بكم إنذارهم الرحمن الرحيم
WORKING CASTS AND DIES
• **Working (or master) cast** is the positive reproduction of the prepared teeth, ridge areas, and other parts of the dental arch.

• **Die** is the positive reproduction of the prepared tooth and consists of a **suitable hard substance** of sufficient accuracy.
Requirements of the cast

1- It must reproduce both prepared and unprepared tooth surfaces.
2- Should be free of any bubbles or defects
Requirements of the cast

3- **All surfaces** of the teeth involved in the **anterior guidance** and the **occlusal surfaces** of all unprepared teeth must be properly reproduced to allow for precise articulation of the opposing casts.
Requirements of the cast

4- **All soft tissues** should be reproduced in the working cast, including all **edentulous spaces and residual ridge** contours for **proper pontic fabrication**.

5- Reproduction of the **adjacent & contralateral teeth** to allow **proper alignment & contouring**.

6- Reproduction of **the gingival tissue** accurately.
Requirements of the die

1- It must reproduce the prepared teeth exactly; all surfaces must be accurately duplicated and no air bubbles or voids can be accepted.

2- Finish line complete.

3- The remaining unprepared tooth structure immediately cervical to the finish line should be easily discernible on the die, ideally with 0.5 to 1 mm visible to identify the contour of the tooth & allow margin adaptation.
Materials Science
SELECTION CRITERIA
(Requirement of die material)

1- High **strength** properties to withstand handling without fracture or distortion.

2- High **surface hardness** to resist scratching or abrasion during wax pattern forming.

3- High **stability** and excellent **dimensional accuracy**.

4- **Accurate** detail reproduction.

5- Easily **sectioned and trimmed**.
SELECTION CRITERIA
Requirement of die material

6- Available in **contrasting colors**, so that the preparation margin can be easily detected.

7- Compatible with separating agents.

8- **Wettable** by wax.

9- Compatible with impression materials.
Die Materials

- 1. Improved stone
- 2. Epoxy resins
- 3. Amalgam
- 4. Ceramic (refractory die)
- 5. Electroplated
Working cast and die systems

• I. Working cast and a separate die
• II. Working cast with removable dies
• III. Single Die:
  Stone die
  Amalgam die
  Acrylic die
  Ceramic die (refractory die)
  Electroplated die
I. Working cast and a separate die

- Full arch cast for proximal contact and occlusion
- Sectional cast (Separate die) for wax coping and margins
I. Working cast and a separate die

The working cast & separate dies can be obtained either from:

1- **Separate impression.**
2- Pouring full arch impression **twice (double pour).** In this case the impression material must be rubber base because hydrocolloid (alginate will be distorted if poured twice.
Advantages:

• Ease of fabrication
• Keep the relationship between abutments fixed and immovable.
• The gingival tissues are intact, so we can easily obtain harmonious contour of the wax pattern.
Disadvantages:

- Fragile wax patterns are difficult to transfer between the two parts (from cast to die). So distortion of some of internal adaptation.

- The second pour of the impression may be different (slightly larger) than the first, therefore, seating of the wax pattern may be problematic. It may be necessary to relieve the stone slightly to seat the pattern.
Impression pouring
Impression pouring

• Hard **improved stone** should be used for fabricating the die & cast to prevent surface abrasion

• **Wash the impression** under cold running tap water to remove mucous & saliva.

• Follow the manufacturer’s instructions for the **correct water/powder ratio**, which may affect **setting time, porosity, setting expansion** and **ultimate strength**.
Impression pouring
Mix water and stone by hand with spatula until the powder is completely wet then use vacuum.

Rubber impression should be completely dry, the surface should be free of visible water, but it should still shiny, if the surface appears dull, it has been over dried, and some distortion may occur, then apply the surfactant.
Impression pouring

Proportion P and L

Bulk P
Pre-packaged P

Microstone
Impression pouring

• Using a small instrument to carry stone to the impression of the prepared tooth, place a small amount of stone on the side of the impression above the preparation and vibrate till stone reaches the occlusal surface of the preparation.

• Tilt the impression so that the stone flows slowly across the bottom of the preparation, add stone in small increments. If a large amount of stone is dropped, air will be trapped, and voids will result in the cast.
Impression pouring

• Add small increments of stone to the distal most area of one side of the impression, slowly raise the distal end of the impression, so that stone will move mesially flowing from tooth to tooth and filling each of them from the bottom.

• Add stone and vibrate until all the teeth in the arch are filled.
• Build the stone up to a height approximately one inch over the preparation to allow bulk for an adequate handle of the die.

• To pour a full arch impression, place the tray on the vibrator.
Die Preparation

- The cast from which the die is made, is trimmed on a model trimmer to remove all excess stone around the prepared tooth.

- The cast cutting it down to form the handle of the die, the handle of the die should be slightly large in the diameter than the preparation. Its sides should be parallel or slightly tapered toward the base, and should be parallel to the long axis of the tooth, The handle is approximately one inch long

- Trim the die gingival to the finish line of the preparation, this area should be smooth and free from irregularities.
Die Preparation

- After the die has been trimmed, the finish line should be highlighted with a sharp color bright red pencil, this facilitate carving the margins of the wax pattern.

- The die is then painted with a die strengthening material to close the stone micro porosities, and harden it and decrease scratching.

- The preparation area of the die should be painted with a die relief material to provide space for cement, a relief of 25-50 microns is desired, the tooth preparation on the die is painted within 1-0.5 mm of the finish line.
II. Working cast with removable dies

• Retained by pins in a base (stone or plastic)
• One die used for proximal contacts, occlusion and margins
Requirements of Removable Dies

1. The dies must return to their exact positions.
2. Dies are stable even when inverted and accurately related to adjacent and opposing teeth.
3. Dies are removable individually.
4. The cast containing the die must be easily mounted on the articulator.
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
1-A dowel pin is positioned over each **prepared tooth** in the impression.
2-if the dowel pins are **positioned inaccurately**, they may:
A- impinge on the margins,
B- weaken the die.
C-prevent it from being **easily removed from the cast**.
3- **Bobby pins** can be used for positioning the dowel pins.
4- A dowel is placed between the arms of the bobby pins.
5- The bobby pin is positioned **bucco-lingually across the impression** so that the dowel pin will be entered directly over the preparation & must not touch the impression.
6-The pins should be **flat from one side** to prevent rotation.

7-Stabilize the dowel in the booby pin with **sticky wax**.

8-Die stone is then poured into the impression, filling the impression of the teeth and covering the end “constriction” of the dowel pin.
9-Place a ball of soft wax on the tip of each dowel.

10- The stone around each dowel is lubricated with a thin coat of petrolatum to permit easier separation of the die from the working cast.

11- Then pour stone of the complete base. After complete setting of the stone, remove the cast from the impression and trim off the excess on a model trimmer.
12-Use sharp knife to remove the spheres of utility wax.

13-When the stone is hard and dry, use a saw to cut through the layer of die stone, mesially and distally on each die, the cuts should taper toward each other slightly from occlusal to gingival.
14-Loosen the die gently using an instrument handle.

15-Place wax around the tips of the dowels to protect them from the plaster contamination.

16-Soak the cast in the water and mount it on the articulator, using mounting plaster. After hardening of the plaster remove the the wax covering the tips of the dowels.
17-Trim away any excess stone gingival to finish line, then mark the finish line with the red pencil.

18-Repeat the procedure for each die on the cast.

19-Reseat the dies to make certain that they will seat completely and will be stable.
Sectioning and die preparation
Die trimming:

- Remove most of excess stone with Arbor band.

- Use a pear-shaped acrylic bur to trim the die apical to the finish line of the preparation.

- Then fine trimming and smoothening with scalpel.
Advantages of die trimming:

- **Accentuate** the finish line
- Resembling the normal contour of the **natural root** for proper cervical contouring of the wax pattern.
- **Produce smooth area** gingival to the finish line
The original contour of the tooth structure below the margin must be preserved. Over trimming (dotted line) will result in over contoured restoration.
Die Preparation

• 1. Apply die hardener
  – Cover die beyond finish lines
  – Allow to set for 5 minutes

• 2. Apply die spacer
  – 40 micron thickness allows space for cement
  – 2-3 coats placed
  – Spacer 1 mm from finish line
  – Remove excess with die setting retardant
STONE DIE & PLASTER HARDENER RESIN

A LIQUID PLASTIC which impregnates the stone die. Hardens stone, protects margins, seals and waterproofs. Does not change dimensions of die, or model.

Brush liquid on the stone die or model. Apply 1 or 2 thin coats, allowing 10 to 15 seconds between applications for liquid to be absorbed.
B) Pindex System

Pilot light
Light beam director
Drill hole
Work table
Handle bar
On-off switch
Motor housing
The Pindex system is a reverse drill press is 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 trimmed cast.
• **Steps**

• 1. **Pour the impression** with correct w/p ratio of extra hard stone

• 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.

• 5. Direct the **light indicator** to be centralized over the prepared teeth.

• 6. The drill from the other side (toward the base) will **drill a hole in the base** in the center of the die.

• 7. Each segment must have at **least 2 pins** (∥ to each other) for stability and to prevent rotation
Base of cast to gingival crest 15-20 mm
Index the Cast

1. Glue pins with cyanoacrylate cement
   - Long pin toward **facial**
   - Short pin toward **lingual**
   - Glue short pins first (better access)

2. Place **sleeves** on pins (stability of pins)

3. Box and seal cast

4. Apply separating solution at the area of the removable die.

5. Pour second base with yellow stone

6. Saw mesial & distal to each removable die.
C. Di-lock tray technique
A snap-apart plastic tray with internal orienting grooves and notches also can be used to reassemble the working cast and die.
In this technique to pour the cast, use special tray with orientation grooves on the inner aspect & is made of multiple components, which can be assembled or dismantled.

Impression is poured using two-pour technique.

The first pour is poured up to the level of the impression and the second or base pour is poured after positioning the rim of the di-lok tray over the impression.

Later, the di-lok tray is dismantled and the grooves on the base of the cast formed by the di-lok tray is used as a guide to do die sectioning.
Single pour technique

When set it is removed

The tray is removed

Sectioning ¾ through the stone

Separated and trimmed dies

Mounted cast and tray
III. Single Die
Single Copper band impression technique:

Indication:

- Impression for a single **full metal crown** preparation.

Used with **either impression compound or rubber base** impression material.

Copper band are supplied in **different sizes** and diameter to fit for anterior, premolars and molars.
Copper band impression
Types Of Single Dies

1. Stone die
2. Amalgam die
3. Acrylic or epoxy die
4. Refractory die
5. Electroplated die (silver or copper)
I- Stone die

**GYPSUM PRODUCTS:**
- Type I: Impression Plaster
- Type II: Model plaster
- Type III: Dental stone
- Type VI: High strength dental Stone
- Type V: Improved Stone, Die Stone

Edentulous Cast  Orthodontic Model  Working Cast

Removable Die with Waxed Inlay
I) GYPSUM

Advantages

• Inexpensive
• Compatible with most impression materials
• Reproduce fine details in the impression.
• Easy to use
GYPSUM

Disadvantage

1) Poor resistance to abrasion

Overcome by:

- **Gypsum hardeners** (colloidal silica)
- Application of **low viscosity resin** (Cyanoacrylates).
- Resin-strengthened gypsum product e.g **Resin Rock**
- **Gum arabic and calcium hydroxide mixture.**
2) Setting expansion:
Linear expansion occur during setting (0.06-0.9%).

To Control setting expansion: **Avoid**:
1. Decrease water/ powder.
2. Increasing mixing time.
3. Immersion of gypsum products in water during the setting process.
4. Increasing temperature of mixing water( from 23-30°).

Follow the manufacturer’s instruction for the current water/powder ratio and manipulation.
II) RESIN

- Resin are used as a die material to overcome the low strength and abrasion resistance of die stone e.g:
  - Epoxy resin
  - Polyurethane
- Certain impression materials, **polysulfide & hydrocolloid** are not compatible with resin. But good results are achieved with **silicone & polyether**.
RESIN

Advantages
• High strength
• High abrasion resistance

Disadvantages
• Expensive
• Polymerization shrinkage of resin material so undersized die.
• Long setting time.
III) Ceramic (Refractory die)

- Ceramic material mainly **quartz silica**
- Can withstand very high temperatures without any distortion
- Special for construction of all-ceramics because it allows **porcelain to be built direct on the die**.
Amalgam die

Used only with **copper bands with impression compound**

**Advantages:**
- Very hard die

- **Disadvantages**
- Dimensionally unstable (setting expansion)
- Long setting time
Electroplated die

Electrolytic deposition of a coat of pure metal on the impression.
This technique if performed properly, an electroplated die can be as accurate as die stone.
A. Copper plated die

- Impression compound
- Or Silicon rubber base

Metalizing stage

The impression compound metalized by painting graphite to conduct electricity.

1. The impression rubber base metalized by copper powder.
• Impression connected to cathode (-ve)
• Impression submerged into tank solution (electrolyte):
• Copper plate at anode must be 8 inches away from impression.
• 20 mA current
• 12 hours plating
• After complete plating, pouring the impression with stone or resin.
B. Silver plated die

- The impression material is rubber base.
- Washing and drying impression
- **Metalizing** the impression *(silver powder)*.
• Impression submerged into tank solution (electrolyte)
• Bar of silver as anode (+ve),
• placed 4 inches away from impression
• 10 mA current
• 12 hours plating
• After complete plating, pouring the impression with stone
• The main disadvantage of silver plating is that a cyanide solution is used & this needs special precautions because of its extreme toxicity.

• This technique cannot be performed with all impression materials.
- **Silicone impression** materials have low surface energy, are difficult to be electroplated.

- **Polyether impressions**, because of their hydrophilic nature imbibe water & become distorted.

- **Polysulfide polymers** can be silver plated, but it is much more difficult to copper plate them.
Thank you!