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Lecture 6: Impression and Soft Tissue Management

By Dr Cheryl Fu

Learning Objectives

1. Define the objectives of definitive impressions.
2. Discuss the impact of subgingival margins on the soft tissue management.
3. Define the aims of gingival displacement and describe the different methods of gingival displacement.
4. Discuss the importance of impression timing
5. Describe the ideal impression.
6. Impression material properties

Reading: Fundamentals of Fixed Prosthodontics Chapter 14 +

Impression

Restorations which fit exactly and can be inserted without any further corrections

Exact fitting restorations:

- More efficient and faster working
- Aid periodontal prophylaxis, caries
- Aesthetic results
- Prognosis

Table 2. Periradicular status for various combinations of treatment quality

Group	Endo	Coronal	No. teeth	PPI	API	%API
1	Good (GE)	Good (GR)	330.5	28.5	302.0	91.4
2	Good (GE)	Poor (PR)	164.5	92.0	72.5	44.1
3	Poor (PE)	Good (GR)	302.5	98.0	204.5	67.6
4	Poor (PE)	Poor (PR)	188.0	154.0	34.0	18.1

PPI, presence of periradicular inflammation.
API, absence of periradicular inflammation.

Ray HA, Trope M. 1995

Table 3. Success rate of endodontic treatment of good or poor quality in teeth with good or poor coronal restorations

Endodontic treatment	Coronal restoration	*n*	Failure	Success	Success in percent
GE	GR	364	70	294	81%*
GE	PR	142	41	101	71%*
PE	GR	299	131	168	56%*
PE	PR	196	85	111	57%*

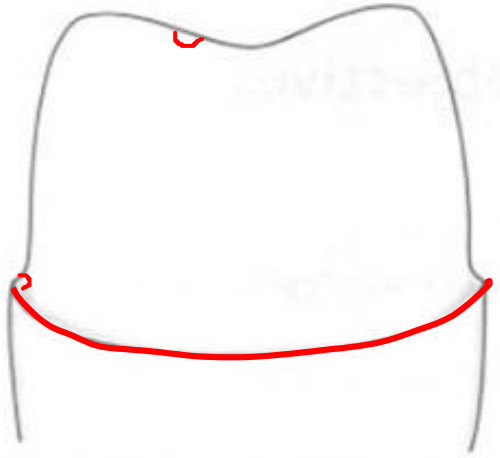
GE=Good Endodontics; PE=Poor Endodontics; GR=Good Restoration; PR=Poor Restoration.
* The difference between the success rate with Good Endodontics and Poor Endodontics was statistically significant ($P<0.0001$) regardless of the quality of the coronal restoration (GR or PR).

Tronstad L, Asbjørnsen K, Døving L, Pedersen I, Eriksen HM. 2000

Impression

Impression Objectives:

1. Exact duplication of the prepared and uncut tooth beyond the preparation to allow evaluation of location and configuration of finishing line
2. Duplicate other teeth and soft tissue to permit proper articulation of the cast and contouring the restoration
3. Must be free of bubbles specially at finishing line and prepared surfaces



Impression

Aim of impression: produce a dimensionally stable “negative”

- Mould for an analogue model

- Scanned with CAD/CAM model

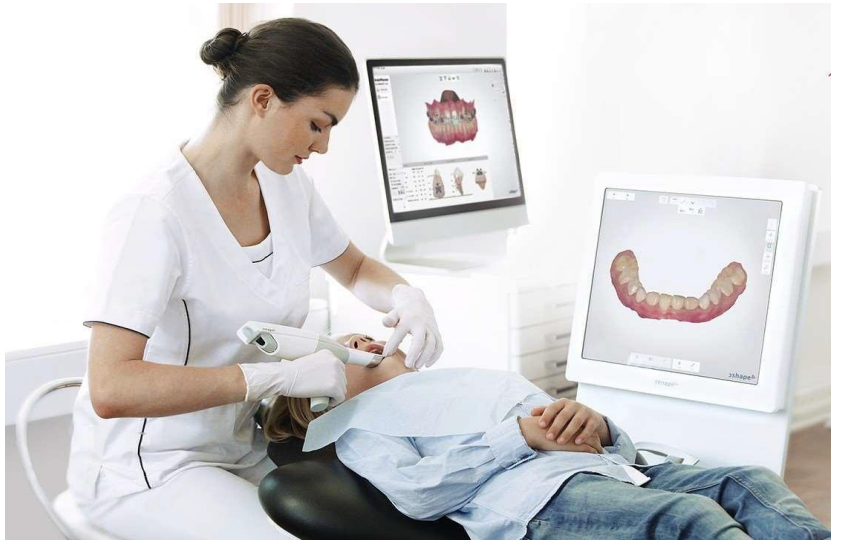
Milled Model

3D Printed Model

Impressions

Impression/Scanning Prerequisites

- Tissue management
- Gingival tissue displacement (if needed)
- Saliva control
- Adequate impression/scanning technique



Tissue management

- Careful preparation
  - Hard tissue
  - Soft tissue
- Atraumatic procedure
- Well-contoured provisional restoration
- Adequate oral hygiene

Tooth Preparation

- Supragingival margins if possible
- Minimally subgingival or intra-crevicular
- Well-defined, smooth and continuous margins
- Well-finished and tidy preparation
- Atraumatic to gingival tissues

Tissue management - supragingival preparation

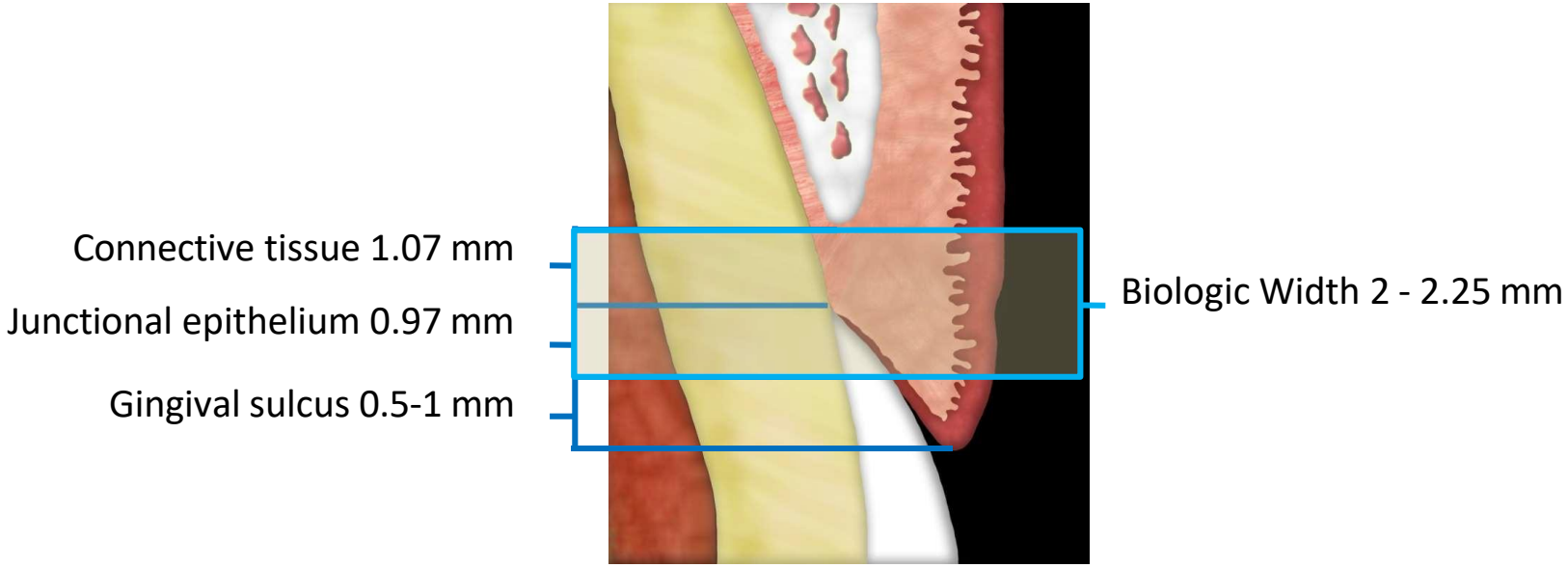
Supragingival preparation

Biologic width

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

Slide by Dr Matsubara

Biologic width



Margin location

► If the margins has to be subgingival it should only be placed intracrevicularly

► Maximum depth around 0.7mm

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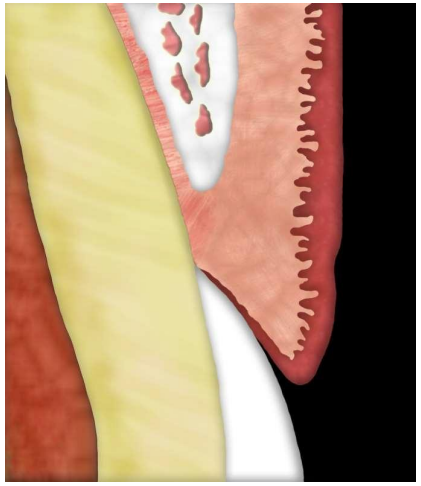
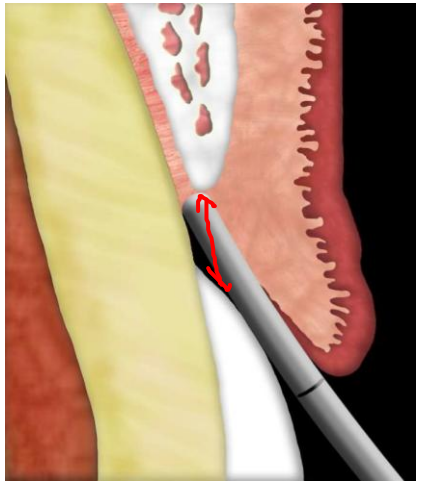
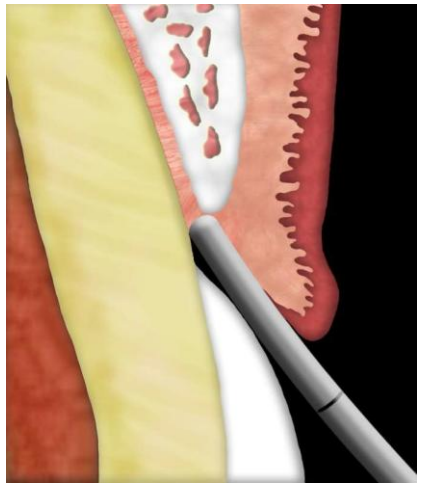
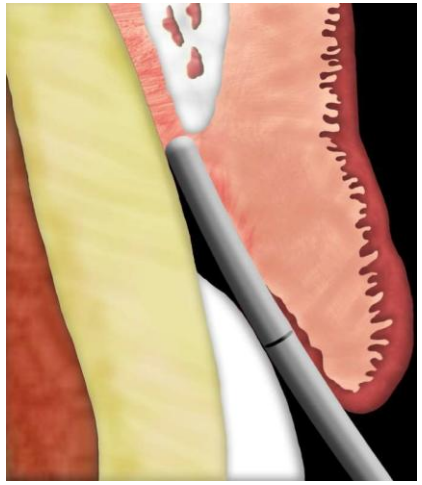
Biologic width









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

Slide by Dr Matsubara

Want to know more about biologic width? Read:
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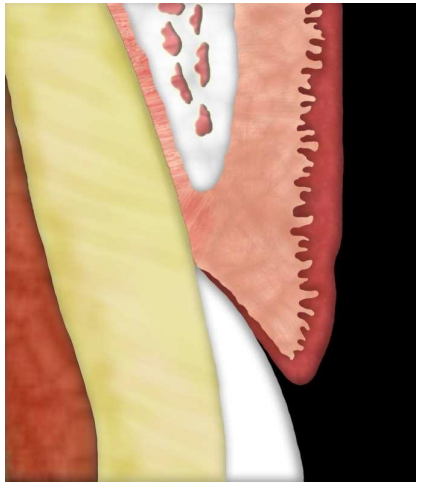
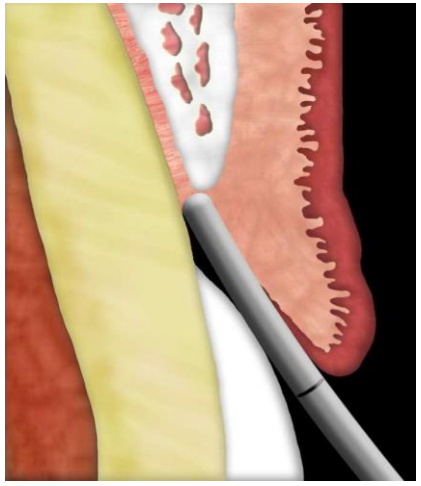
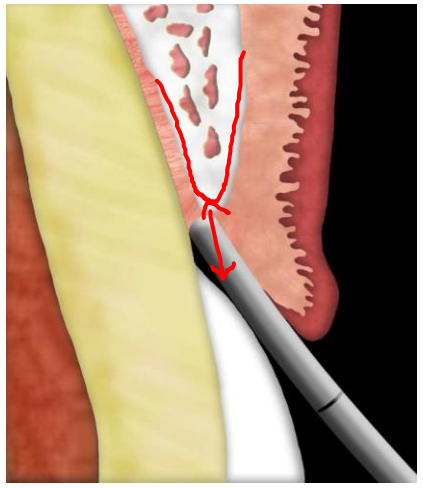
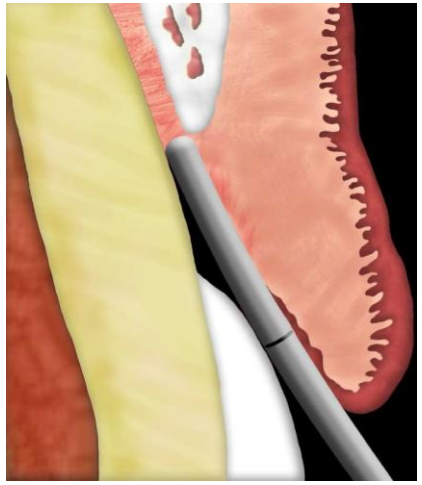
Biologic width









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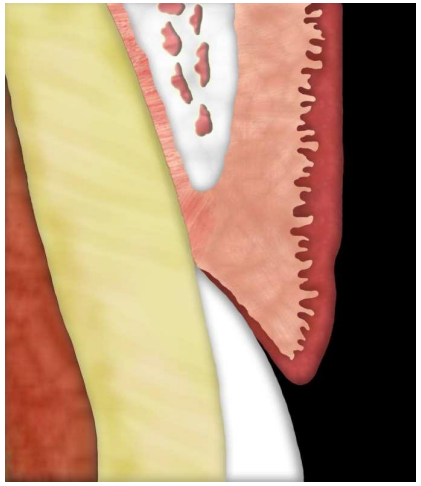

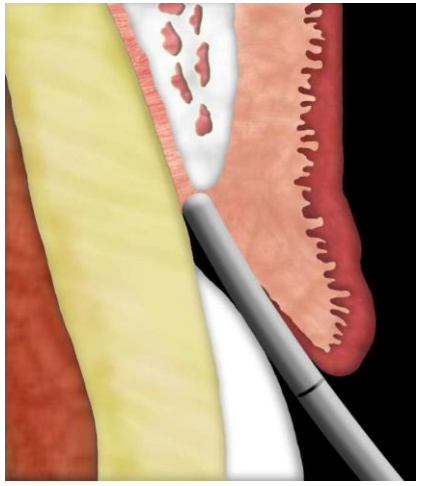

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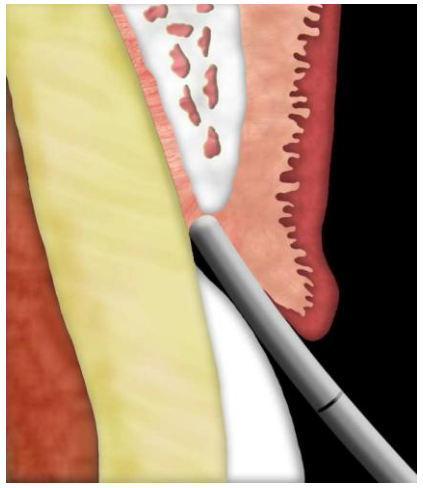

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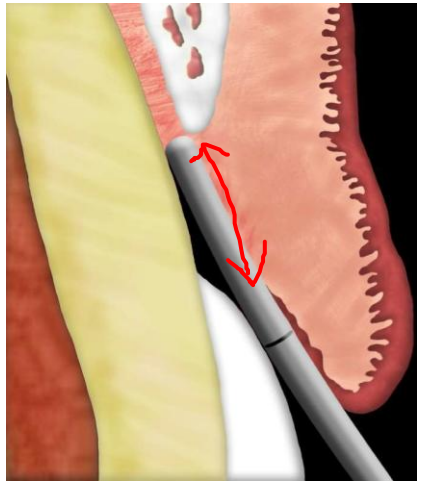

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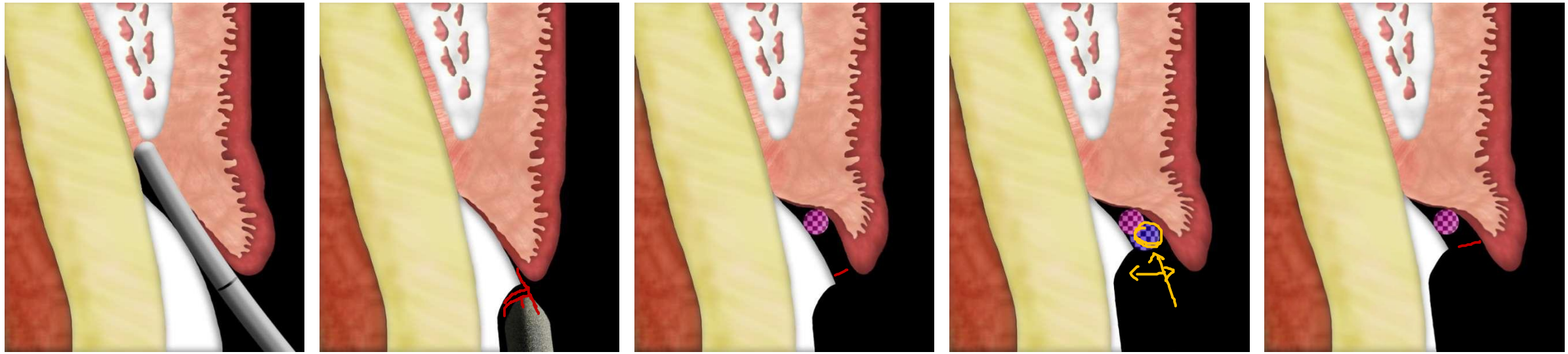
Biologic width

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.

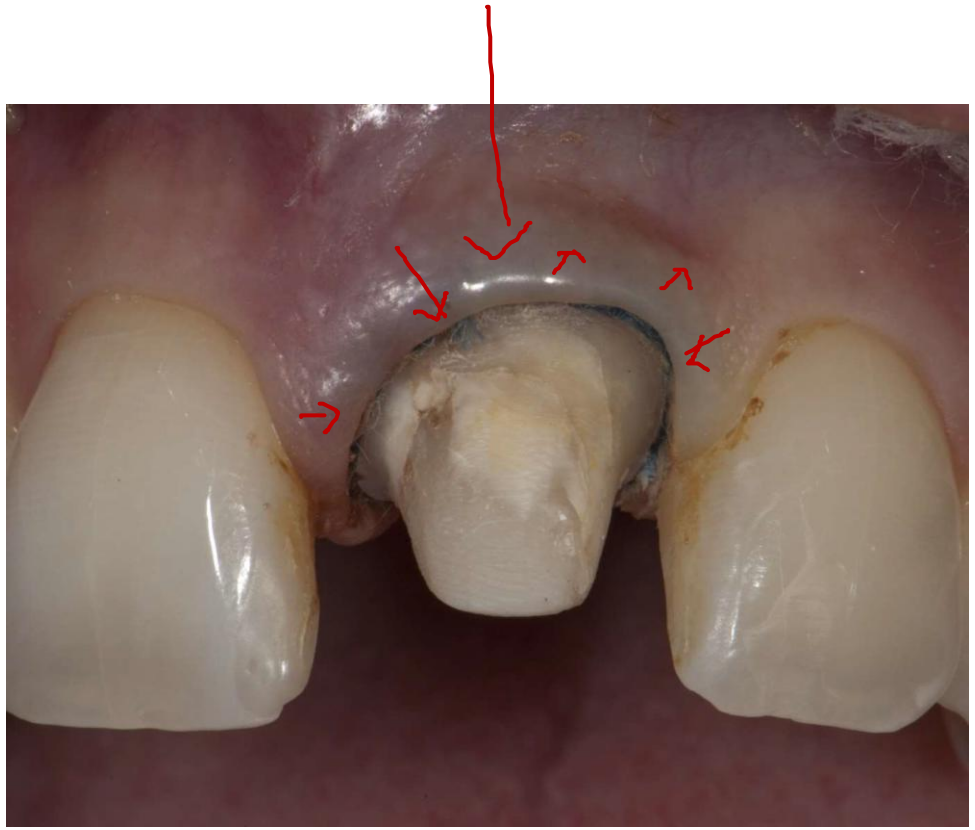
Take Home Message: If you place a margin within 2mm of the crestal bone you will get inflammation, followed by bone loss as the biological width tries to re-establish itself

Normal Crest – Preparation & Tissue Management



Double cord

Tissue Management



Retraction cord

Gingival Displacement

Aims

- Enlargement of gingival sulcus
- Tissue deflection horizontally and vertically to display the margin and root surface
  - Finishing line for the restoration
  - Development of adequate emergence profile
- Control of gingival bleeding and exudate

Gingival Displacement

Mechanical Displacement
- Retraction cord
- Copper band

Chemicals
Astringent: aluminium chloride, ferric sulfate
Adrenaline - transient ischemia and epithelial tissue shrinkage

Combined
- Retraction cord + chemical
- Expasyl (Kerr)

Surgical widening
- Electrosurgery
- Laser

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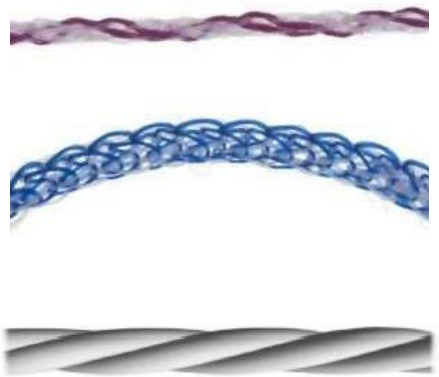
Mechanical Displacement

Mechanical Displacement: Retraction cord

Cord is packed into sulcus stretching the circumferential periodontal fibers 0.3-0.4 mm

Types:

- Braided
- Knitted
- Twisted

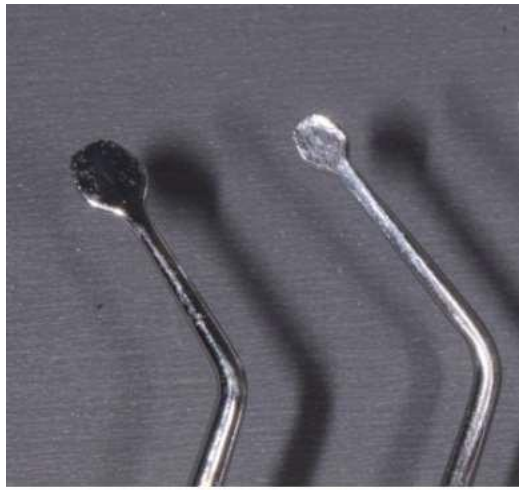


- Medicated and nonmedicated

Retraction Cord

Cord Packer

Serrated



Non-serrated

Cord Packing technique

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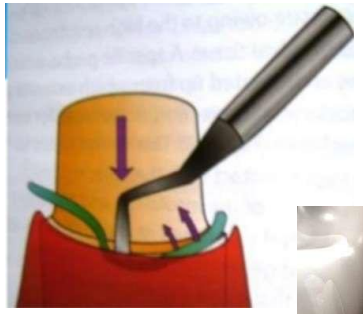
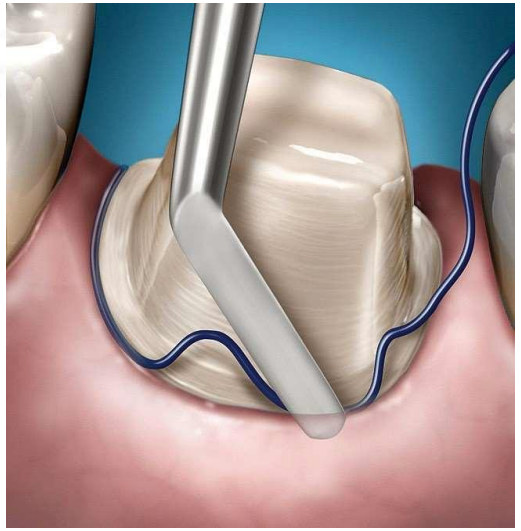
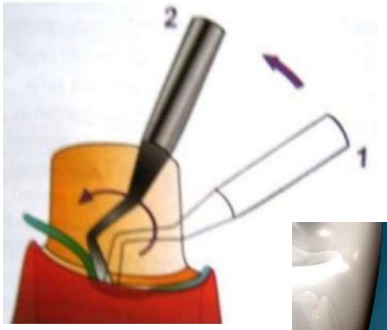
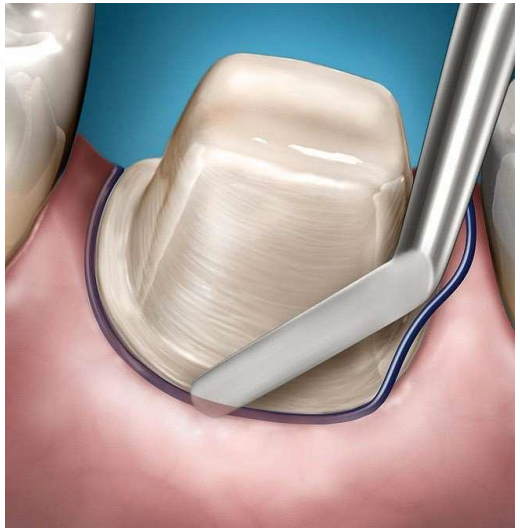
Vertical





Rotational





Retraction cords

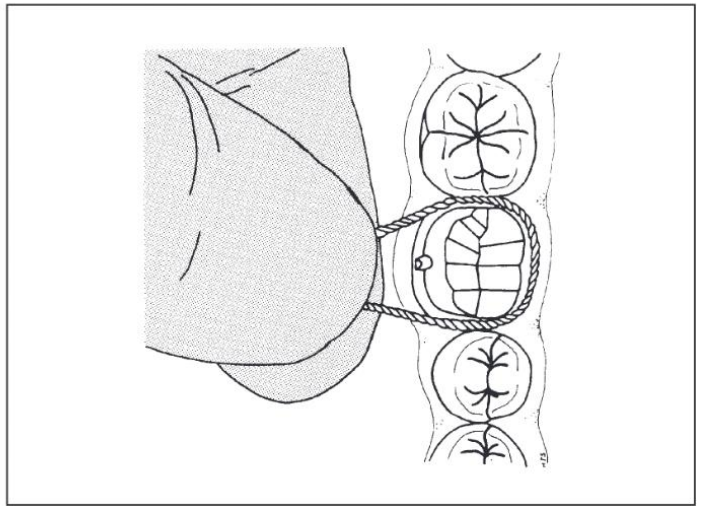


Fig 16-13 A loop of retraction cord is formed around the tooth and held tautly with the thumb and forefinger.

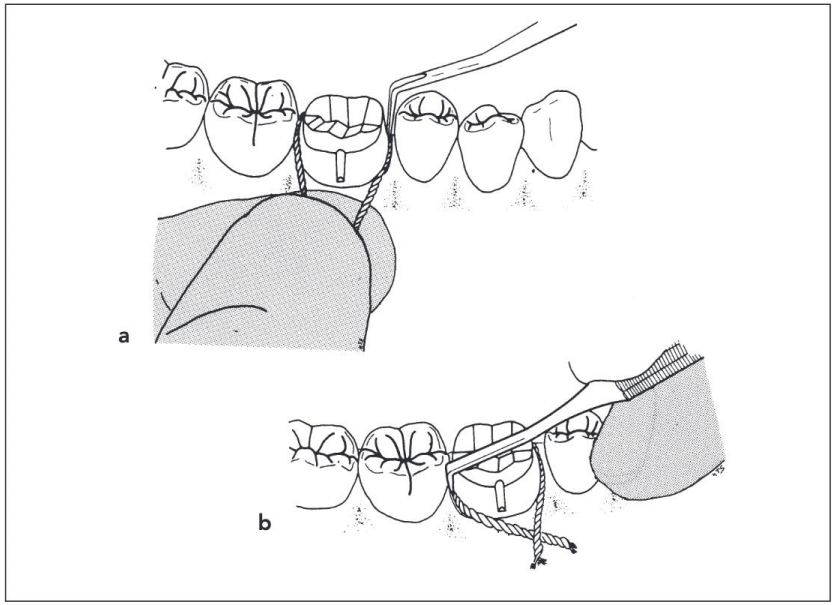


Fig 16-14 *(a)* Placement of the retraction cord is begun by pushing it into the sulcus on the mesial surface of the tooth. *(b)* It should also be tacked lightly into the distal crevice to hold the cord in position while it is being placed.

Mechanical Displacement: Retraction cord

Single cord

Double cord

Leave the cords in place
three to five minutes

Mechanical Displacement: Retraction cord

Single cord

Double cord

1st cord: vertical retraction

2nd cord: Horizontal displacement

GRACIS et al. 2001

Mechanical Displacement: Retraction cord

Single cord

Indication:

- Shallow sulcus
- Thin periodontium

Advantages:

- Least traumatic
- Limited risk for gingival recession

Disadvantages:

- Haemorrhage
- Exudate

Mechanical Displacement: Retraction cord

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Single cord

Indication:

- Shallow sulcus
- Thin periodontium

Advantages:

- Least traumatic
- Limited risk for gingival recession

Disadvantages:

- Haemorrhage
- Exudate

Double cord

Indication:

- Thick periodontium

Advantages:

- Control of bleeding
- Excellent lateral displacement

Disadvantages:

- Time consuming
- Potentially traumatic
- Least predictable gingival response

Chemical Displacement: Hemostatic agent

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Metallic salts

- Causing transient ischemia
- Shrinkage of gingival tissues
- Reduce flow of gingival fluids

Examples:

- Aluminum chloride *(Hemadent)*
- Aluminum sulfate
- Potassium sulfate
- Ferric chloride
- Ferric sulfate *(Astringedent)*

Adrenaline

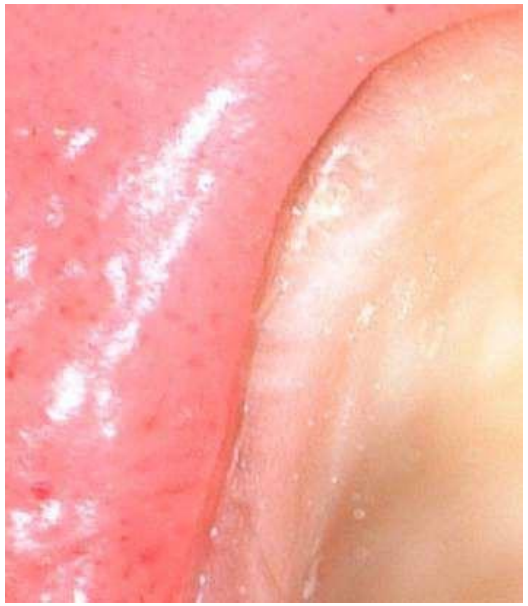
- Can cause tachycardia

Haemostasis - Expasyl

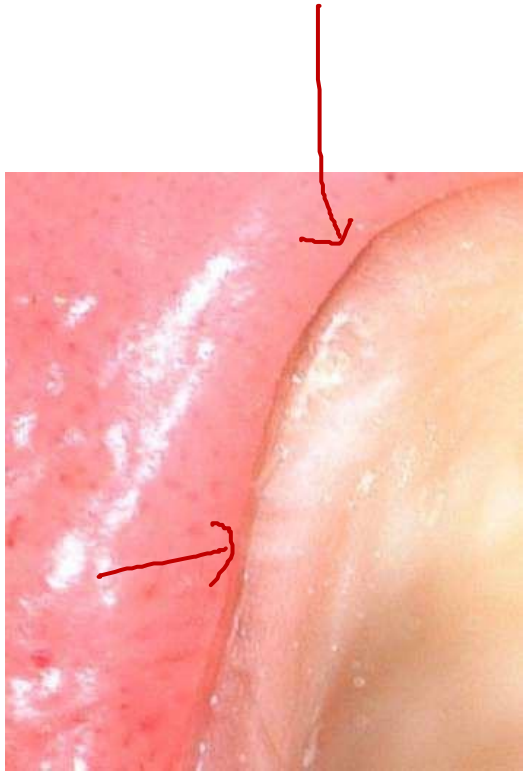
Expasyl
Aluminium chloride with kaolin Dispensed from a syringe
Expands on setting
Left for 1- 2 minutes
Washed away with water spray

Traxodent
Aluminium chloride paste

Expasyl

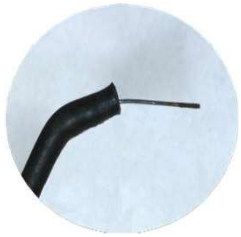


Expasyl



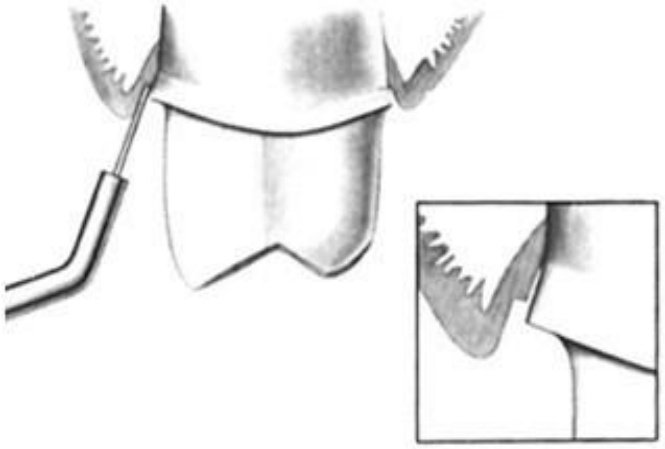
Surgical Techniques

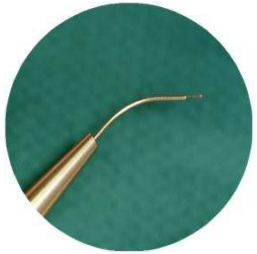
- Remove the inner epithelial lining for better access to finish line, and control of haemorrhage
- Risk of permanent damage
  - Recession
- Avoid for thin gingiva



Examples

- Electrosurgery
- Laser





Surgical Techniques

Electrosurgery

Advantages:

- Lower cost than lasers.
- Electrosurgery cuts rapidly when compared to a diode laser.
- With proper intensity, immediate hemostasis.
- After cutting, the wound is nearly painless.

Disadvantages:

- Contraindicated in patients with any electrical device (PACEMAKERS!)
- You must anesthetize patients
- Burning smell
- Risk of overcutting
- Because of high heat production while cutting, electrosurgery should not be used around implants

Surgical Techniques

Laser

Advantages:

- Minimal local anesthetic needed,
- Does not harm dental hard tissue.
- Can be used around implants (some laser produce heat)
- Can be used around full metal, PFM crowns, amalgam or gold alloy restorations.

Disadvantages:

- Cost
- Cuts much slower than electrosurgery.
- Cutting large pieces of soft tissue is time consuming
- Danger of laser beam

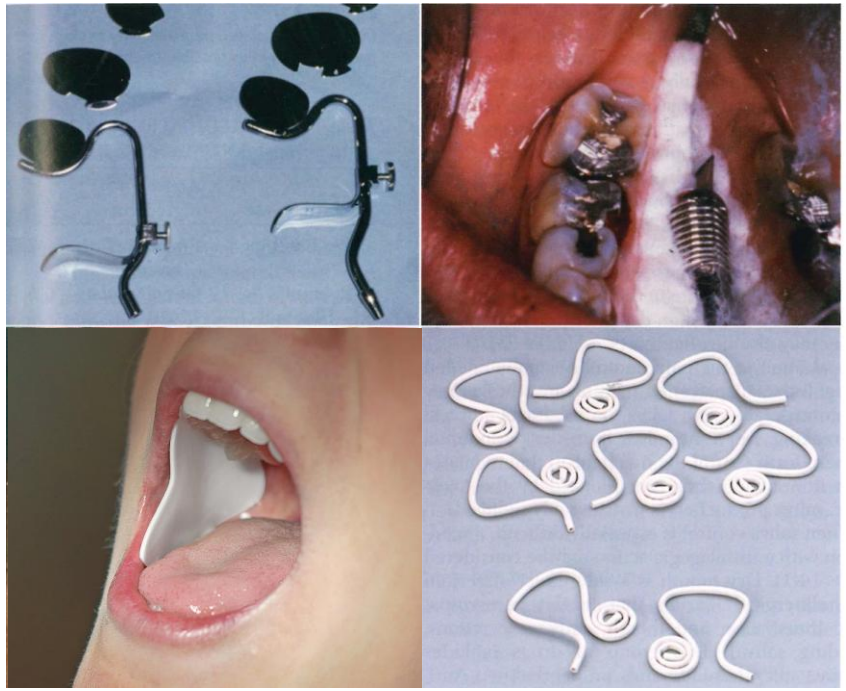
Saliva Control

Absorbents: block salivary ducts

- Cotton rolls
- Absorbing cards

Saliva evacuator

Local anesthesia: controls blood and saliva



Impression Technique

Impression timing

- Inflamed gingivae are by definition swollen
- Impossible to prepare a predictable intracrevicular margin
- Impressions difficult due to uncontrolled haemorrhage
- As soon as periodontal resolution occurs there will be recession

- Therefore, achieve gingival health before embarking on definitive impressions 3-4 weeks with provisional restoration

Impression Materials

Materials for indirect restorations
PVS – Poly Vinyl Siloxane
Polyether

Impression Materials

Qualities

- Dimensional accuracy
- Dimensional stability
- Wettability
- Contact Angle
- Elastic recovery
- Flexibility
- Ease of handling
- Tear Strength
- Cost

Table 17-1 Comparative properties of impression materials*

Type	Type of tray	Setting time	Ease of removal	Finish line readability	Moisture tolerance	Pouring time	Tear strength	Pouring ease	Mixing ease	Odor/ taste	Radio-paque	Shelf life
Reversible hydrocolloid	Water-cooled stock metal	5 min	Very easy to easy	Poor	Excellent	15 min	Weak	Good to excellent	None is needed, but conditioning is complicated	Good	No	24–48 months
Polysulfide rubber base	Custom	8–14 min	Easy to moderate	Good	Acceptable	60 min	Good	Adequate to excellent	Moderate to difficult	Poor	Yes	18 months
Condensation silicone	Custom: two paste systems Stock: putty/reline	6–10 min	Easy to moderate	Good	Poor	60 min	Adequate	Poor to fair	Easy	Good	No	12 months
Polyether rubber base	Custom: 4.0-mm spacer Stock	4.5–6 min	Moderate to difficult	Good	Good	7 days	Adequate	Good	Moderate for hand-mixed; very easy for mechanically mixed	Poor	No	24 months
Polyvinyl siloxane	Stock: single units Custom: fixed partial denture Stock: putty/reline	3–8 min	Moderate to difficult	Good	Poor for standard hydrophobic brands; adequate for hydrophilic brands	7 days	Adequate	Poor for standard hydrophobic brands; adequate for hydrophilic brands	Easy for hand-mixed; very easy for cartridge systems	Good	No	24 months

*Based on data from O'Brien.[2]

Impression Materials

Dimensional accuracy:

- Polyvinyl siloxane (PVS) and polyether impression materials remain dimensionally accurate for 1 to 2 weeks
- Hydrophilic vs Hydrophobic
  - Hydrophobic materials such as PVS may have voids if there is improper moisture control.
  - Polyether materials are hydrophilic and may better cope with the moisture in the oral environment

Impression materials

Dimensional stability:

- “The dimensional stability of an impression material reflects its ability to maintain the accuracy of the impression over time”
- Both polyether and PVS are dimensionally stable compared to alginates

Impression materials

Wettability:

- “Wettability of an impression material relates to the ability of the material to flow into small areas”
- Materials with a high wetting angle do not flow easily into small crevices and are poor candidates for use in fixed prosthodontics. Materials with a low wetting angle flow extensively.

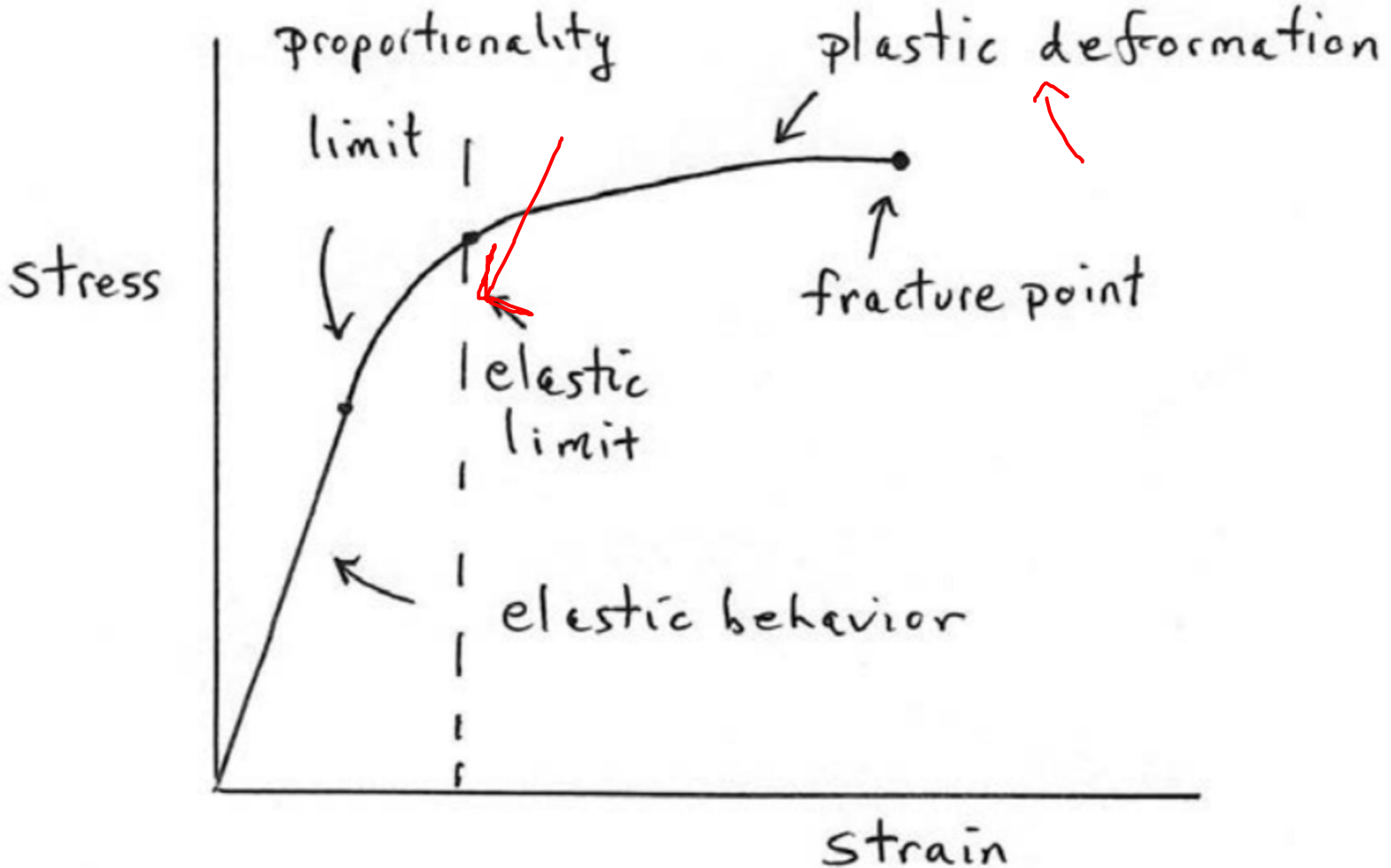
Contact angle:

- “Impression materials with low contact angle enable dental stone to flow easily, and relatively bubble-free casts are produced. Materials with high contact angle require more careful pour technique and attention to produce accurate casts”

Impression materials

Elastic Recovery and Flexibility:

- Materials must distort to allow removal from undercuts
- We want a material to have good elastic properties to allow recovery and minimise plastic deformation
- PVS superior to polyether
- Flexible materials are easier to remove from the mouth
- There HAVE been cases of PVS impressions STUCK in a patient's mouth.
- Polyethers are EVEN MORE rigid
- Alginate the least rigid.


proportionality
limit
plastic deformation
fracture point
stress
elastic
limit
elastic behavior
strain

Impression materials

Ease of handling:

- Prefer materials are that easy to work with in everyday clinical situations
- Thixotrophy

Impression materials

Tear strength:

- “The tear strength of an impression material relates to how resistant a particular material is to tearing after setting”

Dental materials

In order of history:

- Reversible hydrocolloid (Alginate is irreversible hydrocolloid)
- Polysulfides
- Condensation silicon
- Polyether
- Addition silicon

Reversible hydrocolloids

- Eg. Agar which is able to be melted to a gel like consistency, then cooled to form a more solid material
- Requires special materials to prepare for the impression as well as a tray capable of cooling the agar to “set” it

  - Excellent dimensional accuracy if poured immediately

FIGURE 14-36 ■ Hydrocolloid conditioning equipment consists of three thermostatically controlled water baths: boiling or liquefaction, storage, and tempering. (Courtesy Dux Dental, Oxnard, California.)

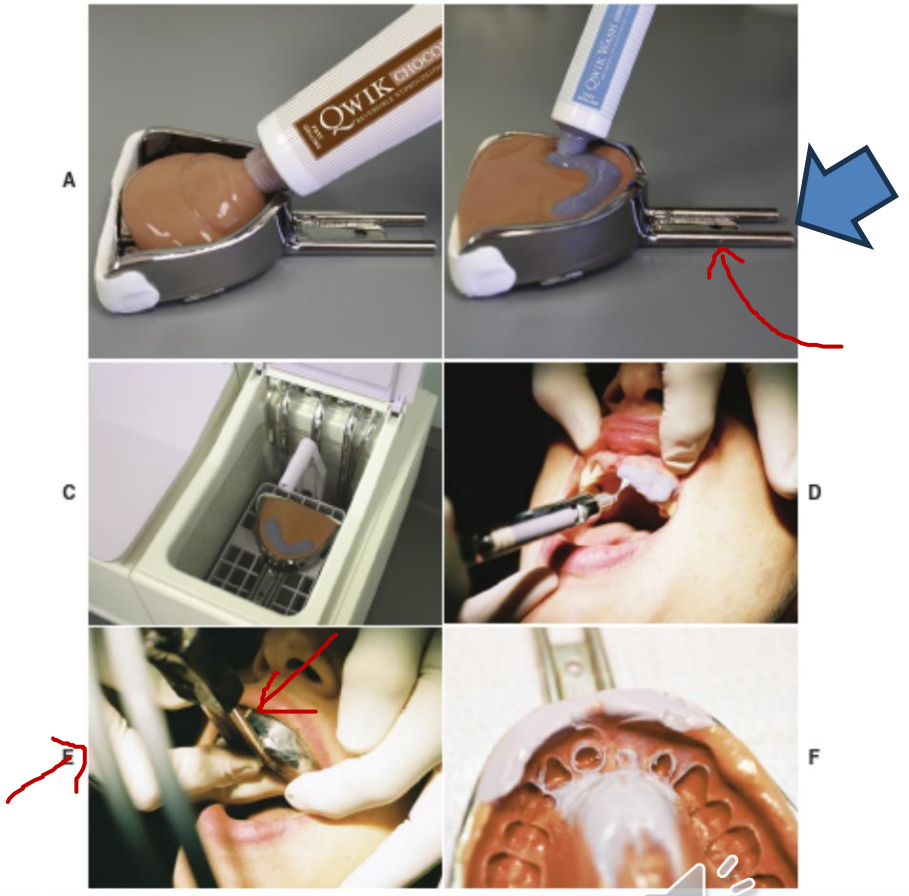


FIGURE 14-37 ■ Hydrocolloid impression technique. **A,** The water-cooled impression tray is loaded with heavy-bodied material. **B,** The wash hydrocolloid is squeezed onto the tray material in the area of the preparations. **C,** The filled tray is placed in a tempering bath for the recommended 3 minutes. **D,** The sulcus is flooded with water or a surfactant. Alternatively, some dentists prefer a syringe technique. **E,** Water-cooling tubes are connected and then the tray is seated. **F,** The completed impression. Light-bodied material should have been displaced by the tray material. (Courtesy Dux Dental, Oxnard, California.)

Irreversible hydrocolloids

- Alginate powder consists of calcium sulfate dehydrate, soluble alginate, and sodium phosphate
- Setting of alginate: Calcium ions from the calcium sulfate dehydrate react preferentially with phosphate ions from the sodium phosphate (retarder to slow setting and increase working time). After the phosphate ions are depleted, the calcium ions react with the soluble alginate to form insoluble calcium alginate, which with water forms the irreversible calcium alginate gel.
- Moderate dimensional accuracy but very poor dimensional stability
- Low tear strength

Polysulfides

- Supplied as a 2 paste system:
  - Base: polysulfide polymer (terminal/side chain −SH groups), titanium dioxide, zinc sulfate, copper carbonate, or silica.
  - Accelerator (catalyst): lead dioxide with other substances, such as dibutyl or dioctyl phthalate, sulfur, and magnesium stearate and deodorants.
  - Sets by oxidation of the −SH groups, which results in chain lengthening and cross-linking and gives it elastomeric properties.
- Better tear strength compared to hydrocolloids
- Low to moderately hydrophilic, so could work in low blood/saliva environments
- However unpleasant odor and long set time (~10mins)

Condensation silicons

- Improvement over polysulfides as it is mostly odourless
- Greater dimensional stability compared to hydrocolloids but not as great as polysulfides
- As a condensation silicon, water is released as a by product. This can cause dimensional accuracy/stability issues from evaporation
- Very hydrophobic

Polyether

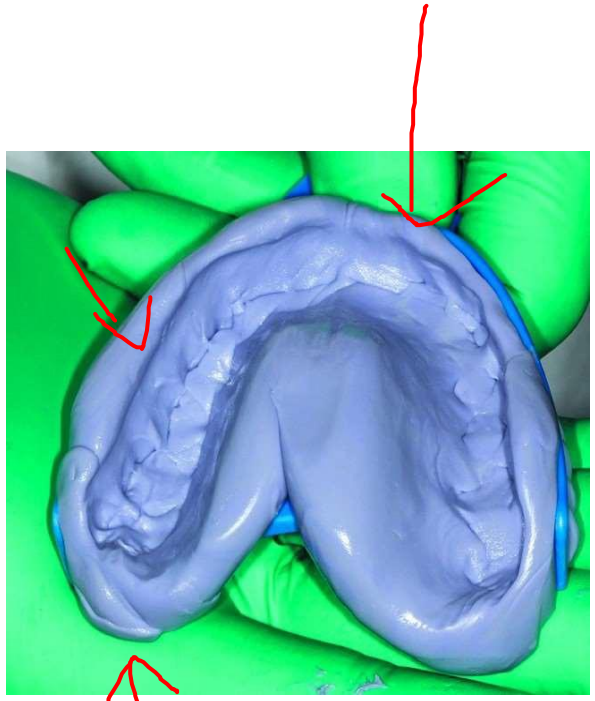
- Polyethers also consist of a base and catalyst system:
  - Base: long-chain polyether copolymer with alternating oxygen atoms and methylene groups ($O\text{-}[CH_2]_n$) and reactive terminal groups.
  - Catalyst paste has a cross-linking agent (aliphatic cationic starter) and filler and plasticizers. Polyethers involve the reaction of the polyether-containing imine ringed side chains with a reactant that opens the rings and causes chain lengthening and cross-linking to form a polyether rubber.
- Acceptable setting time of ~5 minutes
- High tear strength, however material is extremely stiff, hence can be difficult to remove from areas of undercuts.
- Can be poured 1-2 weeks after impression from excellent dimensional stability
- Potential allergy/sensitivity issues

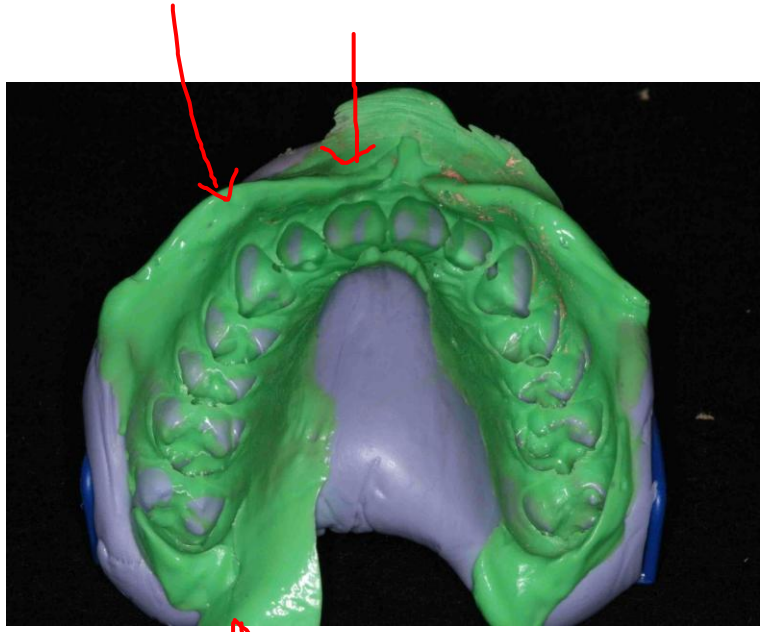
PVS

- Very popular material for impressions
- Setting: linking of vinyl siloxane in the base material with a hydrogen siloxane via a platinum catalyst
- Polyvinyl siloxanes have improved dimensional accuracy compared to condensation silicones.
- Due to by product of hydrogen gas instead of water. Newer products have “Scavengers” that prevent the escape of gas at the polymer-stone interface.
- Stiffness less than polyether allows easier removal from mouth
- Latex gloves (Sulphur compounds) may inhibit set.
- Moderately high contact angle, so sometimes surfactant sprays used to encourage flow of stone during pouring.

Impression Techniques

Single stage

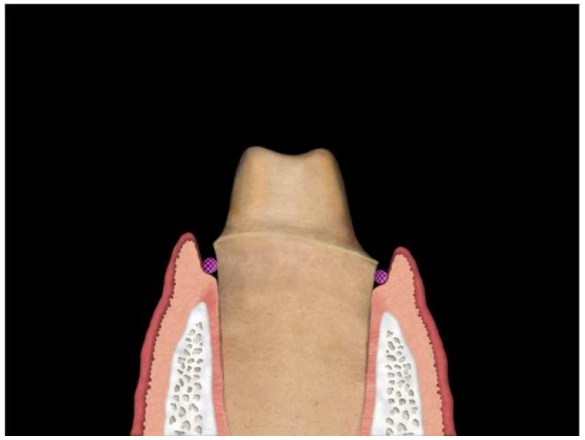




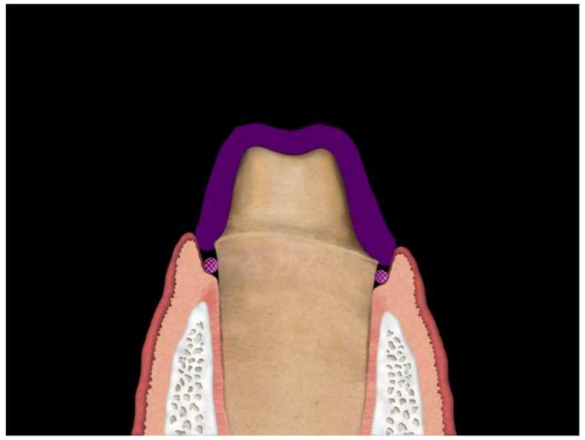
Two Stage

Spacer or No Spacer

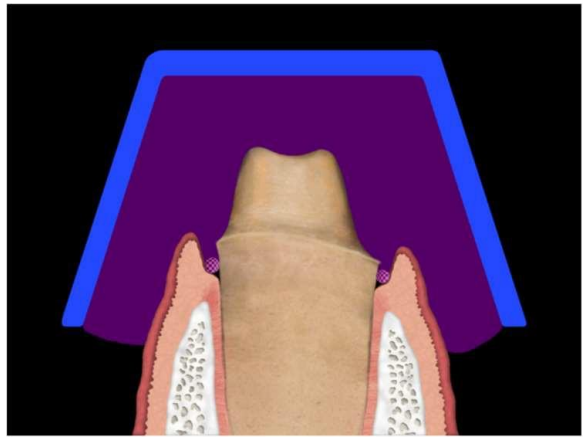
Monophase



preparation with retraction cord



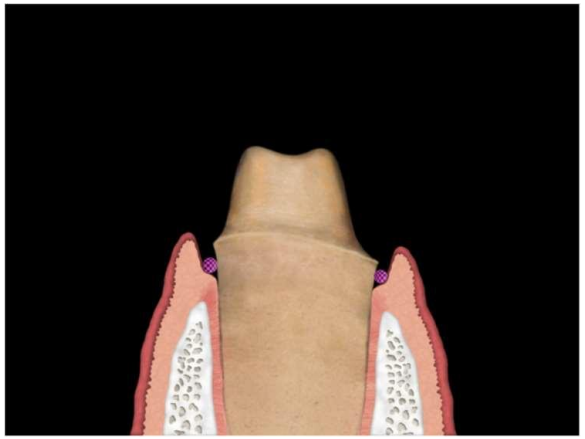
preparation covered with impression material



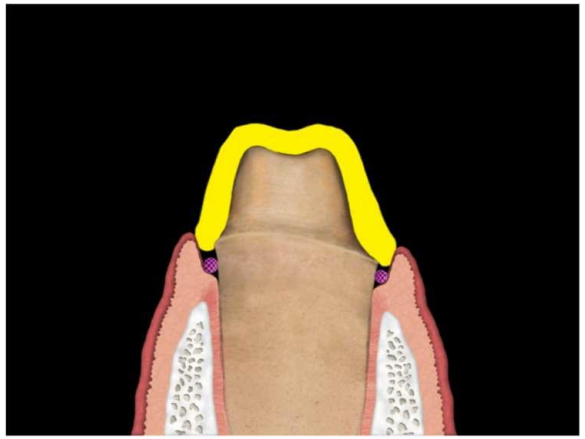
tray inserted with the same impression material

NOT RECCOMENDED DUE TO LOWER DEFINITION

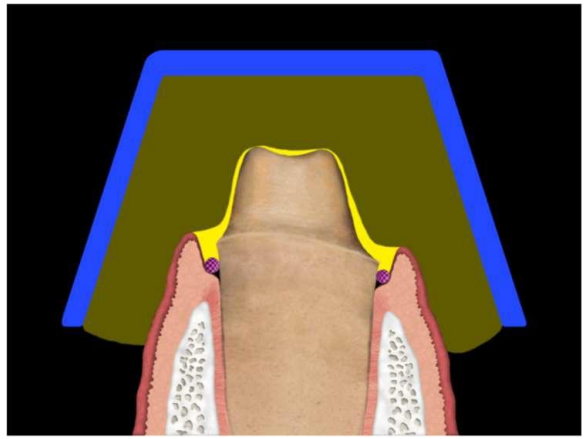
Dualphase – Lightbody & Heavybody



preparation with retraction cord

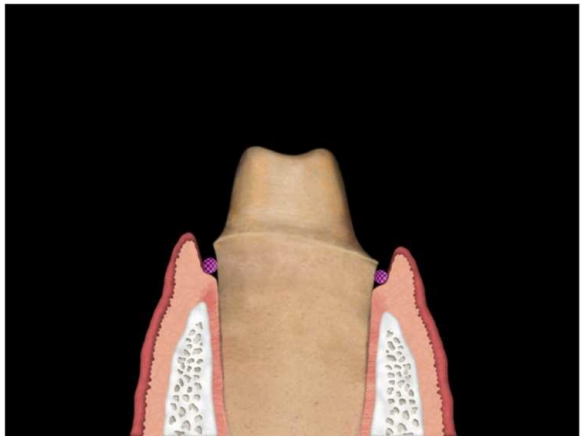


preparation covered with lightbody (LB) material

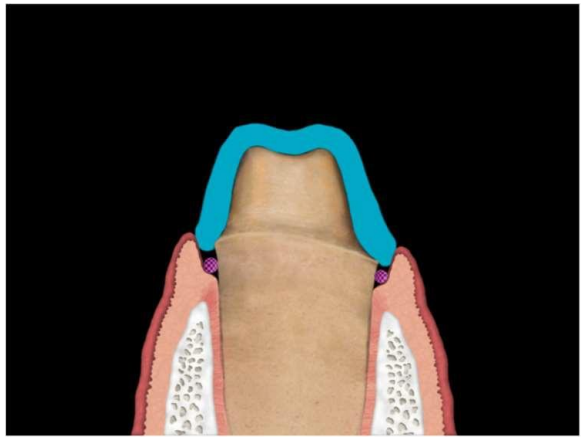


tray inserted with heavy body (HB) material

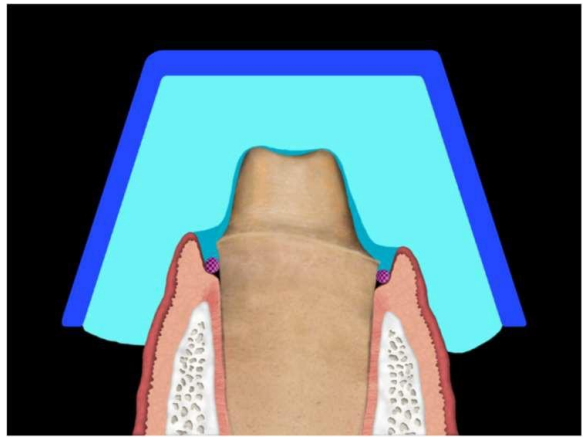
Dualphase – “Putty Wash”



preparation with retraction cord



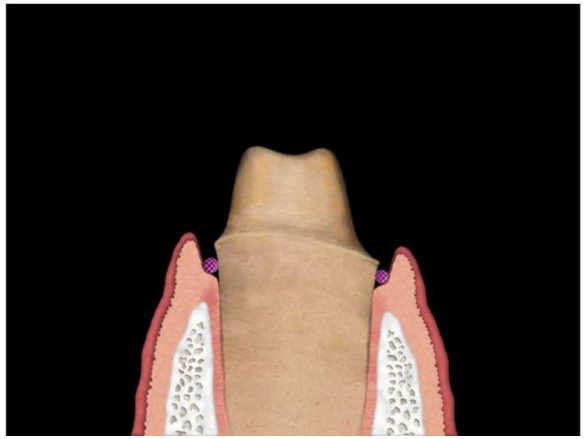
preparation covered with lightbody (LB) material



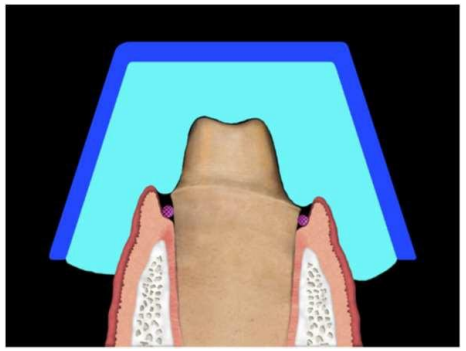
tray inserted with putty material

One-step putty impressions can have significantly lower accuracy compared to two step impressions

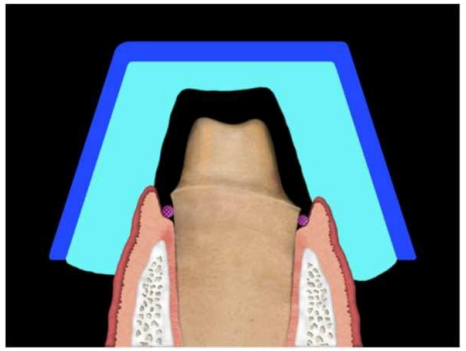
Two-step impression with Putty



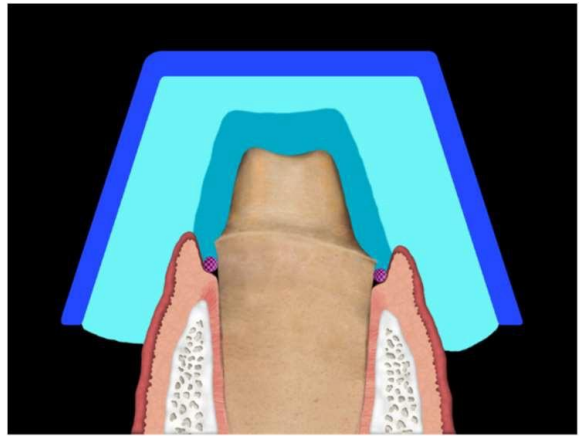
preparation with retraction cord



Impression with putty



Putty cut-out



Preparation / putty cut-out covered with lightbody (LB)

Good accuracy

1-stage vs 2-stage

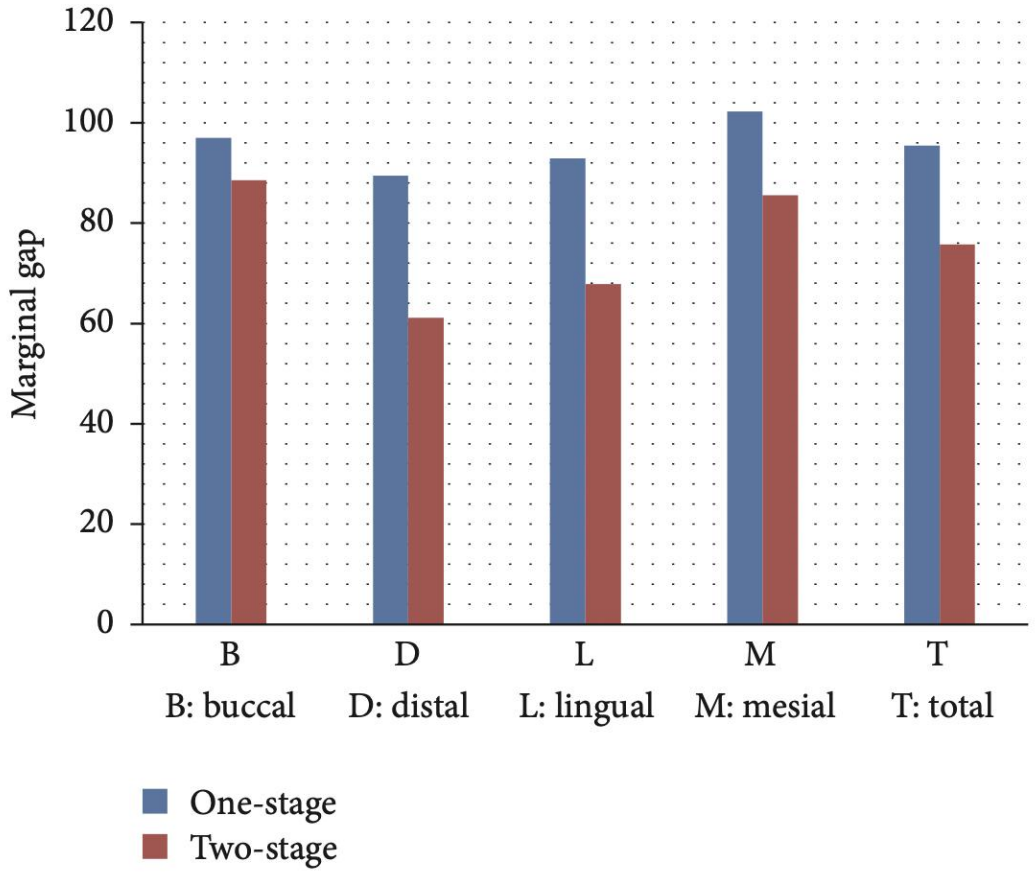


FIGURE 1: Comparison of the means of marginal gaps for one- and two-stage impression techniques.

- Significant differences seen on some surfaces of the impressions
- However both impression techniques are clinically acceptable (marginal gap <120um)

Research Article

Accuracy of the One-Stage and Two-Stage Impression Techniques: A Comparative Analysis

Ladan Jamshidy,[1] Hamid Reza Mozaffari,[2] Payam Faraji,[3] and Roohollah Sharifi[4]

Clinical steps

Intraoral custom tray try-in

- Check for clearance & comfort
- Adjust if required
- Tray adhesive application
  - Adhesive must be applied 15 minutes prior to impression
  - Extend the adhesive over edge of tray to the outer surface of the tray

Gingival displacement

- Isolate prepared teeth (free from saliva and blood)
- Cut sufficient cord length
- Wet the cord in astringent
- Loop the cord around the tooth and gently insert it in the sulcus
- Avoid overpacking
- Dry the teeth (do not desiccate)
- Evaluation
  - Visualize all the margins of the preparation
  - No soft tissue folding over the cord

Clinical steps

Intraoral custom tray try-in

- Check for clearance & comfort
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- Avoid overpacking
- Dry the teeth (do not desiccate)
- Evaluation
  - Visualize all the margins of the preparation
  - No soft tissue folding over the cord

Clinical Steps

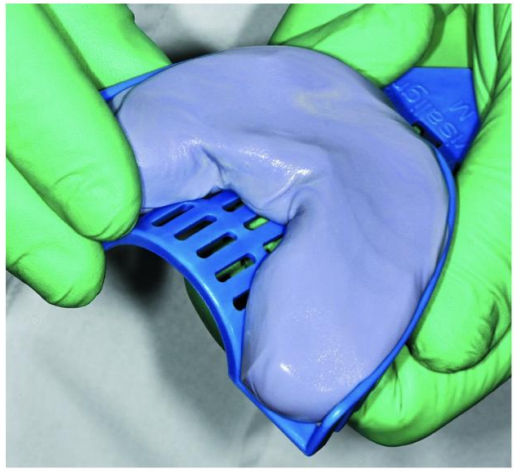
Impression material mixing:
If using “cartridge” system,
- Extrude a little impression material first
- Ensures an even mix of material & no blockage in the cartridge

If using Putty (addition silicon):
- Latex gloves may inhibit setting
- Equal amount of base and catalyst

Clinical Steps

Loading the tray:

- Clinician to apply light body material on the tooth whilst an assistant loads the medium/heavy body in the tray.
- Load adequate amount of material in the tray (just below the height of the tray
- Do not lift the tip of impression material cartridge out from the loaded material
- Be mindful of total setting time



Clinical Steps

Intra-oral material application:

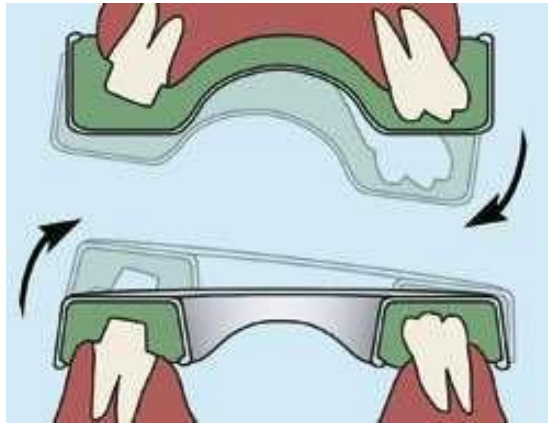
- Remove second cord in double cord retraction technique, rinse off expasyl
- Adequately dry the preparation, ensure good isolation (tongue etc)
- Inject material around tooth
  - Start from the hardest area (likely interproximals)
  - Do not lift tip from impression material
  - Inject on top of the margins/sulcus areas
  - One direction
  - Cover the entire prep and part of the adjacent teeth
  - Optional: Air thin the material with triplex

Tray insertion

- Position tray into correct position in mouth first
- Clear lips from tray
- Using one continuous and slow seating movement of the tray into correct area

Tray removal

- Hold tray in mouth until impression is set
- Optimum removal of impression tray:
  - upper jaw - loosen tray on opposing side
  - lower jaw - loosen tray on prep side.
  - front teeth - both sides at the same time.



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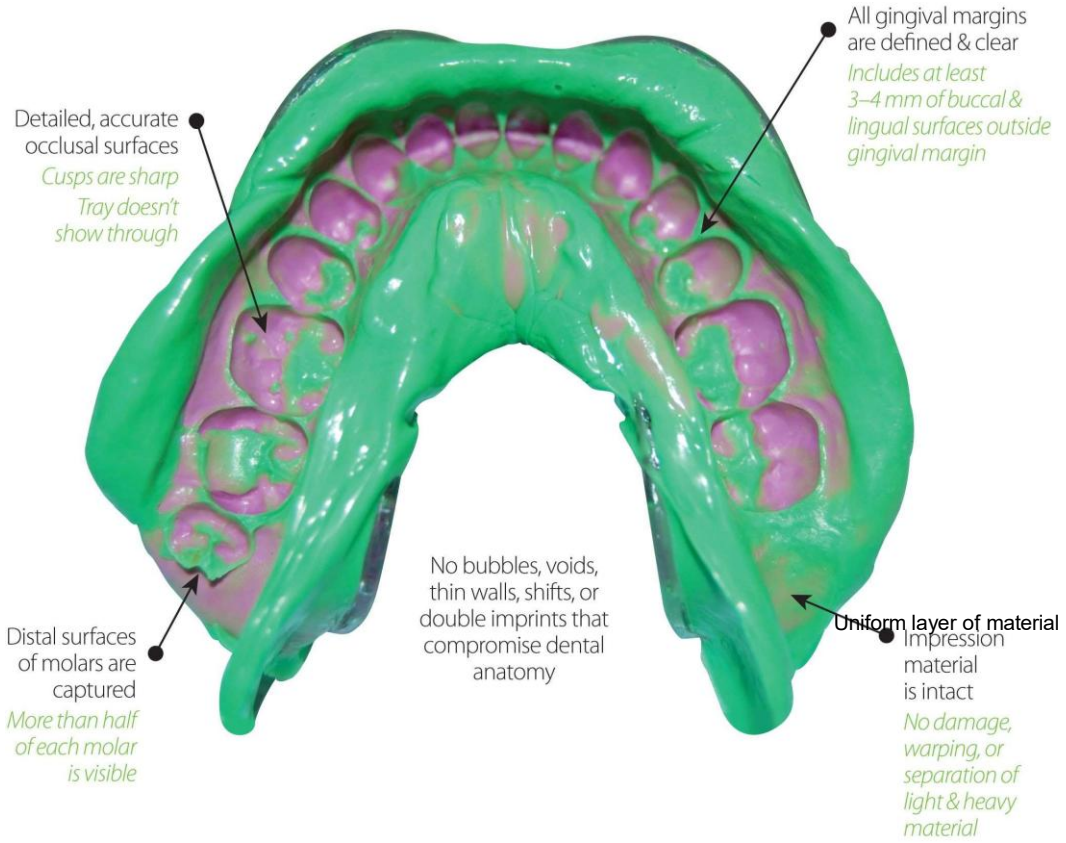
Impression Technique

Impression inspection



Gagging Patients?

- Explain procedure (esp. if likely to gag)
- Use special tray & less material (don't apply material on the palate for fixed pros)
- Have suction and mouth mirror ready to remove excess from posterior border
- Sit patient up
- Do not remove once seated even if you think unsatisfactory
- Reassure patient

Trouble Shooting

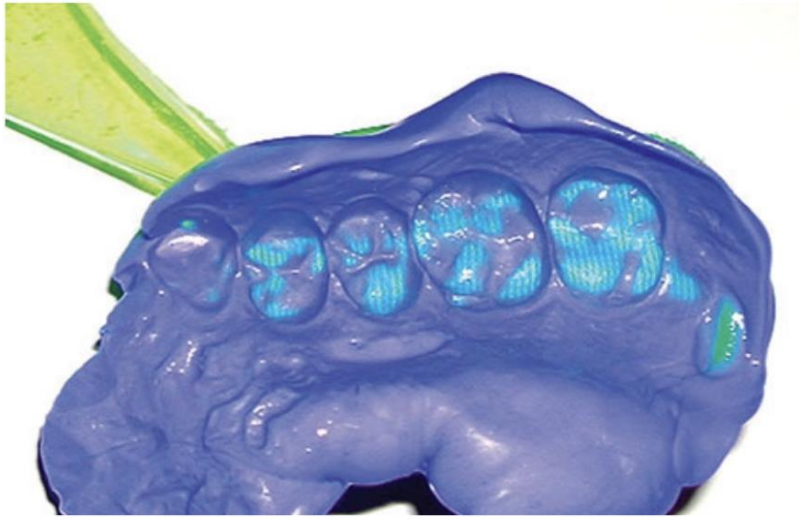
- Bubbles
- Drag lines
- Marginal Tears
- Incomplete set

Trouble Shooting

- Bubbles
- Drag lines
- Marginal Tears
- Incomplete set

Triple Trays

Allows for registration of the upper and lower arch simultaneously.
However not recommended due to distortion of material



Thanks for listening

Please remember this lecture essentially takes the spot of the “Materials for Indirect Coronal Restorations”.

Occlusion lecture to be arranged when Dr Matsubara is available