Dental casting alloy
lec 4

Submitted by
Dr. Saraa Almallah
Alloy is defined as a metal containing two or more metals and all of which are mutually soluble in a molten state.
Properties of casting alloy
1. Biocompatibility

Alloy should not react with the oral fluids and release any harmful products in oral environment.
2. Resistance to tarnish

Tarnish is a thin film of a surface deposit or an interaction layer that is adherent to the metal surface. Tarnish is usually on silver alloys and on gold alloys with higher silver content.
3. Resistance to Corrosion

- Corrosion may lead to catastrophic failure; oxidized components may discolour natural teeth, porcelain veneers and soft tissues.

- Released metallic components may cause metallic taste in the mouth.
4. Aesthetics

The alloys must be in optimal balance among the properties of aesthetics, fit, abrasive potential and clinical survivability.
5. Nonallergenic

Although toxic materials are eliminated from the alloys. However, some individuals exhibit allergic reactions to some components. Since these allergic reactions are peculiar to the individual patient, the dentist should have a record of all the components of the alloy that is being used and should inform the patient accordingly.
6. hardness

The hardness of an alloy should be sufficient enough to resist wear by the opposing tooth or restoration. At the same time, it should not be high enough to cause wear of the opposing enamel.

Hardness of an alloy should not be less than 125 kg/mm\(^2\) or greater than 340 kg/mm\(^2\).
7. Ease of fabrication

The material should be easily manipulated and the procedure for fabrication should not be too complicated and lengthy.
Classification of metal ceramic alloy
According to composition

1. High noble alloy (commonly referred to as gold alloy)

Very precious metal Contains >40 wt% Au and > 60 wt% noble metals

a. Gold-palladium-platinum alloys
b. Gold-palladium-silver alloys
c. Gold-palladium alloys
2. Noble alloy (commonly referred to as Palladium alloy)
Precious metal Contains a >25 wt% of noble metals
Palladium-silver alloys
Palladium-gallium-silver alloys
  Palladium-gold alloys
Palladium-gold-silver alloys
Palladium-copper alloys
Palladium-cobalt alloys
3. base metal alloy

base metal Contains < 25 wt% of noble metal

Nickel-chromium alloys
Nickel-chromium-beryllium alloys
Cobalt-chromium alloys
According to Strength

**Type I (soft)** for restorations that are only subject to slight pressure e.g small inlays

**Type II (moderate)** for restorations under moderate pressure e.g three quarter crown, abutment, pontic, and full crown.
Type III (hard) for high pressure restorations e.g. thin three quarter crown, abutment, pontic, full crown, denture base, short fixed partial denture

Type IV (extra hard) for very high stress situations. Examples: inlays that are subjected to very large stresses, including base plates and clutches of dentures, metal frame partial dentures, and long fixed partial dentures.
Types 1 and 2 alloys are often referred to as inlay alloys. Types 3 and 4 alloys are generally called crown and bridge alloys.
THANK YOU
Bite Registration

Submitted by:
Dr. Saraa Almallah
Interocclusal Record (Bite Registration Record)

an imprint of the positional relation of opposing teeth or jaws to each other, made of the surfaces of occlusal rims or teeth with a bite registration material such as plaster of paris, wax, zinc oxide-eugenol paste, or acrylic resin
Objective of bite registration:

- To transfer the relation between the upper and lower dental arches from the patient’s mouth to the articulator. Proper interocclusal record is important to orient the die (s) of the same arch to the opposing arch.

- An accurate interocclusal record and correct mounting of the casts on an articulator allow the laboratory technician to create proper contours and alignment of the restoration.

- Failure to capture an accurate interocclusal record will result in time-consuming chairside adjustments, the need for remounting casts and possible refabricating of the prosthesis.
Bite Registration Materials
1. Impression plaster (soluble plaster)

- Type 1 modified with addition of accelerators to decrease setting time & setting expansion
- Records are accurate
- Rigid after setting
- Do not distort with extended storage
- Difficult to handle
- Not used now
2. Bite registration waxes

- Ease of manipulation.
- High coefficient of thermal expansion.
- Distortion of wax during removal is also very common.
- Dimensionally Inaccurate, may interfere with active & passive movements.
3. Zinc oxide eugenol paste

- Adhesion to carriers
- Rigid and inelastic after setting
- Accuracy in recording occlusal and incisal surfaces
- High degree of reproducibility
- Sticks to tissues
- Unless trimmed, flash around the teeth may prevent accurate seating of casts
4. Acrylic Resin

The most frequent application of acrylic resins for interocclusal records is in the fabrication of single stop centric occlusion records. Acrylic resin is both accurate and rigid after setting.

Disadvantages:

• Dimensional instability due to polymerization shrinkage.
• Rigidity of the material can damage plaster cast and dies during mounting on the articulator.
5. Elastomers

- Least error among the materials studied.
- They are easy to manipulate.
- Set to a consistency that makes them easy to trim without distortion, and accurately reproduce tooth details. Among the elastomers, addition silicones exhibit least amount of distortion.
- Dimensional stability, accuracy and elastic recovery, with short working time.
How TO Record interocclusal

- Whatever the material used to record the relation, you have to guide the mandible to the required relation (centric or eccentric).

- ask the patient to close and guide him, put reference point (occlusion of the teeth opposite to the side of treatment)

- put the record material and register the relation. The recording material should place over the area between the prepared teeth only.
The most widely used material to record the occlusal relation is **pink base plate wax or elastomer**. The procedure is by softening the wax at first, then apply the soft wax over the occlusal surface of the prepared teeth, then, ask the patient to bite on it, keeping in your mind that you have to guide the mandible of the patient to the reference point that you mark it, to have the correct registration. The patient is asked then to mold the wax at the lingual area by his tongue, while by your finger adapt the wax on the labial side.
In case of using elastomer you can ask the patient to close, then you can inject the material at the area of treatment. After complete setting remove the record from the patient mouth, trim the excess and attach it to the cast and transfer it to the articulator.
ANY QUESTIONS
Crown & Bridge I

Presented by:
Saraa Almallah
FIXED PROSTHODONTICS.

It's a branch of dental science that deals with replacement and restoration of the natural teeth by artificial substitutes that are not readily removable from the mouth.
Replacement
Restoration
It is a cemented extracoronal restoration that covers or veneers the outer surface of the clinical crown.

Primary function is to protect the underlying tooth structure & restore the function, form and esthetics.
Types of crown

1) Full veneer crown.
2) Partial veneer crown.
   - three quarter crowns
   - seven-eight crowns
   - inlay
   - onlay
   - laminate veneer
Full Veneer Crown

If it covers all of the crown, the restoration is a full or complete veneer crown.

It may be fabricated entirely of a gold alloy or some other untarnishable metal, a ceramic veneer fused to metal.
Partial Veneer Crown

An extracoronal metal restorations that covers only part of the clinical crown is considered to be a partial veneer crown
1- Three-quarter crowns

This type of crowns restore the occlusal surfaces and the three of the four axial surfaces but not including the facial surfaces.
2- Inlay

A fixed intracoronar restoration; a dental restoration made outside of a tooth to correspond to the form of the prepared cavity, which is then luted into the tooth.

Inlay may be used as a single tooth restorations for proximo-occlusal lesions with minimal to moderate extensions.

The entire work of inlay lies within the cusps on the chewing surface of the tooth.
3- Onlay

A restoration that restores one or more cusps and adjoining occlusal surfaces or the entire occlusal surface and is retained by mechanical or adhesive mean.

It is used for restoring more extensively damaged posterior teeth needing wide mesio-occluso-distal restorations.
Inlay Vs Onlay
4- Laminate Veneers/Facial Veneers

- It consists of a thin layer of dental porcelain or cast ceramic that is bonded to the facial surfaces of the tooth with an appropriate resin.

- It is used in situations requiring an improved cosmetic appearance on the anterior tooth.
Keep smiling...
Fixed prosthodontic dental Bridge

Presented by: Saraa Almallah
Dental bridge

A dental bridge is a fixed dental prosthesis used to replace one or several missing teeth by permanently joining an artificial tooth to adjacent teeth or dental implants.
Parts of dental bridge

- Retainer
- Abutment
- Pontic
- Connector
1- Retainer

It is the artificial crown or crowns used to attach the bridge to the abutment tooth/teeth.

**Requirement**
- must be so designed that it has sufficient strength
- margins prevent irritation of the soft tissues and recurrence of caries
- must be self-cleansing
2. Pontics

An artificial tooth that replaces a missing natural tooth, restores its function, and usually fills the space previously occupied by the clinical crown.
Requirements of pontics

- restore function
- provide esthetics and comfort
- be biologically acceptable
- permit effective oral hygiene
- preserve underlying residual mucosa

Material used

• Metal-ceramic pontics
• Resin veneered
• All metal
• Facings
3. Abutment

It is the selected remaining tooth or teeth where a crown or a bridge is attached
Connectors

the portion of a fixed dental prosthesis that unites the retainer(s) and pontics

Requirement

- connector should be approximately 2mm. in size
- connector should always pass through what would be normal contact area of teeth being replaced
- allows for creation of normal embrasures and interdental spaces
Types of connector

- Rigid connectors
- Non rigid connectors
  - tenon mortise connectors
  - loop connectors
  - split pontic connectors
  - cross pin and wing connectors
Types of bridge
1- Fixed-Fixed Bridge

It is a bridge in which the pontic is joined at both ends to the retainers by rigid connectors.
2. Cantilever Bridges

The cantilever bridge is used when there is only one anchor tooth available to support the missing tooth or teeth. This bridge design is not recommended for use in the back of the mouth where too much bite force can be put on the abutment tooth.
3. Maryland Bridges

- This type of bridge is a winged bridge and often referred to as a resin bonded bridge.
- Metal attachments located on opposing sides are bonded to existing anchor teeth. This special resin bonded form of bridge work is mainly used on front teeth, in cases where the adjoining teeth are still in stable condition.
4. Spring Cantilever Bridge

It is a bridge in which the pontic takes its support from a remote abutment by a resilient curved arm (palatal spring).
The implant supported bridge has been rising in popularity over the years, because there is normally no damage to the adjoining natural teeth. There is no support needed by trimmed down tooth stubs with crowns or bulky substructures, these types of dental bridges are supported exclusively by implants.
Any questions?
Impression materials and techniques for fixed prosthodontic

Lec 5

Done By
Dr. Saraa Almallah
**INTRODUCTION**

Impression: is a negative reproduction of the prepared teeth, adjacent teeth and surrounding soft tissues.

A variety of impression materials exists in order to capture the surface detail and dimensions of hard and soft tissues for fabrication of prosthesis.
Clinical criteria for Impression Material

The ideal impression material should possess multiple characteristics:

1- The hydrophilicity of impression material, which is defined as having a high affinity for moisture, providing good surface wetting, and allowing for greater surface detail.
2 – The **dimensional stability** of the material, which is critical for **accurate replication of the intraoral structures**.

Dimensional changes may occur due to (1) contraction from polymerization, (2) liberation of a by-product or accelerator component, (3) water absorption from a wet or humid environment, (4) a change in temperature. Materials with good dimensional stability can remain unchanged for a period of approximately 7 days and resist temperature extremes during shipping.
3- Tear resistance and elastic recovery. These are important for preserving the accuracy of the impression during removal from the mouth and after cast separations. Materials with sufficient tear resistance and elastic recovery will withstand multiple pours.
4– Other properties for an ideal impression material would have a pleasant odor, taste, and acceptable color. Absence of toxic or irritant constituents, setting characteristics that meet clinical requirements, compatibility with cast and die material, readily disinfected without loss of accuracy.
Classification of Impression materials

- **Impression material**
  - Elastic
    - Hydrocolloids
    - Non-aqueous elastomers
  - Nonelastic
    - Plaster
      - Impression Compound
    - Impression waxes
      - Zinc oxide Eugenol
      - Addition silicone
      - Condensation silicone
      - Polyethers
      - Polysulphides
      - Alginates
        - Reversible
        - Irreversible
      - Agar

# Polysulphide

<table>
<thead>
<tr>
<th>Advantage</th>
<th>Disadvantage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Low price.</td>
<td>1. Should be poured within 0.5 – 1 hour.</td>
</tr>
<tr>
<td>2. Long working time.</td>
<td>2. Unpleasant mercaptane smell.</td>
</tr>
<tr>
<td></td>
<td>3. Long setting time app. to 10 min.</td>
</tr>
<tr>
<td></td>
<td>4. Poor elastic recovery – prone to plastic deformation.</td>
</tr>
</tbody>
</table>

*Old fashioned – not frequently used*
## Polyether

<table>
<thead>
<tr>
<th>Advantage</th>
<th>Disadvantage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Naturally hydrophillic.</td>
<td>1- Swells in disinfectant or moist environment.</td>
</tr>
<tr>
<td>2. Accurate and high dimensional stability.</td>
<td>2- Rather stiff when set material (difficult to remove from mouth).</td>
</tr>
<tr>
<td>3. Good elastic recovery.</td>
<td>3- Very expensive.</td>
</tr>
<tr>
<td>4. Low setting contraction.</td>
<td></td>
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<tr>
<td>5. Excellent surface detail reproduction.</td>
<td></td>
</tr>
<tr>
<td>6- Highly acceptable to patient.</td>
<td></td>
</tr>
<tr>
<td>Advantage</td>
<td>disadvantage</td>
</tr>
<tr>
<td>-----------------------------------------------</td>
<td>-----------------------------------</td>
</tr>
<tr>
<td>1- Easy to disinfect.</td>
<td>1- Must pour within one hour.</td>
</tr>
<tr>
<td>2- Highly acceptable to patient.</td>
<td>2- Low tear strength.</td>
</tr>
<tr>
<td>3- Accurate impressions when poured soon.</td>
<td>2- Hydrophobic.</td>
</tr>
<tr>
<td>4- Good elastic recovery.</td>
<td>3- Dimensionally unstable.</td>
</tr>
<tr>
<td>5- Lower price.</td>
<td></td>
</tr>
</tbody>
</table>
### Addition-cured silicone

<table>
<thead>
<tr>
<th>Advantage</th>
<th>Disadvantage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1- Good surface detail (dry surface).</td>
<td>1- Hydrophobic (unless surfactant added.</td>
</tr>
<tr>
<td>2- Good dimensional accuracy.</td>
<td>2- Low tear strength.</td>
</tr>
<tr>
<td>3- Low permanent deformation.</td>
<td>3- High cost.</td>
</tr>
<tr>
<td>4- Highly acceptable to patient.</td>
<td></td>
</tr>
<tr>
<td>5- Good storage stability.</td>
<td></td>
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</tbody>
</table>
Mixing Systems of Impression Materials

Manual mixing

Auto mixing
The auto mixing result in fewer voids than hand mixes.

Equal mix without leaving any material unmixed.

Low material waste than hand mixing.
Impression technique for fixed prosthodontic

1- Dual-Viscosity Technique.

2- Single-mix Technique or Monophase Technique.

3- Putty-Wash Technique.
1- Dual-Viscosity Technique.

Dual-viscosity technique also called one-step technique in which low-consistency material is injected with a syringe into critical areas and the high-consistency material is mixed and placed in an impression tray.
In the single-viscosity or monophase technique, impressions are often taken with a medium-viscosity impression material. To overcome problems associated with using two different viscosities such as using two mixing guns and any difference between the viscosities, a monophase impression technique with medium viscosity was suggested.
3- Putty-Wash Technique

The putty-wash technique is also called two-step technique whereby an impression is taken in high- or putty-consistency material. Then a low-consistency material is syringed into the area and the impression is reinserted.
Two-step putty wash A. Silicone impression technique by Maria Zebian (360P).mp4
Investing

Dr. Saraa Almallah
Investing

It is the surrounding of the wax pattern with a mold of heat resistant material that can accurately duplicate the shape and anatomical features of the wax pattern to obtain a mold after burning out the wax pattern.
To do investing we need:

1-Casting ring.

2-Ring liner.

3-Crucible former.
Casting Ring

The casting ring is made of metal and is used to hold the investment material in place during its setting and to restrict its expansion.
Ring Liner

The liner is used to line the inside of the casting ring. It is made from a compressible material. e.g., asbestos (0.6mm thick) that allows the investment material to expand to some degree.

The liner should be 3mm shorter than both ends of the casting ring because it will bind the investment to the ring to prevent the slipping of the whole mass during the casting procedure.
Advantages of the ring liner

1. It provides a room of pliable material against which the investment can expand to enlarge the mold cavity to compensate for solidification shrinkage of the metal.

2. It permits easier removal of the investment and casting from the ring after the burnout procedure.

3. It acts as an insulator against loss of heat during the casting procedure.
Crucible Former

It is a cone-shape base made of rubber or metal, which forms the base of the casting ring, and to which the other end of the sprue is attached.
A dental investment: Is a refractory material that is used to surround the wax pattern during the procedure of fabricating the metallic permanent restoration. It forms the mold into which the alloy is cast after the wax has been eliminated.
The requirement of investment

1. The investment material should be of a suitable consistency for adaptation to the wax model and have a reasonable setting time.

2. To withstand the temperatures required for the casting process, there should be no distortion, no decomposition; the investment should not fragment under the impact of the molten metal.

3. The material should be porous to allow the escape of air and gases and the investment should be easily removed from the casting after cooling.
Classification of Dental Investment Materials
1. Gypsum-bonded investments

The binder is calcium sulfate hemihydrate. It is used with an alloy which has a low melting temperature, at high temperature decomposition of calcium sulfate occurs which results in the release of sulfur into the mold and mixes with gold resulting in brittle casting, so it is unstable in burnout temperature above 650 ºC.
2. Phosphate-bonded investments

binder is a metallic oxide and a phosphate. Two types: (Type I) is used when casting base metal alloys for metal-ceramic crowns and (Type II) is used for removable partial denture frameworks. Are capable of withstanding high temperatures (above 1,100°C).
3. Silica-bonded investments

binder is ethyl silicate. Not used much today.
Methods of mixing the investment material

1. **Manual**: mixing and pouring of the investment is done by the spatula manually.
2. **Mechanical**: mixing is done by a vacuum mixer to ensure that the mix is completely free from any bubbles. Pouring the investment is done by one of the following methods:

I. **Brush technique**: the investment is applied to the wax pattern with a brush and then we fill the casting ring.

II. **Vacuum technique**: the casting ring is attached to the vacuum mixing bowl. The bowl is inverted under vibration to fill the casting ring.
occlusion

Submitted by:
Dr. Saraa Almallah
OCCLUSION

The contact of the opposing surfaces of teeth of the two jaws”. It is a relationship of the mandibular and maxillary teeth when closed or during side to side movements of the mandible.
CLASSIFICATION OF OCCLUSION
1. BASED ON MANDIBULAR POSITION

A. Centric Occlusion (CO)
B. Eccentric Occlusion
Centric Occlusion (CO)

The occlusion of teeth as the mandible closes in centric relation. It’s a tooth-to-tooth relation. It is a reference point from which all other relations are eccentric.

**Centric relation (CR)** Centric relation is a bone-to-bone relation. It is the relation between the maxilla and the mandible when the condyles are in the most upper mid position in the glenoid fossae.
Eccentric Occlusion

- Lateral occlusion: (working or functional side occlusion)
- Protruded Occlusion
Lateral occlusion: (working or functional side occlusion)

It is defined as the contact between opposing teeth (canines and posterior teeth) when the mandible is moved right or left of the midsagittal plane. The contacts occur on the sides towards which the mandible moves (working side).
Protruded occlusion

The occlusion of the teeth when the mandible is protruded. The position of the mandible is anterior to centric relation. Ideally the six anterior teeth contact along the lingual inclines of the maxillary anterior teeth while the posteriors disocclude.
lateral and protrusive movements (360P).mp4
2. BASED ON THE ORGANIZATION OF OCCLUSION

According to the pattern of occlusal relation of opposing teeth during lateral movement of mandible, occlusion can be divided into:

A. Unilateral Balanced Occlusion: (Group Function)

B. Bilateral Balanced Occlusion

C. Canine guided (protected) Occlusion
A. Unilateral Balanced Occlusion: (Group Function)

Simultaneous contact of maxillary and mandibular teeth on working side as they glide over each other during lateral movement mandible movement from centric relation to the right or left side acting as a group to share & distribute forces, however, teeth on the balancing side (non-working) are free from any contact. It is widely accepted and used concept in fixed restorative dentistry.
B. Bilateral Balanced Occlusion

The simultaneous contact of maxillary and mandibular teeth as they glide over each other on the right and left, in anterior and posterior occlusal area when the mandible moved from centric relation to eccentric occlusal relations. This type of occlusion rarely found in natural dentition, however, generally considered necessary for denture stability.
C. Canine guided (protected) Occlusion

During lateral mandibular movements, the opposing upper and lower canines of the working side contact while causing disclusion of all posterior teeth on the working and balancing sides.
3. Based on relationship of first maxillary permanent molar

a) Class I : Neutro Occlusion

b) Class II : Disto Occlusion

c) Class III : Mesio Occlusion
Class I: Neutro Occlusion

Mesiobuccal cusps of the upper first permanent molar occludes with the mesiobuccal groove of the lower first permanent molar. This is called the key of occlusion.
Class II : Disto Occlusion

Condition in which the mandibular first Permanent molar is placed posterior in relation to the normal class I condition

- Division I
- Division II
Class III: Mesio Occlusion

Condition in which the mandibular first permanent molar is placed anterior in relation to the normal class I condition.
Any questions?
Principles of Tooth Preparation

Presented by:
Saraa Almallah
Tooth preparation is defined as the mechanical treatment of dental lesions, or injury of hard tissue of teeth to restore a tooth to original form.

Adequate tooth preparation, can determine the success of fixed prosthesis.
Principles of preparation

Biologic
- Pulp consideration
- Periodontal consideration

Mechanical
- Preservation of structure of tooth
- Path of insertion
- Retention and resistance
- Adequate reduction of tooth structures
- Marginal integrity (finish line)
- Smoothing and rounding the angles

Esthetical
- Color selection
- Type of material
- Restoration design
Mechanical principles

1- preservation of tooth structures

- minimal reduction
- partial veneer crown or laminate (partial coverage) versus full veneer crown (full coverage)
- Supragingival margin versus subgingival margin

Supra-ging At crest Sub-ging
2- path of insertion

It’s the specific direction in which a prosthesis is placed onto the abutment or removed from the abutment. Any deviation (undercut) from this line will result in distortion of pattern wax and failure of restoration seating.

- Axial reduction must be with Taper
Taper

its defined as a convergance between two opposing axial walls, in occluso-axial junction

Two opposing surfaces, each with a 3 degree of inclination would give the preparation a total of 6 degree taper

taper must be 5-10 degree of inclination

Why tapered?

1- To visualize preparation walls
2- To prevent the undercuts
3- To compensate for inaccuracies in the fabrication process
4- To permit complete seating of the restoration during cementation
Undercut

It's defined as a divergence between opposing axial walls, in a cervical–occlusal direction. If the cervical diameter of tooth preparation at the margin is narrow than at the occluso-axial junction (reverse taper), it will be impossible to seat a complete crown.
3- Retention and resistance

Retention

It’s the quality of the preparation to prevent removal of the restoration along the axis of the tooth (its path of insertion).

Retention depend on the factors:

1 - magnitude of the dislodging forces
2 - geometry of preparation
   - taper preparation
   - duplicating anatomical form of occlusal surface preparation
3 - roughness of the internal surface of the restoration
   (air-abrasion – oxide layer → microretention)
4 - type and film thickness of luting agent (cement)
Resistance

It's the ability of the preparation to prevent dislodgement of the restoration by forces, directed in apical, oblique or horizontal direction

Factors affecting resistance:

1. Length of preparation

   The more occluso-gingival dimension, the more resistance

   Resistance is increased due to the amount of tooth structure interfering the arc of rotation with (lateral or oblique force)
2- Taper
The resistance is increased by decreasing the taper of the preparation

3 – Ratio of diameter to length of preparation
There is a balance ratio between the diameter and height, which provide more resistance

4 – occlusal irregularity of reduction
Duplicating the anatomical form of occlusal surface during preparation, increase the resistance.

*flat reduction of the occlusal surface of the tooth may decrease the resistance*
4 – adequate Reduction of the tooth structure

Steps of tooth reduction (preparation)

- Occlusal (incisal) reduction
- Axial reduction
  - buccal (facial)
  - lingual (palatal)
  - mesial
  - distal
  - proximal
1- occlusal (incisal) reduction

Occlusal and incisal reduction is preformed to provide adequate clearance between the prepared surface and opposing teeth.

The occlusal and incisal surfaces must be reduced by minimum 1.5 mm clearance for (full metal crown) and 2 mm clearance for (full ceramic and metal ceramic crown)

To allow:

- adequate thickness of restorative material (metal – ceramic) to be enough strong (to prevent fracture of crown)
- To form anatomical morphology in occlusal surface of the restoration to be more esthetic
Adequate clearance → more strength of restoration

Adequate clearance → adequate anatomical form → more esthetic and more chewing effect
- **Occusal depth cuts**

Occlusal cut acts as a guide for reduction, and placed using round bur No2 (1,5mm) or by round ended-taper bur on the grooves and cusps.

**Depth cuts**
Axial Reduction

Axial reduction commonly includes the entire circumference of the tooth (buccal – lingual – mesial distal surfaces)

Buccal and lingual reduction

The buccal and lingual surfaces must be reduced so that the restoration can be reestablish tooth contour.

- Depth cuts

For adequate and uniform reduction is achieved, can use the depth cuts in buccal and lingual surfaces as guide to preparation. Depth cut of reduction in the buccal and lingual surfaces 1 – 1.5 mm. By taper round-ended diamond bur making 2 -3 depth cuts equally placed along the mesio-distal dimension of buccal and lingual surfaces in the posterior teeth.
Placing depth cuts
Mesial and distal (proximal) reduction

The reduction form of the proximal walls (surfaces), should be taper occlusogingivally 5 – 10 degree with chamfer or edge-knife finish line.

Reduction of proximal surfaces complete by using the taper round-ended diamond bur with tip 0.8 mm, interproximal space must be 0.8 – 1 mm and not less than 0.6 mm. Insufficient reduction of the proximal walls leads to inadequate embrasure with predictable periodontal implications.

Access to proximal reduction

Care must be taken during the proximal reduction to avoid the damage of adjacent tooth or restoration with rotary instrument.

- **break the contact with adjacent teeth** by carbide bur 169L or by needle diamond bur, work bur through the proximal area in occluso-gingival and buccolingual “sawing’ motion until gingival contact is broken with adjacent teeth.
Making or creating “flanges or enamel lip” on the buccal and lingual surfaces during their reduction, which serves as a guide to avoid the contact with adjacent teeth and help to complete the preparation of the proximal surfaces.

Using the matrix band – matrix band can be placed around the adjacent teeth to protect it from the abrasive contact.

Note: Tapere round-ended and needle diamond burs are used to reduction of proximal surfaces.
Thank you!
Spruing

presented by
Dr. Saraa Almallah
Sprue

It’s a channel through which the molten alloy can reach the mold in an invested ring after the wax has been eliminated
Role of the sprue

1. The sprue must allow the molten wax to escape from the mold.

2. The sprue must enable the molten metal to flow into the mold.
The sprue can be **wax**, **plastic**, or **metal**.

**Wax sprues** are preferred for most castings because they melt at the same rate as the pattern and thus allow easy escape of the molten wax.

**Plastic sprues** soften at a higher temperature than the wax pattern and may block the escape of wax, resulting in increased casting roughness.
Metal sprue is used; it should be made of non-rusting metal to avoid possible contamination of the wax. Metal sprues are often hollow to increase the contact surface area and strengthen the attachment between the sprue and pattern.
Requirements of sprue
1. Diameter

In general, a relatively large diameter sprue is recommended because this improves the flow of molten metal into the mold. Molar around 2.5 mm (10 gauge), premolar 2 mm (12 gauge)
2. Location

the attachment of the sprue with the wax pattern should be to the bulkiest area of the wax pattern and should be at an angle to allow the incoming metal to pass freely to all portions of the mold cavity without any turbulence. Normally, the largest nonfunctional cusp is used.

Fuctional cusps : Buccal cusps of the mandibular posteroir teeth & Lingual cusps of the Maxillary posterior teeth.
3. Length

The length of the sprue former should keep the wax pattern 6 mm from the casting ring. **If the pattern is too close to the end of the ring** the molten alloy may blast through the investment during casting, **if it's too far**, gases may not escape rapidly enough to permit complete filling of the mold with alloy. The pattern should be placed as possible to the **center of ring**.
4. Venting

Small auxiliary sprues or vents have been recommended to improve casting of thin patterns and may help in:

- gases escape during casting.
- compensate for the shrinkage during solidification.
Spruing technique

Direct

Indirect
Direct spruing

As the name indicates, direct spruing involves the flow of molten metal *straight (directly)* from the casting crucible to the pattern area in the ring. This spruing method is *not as complex* as the indirect method and usually requires *less time and effort.*
Indirect spruing

With indirect spruing, molten alloy does not flow straight from the casting crucible into the pattern area in the heated mold. Instead, the casting alloy takes a circuitous (indirect) route before it reaches the pattern areas—hence the name indirect spruing.
thank you
Types of finish line

Presented by:
Dr. Saraa Almallah
Formation of finish line

Finish line

It’s the point at which the preparation terminates on the tooth

Finish line serves many functions

1- its delineate the extent of the cut in apical direction of the restoration

2- the finish line is one of the features that indicate and evaluate the precision (correctness) of impression

3- the correct marginal adaptation of the wax pattern depends on an obvious finish line

4- evident finish line helps in the evaluation of quality of the die
Finish line location

Supra-gingival location – finish line located above the gingiva and its easy to manipulation and save for periodontal tissue (more healthy) but (non-esthetic)

Sub-gingival location – finish line located in the free gingiva (sulcus) requires special care to avoid excessive soft tissue trauma from rotary instruments, the gingiva must be carefully held out of contact with bur by placing a retraction cord in the gingival sulcus (high esthetics).

At the gingiva located at the gingival margin border its not healthy because causing secondary caries (poor oral hygiene)
There are four basic types of finish lines

1- edge knife (chesil)

It's an extremely thin finish line, this line terminate on the cementum and formed by needle diamond burs or by thin flame. It's used in the posterior teeth for full metal and gold crown, used for inaccessible areas of oral cavity (limited mouth opening), and used in drifting or maloaligned teeth in mesial surface.

- difficult to wax up and cast
- difficult to produce smooth margin
- susceptible to distortion
2- Chamfer

It’s a concave extra-coronal finish line that is possess a curved slope from the axial wall till margin. The chamfer formed by taper round ended bur, chamfer used for cast metal crown, metal-acrylic veneer crown, metal ceramic crown in the posterior teeth and in the lingual margin for metal-ceramic crown in the anterior teeth.  

- chamfer seem as a negative image of a tip of round-ended bur

- less stress and good success rate

- improper (excessive deep) reduction will produce an desirable fragile piece of enamel (lipping)
- shoulder

Subgingival located finish line, which extend in gingival sulcus (crevice) to 0.05 - 0.8mm and has 1mm depth. It should be terminated on enamel.

Shoulder formation require using the retraction cord to prevent gingival injury during procedure, retraction cord placed into gingival sulcus, the cord provides about 1mm gingival displacement, which allows the shoulder to be formed at the level of cord and located cervically without trauma from rotary instruments.

Shoulder is formed by using flat-end bur, and used for metal ceramic and all-ceramic Restorations, specially in anterior teeth to gain the restoration more retention and very Esthetic appearance.

<table>
<thead>
<tr>
<th>gingival sulcus</th>
<th>0.8-1mm (free gingiva)</th>
</tr>
</thead>
<tbody>
<tr>
<td>junctional epithelium</td>
<td>1.5mm (attached gingiva)</td>
</tr>
<tr>
<td>cementum</td>
<td>Supracrestal fiber tissue</td>
</tr>
<tr>
<td>alveolar bone</td>
<td></td>
</tr>
</tbody>
</table>
Placing retraction cord

Cord is placed with gingiva and retracted forming shoulder

Cord is removed and completely formed shoulder

Impression with negative details of shoulder

Retraction cord (ultra-pack)

Cord packer
Beveled shoulder – its modification or similar to shoulder with bevel about 0.2mm of width, and forms an angle of 45 degree relative to the floor of shoulder. This finish line improve marginal adaptation of the restoration.

Beveled shoulder indicated for all-ceramic and metal-ceramic restorations.

To form beveled shoulder, too need a retraction of gingiva to avoid gingival trauma.

Beveled shoulder is formed by using bevel-end cylinder bur or by torpedo bur.
Die Hardener Materials

This materials applied on the surface of die to increase the surface hardness. It effectively improves the hardness and abrasion resistance of stone dies. Die Hardener Should have low viscosity.
Materials used:

Commonly used materials as die hardeners:

- 1. Cyanoacrylate resins
- 2. Acrylic resin lacquer
Application of die hardener

- Applied to finish line area of the die to prevent abrasion by waxing instruments during the fabrication of wax pattern. Applied with brush.

- Quickly blown off and dried by air from above the margin toward the cervical area or Blot with tissue.

- Optimal Thickness: 2-3 microns
Marking the margins

1. The margins should be marked in order to locate it during wax carving.
2. It should be delineated with a contrast coloured pencil like red for green wax.
3. If required the marked area can be coated with a thin layer of cyanoacrylate
4. Use the side of the tip of pencil
5. Do not press on the margin to preserve the finishing line
Die spacer

Die spacer is an agent applied to a die to create space for the luting cement in the finished casting.
Different types of die spacers are:

- Red, 7 microns
- Yellow, 7 microns
- Blue, 10 microns
- Gold 13 microns
- Silver, 13 microns
How to Apply die spacer

- A. 40 micron thickness allows space for cement.
- B. 2-3 coats placed.
- C. Spacer 1 mm away from finish line.
- D. Remove excess with die setting retardant
thank you
WAX ELIMINATION OR BURNOUT
Wax elimination

Wax elimination or burnout consists of heating the investment in a thermostatically controlled oven until all effects of the wax are vaporized.

The temperature to which the ring is heated during wax elimination must be sufficiently high
It should be maintained long enough ("heat soak") to minimize a sudden drop in temperature upon removal from the oven. Such a drop could result in an incomplete casting because of excessively rapid solidification of the alloy as it enters the mold.

Once the investment is heated during the wax-elimination procedure, heating must be continued, and casting must be completed. Cooling and reheating of the investment can cause casting inaccuracy because the refractory and binder will not revert to their original forms.
Step-by-step procedure

1. Allow the investment to set for the recommended time (usually 1 hour) and then remove the rubber crucible former. If a metal sprue is used, remove it as well. The smooth skin that forms on the ring with phosphate-bonded investments should be removed, and any loose particles of investment should be blown off with compressed air.
2. Reexamine the ring for any residual particles and then place it with the sprue facing down in the furnace on a ribbed tray.

3. Place molds directly into preheated oven at 700-900c. Hold for 30-40 minutes and cast.
Casting

the action of pouring or injecting a flowable material into a refractory mold.
Casting machine

Various Casting machines are used like:-

1. Centrifugal force type
2. Air pressure type
1. A casting machine requires a heat source to melt the alloy and a casting force.

2. For a complete casting, the casting force must be high enough to overcome the high surface tension of the molten alloy as well as the resistance of the gas within the mold.

3. The heat source can be either the reducing flame of a torch or electricity.
4. Conventional alloys can be melted with a gas-air torch (A), but the metal-ceramic alloys in a higher melting range need a gas-oxygen torch (B). Base metal alloys need a multi-orifice gas-oxygen or oxyacetylene torch (C).
The flame used in the casting composes of 4 zones:

A- Mixing zone: It's cool, colorless zone.
B- Combustion zone: Its greenish-blue zone in which partial combustion takes place, this makes an oxidizing the alloy.
C- Reducing zone: It’s a dim blue tip, it’s the hottest zone.
D- Oxidizing zone: In which final combustion between the gas and surrounding air occurs, it makes an oxidizing the alloy.
Gas-Air Blowpipe
Casting procedure

- Alloy is melted with a suitable heat source.
- When the alloy is molten it has a mirror-like appearance and shifts like a ball of mercury.
- Hot casting ring is shifted from burnout furnace to the casting machine.
- Arm is released and allowed to rotate which creates a centrifugal force which forces the liquid metal into the mold cavity.
The arm is allowed to rotate till it comes to rest.

The ring is allowed to cool for 10 minutes till the glow of the metal disappears.

The ring is then immersed in water which leaves the cast metal in an annealed or softened condition.
ANY QUESTIONS
Wax pattern fabrication

Submitted by
Dr. Saraa Almallah
Waxing instruments

Waxing instruments can be categorized by the intent of their design:

1. Wax addition
2. Carving

Of the popular PKTs (designed by Dr. Peter K. Thomas specifically for the additive waxing technique)

- No1 and No 2 are wax addition instruments
- No. 3 is a burnisher for refining occlusal anatomy
- No. 4 and No 5 are wax carvers.
Sequence in wax pattern fabrication

1. Coping fabrication.
2. Wax pattern removal and evaluation.
3. Proximal surfaces.
5. Occlusal surfaces.
1. Coping fabrication

- Before coping is fabricated die lubricant is applied, the wax is added by using PKT no1 or no 2.
- Initial layer should be completely molten. Whenever subsequent layers of wax are added the previous layer which was applied should be remelted or else creases or folds would form on fitting surface.
- Dipping the die in molten wax pot is easiest and better way to fabricate a coping.
2. Wax pattern removal and evaluation

When the wax pattern sufficiently cooled, Removed using the thumb and forefinger with light grip pressure. If the pattern is not coming out the excess wax at the margin should be trimmed of. After it remove the patterns is evaluated
3. Proximal surfaces

The proximal surfaces of natural teeth tend to be flat or slightly concave from the contact area to the cementoenamel junction, and any restoration must reproduce this feature.

Over contouring → maintaining periodontal health difficult.

Excessively concave → flossing ineffective.
4. Axial surfaces

The buccal and lingual surfaces are shaped to follow the contours of adjacent teeth. The height of contour, which is also known as the crest of curvature, is the greatest area of contour cervically on the facial and lingual surfaces, and is best observed by viewing these surface outlines from a proximal aspect. The height of contour should be adequately placed usually at the gingival third of all the teeth except in mandibular molars it is present in the middle third.
5. Occlusal surfaces

The cusps and ridges of the occlusal surfaces should be shaped to allow even contact with the opposing teeth while stabilizing the teeth and directing forces along their long axes.
Importance of Occlusal Morphology

Point contacts between opposing teeth are preferred to broad, flat occlusal contacts because
1. Wear of the restorations will be minimized
2. Mastication of tough or fibrous foods improved.
6. Margin finishing

Lift of the pattern, replace it and check for defects:

1. Over waxed margin
This may lead to breaking off when a pattern is withdrawn from the die.
2. Short margin

The waxing does not extend to the red finish line will not provide an adequate seal for the final restoration.
3. Ripples

Any roughness in the wax near from the margin will be duplicated in the casting. These roughness's in the final restoration lead to plaque collections that lead to irritation and inflammation of the adjacent gingival tissue.
4. Thick margin

Thick, round margin will result in poor sealing of the restoration and poor axial contours which lead to periodontal problems. The margin should be fabricated with a fine edge.
4. Open margin

It may occur during any stages of the fabrication of the wax pattern. If the wax is not well adapted, a black shadow line will be visible.
7. Finishing

- Occlusal surface is polished by dipping a cotton in die lubricant and slowly passing it over the occlusal surface without any pressure.
- It is done same over the axial surface, then with dry cotton pellet the surface is smoothened off carefully.
- Die lubricant should not be left on the pattern.
- Any depressions are filled with wax.
Wax pattern

Presented by

Dr. Saraa Almallah
Wax pattern

It is the precursor of the finished cast restoration that will be placed on the prepared tooth; it should be clear, smooth, should be duplicate accurately the final anatomical feature of the original tooth & should be free from any debris. The information needed to duplicate the anatomical feature is taken from the adjacent teeth, opposing teeth & from the general knowledge of the dental anatomy.
Techniques of construction of wax pattern:

1. Intra oral technique (direct technique)

2. Extra oral technique (indirect technique)
1. Intra oral technique (direct technique)

In which the wax pattern is constructed inside the patient mouth using type I inlay wax, mostly we use this technique in construction of the posterior inlay restoration & anterior post-crown
2. Extra oral technique (indirect technique)

Here we use type II inlay wax to construct the wax pattern on the die of the working cast.
The advantage of the indirect over the direct technique:

1. It reduces chair time so it saves the dentist time & more comfortable to the patient.

2. It offers a chance for the imagination of the restoration & readily (direct) access to waxing the margin.

3. It is probably the easiest mean of fabricating cast restoration
Classification of inlay wax

The American dental association [ADA] No.4 divided inlay casting wax.

Type I: a medium wax, used with direct techniques.

Type II: soft wax, used for the indirect techniques.
Requirements of inlay wax

1. It must flow readily when heated, without distorting or loosing its smoothness.
2. It must be capable of being carved without chipping or distorting.
3. Evaporate without leaving any debris or residual ashes, which can contaminate the produced cast restoration.
4. Has acceptable strength and rigidity after cooling.
Waxing technique:

1. Dipping method

To develop a thin, uniform and adapted layer of thin wax on the die. This is done by dipping the die into wax that has been thoroughly melted (using wax dipping pot).
2. Addition method

To obtain a bulk of the wax pattern, then carving is carried out this is done by melting the wax and dropping it on the die until complete building of the pattern and then carved by sharp carver. The main drawback of this technique is due to stress collected from multiple addition of wax tend to release with time and subsequently distort the wax pattern.
3. Molten press method

It is the most suitable method to construct accurate and adapted wax pattern. This is method is done by adding a molten wax and pressure is applied with fingers at each application, this procedure assure that the wax is closely adapted and free of irregularities, this method overcomes the most drawback of addition method.
thank you
• **Working (or master) cast** is the positive reproduction of the prepared teeth, ridge areas, and other parts of the dental arch.
Die: It is the positive reproduction of the prepared tooth on which the wax pattern is made and are finished. It consists of a suitable hard substance of sufficient accuracy.
Requirements of the die

1. It must reproduce the prepared tooth exactly.
2. It must be free from air bubbles and voids.
3. It must return to its exact position on the cast when it is removed.
4. It must be stable even when the cast is inverted
Die Materials

• 1. Gypsum dies
• 2. Resins dies
• 3. Electroplated dies
Types of dental gypsum products (according to ADA Specification):

Type I: impression plaster.
Type II: model plaster.
Type III: dental stone.
Type IV: high strength dental stone (die stone).
Advantages of stone die:

1. Easy to be prepared.
2. Can be used with all types of impression material.
3. Cheap.
4. Need less requirements and easy to manipulate.
Working cast and die systems

I. Working cast and a separate die
II. Working cast with removable dies
   a. dowel pin.
   b. Pindex system
   c. Di-Lok tray
   d. DVA Model System
   e. Zeiser Model system
I. Working cast and a separate die

Here, two casts are poured from a single impression and one cast is sectioned and used as a die and the other is not sectioned and is used as the working cast. The wax pattern is prepared on the die and later transferred to the working cast. The main disadvantage of this method is the wax pattern may get distorted while transferring it from the die to the cast.
II. Working cast with removable dies

The final impression is poured for one time only to construct a working cast that involves removable dies.
Removable Die construction Techniques:

A. Dowel Pin technique
B. Pindex system
C. Di-lock tray technique
D. DVA Model system
E. Zeiser Model system.
A. Dowel Pin Technique

Dowel pins: these are ready-made metal pins which are used as a means of orienting the die(s) to the original working cast, which allow the die(s) to be easily removed and accurately replaced into the working cast. The dowel pin is tapered and cylindrical with one flat side for positive seating.
steps

1. Dry the impression.

2. A dowel pin is used for each prepared tooth. It is placed over the center of the prepared tooth parallel to its long axis. A bobby pin is used to hold the dowel pin in this position by placing it between its arms. The bobby pin is positioned **bucco-lingually** across the impression so that the dowel pin is centered directly over the prepared tooth. Then a straight paper pin is inserted between the arms of the bobby pin and into the impression buccally and lingually. The dowel pin is then stabilized within the bobby pin and the bobby pin itself against the straight pin with sticky wax.
3. The impression is placed over the vibrator and dental stone is added in small increments to about 2 mm above the cervical margin. The dental stone should cover the serrated end of the dowel pin.

4. When the first layer of the stone has set, the bobby pin(s) are removed from the impression. A ball of soft wax is placed on the tip of each dowel pin.
5. The surface of the first layer of the stone is lubricated with a separating medium, and a second layer of stone is poured (base) that should cover the dowel pin(s) completely.

6. After complete setting of the second layer of the stone, the cast is removed from the impression. Then using a sharp knife the wax ball which is placed on the tip of each dowel pin is removed.
7. A saw is used to section the proximal sides (mesial and distal) of each prepared tooth buccolingually to obtain the die. The cutting should be through the first layer only, and the cutting should be diverged toward the occlusal surface to facilitate removal of the die.
B) Pindex System

The pindex system is a reverse drill used to create a master cast with dies that can be removed and replaced repeatedly with great precision. The impression is poured without positioning and attaching dowel pins. The machine accurately drills parallel holes from the underside of a trimmed cast.
Steps

1. Pour the impression in a usual manner. Allow the cast to set 60 minutes and remove it from the impression.

2. Base of the cast is flat and smooth and parallel to the occlusal plane.
3. Cast is **15-20 mm** thick from gingival crest to the base
4. Place the cast on the flat table of the machine and direct the **light indicator** to be centralized over the prepared teeth.
5. The drill from the other side (toward the base) will **drill a hole in the base** in the center of the die.
6. Glue pins with cyanoacrylate cement
   - Long pin toward **facial**
   - Short pin toward **lingual**
   - Glue short pins first (better access)
7. Apply separating solution at the area of the removable die.

8. Pour second base with yellow stone
Saw mesial & distal to each removable die.
C. Di-lock tray technique

The Di-Lock technique involves the use of a specially articulated tray for precise reassembly of a sectioned definitive cast.

The impression is poured, and the cast is trimmed into a horseshoe configuration that fits in the special tray. The tray is filled with a second mix, and the cast is seated. When the stone has set, the tray is disassembled, saw cuts are made on each side of the preparation, and the resulting die is trimmed. The cast and die can be reassembled in the tray, which is then mounted on an articulator.