CRASH COURSE IN FIXED PROSTHODONTICS

DENTISCOPE

WWW.DENTISCOPE.ORG

DONE BY : SIMA HABRAWI

EDIT BY : HAIF ALQAHTANI

DENTISCOPE 2020

Table of Contents

Occlusion examination ***4***

Assessing tooth restorability ***5***

Process of assessing tooth restorability **5**

Ferrule effect **5**

Diagnosis & treatment planning for single tooth restoration ***7***

Bridge classification **8**

Treatment planning for missing teeth ***9***

Biomechanical principles of tooth preparation ***12***

Finish lines **14**

All metallic restorations ***16***

Dental Ceramics ***17***

Glass ceramics **19**

Oxide ceramics **20**

All ceramic restorations ***22***

All ceramic anterior crown preparation **23**

Surface treatment of the ceramic **24**

Surface treatment of the tooth **24**

Metal Ceramic restorations ***26***

Framework design [metal part] of metal ceramic restorations **27**

Anterior PFM crowns ***29***

Procedure and guidelines **29**

Posterior PFM crowns ***31***

Procedure and guidelines **31**

Porcelain veneers ***33***

Composite veneers **33**

Veneers **33**

Veneers preparation **33**

Impressions 35

Temporizing 35

Bonding / cementation 36

Esthetic considerations and shade selection *37*

Smile line **37**

Length of maxillary incisors **37**

Length of lower incisors **37**

Monotonous smile **38**

Metamerism **38**

Luster **38**

HUE **38**

VALUE **38**

CHROMA **38**

Shade guides **39**

Management of endodontically treated teeth *40*

Post systems **40**

Custom made – cast metal post + core 42

Cementation of posts 43

Fiber reinforced posts 43

Fluid control + soft tissue management *44*

Single cord technique **44**

Double cord technique **44**

Hemostatic agents **45**

Impression in fixed prosthodontics *46*

Trays **46**

Impression materials **46**

Impression techniques *49*

1- Putty wash techniquee **49**

2- Dual phase technique **50**

3- Monophase **50**

4- Dual arch **50**

Impression mistakes **50**

Minimal preparation bridges *52*

- **Bonded pontic and Fiber-reinforced resin bridge** **52**
- **RPD flipper denture** **52**

- **Inlay / onlay bridge 52**
- **Cantilever bridge 52**
- **Resin bonded bridge 52**

Preparation of RBB 54

Working casts + interocclusal records of conventional bridges 55

Working cast materials 55

Die systems 55

Pindex system 56

Interocclusal record materials 57

Provisional restorations 58

Temporization techniques 58

Cementation 60

Try in & delivery of crowns 61

Adjustment 64

Dental Cements 65

Biomechanical considerations + special problems in bridges 67

Problems with long span bridges 67

Pier abutment 68

Tilted molar abutments 69

Missing canine 70

Pontics and edentulous ridges 72

Siebert ridge classification 72

Pontic designs 73

Ridge lap 73
Modified ridge lap 73
Ovate 73
Conical 74
Bullet / heart shaped 74
Sanitary/ hygienic 74
Modified hygienic 74

References 76

Disclaimer 77

Occlusion examination

Occlusal problems can lead to :

1- Tooth wear [Attrition, abfraction]
2- Fracture of tooth or a restoration
3- Restoration de bonding
4- Bone resorption + gingival recession + tooth mobility
5- PDL sensitivity and pain

Ideal bite :

A. **In static occlusion - ICP / MI : you ask the pt to tap down on the articulating paper**

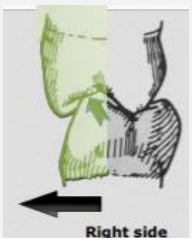
There should be equal contacts on all cusp tips and fossa – heavier contacts posteriorly - pre mature contacts will be heavily stained with less stain on adjacent points

Premature contacts are caused by high cusps – deflective contacts are caused by large cusps they will cause the tooth or mandible to deflect in ICP [more harmful]

- To examine location of contact points → use articulating paper [40 um]
- To examine how heavy the contact is → use shimstock

B. **In dynamic occlusion – lateral excursion: You ask the pt to slide their jaw to the right and to the left side**

Lateral guidance
seen on the buccal cusps in the upper and lower arch



Working side interferences
markings on the outer [palatal] inclines of the upper palatal cusps

Non working side interference
markings on the inner [buccal] inclines of the upper palatal cusps

Ideally there should not be any interference on working or non- working side [non working side interference is needed in complete denture pts]

C. **In protrusion:** ideally you should have **Even** contacts on all anterior teeth and no posterior interference.

Occlusal analysis should be done before any restoration. – if the pt has an interference [do not adjust it because the pt is already accustomed to it]

Do not create an interference yourself !

Place the articulating paper [red facing the arch being examined] then ask the pt to move their jaw to the right or the left then use the blue side to record ICP . Any pure red mark [not over lapped by blue] is an excursive mark [can be guidance or interference]

Assessing tooth restorability

Process of assessing tooth restorability

1- Remove all caries and previous restorations
2- Asses remaining tooth structure [ferrule vertically and horizontally]
3- Asses crown root ratio
4- Endodontic considerations [ease of RCT and post placement, check if there are curved canals, calcified canals, root resorption , root fracture / perforation , PA lesions etc]
5- Periodontal considerations :
   A. Tooth factors [pocket depth , CAL , bone loss, mobility , if there are endo perio lesions etc]
   B. Patient factors [if the pt has any systemic disease or risk factors like smoking]

Ferrule effect

vertical measurement - from the gingival margin to the top of the remaining wall [should be measured from buccal , lingual, mesial and distal using a probe with a rubber stopper]

	Vertical ferrule
Class 1 ferrule	Height of remaining tooth ≥ 2 mm at 4 locations [ideal]
Class 2 ferrule	Height of remaining tooth 0.5–2 mm [acceptable if you do post + core]
Class 3 ferrule	Height of remaining tooth < 0.5 mm [un acceptable even with a post and core]

horizontal measurement – thickness of the remaining walls at the level of the future crown margin [should be measured from buccal , lingual, mesial and distal using gauge calipers or if space does not permit → use a probe with a rubber stopper]

Horizontal ferrule **Wall width should be at least: the minimum thickness of preparation +1mm** **Aesthetic Margin (AM) – metal-ceramic or all-ceramic** **Non-Aesthetic Margin (nAM) – metal only**	
Class 1 ferrule	Width of remaining wall ≥ 2.2 mm (AM) or ≥ 1.5mm (nAM)
Class 2 ferrule	Width of remaining wall ≥ 1.5mm (AM) or ≥ 1mm (nAM)
Class 3 ferrule	Width of remaining wall < 1.5mm (AM) or < 1mm (nAM)

chamfer margin width = 0.5 mm **shoulder margin width = 1.2 mm**

	Class I	Class II	Class III
Ferrule - Vertical	≥ 2mm	≥ 0.5–2 mm	< 0.5 mm
Ferrule - Horizontal	≥ 2.2 (AM) ≥1.6 (nAM)	≥ 1.5mm (AM) or ≥ 1mm (nAM)	< 1.5mm (AM) or < 1mm (nAM)
Crown-Root ratio	1:1.5	1:1	< 1:1
Prognosis	Good	Moderate	Poor
Restorability	Tooth is restorable	Tooth should not be used as an abutment. A new evaluation should be performed after stabilisation.	Tooth is non-restorable.

Extensively damaged tooth can gain retention and resistance by :

1- Ortho extrusion
2- Crown lengthening
3- RCT + post and core

NOTE: if you are restoring the tooth with composite resin or using resin cement [Ferric sulfate and Aluminum chloride astringents used with retraction cords - affect the bond strength of composite to dentin.] – if astringents contact the prep just rinse with water spray

Q: when do you decide to crown a tooth ?

1- You can't place a large direct restoration with an good contour, contact point and occlusal contacts.
2- When most or all axial surfaces of a tooth are weakened or are restored OR you need to correct axial contours.
3- As an abutment for a bridge.
4- To minimize the risk of tooth fracture.
5- To include design features of a metal based RPD.

If you don't have enough ferrule and you place your margins sub gingivally:

1- you can violate the biological width → bone resorption + gingival irritation
2- you won't be able to get smooth and clear finish lines
3- it is difficult to record subgingival finish lines in an impression

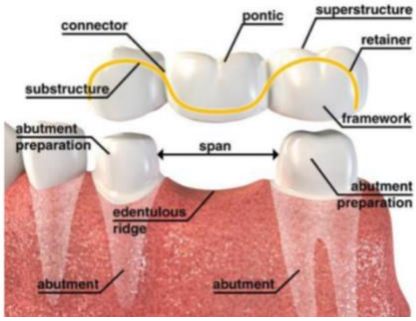
** if the tooth has a previous restoration → check the margins and if there are any caries. If the margins are intact and free of caries you can keep the restoration and prepare the tooth around it.

Diagnosis & treatment planning for single tooth restoration

1- Medical history + CC
2- Clinical examination :
   A. Extra oral – notice smile line [this will let you know where to place your margins and what materials to use]
   B. Intra oral
      - Tooth restorability
      - Vitality and sensibility tests
      - Perio chart
3- Radio graphs :
      - OPG [screening for all teeth + gives indication of bone height , any remaining roots , cysts etc]
      - Bitewings + PA [check for any PA pathology]
4- Take primary impressions and pour diagnostic casts for :
      - Occlusal assessment
      - Diagnostic wax up
      - Making temporary restorations

Tx options:

1- Nothing
2- RPD
3- Implants
4- FPD



Bridge components

Q: why do we need to replace missing teeth?

1- Restore function and esthetics
2- Provide occlusal stability

- not all pts need their missing teeth replaced. Many pts can function with a shortened dental arch [from premolar to premolar]
- **Pier abutment** = a tooth surrounded by edentulous space from both sides

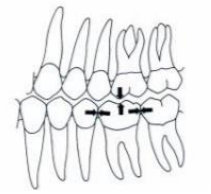
BRIDGE CLASSIFICATION

BASED ON PREPARATION		
CONVENTIONAL	You remove tooth structure / restoration and replace it with a retainer	
MINIMAL PREP	Resin bonded bridge or Maryland bridge [wings on the palatal surface of teeth] Indicated when you have intact abutments that you want to preserve Or if the pt is young and you want a temp solution until the pt is old enough to get implants	
HYBRID	Conventional + minimal prep retainers	
BASED ON DESIGN		
FIXED – FIXED	Can be **conventional or minimal prep** Has a rigid connector at both ends of the pontic. The abutment teeth are rigidly connected together.	
FIXED – MOVABLE	Can be **conventional or minimal prep** **Stress breaker** A **rigid connector** [usually at **the distal end** of the pontic] and a movable connector that allows some vertical movement of the mesial abutment tooth	
CANTILEVER	Can be **conventional or minimal prep** Provides support for the pontic at one end only. May be attached to one or more retainers at one end	
SPRING CANTILEVER	**Only conventional** Restricted to the **replacement of upper incisor teeth.** Preserves the intact anterior teeth when the posterior teeth needed crowning. Preserve diastemas	

Treatment planning for missing teeth

How you will replace a missing tooth should be decided BEFORE extraction.

A single missing tooth tx options [most to least conservative] : implant → RBB→ cantilever → 3 unit bridge



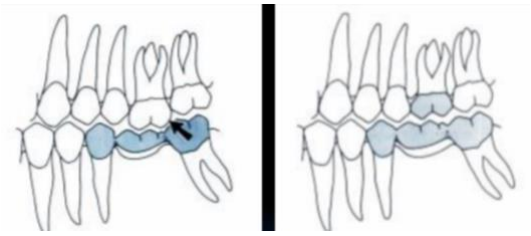
Dynamic equilibrium = when the arch is intact and the teeth are in their correct positions due to the pressure from the lips, cheeks, tongue etc.

When a tooth is extracted the balance will be lost, [Ex: the most commonly extracted tooth is the first molar , when it is extracted the 2nd molar will tip mesially and the 2nd premolar will tip distally and the opposing will super erupt to achieve a new level of balance and equilibrium]

Q: what are the consequences of losing balanced occlusion?

1- The tilted teeth will cause occlusal interferences
2- Tilted teeth will change the interocclusal space available and affect how your occlusal reduction will be and also what materials to place + change bridge design
3- You might need to do elective RCT on the opposing super erupted tooth

Q: what can you do if the opposing tooth is super erupted?



A. Keep the occlusal plane as it is and reduce the thickness of the pontic
B. Adjust the upper occlusal plane by enameloplasty + you might need to do elective RCT

RPD indications	FPD indications
1- cross arch stabilization is needed 2- bilateral missing spaces with more than 2 teeth missing or multiple edentulous spaces 3- long edentulous span [free end saddle] 4- when you need ridge support or there has been severe ST loss **5- anterior space more than 4 incisors** **6- space includes a canine + 2 other teeth** **7-** advanced age and systemic problems	**1- two or fewer missing posterior teeth** **2- four or fewer missing incisors** 3- Short cantilevers 4- Good abutments with favorable loading 5- No gross soft tissue loss 6- **Favorable occlusion (inter-arch space)**

Avoid RPD in:

- pts with large tongue.
- Muscular dis-coordination.
- Xerostomia [there ill be no lubrication + frictional trauma]

Avoid FPD in :

- Pts with active caries or perio disease
- Dry mouth / xerostomia [at higher risk for marginal caries]

Q: why can't you place a bridge if the canine + 2 other teeth are missing? Because the canine is involved in guidance and these teeth will be subjected to a lot of load

Resin bonded Bridges

- **Usually used to replace a <u>single</u> missing incisor or premolar [sometimes** a single molar can be replaced only if patient's muscles are not too well developed/ low occlusal forces]
- **Usually is a transitional / temporary restoration**
- **The pontic is r**etained by 1 or 2 palatal wings on teeth mesial and distal to the space
- **The pontic should not have any load**
- **If the teeth are mobile you can have an ortho wire connecting the wings together**

Contraindications :

deep bite / parafunctional habits
short clinical crowns
if abutments are not well aligned

Implants- Indications :

1- Inadequate number of abutment teeth [you can place 2 implants and a bridge or one implant and make a bridge with a natural tooth]
2- Inadequate strength to support a conventional FPD
3- A long span ban be replaced by multiple implants
4- Single missing tooth with sound adjacent teeth
5- If the pt has too many failed previous RPD → go for implants and fixed prostho

NOTES:

Implants have different micromechanical movements compared to natural teeth → unequally distributed load will lead to implant failure [this can be avoided by connecting placed implants with a bridge so they have the same movement]

Combining an implant and a natural tooth is not recommended because the tooth and the implant will respond differently to the occlusal loading and have different movements → the cement underneath will be crushed → recurrent caries

Forces need to be as vertical as possible to the implant

Q: how do you asses abutments for a bridge?

1- Take radiographs to check for any perio problems – bone loss – PA radiolucency and Crown root ratio. [optimum C:R ratio is 2:3 and minimum acceptable is 1:1]
2- Asses pulp health if vital and asses quality of RCT if it was previously treated
3- Asses periodontal support [pocket depth , inflammation and mobility]
4- Remove all previous restorations an determine restorability

When there is bone loss the center of rotation shifts more apically → tooth is easily harmed by lateral forces

Q: when can you accept a low C:R ratio?

1- No opposing
2- Opposing periodontally weakened teeth or artificial teeth

Cases where roots become more retentive

- Roots that are broader BL
- Widely separated roots
- Abnormal curvature in the apical 3rd
- Well aligned tooth

Biomechanical principles of tooth preparation

Biomechanical principles of tooth preparation:

1- **Conservation of tooth structure [be as conservative as possible]**

Excessive removal of tooth structure can lead to :

1- Over tapered short tooth with poor retention and resistance
2- Pulp hypersensitivity → inflammation → necrosis [it is contraindicated to do a crown for a pt below 18 because the pulp chamber is big and you can easily cause pulpal irritation]

2- **Retention and resistance : affected by**

A. **Taper :**

The walls of the prep should converge occlusally - When you hold the bur parallel to the long axis of the tooth this will cause a 3° taper [you need a total of 6° taper]

Importance of taperness:

1- Allows full seating of the restoration during cementation
2- Compensates for inaccuracies during fabrication
3- Allows you to visualize the prep walls and margins – without taperness you might have an undercut and not detect it

** retention and resistance decrease as taperness increases

Q**: how do you check taperness?** Look at the prep with <u>one eye</u> from a distance of 30 cm , you should see all margins and no undercuts [as if there is a ring around the tooth]

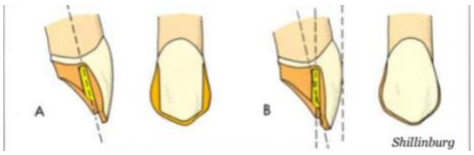
B. **Freedom of displacement :** maximum retention and resistance is achieved when you have only one path of withdrawal

C. **Length :** the longer the prep the better it's retention and resistance
If you have a short tooth , the wider the prep the more retentive it is.

D. **Path of insertion :**
considered in 2 dimensions [mesio distally and bucco lingually]
must be determined before the preparation
usually it is along the long axis of the tooth
in bridges all abutments should have the same path of insertion
Q: what to do if the tooth to be restored is tilted but adjacent teeth are well aligned?
You design the prep to be parallel with the adjacent teeth but trim the tooth from one side more than the other

Q: what to do if the tooth to be restored is well aligned but adjacent teeth are well tilted?
Severe tilting might need ortho adjustment but mild tilting → trim a little bit from the teeth

In anterior PFM crowns if you go along the long axis of the tooth you have more metal showing → so the incisal 3rd should be with the long axis of the tooth to reduce metal showing.



E. **Internal features :** grooves, boxes , pins

3- **Structural durability:** the restoration should have enough bulk to withstand forces – this is provided by:

A. Occlusal reduction : depends on the type of material used + pt's occlusion [if the tooth isnot touching the opposing you can be more conservative in your reduction]

Material	Functional cusp	Non functional cusp
Full metal	**1.5 mm**	**1 mm**
PFM	**1.5 – 2mm**	**1-1.5 mm**
Full ceramic	**2 mm**	**2 mm**

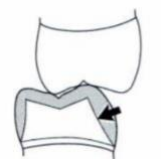
B. Functional cusp bevel : 45° wide bevel on the functional cusp to provide material bulk and withstand forces

Q: what are the consequences if you don't bevel the functional cusp?

A. If the technician waxes the crown to the optimum thickness → over contoured cusp + high occlusion

B. If the technician waxes the crown to the normal contour → thin metal under the ceramic

If you attempt to gain clearance by increasing the inclination and not by bevelling → you will remove tooth structure + result in poor retention and resistance + might expose the pulp



C. Axial reduction : provide rigidity and durability

4- **Marginal integrity:**

Finish line → on the tooth **margin** → on the prosthesis

Margin of the prosthesis will affect:

1- Esthetics
2- Periodontal health
3- Marginal seal
4- Tooth substance conservation
5- Impression taking

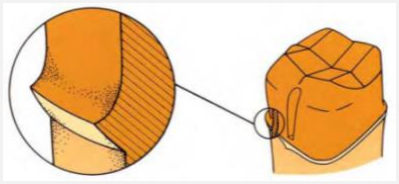
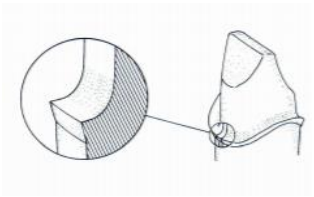
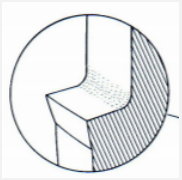
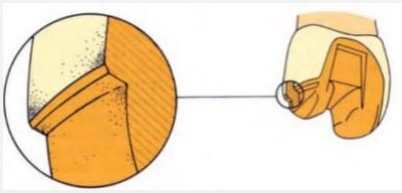
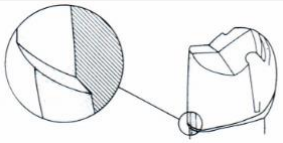
We usually try to avoid subgingival margins but if the tooth already has a restoration that extends subgingivally :

1- If there is a pocket → place the finish line of the crown apical to the restoration margin and If the finish line becomes close to the bone → do crown lengthening
2- If crown lengthening is not indicated → place the finish line coronal to the restoration but make sure the finish line is perfect [if the restoration is amalgam → less risk of secondary caries]

Finish lines:

A. **Knife edge: zero ledge** → Conservative to the tooth but plaque retentive
B. Chamfer: curved ledge → Reasonably conservative non-plaque retentive
C. **Shoulder: flat ledge** → Most destructive – non-plaque retentive

Finish lines

FINISH LINES	USES / NOTES
CHAMFER	used in : **All <u>metallic</u> restorations + Lingual portion of PFM** Distinct and easily identified Reasonably conservative and non plaque retentive Done by : round end tapered diamond bur or torpedo bur **[use only half of the bur tip]** **Depth = 0.3 – 0.5 mm** 
HEAVY CHAMFER	Used in : **all ceramic restorations** Rounded internal angle + 90 degree cavo surface angle Done by : round end tapered diamond bur or torpedo bur **[use only half of the bur tip]** **Depth = 1mm** 
SHOULDER	Used in : facial portion of PFM + can be used for **all ceramic restorations** [but internal angle has to be rounded] BUTT JOINT The angle between the shoulder and axial wall can be 90 °, less, or more = 120° **Shoulder can be beveled to minimize marginal leakage** Done by : flat end tapered diamond bur ** most destructive type of finish line → Sharp 90° internal line angle → Concentrates stress on tooth → Coronal fracture **Depth = 1.2 mm** 
SLOPED SHOULDER	used in : facial portion of PFM 120° sloped shoulder margin - No unsupported enamel 
BEVELED SHOULDER	Used in: Facial finish line of PFM crowns when gingival esthetics not critical - Proximal box of inlays, onlays- Occlusal shoulder of onlays and mandibular ¾ crowns The bevel will : • removes unsupported enamel • allows the cast metal margin to be burnished against the prepared tooth structure → minimizes marginal discrepancy 
KNIFE EDGE	Used in : **Mandibular posterior teeth with very convex axial surfaces – Lingually tilted lower molars.** Permits acute margin of metal Thin margin difficult to wax and cast + Susceptible to distortion 

Common mistakes in finish lines :

1- discontinuity
2- roughness – you can smoothen the margins using enamel hatchet
3- undercuts – due to improper taperness
4- insufficient proximal clearance → can damage the finish line during die preparation in the lab
5- marginal lip → if you insert more than half of the bur [for chamfer you use a 1 mm diameter bur and insert it only half way]

** **Margins ideally should be supragingival [0.5 mm away from gingiva]**

All metallic restorations

**** the pt should have completed the stabilization phase [perio and caries control] – occlusal analysis is done and a study cast is poured → Make putty index**

- Depth guiding grooves then **occlusal reduction**
  Functional cusp [upper palatal and lower buccal cusps] = 1.5 mm
  Non functional cusp = 1 mm
  Bevel the functional cusp at 45°

If you don't place a bevel :

1- thin casting
2- poor morphology of the restoration
3- occlusal interferences.

- **Buccal reduction** (2 planes: incisal and gingival)

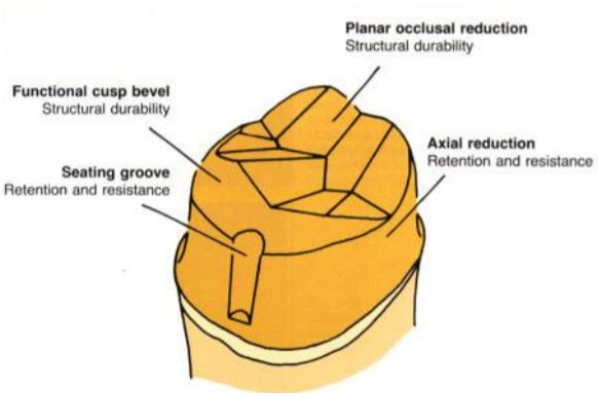
chamfer margin = 0.3 -0.7 mm

Gingival 3rd → parallel to long axis of the tooth

- Lingual reduction (one plane)

chamfer margin = 0.3 -0.7 mm

- Proximal reduction: break the contact with a needle bur first then continue the margin with round end tapered bur.
- **Finishing**
- **Placing seating grooves** - <u>0.5 away from the finish line</u>
  Placed in **the axial surface with the greatest bulk** to prevent any rotational tendencies during cementation + increase resistance and retention and help guide the casting to place.



Dental Ceramics

Ceramic uses in dentistry:

1- To veneer metal [PM] or zirconia core.
2- To be applied on the tooth directly with no substructure
3- Ceramic gingiva
4- Denture teeth
5- Implants
   - **Porcelain is a specific type of ceramics that contain**: Feldspar + kaolin + quartz

Fabrication of ceramics: 2 main ways wither you mix powder + liquid or use a block/ ingot of ceramic

Powder + liquid	Blocks / ingots
Sintering Slip casting	Heat pressing Machining/ milling

1- **Sintering :** powder and liquid are mixed and then applied on the cast using a brush then fired at high temp.
2- **Slip casting:** The master cast is duplicated in refractory material that can withstand high temp. The refractory is layered with the ceramic, but when it subject to high temperature it shrinks more than the ceramic, which helps separating the ceramic restoration from it. [the ceramic slips off the cast]
3- **Heat pressing:** lost wax technique – then the ceramic is softened and poured into the mould that forms
4- **Milling:** a block of ceramic is cut by a machine

Ceramics based on melting (fusing temperature):

- **High melting →** used when they make the actual ceramic block that will later be cut
- **Average melting →** use in all ceramic restorations
- **Low melting →** used in PFM
- **Ultra low melting →** for esthetic retouches

All ceramic restorations can either be:

A. Ceramic core [zirconia]
B. One block all the same material

Ceramics : Glassy Matrix + particles [crystalline or glass particles that melt at high temperatures]

- **The more the glassy phase the more translucent the ceramic is.**
- **The more the crystalline phase the stronger the ceramic and more resistant to crack propagation**

- Predominately poly crystalline → **zirconia**
- Partially filled glass → **lithium disilicate**
- Predominantly glass → **feldspar**

Ceramics used for all ceramic restorations have higher amount of crystalline.

Most to least esthetic: Feldspar → lithium disilicate → zirconia
Strongest to weakest : zirconia → lithium disilicate → feldspar
The more crystalline particles the more opaque the material gets

Translucent ceramics [predominantly glass and partially filled glass]	**Opaque ceramics [polycrystalline oxide ceramics- can be veneered by glass ceramics]**
1. Feldspathic 2. Leucite reinforced [ex: IPS empress] **3.** Lithium disilicate [ex: IPS e.max]	1. Alumina based 2. Zirconia based

Since ceramic is brittle it can be strengthened by:

1- Glass infiltration – increasing the volume of crystals inside the glassy matrix
2- Dispersion strengthening : adding zirconia, lithium or aluminum to change the physical or optical properties
3- Transformation toughening [for zirconia]

Glassy ceramics are mostly used in cases where the shade of the tooth is okay and you need to change the shape or contour, opaque ceramics are used when you need to change the shade or mask discolorations like tetracycline.

Glass ceramics

Strength increases

1- Feldspathic ceramic:

- Most conservative and most translucent ceramic but weakest
- Needs a **thickness of at least 0.2 -0.3 mm** for each shade change
- Used in cases where **more than 50% of the enamel remains** [enamel Is needed for optimum bonding]
- **Not used in pts with abnormal occlusion / bruxism**
- **Most successful ceramic used in inlays and onlays ****
- **Can be sintered or milled**

2- Leucite ceramics [ex: IPS empress]:

- **Minimum working thickness = 0.8 mm**
- **potassium oxide [less than 50%] -** is added to the glass matrix
- Stronger material because it is made from industrial dense blocks + leucite has the ability to alter the coefficient of thermal expansion → **inhibits crack propagation**
- **Heat pressed or milled**

3- Lithium disilicate [ex: IPS empress II , IPS e.max]

- **Lithium oxide [more than 50%] –** is added to the glass matrix
- **Strong + very translucent [even though is contains more particles it is still translucent because lithium has low refractive index]**
- **Can be used for posterior crowns and 3 unit bridges not extending beyond the 2nd PM** [it can't withstand high occlusal loads or parafunctional habits]
- **Heat pressed or milled**
  IMP: when you first mill lithium disilicate it is purple in color [because it is lithium metasilicate] → try it inside pt's mouth [check fit and occlusion and adjust if needed] → fire it again [this should be done inside your clinic not an outside lab] to get the white restoration [lithium disilicate] . after getting lithium disilicate you can add stains
  IMP: in PFM bridges the connector thickness should be minimum 3 mm [height and width] – in lithium disilicate bridges the connector is thicker → pt can't clean in between + the thick connector irritates the gingiva.

4- Zirconia – reinforced lithium disilicate :

- Lithium silicate glass + 10% zirconia crystals
- Highest strength of all glass ceramics
- Indicated when less than 50% of enamel remains
  - **Q: how can you increase the strength of glassy ceramics**? By using adhesive bonding with resin cements
  - **All glassy ceramics are bonded to the tooth not cemented – only glassy ceramics can be etched**
  - **Ceramics used to layer metal or ceramic cores** = feldspar or leucite reinforced
  - **Ceramic used to cover alumina oxide cores =** lithium disilicate
  - **The main drawback of lithium disilicate bridges =** the need for a thick connector
  - **Glass ceramics are mainly used to layer metals or zirconia cores**
  - **Oxide ceramics are mainly used by them selves or to make the ceramic cores**

Oxide ceramics: [cannot be etched]

1- **Alumina based ceramics: [glass infiltrated with aluminum oxide particles – still has some glass matrix]**
   - **In ceram alumina, In ceram spinell , In ceram zirconia** → high content of crystalline → very opaque [used only as core material that will later be layered with feldspar] **– but they are no longer available**
   - **Procera:** densely filled with aluminum oxide [99.9 % oxide particle and has no glass matrix or silica] – highest strength of alumina based material but it's strength is lower than zirconia
     **** although Procera is considered a subcategory of alumina based ceramics , it is closer to zirconia in it's properties.**

2- **Zirconia based ceramics:**
   - **Highest strength = 100 % polycrystalline [no glass- therefore cannot be etched]**
   - **Very damaging to the opposing tooth**
   - **Polymorphic material [exists at different forms in diff temperatures]**

   Zirconia has 2 forms :
   A. **Tetragonal form :** at high temp – this form is very resistant to crack propagation
   B. **Monoclinic form :** at room temp or when it cools down - at this form zirconia increases in volume → cracks

   To stabilize zirconia in the tetragonal form – they heat zirconia until it reaches tetragonal form and then add Yittrium to form → (3Y-TZP) – [stabilizing zirconia with yittirum will allows the transformation from tetragonal to monoclinic form to happen under external stress→ increase volume → closing of the crack.

   - **Zirconia can be**
     A. bi- layered [zirconia core and then layered with glass ceramic] – most common complication is chipping of the porcelain veneer and least common is fracture
     B. monolithic [one block – the entire restoration will be zirconia]
   - **Latest advancements of zirconia:**
     A. Zirconia became available in multilayers
     B. Highly translucent zirconia

Repairing chipped ceramic:

1- Etch with hydrofluoric acid
2- Silane coupling agent
3- Bonding agent
4- Flowable composite
5- Then fill with the porcelain repair kit

If after try in of zirconia you had to adjust occlusion you need to send it back to the lab for re glazing + provide the pt with a night guard.

3- **Hybrid ceramics:** ceramic + composite polymer
   - Adding composite :
     it can be etched
     have very similar properties to enamel and dentine
     easy to polish + you can light cure stains in the clinic
     no need for 2nd firing – can be used directly after milling
   - Ceramic component provides strength

   Strongest to weakest: zirconia → procera → In ceram [alumina, spinell, zirconia] → lithium disilicate → leucite reinforced → feldspar

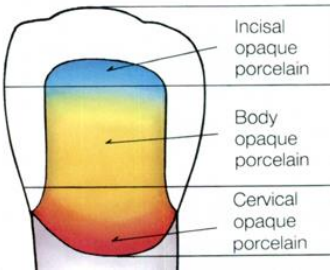
All ceramic restorations

Advantages of all ceramic	Disadvantages of all ceramic
Highly esthetic & translucent **Permits characterization and shade modification because there is no underlying metal**	1- reduced strength because: • Ceramic is brittle • There is no underlying metal supporting structure Fracture of all ceramic restorations is lessened by using resin adhesive bonding + making sure you have enough thickness of ceramic [correct preparation + CSM should be 90°] ** sloping margins [not 90 °]→ not enough thickness of the material + if the pt has unfavorable occlusion → half moon fracture in labio gingival area 2- Porcelain is very aggressive and can cause wear of the opposing tooth [specially if it is not glazed or you don't give the pt a night guard] **3- When used in bridges they need thicker connectors which jeopardizes the periodontium and makes the bridge inaccessible for cleaning by the pt**

Indications	Contraindications
• High esthetic areas • Enough tooth structure remaining **[in short clinical crowns go for PFM]** • Favorable occlusal load	• When a more conservative restoration can be used • Unfavorable occlusal load [An edge-to-edge occlusion / Deep bite / parafunctional habits] • Teeth with short clinical crowns

Porcelain layering:

Opaque [0.2 mm]	To mask the color of the opaque core and initiate color
Dentine [1.5 mm]	Makes the bulk of the restoration + provides color
Incisal enamel	Provides translucency



The thickness of the preparation is also determined by how much you need to change the shade of the tooth [for every shade change you need to remove 0.2 -0.3 mm more]

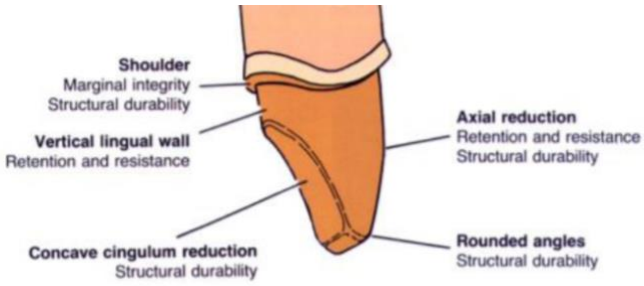
To be more conservative, in RCT teeth you can do internal bleaching first to brighten the discoloration before you prep for a crown.

**** the pt should have completed the stabilization phase [perio and caries control] – occlusal analysis is done and a study cast is poured**

1- **Make putty index [it can be cut bucco lingually or mesio distally to help you see the reduction from different aspects]**
2- **Prepare the tooth**

All ceramic anterior crown preparation

- Depth guiding grooves then **incisal reduction (inclined lingually / palately)** = **2mm** [preferably made before buccal reduction]
- Depth guiding grooves then **buccal reduction** (2 planes: incisal and gingival)



1.2mm [gingivally] → 1.5mm [incisally] with **shoulder margin**

Gingival 3rd → parallel to long axis of the tooth

- Lingual reduction (2 areas: gingival (cingulum) and lingual)

1.2 m [gingivally] → 1.5mm [lingually] with **shoulder margin**

Gingival 3rd → parallel to long axis of the tooth

Use a rugby bur to provide the concave lingual surface – make sure you don't reduce the height of the cingulum [this will compromise retention]

You can use both shoulder and chamfer[no butt joint better esthetic] margins with all ceramic restorations but minimum width of the margin should be 1 mm

- Proximal reduction
- Finishing

IMP: Centric contacts should be confined to the **middle third of the lingual surface**; where porcelain is supported by tooth structure. + Anterior guidance should be smooth and shared with the adjacent teeth

Q: why is it important to have very smooth crown preps [regardless of the material being used]? Any sharp areas will be replicated in the impression then the coping or cast metal and will act as stress concentration areas that will cause crack propagation and fracture

Minimum clinical crown height after crown prep should be [3mm anteriors and 4 mm posteriors]

The occlusal or incisal reduction for all ceramic types is the same – but some ceramics can have **different axial** reduction

Q: how can you modify the shade of the restoration without affecting the prep? By adding stains or by changing the shade of the underlying resin cement

- Posterior all ceramic crowns have less survival rate compared to anterior all ceramic
- PFM anterior or posterior crowns have similar survival rates

Surface treatment of ceramics before delivery: Surface treatment is needed so the ceramic surface will accept the resin cement.

Notes:

- **You can only etch glassy matrix [silica]**
- **Silane coupling agent can only bind to silica in porcelain [if the ceramic is polycrystalline and has no glassy matrix (silica) → tribochemical coating]**

Surface treatment of the ceramic

A. Etching [only glassy ceramics]:

1- **Etch with hydrofluoric acid** to create micro pores and mechanical interlocking

2- **Condition the surface by applying silane coupling agent** to lower the surface tension and increase wettability of the ceramic
[the primer is a bi functional monomer that binds to the Bis – GMA of the resin cement and the silica portion of porcelain]

- Feldspathic / leucite reinforced porcelain is etched with 5-10 % HF acid for **60 seconds**
- Lithium disilicate porcelain is etched with 5-10 % HF acid for **20 seconds**

B. Sand blasting : using aluminum oxides particles under high pressure to create surface roughness on the ceramic fitting surface

C. Tribochemical silica coating [for zirconia and alumina oxide ceramics]:

1- Air blasting **Alumina particles coated with silica** under high pressure onto the ceramic fitting surface [zirconia / alumina oxide are mainly polycrystalline with no glassy matrix (no silica) to bind with the silane coupling agent]

2- **Condition the surface with saline coupling agent** [10 – MDP (silane + phosphate monomer)]

- **The only cement that works really well with zirconia is Panavia -21 [self adhesive phosphate modified resin cement]**

IMP: if the ceramic is already pre- etched by the lab → after trying it inside the pt's mouth just clean it with phosphoric acid to remove salivary proteins

Surface treatment of the tooth

Etch the tooth with 37 % phosphoric acid + bonding agent then apply resin cement

Resin cements	
Light cured	**For thin ceramics [ex: variolink veneer, Rely X veneer]**
Dual cured	**For thick opaque ceramics [ex: Rely X ARC]**
Self adhesive resin cement	**For PFM and posts [ex: Rely X unicerm , panavia]**

Summary of tooth preparation

Type of material	Occlusal – functional cusp	Occlusal – non functional cusp	Margins
All metallic	1.5 mm	1 mm	Chamfer all over
PFM	2 mm	1.5 mm	Chamfer lingually Shoulder buccally
All ceramic	2 mm	2 mm	Chamfer or shoulder all over

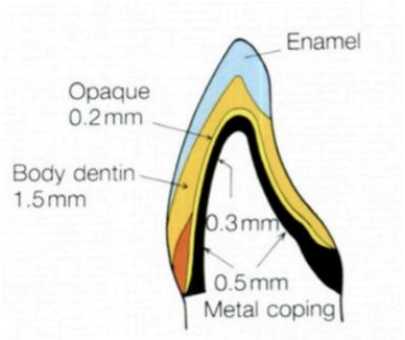
** if you expect complications after cementation it is better to go for PFM [because zirconia is very difficult to retrieve later and it cannot be trimmed]

** if you are bonding very thin ceramics anteriorly like veneers , just air spray the bonding agent and don't cure it before cementing [if you cure it you might have flexes of the bonding agent]

Metal Ceramic restorations

Metal	Ceramic
Can be: • Base metal [ex: cobalt chromium/ nickel chromium] **Less than 25 % noble metal content** **** importance of Chromium : it forms** chromium oxide layer**, which prevents corrosion of the underlying Nickel and Cobalt + bonds with the overlaying ceramic** • Noble [ex: palladium silver] **25% or more noble metal content** • High noble [ex: gold palladium] **60% or more noble metal content including at least 40% gold** **** gold and palladium have high resistance to corrosion** **The metal of choice should :** 1- Be biocompatible 2- Have corrosion resistance 3- Have low coefficient of thermal expansion **4-** Have a melting point higher than ceramic	**Porcelain is a specific type of ceramics that contain**: Feldspar + kaolin + quartz

Porcelain layers:



2- Opaque porcelain: [0.2 mm]
- Conceals the metal
- Initiates the shade
- Provides the bond between ceramic and metal

3- Body : Bulk of the restoration - Provides most of the color

4- Enamel : provides translucency of the edges

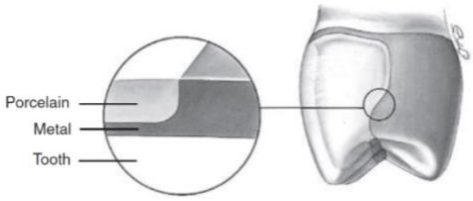
Q: how is the porcelain bonded to the metal?

1- Mechanical entrapment by air abrasion of the metal
2- Metal has a higher coefficient of thermal expansion than porcelain → porcelains draws [attracted to] the metal when it cools down after firing
3- Oxide layer that forms on the metal

Q: what causes the complete separation of the porcelain from the underlying metal? Excessive oxide layer formation or contamination of the metal surface during firing

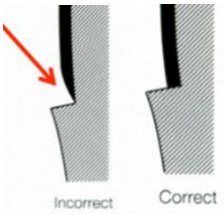
Framework design [metal part] of metal ceramic restorations

Porcelain metal junction:



- At the porcelain-metal interface, **the ceramic material should be at least 0.5 mm thick.**
- The framework should have a distinct margin so that the porcelain is not overextended.
- No abrupt contour change between the metal and porcelain.

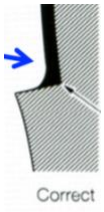
Axial aspect:



- Thickness of the metal layer: ideally 0.5mm (minimum 0.3mm)
- Thickness of porcelain layer: ideally 1mm (minimum 0.7mm)

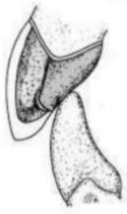
The metal layer should be convex (in the axial wall), but with no undercut [undercuts can cause crazing of the porcelain]

obtuse angle it is more supportive but can lead to a grey shade at the margin.



Occlusal aspect:

Upper anteriors:

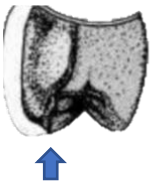


ICP should be on metal whenever possible because **ceramic is very abrasive and is more susceptible to fracture** - <u>The metal-porcelain edge should be 1mm away of ICP .</u>

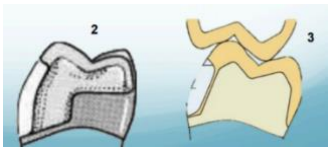
If the patient's **ICP contact is close to the incisal edge (a "shallow" overbite)** the porcelain should be extended more towards the gingival margin to prevent fracture

Upper posteriors: Full porcelain occlusal cover (with lingual metal collar) - provides good aesthetics but **risk of porcelain fracture and wear of opposing tooth**

To be more conservative the porcelain can extend over the buccal cusp tip (1.5mm away from the ICP) - The metal ledge under the porcelain must be rounded to prevent ceramic fracture.



Lower posteriors: Full porcelain occlusal cover (with lingual metal collar) - provides good aesthetics **for 1st premola**r but for the 2nd premolar and for molar a more conservative approach [metal covering the functional cusp]



Optionally, the mesial half of the occlusal surface can be veneered while the distal half is kept in metal and receives the occlusal contact.

Marginal extent of the porcelain veneer: when possible, a **3mm lingual metal collar** should be provided to minimize tooth prep (upper & lower) and If aesthetics allow, **a 1-2mm buccal metal collar** to further minimize tooth prep

If the **aesthetic needs are high (e.g. the crown margin shows on smile)** → the margin can be made by porcelain only.

Mesial and distal extent the porcelain veneer:

- **Mesial surface:** The porcelain-metal joint should be placed **palatal or lingual to the contact point**
- **Distal surface:** The porcelain-metal joint could be placed **buccal to the contact point if the aesthetics allow it.**

Advantages of PFM	Disadvantages
- Combines the strength of metal and the esthetic appearance of the ceramic - More conservative than all ceramic restorations [lingually] - Good resistance and retention since axial walls are included in the prep - Easier prep compared to partial coverage crowns	- Removes significant amount of tooth structure [more than all metal but less than all ceramic] - If you place the facial margin sub gingivally for aesthetics → irritation to the periodontium - Nickel in the metal can cause allergy - Esthetics is less compared to all ceramic restorations [PFM looks very dull] - Ceramic can fracture

**supra gingival facial margin is indicated in lower anteriors and when the smile line is low and will cover the margin.

Indications of PFM	Contraindications of PFM
- PFM is better than all ceramic for long span bridges ** For short span bridges PFM and all ceramic have similar success - PFM if better if it is planned to retain a metal frame work of an RPD	- High esthetic demand → use all ceramic - Pt is allergic to nickel → use nickel free alloys - A more conservative restoration can be done [bleaching, resin bonded bridge] - No sufficient tooth structure remaining and the tooth needs a post and core - Young pt [if they really need a posterior crown consider all metal – less risk of damaging the pulp]

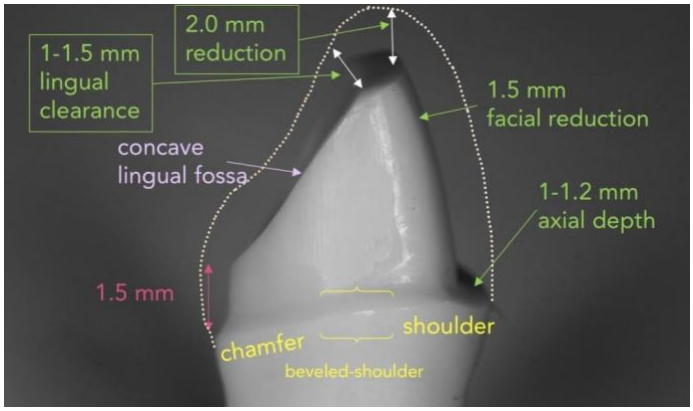
Anterior PFM crowns

Procedure and guidelines

**** the pt should have completed the stabilization phase [perio and caries control] – occlusal analysis is done and a study cast is poured**

1- **Make putty index [it can be cut bucco lingually or mesio distally to help you see the reduction from different aspects]**
2- **Prepare the tooth :**

- Depth guiding grooves then **incisal reduction (inclined lingually/ palately)** = **2mm** [preferably made before buccal reduction]
- Depth guiding grooves then **buccal reduction** (2 planes: incisal and gingival)



1.2mm [gingivally] → 1.5mm [incisally] with **shoulder margin**

Gingival 3rd → parallel to long axis of the tooth

- Lingual reduction (2 areas: gingival (cingulum) and lingual)

0.5mm [gingivally] → 1.5mm [lingually] with **chamfer margin**

Gingival 3rd → parallel to long axis of the tooth

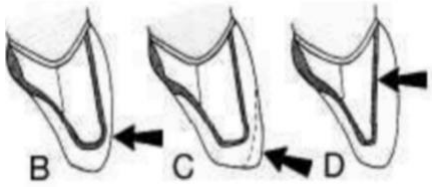
Use a rugby bur to provide the concave lingual surface – make sure you don't reduce the height of the cingulum [this will compromise retention]

***always check the reduction with the putty index [better stay 0.5 mm less than the reduction needed because you will reduce more when you join different aspects of the prep]**

The prep has to be in 2 planes and follow the anatomy

If the prep is made in 1 plane only, one of these will happen:

1- porcelain will be thin and un-aesthetic [B]
2- technician will make it thick enough but this will make the crown bulky [c]
3- the one plane will be too tilted palately providing sufficient thickness for the porcelain, but compromising the pulp/tooth. [D]



PFM 5 year survival	All ceramic 5 year survival
PFM crowns slightly higher survival than all ceramic crowns PFM bridges significantly higher survival than all-ceramic bridges	Posterior all-ceramic crowns have **different survival rates** depending on the material used The frequencies of fractures (framework and veneering material) are more for all-ceramic bridges
Anterior all-ceramic crowns have a comparable survival rate **to metal-ceramic crowns** **loss of retention, caries and loss of pulp vitality are similar between metal-ceramic and all-ceramic bridges. [zirconia crowns have significantly higher secondary caries rates]**	

Posterior PFM crowns

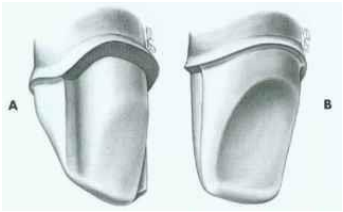
Glazed porcelain is very abrasive → if the pt has parafunctional habits → give night guard or make occlusal surface metal

Procedure and guidelines

**** the pt should have completed the stabilization phase [perio and caries control] – occlusal analysis is done and a study cast is poured → Make putty index**

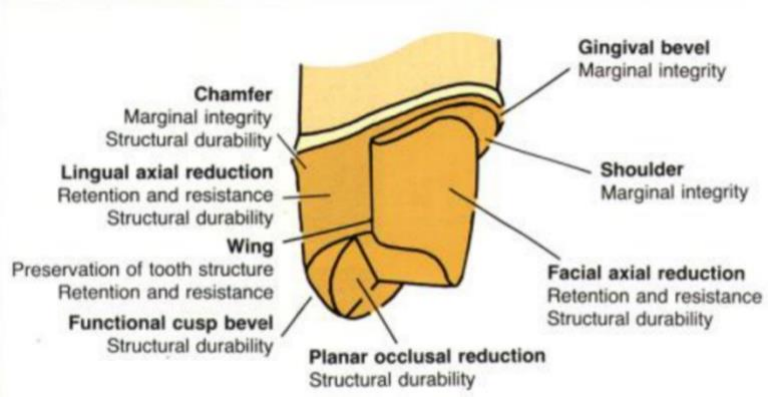
Preparation:

- Depth guiding grooves then **occlusal reduction**
  Functional cusp [upper palatal and lower buccal cusps] = 2mm
  Non functional cusp = 1.5 mm
  Bevel the functional cusp at 45°
- Depth guiding grooves then **buccal reduction** (2 planes: occlusal and gingival)
  1.2mm [gingivally] → 1.5mm [occlusally] with **shoulder margin**
  Gingival 3rd → parallel to long axis of the tooth
- Lingual reduction (one plane)
  0.5mm [gingivally] → 1 mm [occlusally] with **chamfer margin**
- Proximal reduction
  A. **Wing prep :** wings are placed 1 mm palatal / lingual to the contact point **– results in a vertical wall that aids in retention – perfect if you need to place a post**
  B. **Wingless prep**: shoulder → chamfer transition [the transition should be located lingual / palatal to the contact point]
- **Finishing –** make sure all angles and walls are smooth



Inadequate reduction to provide sufficient thickness of ceramic material may result in:

1. Poorly contoured restoration - cosmetic effect and the health of the surrounding gingiva.
2. Poor shade match and translucency of the restoration.



Check :

- Clearances should be verified in the static occlusion as well as in all excursive movements.
- Axial walls should exhibit 6° convergence.
- No undercuts + Smooth, continuous finish line following gingival contours.

Porcelain veneers

A. Direct veneers [composite]
B. Indirect veneers [composite, acrylic resin, porcelain , gold]
   ** if the pt has erosion palately – gold can be used to cover the palatal surface and reduce sensitivity or gold can be used on the lower anteriors if the pt doesn't mind esthetics

Composite veneers

Advantages	Disadvantages
Simple , quick No need for lab	Mono chromatic appearance [same color all over] Requires high skills + time consuming Cannot mask deep discolorations [otherwise it will be overcontoured]

Veneers

Indications	Contraindications
1- Mild discolorations 2- Mild spacing or mal alignment 3- Small diastema closures or tooth wear 4- Hypocalcifications **5-** Correct lingually inclined teeth **	1- Heavy discolorations / fluorosis [will resist etching] 2- Poor OH and high caries risk 3- Mouth breathers 4- Bruxism / edge to edge occlusion / crossbite **5-** Labially inclined teeth

**** mouth breathers will have constant wetting and drying of the labial surface → stresses on the veneers and more susceptible to caries**

Some cases of diastemas can be closed using partial veneers [very technique sensitive, difficult to place and you might break them while placement because they are very thin]

Veneers preparation

- You must remain in enamel but provide enough thickness of porcelain [0.5 mm]
- No undercuts or sharp line angles
- Enough interproximal clearance to place a mylar strip between adjacent teeth during bonding
- Any visibly accessible area should be covered with porcelain
- LA is given AFTER shade selection [because it might affect the shade]

Facial reduction: [not uniform reduction to avoid exposing dentine]

- A 3 wheeled diamond bur is used to create depth grooves facially [cervically = 0.3 mm and incisal half = 0.5 – 0.7 mm] – the wheels on the bur don't have the same diameter [the wheel used cervically is narrower [0.6 mm diameter] than the wheel used incisally [1 mm diameter]
- If you don't have a 3 wheel diamond bur you can use a round bur of 1 mm diameter and sink it half way only to create a 0.5 mm groove]

- after making the depth guiding grooves → connect the grooves together using round end tapered diamond bur [make sure you have 2 plane reduction]
- you always need a finish line because the technician needs to know where the restoration ends : Finish line is either **knife edge or chamfer .**

you might not always do facial reduction but you always need a finish line

proximal reduction:

- extension of the facial reduction [you should not break the contact]

breaking the contact :

A. harder for the pt to clean the margins
B. might cause tooth movement while you construct the veneer → you need to temporize
C. can create undercuts if the path of insertion is labial

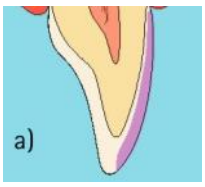
cases where you need to break the contact:

A. peg shaped laterals [the technician needs to build up the shape of laterals]
B. crowding
C. diastema
D. minor class 3 restorations [you need to end on sound tooth structure]

incisal reduction: [not needed in all cases]

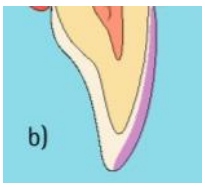
A. window veneer prep : veneer is taken close to but does not include the incisal edge

- **ADV:** Retain natural enamel on the incisal edge – used when occlusion doesn't allow you to extend your prep palatally
- **DISADV:** incisal edge is weakened by the prep – difficult to hide the cement incisally



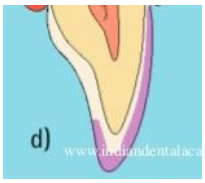
B. Feather: veneer is taken up to the incisal edge but the edge is not reduced

- **ADV:** anterior guidance remains on natural tooth structure
- **DISADV:** veneer is prone to fracture at the incisal edge



Path of insertion for feather or window: just stick the veneer labially

C. Incisal overlap: The incisal edge is reduced and veneer extends palatally [finish line cervically and finish line palatally] STRONGEST DESIGN
Indicated when you need to increase the length of the teeth – the junction of porcelain and natural teeth should **be 1 mm away from centric contact**



- **ADV:** provides a positive seat for cementing
- **DISADV:** more aggressive + you need to modify the path of insertion of the veneer

Lingual reduction : 0.5 mm chamfer finish line located ¼ down the lingual surface – 1 mm away from centric contact – the position of the lingual finish line will depend on the thickness of the tooth + patient's occlusion
[Extending lingually will increase the surface area for bonding → enhance retention]

Path of insertion = hinged path [you place the veneer under the incisal edge then rotate it towards the facial surface – this is done to prevent over reduction of the gingival 3rd] – if the path of insertion was inciso gingivally → the gingival 3rd needs to be reduced more

Impressions

1- **Retraction cord placed**
2- **Take impression with PVS or polyether**
   In PVS place light body around the teeth and then take the impression with heavy body
   Usually -no need to temporize after veneers – temporize only if:
   1- Teeth are sensitive due to exposed dentine
   2- You did incisal reduction [specially in the lower veneers]
   3- You are replacing only one out of many veneers
   4- Multiple preparations
   5- If you broke the contact

Temporizing Spot etching with [free hand carving , vaccum tray or silicone index]

Just place a spot of etchant other wise you wont be able to remove the restoration and you have to trim it changing the previous prep.

Veneers for lower incisors:

- Should have incisal overlap
- To overcome the risk of over eruption – composite stops are placed on the palatal surface of opposing teeth

- **Crowns have higher incidence of caries**
- **Veneers have higher esthetic potential because they preserve the optical properties of teeth**

During try in of veneers if the shade is okay you can go ahead then clear resin cement. if you need to adjust the shade → try chemical cured resin cement until the color is acceptable then remove the veneers and clean then with acetone **The final color of the veneer is 90% from the porcelain color / tooth color and only 10% cement color**

Bonding / cementation

1- Rubber dam + Mylar strips between teeth [to prevent veneers from sticking together] + Teflon tape on adjacent teeth [to protect them from etchant]
2- Clean the preps with pumice / polishing paste and rubber cup
3- Etch the tooth with 37% phosphoric acid and apply bonding agent **[air thin and don't cure]**
** if there is any bleeding during cementation → stop and postpone to a different day
4- Etch the veneer fitting surface with hydrofluoric acid + wash
5- apply saline coupling agent and air thin then apply bonding agent and air thin
6- Apply resin cement onto the veneer and place it on the prep [veneer is held with a sticky micrbrush]
7- Tack cure for 3 seconds → remove excess cement then light cure for 60 seconds
Dual cured composites and mainly used with :
   A. Restorations outside the smile line
   B. Restorations more than 0.7 mm thick
   C. Opaque veneers
8- Finishing with diamond burs and polishing strips and discs then diamond paste + rubber cup

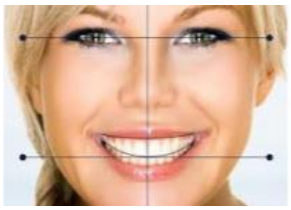
Esthetic considerations and shade selection

Q: what can you do to match between pt's expectation and reality?

1- **Diagnostic wax up :** wax up the changes to be done or the restoration on the cast and show it to the patient [you can also change It to a mock up that is tried inside the pt's mouth for a while, or a provisional restoration that the pt can wear for a while]
2- **Composite resin:** you apply a small piece of composite to see if the pt likes it or not.
3- **Water soluble ink:** only used if you are going to remove from the tooth structure [if you are going to do enameloplasty to adjust the occlusal plane – the ink will only show the areas that you will remove]
4- **Using computer softwares:** those programs don't give realistic results and the pt might have high expectations
5- **Show the pt photographs of your previous cases**

Mock ups: after doing wax up on the cast – the cast is duplicated into stone and a vaccum tray is made. you inject temporary crown material in the vaccum tray and stick it inside the pt's mouth [this way you can test for speech, phonetics and occlusion but not esthetics]

https://www.youtube.com/watch?v=UkfsElWv_uM



Smile line : composed of the incisal edges of the maxillary anteriors , it Is parallel to the **inner curvature of the lower lip** and **inter pupillary line** and perpendicular to the facial midline.

[women show **twice more** of their maxillary incisors when their upper lip is at rest]

When choosing the midline of the patient, you choose the closest structure towards the midline [the nose or the philtrum]

Length of maxillary incisors : established by anterior guidance and phonetics [saying letter F , the upper incisal edges should contact the wet line of the lower lip]

Length of lower incisors : the incisal edges of the lower incisors should be 1 mm behind and 1 mm below the incisal edge of the maxillary incisors when the pt says the letter S.

- **Long maxillary incisors will lock the anterior guidance** → Pt can't slide forward + TMJ problems + affects phonetics [F sound]
- **Long mandibular incisors** → letter S will be affected + the teeth can hit the palate

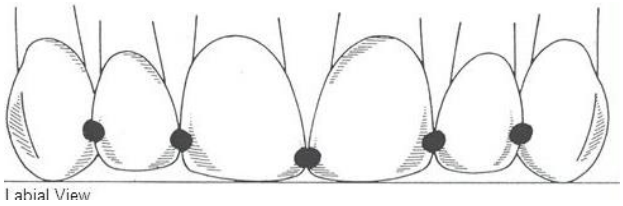
SMILE LINES:

- **High smile line [gummy smile] :** pt exposes all of the anterior teeth + soft tissues
  Caused by short upper lip or very active lips or very pronounced skeletal make up
- **Average smile line:** pt exposes only 75-100 % of their teeth without exposing soft tissues
- **Low smile line:** pt exposes less than 75% of anterior teeth

NOTE: old patients have low lip lines because with age muscle tone decreases → the upper lip becomes longer → low lip line. at the same time they start exposing their lower anteriors because the decrease in muscle tone will cause the lower lip to drag down exposing the teeth.

Monotonous smile: the centrals, lateral and canines all look the same.

- The incisal portions of the long axes of the crowns are more mesial than the gingival segments+ the incisal / occlusal segments of teeth are always lingually inclined. [teeth are mesially and lingually inclined]
- As you go posteriorly – the interproximal contacts of teeth become more gingival and the incisal embrasures increase [the contact between centrals is in incisal 3rd , contact between central and lateral is junction between incisal and middle 3rd]
- **Recued incisal embrasures are associated with older age and attrition – increased incisal embrasure are associated with a more youthful smile.**
- **Golden proportion:** height to width ratio of 0.618 – each anterior tooth is **40% narrower than the tooth mesial to it.**



Metamerism: the object will look differently under different light sources

How smooth the restoration is will determine the amount of light reflected

> Proper tooth reduction will allow the technician to layer ceramics properly → better esthetics **but** you might compromise remaining tooth structure
> If you don't give the technician enough space to layer ceramics → the restoration will be over contoured to make it more esthetically pleasing

Luster = the level of glaze of porcelain – over polishing porcelain will make the molecules fuse and it will increase it's opacity!

HUE = the color itself [dentine provides most of the color in teeth but the color is modified by the translucency of enamel.]

VALUE = how light or dark the color is. [high value = light , low value = dark] – 2 completely different colors can have the exact same value

CHROMA= intensity or saturation of color [high chroma = high saturation, low chroma = low saturation]

Dentine affects the hue & chroma , enamel affects the value.

Shade guides

A. **Vita classic :** based on hues **[4 letter and 4 colors]**
A1 -A4 (reddish-brownish)
B1 - B4 (reddish-yellowish)
C1 - C4 (greyish shades)
D2 - D4 (reddish-grey)

As numbers rise => Chroma increases and Value decreases.

Chroma: (1= low, 4= high) Value: (1= High, 4= low)

B. **Vita pan 3D master [the only one approved by the ADA – produces least error] :** based on value – can be converted to vita classic but not the opposite
Value = 5 levels [1,2,3,4,5]
Hue = M,L,R

Drawbacks of shade guides:

1- They don't cover the entire range of tooth colors
2- They lack the metal substructure if you are using them for PFM
3- The tabs are made from different type of porcelain than restorations
4- The tabs are thick while the porcelain placed in restorations is only 1.5 mm thick

Q: how to minimize errors while choosing the shade of the restoration?

1- Choose the shade at **the beginning of the appointment [to avoid eye fatigue] +** done under mid day light and under different light sources to prevent metamerism
2- Before shade selection the teeth should be cleaned from any stains and kept wet
**Make sure you and your technician use the same type of shade guide
3- Patient should be upright , at your eye level and surroundings should be neutral
4- You choose the **value first** by squinting your eyes [low amount of light is needed to activate the rods at the periphery of your retina which is responsible to differentiate values]
If the shade of the tooth is between two tabs → choose the one with **higher value and lower chroma** [can latter be adjusted by adding stains]
5- Choose **hue** by opening your eyes wide [high amount of light is needed to activate the cones in the center of your retina which is responsible to determine hue]
6- Look at the middle of the tab when choosing dentine color, view it from both mesial and distal sides [one eye will be dominant and will perceive the color] – DON'T LOOK FOR MORE THAN 5 SECONDS [YOU'LL LOSE SENSITIVITY TO YELLOW]

- Ideal light source is balanced day light with average color temp of 6,500 K and it should be around 30 cm away from the pt
- When checking shades it is recommended that the pt wears **a grey bib [because it has no complementary color – blue bibs will increase sensitivity to yellow / orange colors**
  - **The centrals, laterals and premolars have similar color. The canine is a shade darker**
  - **Mandibular incisors are a shade lighter than maxillary incisors**

Management of endodontically treated teeth

Remaining tooth structure is more important for preventing fracture of the tooth and retention of the restoration than the post design.

A post will not strengthen and reinforce the tooth – post preparation will further weaken the tooth
Teeth with posts have more apical periodontitis - Teeth with less than 3mm remaining root filling have significantly more radiolucencies

when significant tooth structure is lost and the remaining structure cannot retain the restoration → a post + core is needed [you still need a 2 mm ferrule]

Tx options if you don't have enough ferrule:

1- Crown lengthening
2- Orthodontic extrusion

Q: what affects your choice of posts ?

1- Type of tooth
2- Amount of remaining tooth structure
3- Shape of the canal [regular, wide and oval etc.]

Post systems

1- **Active posts (tapered/parallel):** retention provided by the use of threads. I**ndicated in short, curved canals. [ex: self threading or pre tapered]**
2- **Passive posts:** retention provided by the luting cement.
   - Cast post and core
   - Preformed passive posts (tapered/ parallel, smooth/serrated)
   - Fiber posts (slight flexibility)

NOTES:

- threaded or serrated posts are more retentive than smooth surf posts
- **parallel sided posts are more retentive than tapered posts [but they can cause root fracture apically]**
- **Tapered posts act as wedges leading to root fracture - Parallel sided posts do not cause this wedging**
- cement retained posts → **distribute masticatory forces evenly to the tooth** [cement acting as a buffer between post and the tooth]

Q: why is it better to have a post + core alone then a crown and not have it as one piece?

1- get better marginal adaptation
2- you can replace the crown separately without replacing the post
3- allows you to have different path of insertion for each of the crown and the post

Factors affecting post retention:

1- **Post length**
   Retention increases with post length [post should be as long as possible without jeopardizing the apical seal or strength of the remaining root structure]
   - Posts shouldn't be shorter than the remaining coronal height – if the root is short and the crown is long → **you can leave an apical seal of a minimum 3mm**
   - Posts are not placed in curved roots

2- **Post diameter**
   Shouldn't be greater than **1/3 of the diameter of the root**
   At least **1mm wall thickness is needed circumferentially**.
   Increased post diameter does NOT significantly improve post retention.
   Optimal post diameter measurements :

Custom made post + core can be cast metal or CAD/ CAM milled

You need to keep 4-5 mm of GP apically.

Custom made – cast metal post + core

Indications: Excessively flared canals or non circular - Very little preparation is needed for custom-made posts.

- In round canals **: anti-rotational device or notch placed in coronal part of preparation**.

DISADV:

1- **Less retentive than parallel sided post.**
2- Wedging effect produced within root.
3- More time consuming + needs a lab
4- needs to be slightly undersized in comparison with the canal to achieve optimal internal seating.

In post and core prep – the reduction for the crown prep is ALWAYS DONE FIRST - and the remaining coronal tissue is prepared perpendicular to the path pf placement of the post.

GP can be removed by : warmed plugger or rotary instruments [Gates Glidden] or chemical

Cast metal post + core fabrication

Direct method	Indirect method
made in patient's mouth using auto polymerized or light-polymerized resin. **Used for single canal and good clinical access** **Procedure:** 1- Fit a prefabricated plastic post to the canal. [Must extend to the full depth of the prepared canal] 2- Lightly lubricate the canal (dry the canal by air directed across the root surface not into the canal). 3- Use "brush-bead" technique to add resin to the occlusal half of the dowel and seat. 4- Don't allow the resin to fully set, loosen & reseat several times while it's rubbery. 5- Trim the plastic post until it is 2mm occlusal to the finish line then buildup the core. 6- Finishing resin is not added to the apical portion of the prefabricated plastic post as it corresponds in size to the twist drill used. https://www.youtube.com/watch?v=QFB50gSRGIs	**Made in the lab** **Procedure :** 1- Cut ortho wire to length and shape it as "J" 2- Coat wire with tray adhesive, lubricate the canals. 3- Use Lentulo spiral to fill the canals with elastomeric impression material (clock wise) 4- seat the wire →use a syringe to fill in more impression material around the prepared teeth → insert the tray. 5- The removed impressed will have an impression of the prepared canal

The marginal fit of a cast post is not as crucial as that of extra-coronal restoration because it will be covered by the final crown.

Temporization for cast metal post: Use a wire of suitable diameter or an interim post - Core is then fabricated with autopolymerized resin by direct technique.

Cementation of posts

Luting agent **has little effect on post retention or fracture resistance of dentin**.

Fiber post	Cast post
No pre treatment needed Check the fit and take radiograph Clean with alcohol **Cement with rely X [self adhesive resin cement]**	No pre treatment needed Check the fit [if the fit is tight you can remove shiney spots with a bur] **Cement with GIC**

Other cements that can be used : Zinc phosphate, RMGIC, chemical or dual cured resin cements

cement applied to the canal with Lentilo spiral + Cement applied to post itself → Gentle pumping action of post on seating to allow venting of cement coronally - **Insert gently to lower hydrostatic pressure that may cause root fracture.**

Fiber reinforced posts

Fiber posts **have shorter longevity than metal posts** (less stiffness & strength)

ADV:

1- Easy removal if re-RCT is necessary.
2- Post absorbs/ dissipates stress (rather than transfer to tooth)
3- **More biocompatible than metal- low elastic modulus (similar to dentin- more compatible, not traumatic to tooth).**
4- Aesthetic - ideal for use with composites and all ceramic crowns.
5- No interim restoration is needed.

Failure rate of restorations (post & core) under FPD was significantly lower than under single crowns (load distribution).

Most common cause of failure of post and core [most to least] : crown fracture → periodontal problems → root canal failure

Fluid control + soft tissue management

Svedopter = a metal saliva ejector with tongue guard

Isolite = tongue & cheek retractor + provides light + suction + bite block

Incases of extreme salivation you can give anticholinergic drugs [ex: anti sialogogue] but they have severe effects on the general health [should not be given to any pt with heart disease or pt's with glaucoma – can cause perm blindness]

Clonidine = anti hypertensive drug that is considered a safe alternative to anti cholinergics [used with caution in pts taking hypertensive medications]

Retraction cords :

- Twisted retraction cords can be customized by pulling out one of the cords – not very favorable because the packing instrument slips in b/w the filaments
- Knitted and braided retraction cords both are easier to apply than twisted cords but knitted cords bound back during application because they are resilient while braided cord are more flexible and adapt to the tooth
- **Best retraction cord to use is Braided cords**

Q: how do I decide how many retraction cords to place?

Single cord technique	Double cord technique
• Indicated if you need to take the impression of multiple prepared teeth • Pt has Large gingival sulcus **Leave the first cord during impression**	• Small gingival sulcus **Remove the cord and take the impression**

- The "thin" cord is placed first in the gingival crevice (without overlap)
- The **2nd cord (may be soaked with hemostatic agent**) is placed over the thin cord, with its end overlapping its start to facilitate removal.
- The **2nd cord stays for 8-10 mins**. Before its removal, **slightly moisten the cord with water to minimize the risk of dislodgment of blood clots and bleeding**
- The initial cord is left in place to minimize seepage
- Take the impression within 30 Seconds of removal of the 2nd cord
- REMOVE THE INITIAL CORD !!

Avoid overpacking as it could cause tearing of the gingival attachment, and an irreversible recession.
Avoid repeated use of retraction cords as this can also cause gingival recession.

Retraction cords can be soaked in hemostatic agents

Hemostatic agents

A. **Vasoconstrictors - Epinephrine / nor epinephrine :** reduce blood flow to the area → reduce fluid flow + reduce size of the gingiva
   CAUTION: epinephrine should not be used in :
   1- Hypertension / cardio vascular disease
   2- Hyperthyroidism or known allergy to epinephrine
   3- Diabetics
   4- Pts taking [cocaine, antidepressants and ganglionic blockers]

B. **Astringents [aluminum chloride / ferric sulfate] :** cause transient ischemia → shrink gingival tissues [local effect and safer]
   CAUTION: these solutions are acidic and they can remove the dentine layer leading to hypersensitivity

Retraction pastes are hydrophilic they absorb the moisture and then expand to cause gingival retraction [but they cause less retraction than cords]

Impression in fixed prosthodontics

Trays

- Plastic trays cause distortion & flexion – better use metal trays
- Metal trays interfere with undercuts

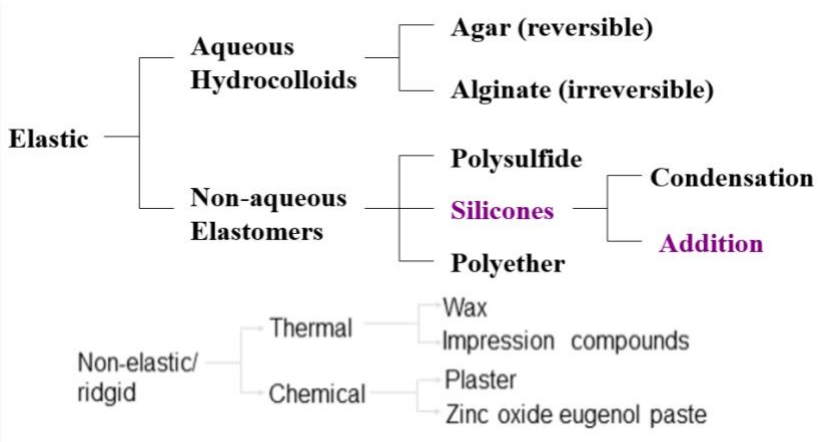
Custom tray	Stock tray
Made specifically for each patient	Made according to measurements
Made from acrylic – should have 2 mm perforations to retain impression material	Made from metal
Less material is used	More material is used

- Spots of acrylic called **stoppers** are added to the custom tray fitting surface to prevent it from sinking into the tissues or sliding and **preserve space for the impression material**
- Impression material should be 2-4 mm thick
- Impression = negative replica to the teeth + soft tissues
- Cast = positive replica of teeth + soft tissues
  Impression material can be retained on a special tray either by tray adhesives or by 2 mm perforations on the tray. [the adhesive will form a chemical bond between the impression and the tray - if you apply tray adhesives you need to wait **10-15 mins** before making the impression]

Impression materials in fixed prostho we use **elastomers** mainly

Ideal impression material :

1- Cheap and easy to use
2- Long working time and short setting time [snap setting]
3- Dimensionally stable , accurate , resists tearing
4- Hydrophilic
5- Easy to disinfect without distortion



- **Impression material should be hydrophilic to be able to wet the tooth surface**
- **the only 2 impression materials that are hydrophilic [can work in a wet environment and are readily wettable by gypsum] = polyethers , hydrocolloids**

Thixotropic property: the property that allows the material to keep it's shape when applied in a tray but when it is applied in the mouth under pressure it flows

Elastomers : [polysulfide , polyether, silicones]

- **The lower the filler content in the elastomeric impression material the higher it's shrinkage, and dimensional changes**

Low viscosity	Light body [wash]
Medium viscosity	Medium body
Heavy viscosity	Heavy body
Very high viscosity	Putty

Surfactants are materials used with silicones that can be :

1- Sprayed on soft and hard tissue before impressions [to increase the wettability of the impression material]
2- Prayed on the set impression material before pouring [to decreases void in the cast]
3- Found intrinsically inside the impression material [to make it more hydrophilic]

- Elastomeric impressions have a working time of 2 mins and a setting time of 2 -6 mins

- Q: how can you increase the working time of elastomeric impression materials? Place it in a fridge [cold temp]

Impression material	Characteristics / notes
Poly sulfides	**Supplied as :** 2 pastes [base and catalyst] even quantity - mixed together - Best used with special tray - **Long setting time [8-14 mins]** - **Bad smell [because of thiol]** - Condensation rxn → not dimensionally stable/ shrinkage [produces by product of **water**] - **Dies resulting from polysulfide impressions are usually wider and shorter than the actual tooth prep** - **Best tear resistance** - **Wait 20-30 minutes before pour for stress relaxation to occur**
Condensation silicone	**Supplied as :** 2 pastes [base and catalyst] or paste and liquid - Light , medium and heavy body, putty - Long setting time [10-12 min] - **Mostly used in the lab** - Limited shelf life - Condensation rxn → not dimensionally stable/ shrinkage [produces by product of **alcohol**] - **Wait 20-30 minutes before pour for stress relaxation to occur**

Addition silicone [PVS]	**Supplied as :** 2 pastes or 2 putty systems - Light , medium and heavy body, putty - No by product / less shrinkage and better dimensional stability - Used in lab or clinics - Contains surfactant → better wettability [hydrophilic] - Old PVS Contained H2 which evaporates and causes voids [you had to wait 60 mins before pouring] new PVS has palladium to prevent evaporation of H2 [can be poured immediately] - Can be poured multiple times **CAUTION** : you should not mix PVS putty with latex gloves [sulfur in the gloves will react with the PVS catalyst → inhibit polymerization] – hemostatic agent containing ferric salts will also react with the catalyst and inhibit polymerization
Polyether	**Supplied as:** 2 pastes [base + catalyst] - **Hydrophilic , very good wetting properties** - **Very quick setting (5-6 mins) [snap setting]** - No by product → dimensionally stable [but can dimensionally change by absorbing water if it is stored in contact with water] → they should be only washed and dried - **Polyether [perfect to use with dental implants]** - **Very rigid and cannot be used if the pt has undercuts or mobile teeth** - **Needs tray adhesive [for both custom and stock trays]** - **Impression should not be stored in water or direct sunlight** - **Best poured within and hour [but still can be poured after 48 hours]** - **May cause allergic reaction**

- Condensation reactions [condensation silicone / polysulfides] → have by products →not dimensionally stable + shrinkage
- Addition reactions [addition silicone / polyether] → no by product → better dimensional stability / low shrinkage

Vinyl Siloxanether = a new material that has polyether [making it hydrophilic and have great wettability] + PVS [making it easy to remove]

Bite registration : Addition silicone OR Polyether

Disinfection of impression:

1- Wash with tap water
2- Immerse or spray with disinfectant

Addition silicone Impressions are disinfected using 1% sodium hypochlorite or 2% glutaraldehyde.

Polyethers and hydrocolloids are hydrophilic → disinfection by spraying not by soaking [all others by soaking]

Impression techniques

Shrinkage :

- Shrinkage always occurs towards the tray [because of the adhesive] → this results in a slightly oversized die [this is counterbalanced by the expansion of the gypsum]
- If you are using a material that absorbs water [polyether] → this will result is a smaller undersized die and tight fitting crowns

Q: why should you always combine light body with heavy body or light body with putty?

to reduce polymerization shrinkage , the light body [low viscosity and high shrinkage] will flow and wet the surfaces + capture details and the bulk of the impression is provided by the heavy body [high viscosity and low shrinkage]

impression techniques:

- **Selective pressure technique:** done in cases of flabby ridges [only metal stock trays used]

1- Putty wash techniquee:

A. **One stage:** putty and light body and placed together at the same time
Mix putty and load it in a tray → inject wash material around the teeth and inside the tray → seat impression inside pt's mouth

B. **Two stage:**
Mix putty and load it in a tray with a spacer (nylon sheet) – [to preserve space form the light body] → seat impression with space inside pt's mouth → remove impression and remove spacer → **clean impression with alcohol** → apply light body material around teeth and inside tray and re seat impression again
** excess light body material can cause pressure epreventing the material from seating properly

One step	Two step
Light body gets displaced by the putty – might be pushed away from the margins [if the margins are recorded by the putty → less accurate impression No seating difficulties Quick and less technique sensitive Better bonding between putty and light body	Difficult to reseat the tray Uneven thickness of wash material No proper bonding between light body and putty → can cause debonding

The putty will fill the space of the stock tray and customize it to minimize the amount of light body used.
If putty was placed inside a custom tray → it will be too bulky to place inside the pt's mouth + the custom tray will causes stresses on the putty

2- **Dual phase technique: [most accurate]**

Heavy body + light body in a stock tray [heavy body = less viscous and less tendency to displace light body away from the finish line

** if you are using special tray you use medium body + light body

3- **Monophase : medium body addition silicone / poly ether** in a special tray is used to make the bulk of the impression and medium body in injected around the teeth

- Not very accurate

4- **Dual arch :**

- Closed mouth technique / double bite technique

Records : prepared tooth , adjacent teeth , opposing teeth and the contact in ICP in one step [no need for bite registartaion]

- The impression material is loaded on both sides of the meshwork [the mesh can be dispalced by the gypsum during pouring → causing distortions]
- Has specific pouring and mouting procedure
- Pt should have class 1 relationship , stable and reproducible ICP [and can bite dircetly into ICP] + canine guidance
- Canaine should be recorded in the impression [to avoid occlusal interferences]
- Pt should have enough space for the connector behind the last molar
- Only used for crowns or short FPD [max 3 unit bridge]

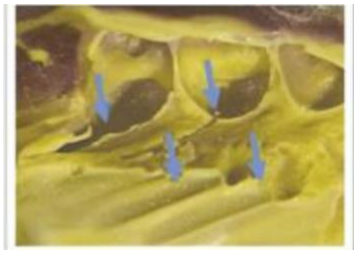
PVS / polyether can be used

ADV: less material is used , quick , records ICP and **causes less gagging**

DISADV: the meshwork can be dispalced – the impression material distribution is not uniform – results in shallow impressions [difficult o pour and mount]

Impression mistakes

Pt moved their tongue during impression and displaced the light body



Drags cause by improper seating or mixing

Digital impressions and normal impressions have equal accuracy

Minimal preparation bridges

Ways you can retain a false tooth:

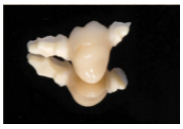
- **Bonded pontic and Fiber-reinforced resin bridge**

  Used in emergency cases [avulsed tooth that you cannot re implant you can cut off the root and join it with the adjacent teeth using a flexible fiber] – only for a few days or maximum weeks

  The fiber band used is very flexible but once it is cured it will be rigid – then you can bond the pt's own tooth or a denture tooth in the space

- **RPD flipper denture** : an RPD made from silicone without clasps , gets it's retention from engaging the undercuts of the teeth – temporary solution

- **Inlay / onlay bridge** : the pontic gets it's retention from the inlays/ onlays on the abutments



- **Cantilever bridge**

- **Resin bonded bridge** : you prepare only the palatal surface of the abutments [confined to the enamel – better etching and bonding since they are cemented with resin cements]

RBB advantages	RBB disadvantages
more conservative no LA required less clinical time and work more esthetic [since wings are lingually placed]	Compromised retention poor longevity No correction / matching of abutment teeth **if metal is used palatally it can show through the translucent edge of the teeth**

# of pontics : Only can only use one pontic – maximum 2 pontics [only in the lower anterior teeth]

Design of the pontic :

- light contact in ICP [to prevent opposing from super-eruption]
- NO contact in excursive movements (protrusive or lateral).

# of retainers :

- 1 retainer (cantilever bridge) - incases of missing lateral with the canine being the abutment

  If you use 2 retainers to hold a lateral incisor → the teeth move differently pulling the pontic → debonding
- 2 retainers (fixed-fixed)

Retainer material : noble metal , base metal , zirconia

Q: how can the wings be retained on the abutments?

A. **Mechanical retention** : the wings are made from **perforated metal** to provide interlocking with the resin cement [DISADV: the metal is thick and can interfere with occlusion or you need to remove all enamel to provide thickness without affecting occlusion , the resin will wear off leaving hole sin the metal that accumulate plaque]

B. **Macroscopic retention:** the wings are made from cast mesh or the metal has added salt crystals to provide rough surfaces for retention

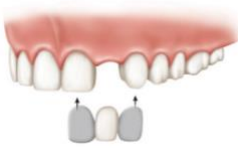
C. **Micromechanical retention [Maryland bridge]:** the wings are made from etched metal

D. **Chemical retention:** the metal on the wings is sandblasted and then the RBB is cemented using resin cement

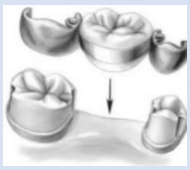
Resin bonded bridge	
Indications	**Contraindications**
• Replacement of missing anterior teeth (esp. in children and adolescents) • Replacement of a single posterior tooth • Periodontal splinting • Temporary bridges	• Excessive occlusal loading [Long edentulous span, Deep vertical overbite , Parafunctional habits] • Compromised enamel [extensive caries, large restoration, developmental disorder, wear] • Translucent incisal edge of abutment toot - unless ceramic bridge • Nickel allergy

Preparation of RBB

Path of insertion should be made **occluso gingivally**



Anterior teeth	Posterior teeth
• **Preparation depth = 0.5 mm** • Guiding planes should be made • Prep should extend facially as much as possible – without opening the contacts • **0.5mm deep grooves** • **Distinctive <u>chamfer finish line, above the tooth undercut areas</u>** • **1.5-2 mm below the incisal edge**	• **Preparation depth = 0.5 mm** • Guiding planes should be made • Prep should extend facially as much as possible – without opening the contacts • 0.5mm deep grooves • **Distinctive <u>chamfer finish line, above the tooth undercut areas</u>** • **<u>A spoon-shaped occlusal rest seat, similar to that used for RPD in the proximal marginal adjacent to the gap ± another on the opposing side</u>**



you need to keep the preparation above the under cut to keep your preparation as minimal as possible and avoid forcing the crown lingually.

Q: why don't we need to do rest seats on anteriors? Because the retention comes from the cingulum

Working casts + interocclusal records of conventional bridges

After taking an impression of the crown/ bridge preparation a cast is poured from this impression to form the **definitive / master cast** . The master cast is then duplicated to form the **working cast**.

On the **working cast** the technician will section the **cast , do the wax up and make the restoration then finish it and polish it. [the working cast is more abrasion resistant]**

Working cast can be made from resin, gypsum, flexible die material or by electroplating but most commonly it is made from gypsum type 4 or 5.

Die: the replica of the **prepared tooth** on which the margins of the wax pattern are done.

For the technician to easily locate the margins , the area under the margins should be easily visible.

Working cast materials :

- Not all impression materials are compatible with all gypsum materials – the DISADV of gypsum is low abrasion resistance
- Polysulfides and hydrocolloids are incompatible with resins that are used to make working casts – the DISADV of resin material is polymerization shrinkage
- Flexible cast materials have distortion became they are flexible
- Electroplating = depositing silver or cooper on the impression , very time consuming and expensive and has high risk of toxicity + silicone impressions are difficult to electroplate evenly

Die systems :

A. **Working cast with separate dies / Solid cast-individual die system / Multiple pour technique**.
[one solid cast for occlusion and proximal contact and separate dies for waxing the margins – you either take 2 impressions or pour the impression twice, the first pour is used to make the separate dies and the second pour makes the solid cast]
Since you are pouring twice or taking 2 impression this technique has a lot of discrepancies

B. **Working cast with removable dies:** dies are retained by pins, one die is used for occlusion, margins and proximal contacts [less discrepancies than using separate dies but this is a higher risk to damage the contacts]

If you are using working cast with removable dies, after pouring the working cast holes are drilled using pindex system and then pins are placed.

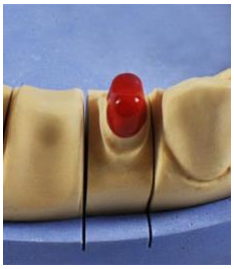
Pindex system: a system used to drill holes in the cast to insert the pins that will allow the dies to be removed from the cast and placed back again.

There should be 2 pins for each die, two for each pontic area and two pins in each terminal segment containing unprepared teeth.

Use <u>short</u> pins in the <u>lingual</u> holes, <u>long</u> ones in the <u>facial</u> holes

After placing the holes, a second base is made then the upper cast is sectioned and the area under the finish line is trimmed to help the technician locate the finish line.

Die preparation:



1- **Apply die space :** very thin material that is coated on the die to preserve the space for the cement [it is coated up to 0.5 mm above from the finish line , because you need intimate contact between the restoration and the margins] **If you don't have space for the cement, you will have pressure while seating the crown that will resist seating.**

2- **Apply die hardener:** applied to the finish line to prevent abrasion by the waxing instruments

Inter occlusal records

- **ICP = maximum intercuspation = centric occlusion [teeth to teeth relationship]**
  Is the mandibular position when maximum inter digitation occurs.
  ICP is the position in which are teeth likely to be **loaded axially.**
  ICP is the **<u>end point of the chewing cycle where maximum force is exerted</u>**.
  ICP is a **habitual position that can change throughout life**
- **Retruded Contact Position (RCP) = Centric Relation [bone to bone relationship]**
  Head of the condyle is in its most **<u>superior anterior part of the glenoid fossa</u>**, and condyles purely rotate around the terminal hinge axis.
  In 90% of the population, ICP and RCP does not coincide. **ICP is about 1 mm anterior to RCP**.
  RCP relies on anatomical positions (bone to bone relationship), it is **constant and more reproducible.**
  Mostly used in edentulous pts and full mouth rehab patients where tooth to tooth contact is lost

Q: what is the difference between confirmative and re organized occlusion and when would you choose each one?

- **Conformative =** you maintain the pt's current occlusion [used if the pt's occlusion is asymptomatic and you are only doing simple prosthetic restorations]
- **Reorganized =** you are changing the pt's occlusion and making ICP/ CO coincide with RCP/ CR [used if the pt has multiple wear facets, widened PDL , teeth mobility, damaging interferences with TMJ problems and muscle tenderness]
  If you need to change OVD → re organized approach

Facebow : registers the terminal hinge movement [pure rotation movement]

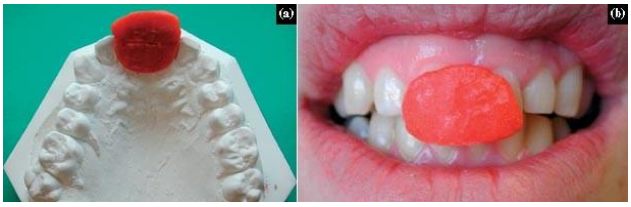
Inter occlusal records should only capture the cusp tips to check the relationship between the maxilla and the mandible

Interocclusal record materials

1- **ALUWAX or base plate wax:**
   It is 1 mm thick and soft so it distorts easily – you need at least 2-3 mm thickness so you fold it and shape it to the correct thickness which is tricky
   Not accurate
   You can add ZOE on it to capture more accurate details but ZOE has a very long setting time.
2- **ZOE bite registration material [least expensive]**
   Unpleasant odor and has burning sensation
   Very messy and becomes very brittle later on to trim
   Long setting time
3- **Polyether**
4- **Addition silicone [O-bite]**

** if you use soft wax for bite registration in the lab the heavy casts might crush the wax or the upper cast might tip posteriorly → you need a rigid elastomeric material [Duralay – rigid acrylic material that is placed posteriorly to balance the bite]

You can also use lucia jig [if the pt is resisting biting in CR, it will relax the muscles and the mandible so you can easily manipulate it into CR]



Provisional restorations

Q: why do we need to place provisional / temporary restorations?

1- Maintain occlusal contact and tooth position [prevent tilting, super eruption, shifting]
2- Maintain tooth function [esthetics + phonetics]
3- Protect the tooth against fracture
4- Stabilize gingival level and contour [specially after crown lengthening / gingivectomy]
5- Provide comfort and cover freshly cut dentine [prevent tooth sensitivity]
6- To monitor the effects of your adjustment [specially if you change OVD]

** provisional restorations must satisfy all requirements of a permanent restoration except for longevity + sophisticated color development

If your temporary crown has shallow regions or voids → under preparation of the crown

Q: what materials can you use for temporization?

1- PMMA [self cured] – has very high polymerization shrinkage + can irritate pulp / soft tissues
2- UDMA [light cured]
3- Bis acryl composite
4- Restorative composite

Q: what can you do if the pt has a history of breaking temporary crowns, or the treatment will be long or a very long span posterior FPD? Use fiber reinforced , heat processed resin or cats metal interims

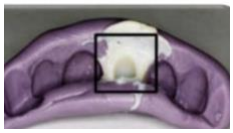
When doing a provisional restoration you need a mold to place your temporizing material in before you seat it on the prep.

A mold can be made with :

1- **Alginate** [absorbs the exothermic heat – but can only be used once]
2- **Elastomeric impression materials (putty)** – can be used multiple times
3- **Clear vaccum formed cellulose matrix** [thin and will not interfere with occlusion – used when you are temporizing with light cured resin- but flexible and can distort while seating]

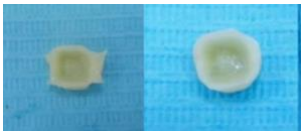
Temporization techniques :

A. **Direct technique :**
Take a primary impression → pour diagnostic cast → form putty index on the tooth [before prep] or on the cast → do your crown prep → fill index with temporary crown material → seat putty intra orally → finish and polish the temp crown → cement with temp cement



- The temporary crown has to have very smooth margins because any sharp edges will cause gingival inflammation and irritation

- When you place the temp crown material inside the putty make sure the tip is in constant contact with the putty to avoid air bubbles and void in the temp crown – keep injecting until you reach the gingival margin [don't over fill because then the temp crown material will go into the gingival margins and get locked there]
- **When you finish and polish the temp crown you should do it from the external surface to avoid shortening the crown**
  DISAVD of direct technique: temporizing materials might have free monomers + exothermic setting rxn that will cause pulpal irritation



B. **Indirect technique:**

- materials used are stronger + they are allowed to polymerize in a **hydro flask** [less porous and stronger material – because all excess free monomers are removed]
- esthetics and occlusal contacts can be developed on an articulator in the lab
- no contact with the free monomer + no heat [no pulpal irritation]
- better marginal fit

  minimal preparation is done on the cast in the lab → isolation with cold mold seal or petroleum gel → seat the putty index containing the temp material on the cast and then trim excess → finish and polish

C. **Indirect – direct technique:**
Same as indirect but then the **temporary can be relined using temporary material inside the pt's mouth**

The technician should only do minimal prep on the cast [because the dentist will always have more reduction that will allow the dentist to reline the temporary crown and have better internal fit]

** you can use the previous crown to temporize the tooth if it have intact outer surface and contour [ex: the pt had to remove the crown to do RCT] just reline the internal surface with temp crown material and cement.

Q: how can you temporize a tooth that is broken down and you have no previous record of how the tooth looks like?

Using pre formed crowns :

A. Polycarbonate crowns

- Mainly used for centrals , canines , premolars
- Choose appropriate size based on MD width then adjust and reline it with temp crown material → finish + polish → cement
- Single shade [can be modified by the shade of the lining resin]

B. Cellulose crowns

- **Thin transparent + Shade depends on the resin used inside of it**
- **Different sizes and in all tooth forms**
- Choose appropriate size based on MD → trim cervical margins to have proper seating → coat the prep with vasline and inject the cellulose crown former with resin → seat and remove the crown former many times to prevent the resin from setting in the undercuts → finish polish → cement

C. Metal preformed crowns [only posteriorly]

Q: what is the last solution to temporize a tooth that does not fit into any pre formed crown ? direct syringing with PMMA + manual shaping

Cementation:

- **ZOE**
- **ZO/ NE [non eugenol – if your final cement is going to be resin cement]**

Try in & delivery of crowns

In every try in you check 6 main things **in order:**

1- Insertion
2- Stability
3- Retention
4- Occlusion
5- Esthetics
6- Phonetics

Q: why do you need to check things in order during try in?

To make sure you don't miss and aspect + avoid damaging the restoration by accident

Ex: if a crown is found high, and you rushed to trim it down before checking if it is fully seated → you will make the crown short and out of occlusion

NOTE: Try in for a PFM crown: there should be a **gap occlusally and proximally** to allow space for the porcelain, but at the **delivery stage there should be no gap.**

TRY IN :

- Metal substructure of PFM restorations should be tried in before adding the porcelain to :

A. spot and correct errors in the metal infrastructure before adding the porcelain
B. differentiate errors caused by the porcelain from those caused by the metal

- All-ceramic restorations try in can be done to check the fitting and aesthetics (shade) of the coping before the final ceramic layer (veneer) is added.

Procedure:

A. Check the prosthesis on the cast : should be done ahead of time before the appointment to detect any obvious problems like short margins and send the work back for correction and not avoid the appointment.

Q: why do you check on the cast before trying the prosthesis inside the mouth?

- Check on the cast the **die, the saddle, adjacent and opposing teeth**
- Check the prosthesis **fitting surface, margins, proximal surfaces , occlusion**

1- **MARGINS:**
Margins should match preparation finish line
over extended margins → over hangs / underextended margins → open margins
There should be no ditches or discontinuity in the margins

2- **FITTING SURFACE:**
should be free from any obvious bleb (excess) that **could prevent the prosthesis from seating, or cause rocking.**

3- **PROXIMAL SURFACES :**
should allow space for the porcelain, if the restoration is PFM
adjacent tooth must not be scratched

4- **CONNECTION WITH PONTIC:**
should be **large enough to withstand occlusal forces**
allow space for the porcelain above the papilla.

5- **OCCLUSION ON THE CAST:**
The occlusal surface must have sufficient clearance if the infrastructure (coping) is to be covered with a ceramic veneer
Correct occlusal contacts if there won't be a veneering

B. Check the prosthesis inside the pt's mouth

1. **Insertion :**

Excellent marginal adaptation would confirm that the restoration is fully seated.
If the crown is not fully seated it might be caused by excess material on any of the following:

- the crown's margins
- the crown's fitting surface
- the pontic's fitting surface
- the contact points with the adjacent teeth
- the abutment tooth itself [residual cement]

*If no excess material is seen on the margins, inspect the fitting surface both visually and using a pressure indicator [with a **special spray or light body silicone**] → seat the crown. The "high" spot will show free of the coating material.*

Examine the tightness of the contact points using a floss [You should have some resistance, similar to normal teeth] **Too much resistance indicates over-contouring**. **A horziontally held articulating paper between the crown and adjacent tooth will help identify the area that needs trimming.**

Bitewings can help detect the margins [**should be used only when the clinical examination suspects an irregularity but is not conclusive]**

Open margins and open contact points will not prevent seating of the crown, but must be spotted during the insertion stage.

Q: what are the consequences of having <u>open margins</u>? Open margins expose the prepared tooth surface to the oral environment causing sensitivity and plaque retention. The cement will initially fill the gap, but later dissolves leaving an open margin.

Q: what are the consequences of having <u>open contacts</u>? Open contact points cause severe discomfort, especially when meat fibers get trapped. They also introduce plaque to an area that is very difficult to clean.

2. **Stability :** The restoration should be stable with no rocking
   - **slight movement** → normal due to the die spacer
   - **seesaw rocking** → must be corrected or rejected.

Causes of the rocking: Excess material on the margin or the fitting surface of the crown or the fitting surface of the pontic [can be examined using the spray or the light body silicone]
If the pontic causes blanching of the gum at the insertion ± pain → the "high" spot that needs reduction can be identified using the light body

3. **Retention :** Crowns should be retentive mechanically, and not rely on the cement to keep them in place.
4. **Occlusion :**
   Occlusal contacts may differ between the try-in and delivery stage depending on the materials and design of the prosthesis.

➔ **AT THE TRY-IN** : If the occlusal surface of a PFM crown is designed to have porcelain → there should be **at least 1 mm clearance** over the metal

*The **clearance should be checked with "Alu wax"** - the thickness of the wax bite can be assessed visually & measured with the thickness gauge. [you can't use articulating papers because they are very thin]*

Q: when using Alu wax to check the available clearance over the metal , how can you make sure that the pt was biting fully? Perforation of the wax in the adjacent tooth confirms that the patient has closed fully [wax perforations over the metal indicates insufficient clearance]

Q: what are the causes of lack of occlusal clearance during the metal try in stage?

1- Insufficient tooth preparation (occlusal reduction)
2- Metal is too thick
3- Over-eruption of the prepared tooth or the opposing one
4- The crown is not fully seated
5- **The requested crown is a full metal or a PFM with a metal island or full metal occlusal surface.**

➔ **AT THE DELIVERY STAGE :**
no clearance (gap over the prosthesis) that prevents proper chewing
no "high" occlusal contact (Premature contact" that may cause trauma
<u>The prosthesis occlusal contacts should replicate the initial records – unless decided otherwise in the Tx plan.</u>

AT DELIVERY STAGE :

- **Static occlusion contacts:**
  <u>ICP contacts should appear on the prosthesis as well as the adjacent teeth and on the contralateral teeth.</u>
  Taking the prosthesis completely off occlusion → leads to over-eruption of the abutments or the opposing teeth + interferences on lateral and protrusive movements.
- **Lateral movements:**
  Lateral guidance should not change with the + must not cause any lateral interference (working or non-working) that did not exist pre-operatively.
- **Protrusive movements** :
  Anterior restoration : Anterior Guidance should be **distributed on all anterior teeth**, and not only on the prosthesis
  Posterior restoration : it **must not introduce any posterior interference** on protrusion that did not exist pre-operatively.
  Checking occlusion can be done by :
  A. Shim stock (thin aluminium foils) to **gauge the heaviness of the contact**
  B. Articulating papers **<u>[20µ]</u>** to identify the **position of the contact [apply vasiline on the porcelain**

5. **Esthetics :**
   At the try-in of a coping (metal or all-ceramic) : inspect if there is sufficient space for the veneering ceramic in all aspects (incisal edge, axial walls).
   At the delivery : inspect all aesthetic aspects (height, contour, texture, shade, translucency, etc.)
6. **Phonetics :**
   Fixed prosthesis can interfere with phonetics if there is a **gap underneath the pontic** (hygienic pontic) or **a gap between the teeth**.
   Solution: training the patient, adding ceramic (white or pink) to close the gap.

Adjustment

Adjustment should be minor, and should take **less than 30 minutes** . If taken longer it is likely that the prosthesis is inaccurate and needs to be remade.

ADJUSTMENTS	
MARGINS	Adjusting overhangs done by approaching the crown margin from the outside (axial) aspect, not from the fitting surface. Open margins cannot be build up, but may be caused by an unseated crown. Remove the cause and you may solve the problem. ***If you accept metal crowns with open margins and request the technician to fill these gaps with porcelain → unsupported porcelain will fracture under occlusal load.***
PROXIMAL CONTACTS	Mostly in delivery stage. Identify (over-contoured) spots with the articulating paper → gently shave the porcelain with a fine diamond bur and polish with sandpaper discs and rubber points.
OCCLUSAL CONTACTS	**At the try-in stage:** if there is insufficient clearance → check the cause + correct **At the delivery:** if there is a premature contact, or an **interference** that wasn't in the mouth initially → **remove using a composite finishing bur** [The reduction should be minimal to avoid leaving a thin layer of the ceramic, which could break later] If too much has to be removed → consider leaving a metal island, or send back to the lab to make the coping thinner in this area and veneer it with ceramic The porcelain surface should be well polished [to prevent abrading the opposing tooth] by using sandpaper discs and rubber points OR the restoration can be sent back to the lab for **SELF GLAZING Not GLAZING.** **Note: glazing means adding another layer of glass ceramic, which will thicken the restoration again.** **Trimming the opposing:** Should be avoided but if necessary **remain within the enamel** + must **not involve an ICP contact on a function cusp.**

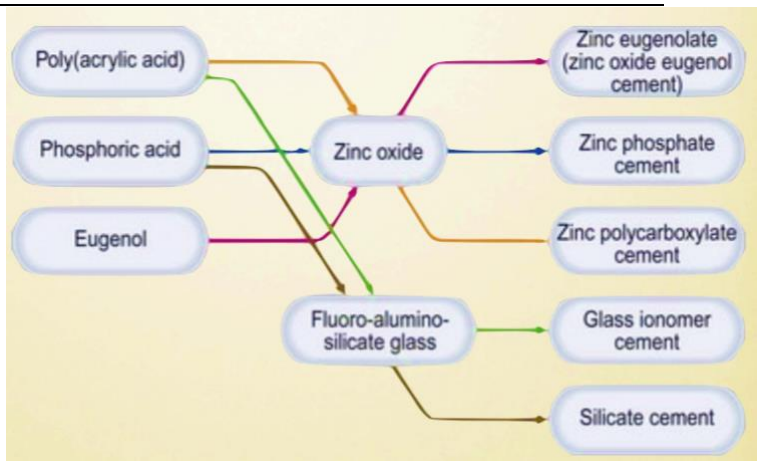
Dental Cements

NOTE: All cements provide mechanical interlocking but only **zinc polycarboxylate , GIC , RMGIC , self adhesive resins** can chemically bond to tooth structure.

Acid based cements = zinc phosphate, zinc polycarboxylate, GIC, ZOE

Cement failure can lead to :

1- Microleakage
2- Sensitivity / pulpal irritation
3- Marginal discoloration
4- Secondary caries
5- Loss of retention



CEMENT	NOTES
ZINC PHOSPHATE	Oldest + gold standard Mixing the powder and liquid is an **exothermic rxn** and mixing should be done in a specific manner to control the heat [the powder is divided **into 6 equal portions** and mixed with the liquid increment by increment on a **glass slab**] ** don't place the liquid until you divide the powder because the water in the liquid will evaporate To increase working time → make the glass slab cold **VERY ACIDIC – needs a liner of CaOH2 underneath it if the remaining dentine is thin** https://www.youtube.com/watch?v=kVgZ4-nI8CA
ZOE	**Temporary cement** Use ZO NE [non eugenol] if : *** 1- the tooth has a composite restoration 2- you are using temporary resin crown 3- the permanent restoration will be cemented by resin cement
GIC	To cement metallic restorations **Type I: Luting** Type II: Restorative Type III: Liner/base Type IV: Fissure sealant Type V: Luting for ortho Type VI: Core build-up material
RESIN CEMENTS	Self adhesive resin cements contain wither 10 – MDP or 4- META which are adhesive phosphate monomers that allow the cement to bond to the tooth structure.

Which cement to use based on restoration type:

Restoration	Cement
Metallic restorations **PFM crowns**	**ZP, ZPC, GIC, RMGIC, Resin** **But best to use GIC or RMGIC**
Metal unretentive preps **Resin-bonded bridges** **Composite inlays, posts, veneers, crowns** **feldspathic, leucite reinforced , lithium disilicate** **All zirconia / alumina restorations**	**Resin cement**

**** ZP= zinc phosphate , ZPC = zinc poly carboxylate**

Q: how can crowns be removed ?

1- **Richwil crown remover**
2- Mallet crown remover / Spring-activated crown remover **[traumatic to the periodontium and surrounding teeth and should be avoided]**

Cementation:

- Only fill half of the crown with cement
- **When seating the crown during cementation Tapping or vibration of the crown or using an ultrasonic device may also help achieve complete seating.**
- Ask the patient to bite on a soft substance such as a cotton roll to ensure complete seating
- For the proximal surfaces, make a large (double) knot in the floss to allow it “catch” interdental cement remnants
- Excess cement causes plaque accumulation areas + gingival irritation
- **Zinc phosphate and zinc oxide–eugenol (ZOE)** → cement **should set completely before the excess cement is removed** [because they don’t adhere to tooth surface]
- **GI, Polycarboxylate, and resin cements** → should be **removed as soon as the seating is completed to prevent adhesion.**
- Resin cements should be light cured for 2 seconds to make them hard and easy to remove

Biomechanical considerations + special problems in bridges

- If the pt has perio disease - losing PDL support is less critical compared to bone loss.

Ante's law : the root surface area of the abutment teeth has to equal or be more than the tooth being replaced

Problems with long span bridges:

- All FPD will flex but the greater the span the greater the flexion
- If the root surface area of the pontics is greater than the abutments → violation of Ante's law [poor prognosis because you are overloading the abutments leading to leverage and torque]

When you overload abutments MATERIAL FAILURE occurs first [porcelain chips, mobility of the connectors etc] then you'll have MECHANICAL FAILURE

Deflection of the bridge is directly related to the cube of the span length = When you only have one pontic the deflection is equal to 3 times the normal deflection – when you have 2 points the deflection is equal to 2^3 = 8 times the normal deflection – when you have 3 pontics the deflection is 3^3 = 27 times the normal deflection

Deflection is inversely related to the cube of the occluso gingival height of the pontic = if you decrease the occluso gingival thickness of the pontic by ½ the deflection increases by 8 times

Q: where would you put retention grooves on a bridge abutment, if needed? Bucco lingually [because the dislodging forces are mesio distally]

Q: What can you do to minimize leverage / deflection and increase retention if you need to place a long span bridge?

1- Pontics and connectors should be made as bulky as possible without affecting gingival health
2- Use high yield strength material like Cobalt chromium that can tolerate more deflection cycles
3- Use secondary abutments [also useful if you have unfavorable C:R ratio] Adding more abutments will compromise the ability of the pt to clean b/w the abutments
4- Add bucco lingual retention grooves

If you are replacing a first molar and the second molar that will serve as an abutment has furcation involvement → do hemi section on the molar and change it to 2 small premolars and use them both as abutments

Secondary abutments should have the same root surface areas as the primary abutments and they should be as healthy as the primary abutments [you can't you mobile teeth, teeth with long posts, or compromised surface area]

Q: what are some cases where more than 2 pontics can be replaced ?

1- Replacing the **4 anterior incisors** [you need to consider direction of forces + there is no bone or ST defect]

- Upper missing 4 anteriors → use both canines and 1st pre molars as abutments
- Lower missing 4 anteriors → use only canines as abutments [because the lower arch has less curvature so you can use less number of abutments]

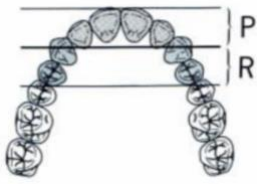
2- Replacing **maxillary canine to 2nd molar**

**** if there is anterior soft tissue loss → go for RPD**

Q: how can you limit deflection is a bridge? Since you cannot change the number of pontics [because they are missing teeth] you should make the occlusogingival height of the pontic as thick as possible

NOTE: During biting the **primary abutments will be subjected to rotational forces** and the **secondary abutments will be subjected to tensile forces** → cement breaks between retainer and abutment → micro leakage + recurrent caries

To minimize this the secondary retention (R) must extend a distance from the primary inter-abutment axis equal to the distance that the pontic lever arm (P) extends in the opposite direction. [the distance is affected by the shape of the arch]



Q**: how can arch curvature affect the design of the bridge?**

1- Teeth have different surface areas and root configurations + different path of insertion
2- Teeth are subjected to different forces and because of the curve the way the molar reacts to the force is different way than anteriors [posteriors have lesser mobility than anteriors]

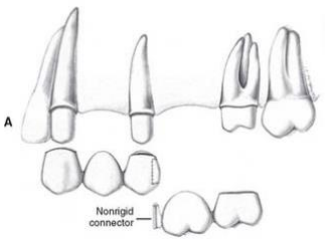
Pier abutment:

If there is a pier abutment the **axis of rotation will pass through it** and it will be subjected to different forces

Tx options for pier abutment:

1- A non rigid connector :

A. Prevents the transfer of stress from the segment being loaded to the connectors and directs it to the bone instead
B. Minimize mesio-distal torqueing of the abutments while permitting them to move independently.
C. Prevent over loading of the anterior segment



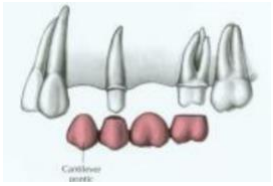
- **The keyway** of the connector: within the normal **distal contours of the pier abutment**.
- **The key:** on the **mesial side** of the distal pontic

  <u>If the key and keyway were placed on the mesial side they will separate from each other under loading – because teeth have a tendency to move mesially during function</u>

  Non rigid connectors should not be used if you are replacing more than one tooth or if the abutment teeth are mobile.

  If you have teeth with decreased periodontal attachment → use rigid connector because it will distribute the forces more equally

2- **Cantilever bridge**



Cannot be used if the canine is missing because it is involved in the guidance + subjected to more lateral forces

Cantilever bridge will not cause bone resorption because the forces are axi to posterior teeth + the connector is rigid → more favourable distribution of forces

Tilted molar abutments

The **<u>path of insertion will be dictated by the smaller premolar abutment</u>** [because it is nearly parallel to the former long axis of the molar abutment before it tilting]

In order to still be able to make a bridge - The long axis of the abutments should not converge more than 25-30 degrees

Tx options for tilted molars:

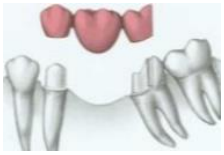
1- **Minor tilting → just do slightly more reduction mesially** [If a 3rd molar is present just do slight enameloplasty on the mesial surface – because the tilted 3rd molar will interfere with the seating of the bridge if not adjusted]

2- **Addition of facial and lingual grooves on the 2nd molar**

3- **Uptight the molar by ortho tx** [takes 3 months] - Immediately post-ortho, teeth are prepared and a temporary FPD is fabricated to prevent relapse

- When the tooth is adjusted occlusally it might cause interferences with the opposing teeth – **you need to do enameloplasty throughout the tx**
- If the 3rd molar is present → extract it to facilitate the uprighting of the second molar

4- **Partial crown**: Only if the distal surface is intact and has low risk of proximal caries + the pt can keep the area clean.



<u>Contraindicated if severe marginal height discrepancy between the distal of the 2nd molar and the mesial of the 3rd molar.</u>

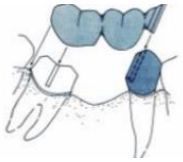
5- **Telescopic crown and coping :**

<u>Usually on non – vital teeth or you need to do elective endo</u>

Do aggressive prep on the tilted molar to accept the metal coping.

The **metal coping will be parallel to the long axis of the tilted molar** but the technician will modify the mesial surface of the coping to be parallel to the long axis of the premolar → the path of insertion of the bridge is along the path of insertion of the premolar

6- **Use non rigid connector :** the connector is placed on the anterior abutment because the molar is already tilted and has more tendency to further tilt.



A full crown prep is done on the molar, with its path of insertion parallel with the long axis of that tilted tooth.

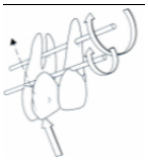
Most useful when the molar has mesial and lingual tilt

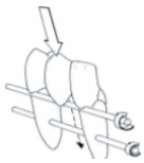
Non rigid connectors are placed in cases of pier abutments [on the distal surface of the pier abutment] or in cases of bridges with tilted molars [on the anterior abutment]

Missing canine

- Canines are involved in guidance and subjected to great forces →
  both the lateral incisor and the 1st premolars are considered weak abutments
  Cantilever bridge [you can prepare both the first and second premolars as abutments]
  ideal management is placing an implant

Q: why is replacing a maxillary canine using FPD is harder than mand canine ? the maxillary arch is more curved than the mandible → when the pt bites down the axis of rotation of the canine will be away from the axis of rotation of the abutments. In the lower arch the curve is less → the axis of rotation of the the pontic is closer to the axis of rotation of the abutments





cantilever bridges: [should replace only one tooth]

- Causes tipping / rotational forces
- **<u>The pontic should always be mesial to the retainer</u>**

Criteria for cantilever bridges:

A. Long clinical crown + long root with favorable configuration
B. Good C:R ratio
C. No parafunctional habits
D. Healthy periodontium

Cantilever for missing lateral incisor – the canine will be the abutment and the pontic should have no occlusal contact in lateral excursions

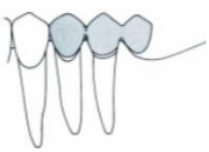
Cantilever for missing 1st premolar - the 2nd premolar can carry the first premolar alone but if the 1st molar needs crowning → you can crown it separately or make the cantilever with 2 abutments [the molar and the premolar]

Cantilever for missing molar - not favorable [might loads on post teeth]

- Can be used if the opposing is a CD or an RPD
  When the pontic is loaded occlusally, the adjacent abutment will act as a fulcrum → lifting on the farthest retainer.

Q: placing a cantilever on a molar is not favourable due to leverage, if it is the only option how can you minimize the leverage?

A. Keep the pontic should be kept as small as possible
B. Abutments should be strong with good crown height
C. There should be light contact in ICP and no contact in excursions



D. The pontic should have maximum occluso gingival height

Pontics and edentulous ridges

If there was previous trauma it might cause more ridge resorption because part of the bone will be fractured during trauma.

If there is excessive ST defect → go for RPD [best] or you can use pink ceramic to replicate the gingiva.

Siebert ridge classification

Normal : minimal deformity.

Class I : Loss of buccolingual ridge width, with normal height.

Class II : Loss of ridge height, with normal width.

Class III (most cases): Loss of both ridge width and height.

The residual ridge must be :

- Free from any frenal attachments
- Have smooth , regular surface gingiva
- Proper height and width to place a pontic with good emergence profile

The tissue contact of the pontic should either be glazed porcelain or polished gold.

You cannot place a pontic immediately after extraction because:

1- The gingiva will not be smooth
2- *when the bone heals the level of the residual ridge will not be the same as the length of the pontic*

*** you wait 2-3 months after extraction before you can place a permanent pontic, but within 2 week you can place a temporary pontic*

If the technician scrapes off the residual ridge on the cast → the pontic will have excellent emergence profile but will cause pressure points on the gingiva + blanching and gingival inflammation and ulcerations

Pontic ridge contact:

- The area of contact between the pontic and the ridge should be **small.**
- The pontic should contact only **attached keratinized gingiva**.
- Should **not contain any junctions between different materials**.
- Pressure-free contact [to prevent ulcerations , inflammation and possible bone resorption]
- The portion of the pontic touching the ridge should be **convex.**

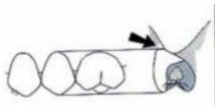
Pontics and oral hygiene :

- The gingival embrasures should be wide open to permit OH.
- The contact between pontic and tissue must allow the passage of floss from one retainer to the other.
- Rigid connectors are easier to clean

Reducing pontic width is desirable if the residual alveolar ridge has collapsed bucco-lingually but it may:

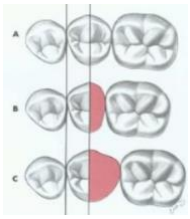
1- interrupt occlusal relationship.
2- cause difficulties in plaque control.
3- not provide proper cheek support

** The extension of the pontic should be beveled towards the ST buccally and mesially to prevent a dead space from forming that can trap food and plaque



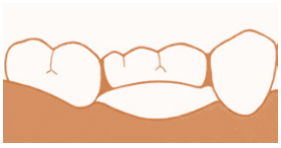
Pontic width: depends on the **MD width of the edentulous areas**.

Pontic BL width : is dictated by the opposite occlusion and ridge resorption.



The retainers and pontics can be proportioned to minimize the discrepancy between them but if a discrepancy has to be made then you can **duplicate the visible mesial half of the tooth and adjust the size of the distal half.**

PONTIC DESIGNS		FEATURES AND USES	
MUCOSAL CONTACT	Ridge lap	Overlaps the facial and lingual aspects of the ridge. **Esthetic – looks very similar to a natural tooth** Forms a large concave contact with the ridge, obliterating the facial, lingual, and proximal embrasures. **Uncleansable - Causes tissue inflammation and ulceration - Should not be used.**	
	Modified ridge lap	**Most commonly used in the esthetic zone [overlaps the ridge buccally giving good esthetics and emergence profile]** Ridge contact must extend no farther lingually than the midline of the edentulous ridge. The lingual surface should have a convex contour to prevent food impaction. Slight facio-lingual concavity on the facial side of the ridge is acceptable and tolerated.	
	Ovate	**The most aesthetic pontic design - The tissue-contacting segment is convex, and is set into concavity in the ridge.** Needs socket preservation techniques - **The tissue-side of the pontic should extend 2.5mm apical to the free gingival margin of the extraction socket**. Works well with a **broad, flat ridge, giving the appearance of 'growing from the ridge' convex in all dimensions** → accessible to dental floss. Usually used if you planned the bridge before extraction	

NON MUCOSAL CONTACT	Conical Bullet / heart shaped	Should be made as convex as possible, with only one point of contact at the center of the ridge → Round and cleansable. Used for: **thin mandibular ridge in the nonaesthetic zone**. If used in a broad, flat ridge, the resulting large embrasure spaces around the tissue contact have a tendency to collect debris. 
	Sanitary/ hygienic	**No tissue contact** - Used in the **non-appearance zone**. **Restores function and stabilizes occlusion** The occluso-gingival thickness should be at least 3 mm. There should be adequate space under it to facilitate cleaning. Made in an **all-convex [MD and FL]** 
	Modified hygienic	**Concave MD** and the undersurface of the pontic is **convex FL.** **Increase connector size & decrease stress concentrated in pontic-connector area**. <u>Sanitary pontics entrap food and might lead to tongue habits!</u> <u>Contraindicated in minimal vertical dimension.</u> 

In case of excessive loss of alveolar bone:

1- The root can be stained to simulate exposed dentin.
2- Use pink porcelain to simulate the gingival tissues (must be supported by the metal framework).
3- Ridge-augmentation procedures.
4- Use RPD

References

- Land, and Junhei Fujimoto. Contemporary Fixed Prosthodontics. St. Louis, Mo: Mosby Elsevier, 2006.
- Shillingburg, H. T. (1997). Fundamentals of fixed prosthodontics. Chicago: Quintessence Pub. Co.
- Smith, B. G. N., & Howe, L. C. (2007). Planning and making crowns and bridges. Abingdon, Oxon, UK: Informa Healthcare.
- McCabe, J F, and Angus Walls.(2008) Applied Dental Materials. Oxford, UK: Blackwell Pub.
- Elsaka SE, Elnaghy AM . Mechanical Properties of Zirconia Reinforced Lithium Silicate Glass-Ceramic. Dental Materials
- 2016; 32(7):pp908-914.
- Livaditis GJ. The matrix impression system for fixed prosthodontics. The Journal of Prosthetic Dentistry. 1998 Feb;79(2):208-216. DOI: 10.1016/s0022-3913(98)70217-3.
- Wassell RW, Barker D, Steele JG. Crowns and other extra-coronal restorations: try-in and cementation of crowns. Br Dent J. 2002;193(1):17-28. doi:10.1038/sj.bdj.4801473
- Esteves, H; Correia, A; Araújo, F (2011) classification of Extensively Damaged Teeth to Evaluate Prognosis. Journal of the Canadian Dental Associa9on; 77:b105.
- Wilson P, Fisher, Bartler D (2003) Direct Core Materials. Dental Update; 30: 362-368.
- Wassell R, Smart E, St. George G (2002) Crowns and other extra-coronal restorations: Cores for teeth with vital pulps. Bri9sh Dental Journal; 192:9, 499-509.
- Manhart J (2009) Core build-up using a dual-curing composite and treatment with all-porcelain restorations. Endodontic practice.

Disclaimer

By using Dentiscope, you understand that:

- This is a non-profit project established by the founders, purely with the intention of relaying knowledge to dental students and young dentists around the world.
- None of the contents should be sold, replicated or translated without prior formal and written consent from the team.
- This is NOT a substitute for medical resources and formal education.

Limitation of liability:

- There may be mistakes in the published content, although it will be reviewed thoroughly before publication. It should be noted that peer-to-peer learning methods are very helpful as learning tools but their limitations should be kept in mind as it relies on the students own experience and understanding of the topic.

- Information posted is all believed to be accurate and useful at the time of posting. All efforts have been made to review content thoroughly. Before performing any procedure, or applying any of the knowledge we have supplied, we recommend and stress that you refer to certified specialists and recent medical literature for accurate evidence. Neither Dentiscope, the content writers, content reviewers or editors can accept any legal liability or responsibility for any errors made. Your reliance on any content from Dentiscope is at your own risk.

Ownership:

All trademarks and logos are under the rightful ownership of the team of Dentiscope

Content:

All copyrights are respected, for any comments or complaints on any of the references used, please contact the team on the email provided.

By submitting your content on Dentiscope you agree that:

- You will be recognized as the content writer by name as long as your contribution remains on Dentiscope
- Your content will be displayed on the Dentiscope website and other forms of social media including (but not limited to): Instagram, twitter and youtube.
- You've allowed Dentiscope a loyalty free license to edit, publish, and publicly display your contribution. You've also allowed Dentiscope to reformat and use your material as best as we see appropriate.