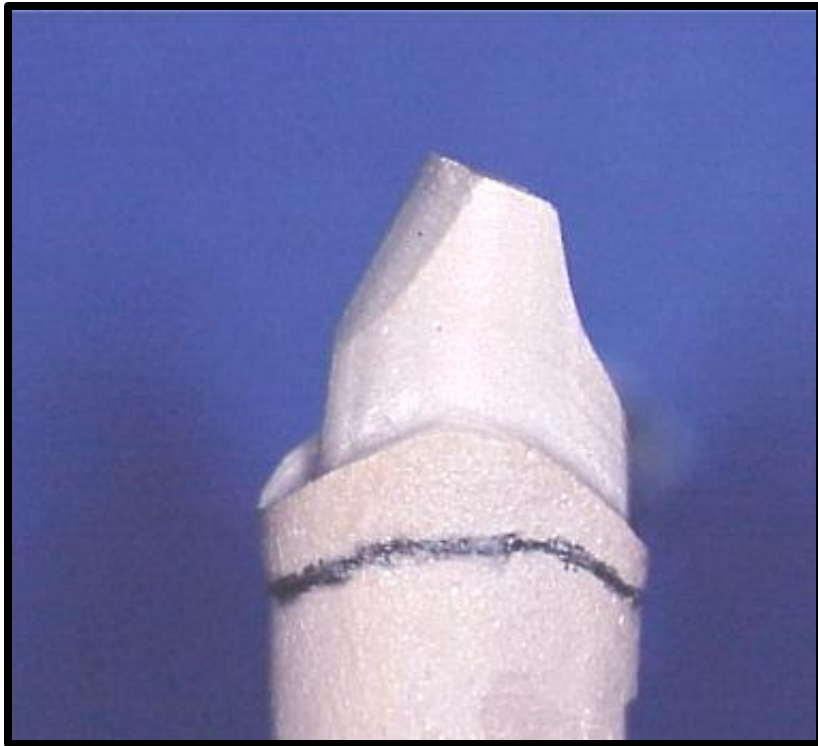
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Anterior Crown
Interproximal reduction



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Anterior Crown
Lingual reduction 2



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Anterior Crown Finishing



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