

Introduction

Prosthetics: The art and science of supplying artificial replacements for missing parts of the human body.

Prosthodontics (Prosthetics dentistry): Is the dental specialty pertaining to the diagnosis, treatment planning, rehabilitation and maintenance of the oral function, comfort, appearance and health of patients with clinical conditions associated with missing or deficient teeth and/ or maxillofacial tissues using biocompatible substitutes.

Prosthesis: An artificial replacement of an absent part of the human body.

Dental prosthesis: An artificial replacement of one or more teeth (up to the entire dentition in either arch) and associated dento/alveolar structures.



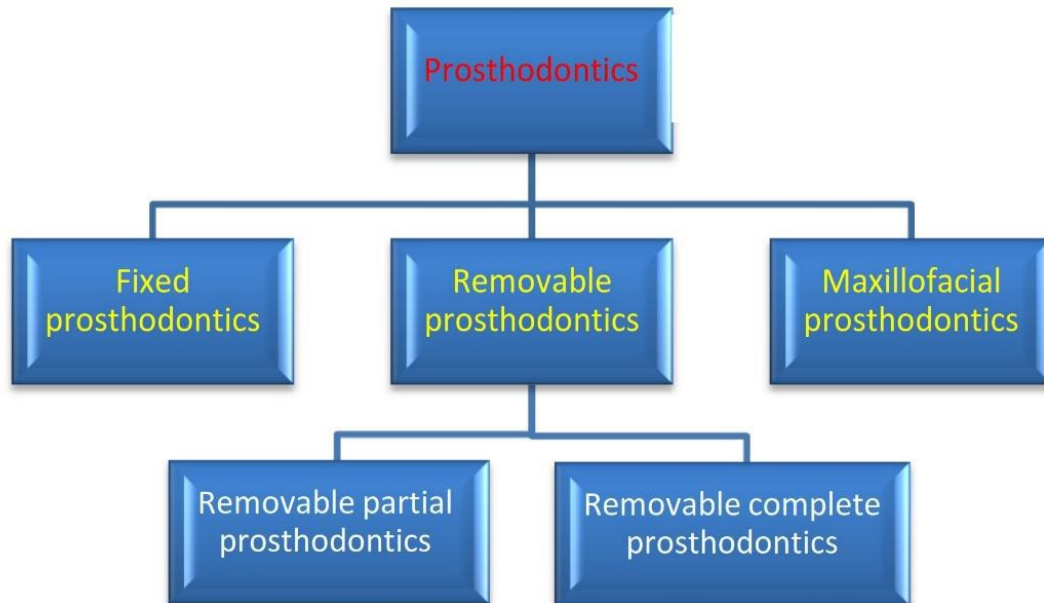
Fixed dental prosthesis: Any dental prosthesis that is luted, screwed, mechanically attached or otherwise securely retained to natural teeth, tooth roots, and/or dental implant abutments that furnish the primary support for the dental prosthesis. This may include replacement of one to sixteen teeth in each dental arch.



Removable dental prosthesis: Any dental prosthesis that replaces some or all teeth in a partially dentate arch (Partial removable dental prosthesis) or edentate arch (complete removable dental prosthesis). It can be removed from the mouth and replaced at will.



Complete denture: A removable dental prosthesis that replaces the entire dentition and associated structures of the maxillae or mandible, called a complete removable dental prosthesis.



Objectives of Complete denture:

1. Restoration of the function of mastication.
2. Restoration of the disturbed facial dimensions and contours. (esthetics)
3. Preservation of the remaining tissues in health.
4. Satisfaction, pleasing and comfort of the patient.
5. Correction of speech due to the loss of natural teeth.

General consideration in complete denture construction:

1. From the operator:

- a. Certain degree of diagnostic skills.
- b. Sound knowledge of biological and mechanical principles to provide a patient with complete denture.
- c. Certain degree of artistic ability to achieve good esthetic requirements.
- d. Careful manipulation of dental materials and devices.

2. From the patient:

- a. Co-operation with the dentist.
- b. Some understanding of the limitation of prosthetic restoration.
- c. Patience during the construction, learning and adjustment of the new prosthesis.

3. From the technician: There should be co-operation between clinical and technical procedures.

Complete denture is composed of the following:

1. Basal or impression surface:

The part of a denture that rests on the foundation tissue and to which teeth are attached.

2. Denture occlusal surface:

The portion of the surface of a denture that makes contact with its antagonist.

3. Denture polished surface:

The portion of the denture surface that extends in an occlusal direction from the border of the denture and include the palatal surface. It is usually polished and includes the buccal and lingual surfaces of the teeth.

4. Denture border:

The margin of the denture base at the junction of the polished surface and the impression surface.

5. Denture flange:

The part of the denture base that extends from the cervical ends of the teeth to the denture border.

ANATOMICAL LANDMARKS

The anatomy of the edentulous ridge in the maxilla and mandible is very important for the design of a complete denture. The consistency of the mucosa and the architecture of the underlying bone is different in various parts of the edentulous ridge.

Hence, some parts of the ridge are capable of withstanding more force than other areas. A thorough knowledge of these landmarks is essential even prior to impression making.

ANATOMICAL LANDMARKS IN THE MAXILLA

The anatomical landmarks in the maxilla are:

Limiting Structures

- Labial frenum
- Labial vestibule
- Buccal frenum
- Buccal vestibule
- Hamular notch
- Posterior palatal seal area (vibrating line).
- fovea palatina.

Supporting Structures

Primary stress-bearing areas:

- Hard palate.
- The postero-lateral slopes of the residual alveolar ridge

Secondary stress-bearing areas:

- Rugae
- Maxillary tuberosity.

Relief Areas:

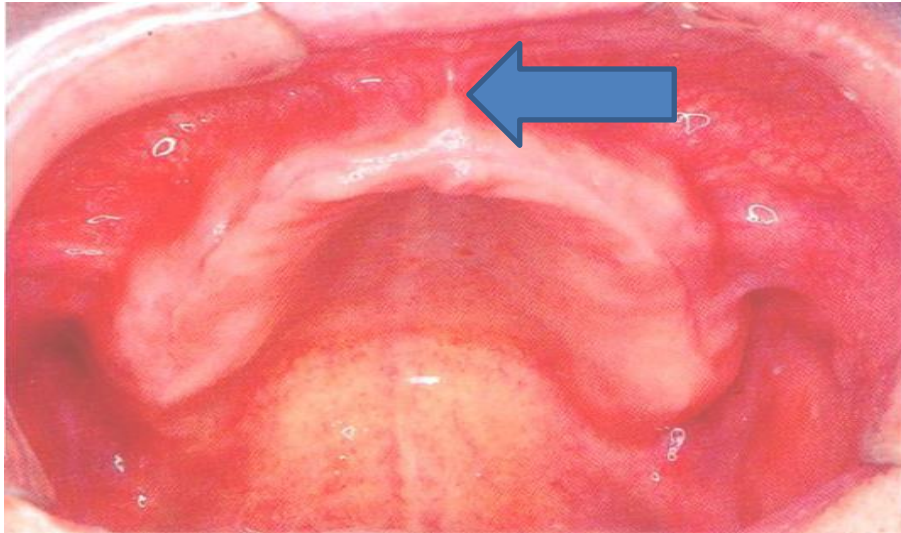
- Incisive papilla
- Cuspid eminence
- Mid-palatine raphe
- Zygomatic process
- Torus palatinus

Limiting Structures

They determine and confine the extent of the denture.

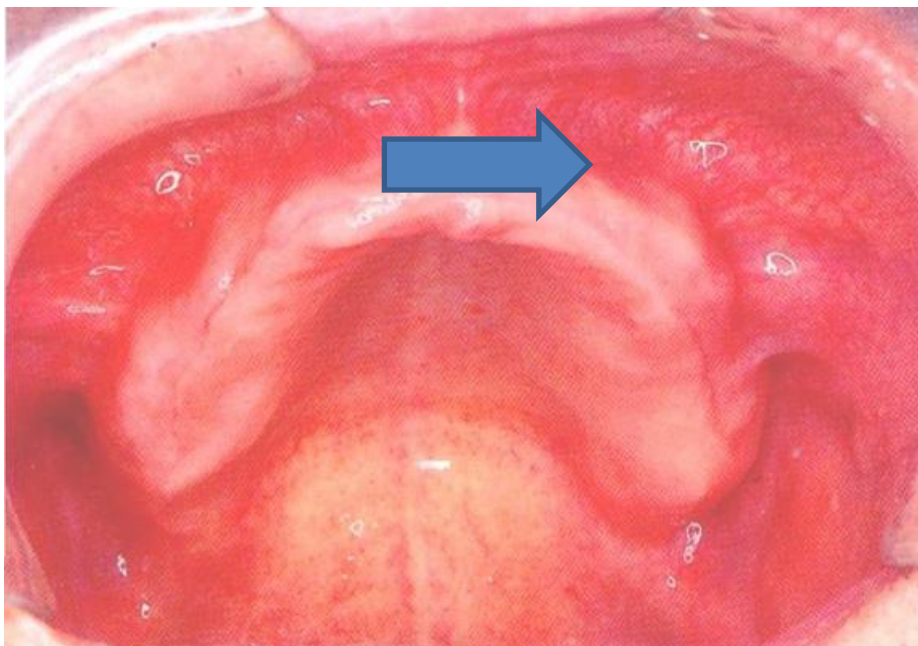
1. Labial Frenum

It is a fold of mucous membrane extends from the mucosal lining of upper lip to the labial surface of the residual ridge. The Frenum may be single or multiple, narrow or broad. It contains no muscle fibers and insert in a vertical direction which creates a maxillary labial notch in the maxillary impression or denture.



2.Labial vestibule

It extends on both sides of the labial frenum to the buccal frenum, bounded by the upper lip and residual alveolar ridge. The reflection of the mucous membrane superiorly determines the height of the vestibule. It contains no muscle fibers. In the denture the area that fills this space is known as labial flange



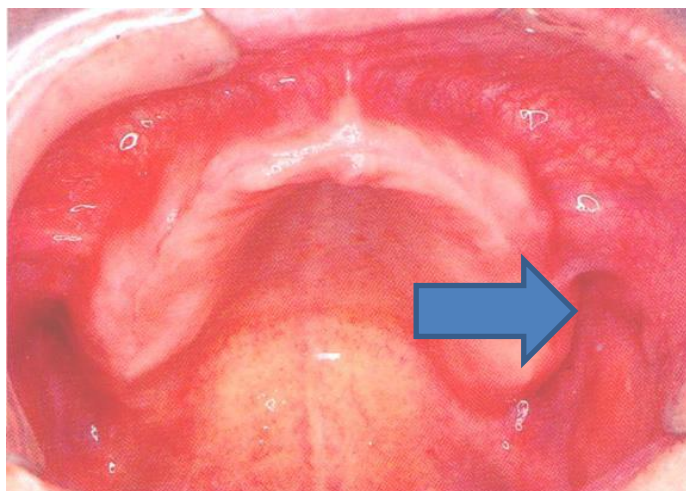
3-Buccal Frenum

A fold or folds of mucous membrane varies in size and shapes. It extends from the buccal mucous membrane reflection area toward the slope or crest of the residual alveolar ridge. It contains no muscle fibers and its direction antero-posteriorly. It produces the maxillary buccal notch in the maxillary impression or denture which must be broad enough because of the movement of the Frenum which is affected by some of the facial muscles as the orbicularis muscle pull it forward while buccinator muscle pull it backward.



4.Buccal vestibule

Is the space distal to the buccal frenum. It is bounded laterally by the cheek and medially by the residual alveolar ridge. The area of the denture which will fill this space is known as buccal flange. The stability and retention of a denture are greater enhanced if the vestibule space properly filled with the flange distally.

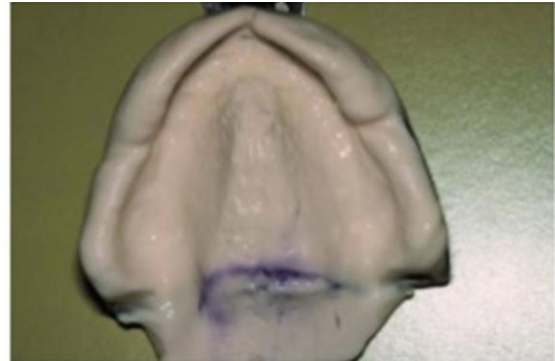


5.Hamular notch

It is a narrow cleft of loose connective tissue situated between the maxillary tuberosity and the pterygoid hamulus (approximately 2mm antero-posteriorly). It is used as boundary of the posterior border of maxillary denture.

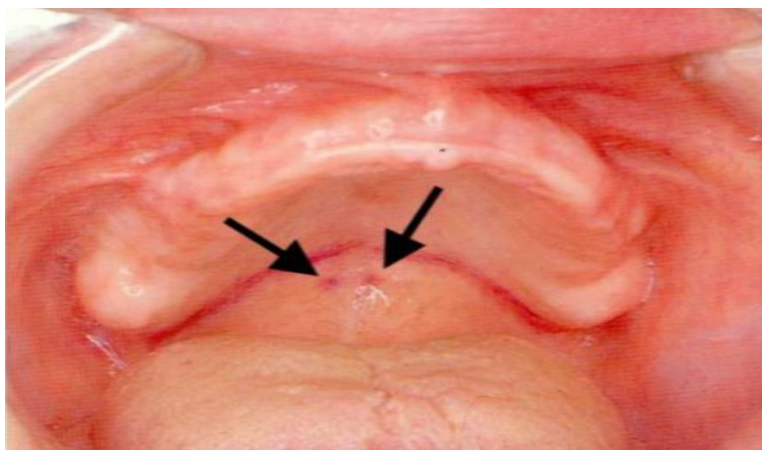
6.Vibrating line

An Imaginary line drawn across the palate extended from one hamular notch to the other.it is not well defined as a line; therefore it is better to describe it as an area rather than a line. The direction of the line varies according to the shape of the palate in the denture. The posterior border of the denture known as posterior palatal seal area.



7.Fovea palatinae

These are two indentations on each side of the midline formed by a coalescence of several mucous gland ducts. They act as a guide in the location of the vibrating line of the posterior border of the denture.



Supporting Structures

These areas are the load-bearing areas. They show minimal ridge resorption even under constant load. The denture should be designed such that most of the load is concentrated on these areas.

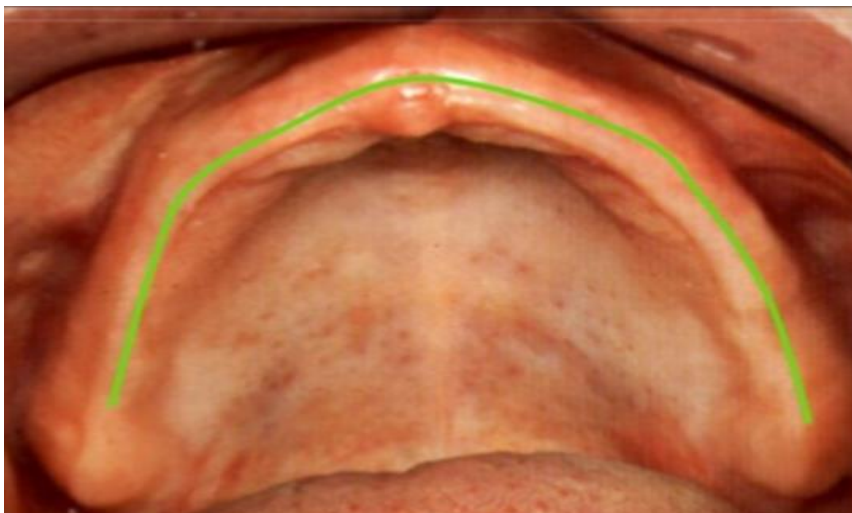
It can be Primary stress bearing areas or supporting area represented by the horizontal portion of the hard palate lateral to the midline and Slopes of residual alveolar ridge and a Secondary stress bearing area or supporting areas represented by Rugae area and Maxillary Tuberosity.

1. Residual alveolar ridge:

The bony process that remain after teeth have been lost is known as **Residual alveolar ridge** which is covered by mucous membrane.

The slope of the Residual alveolar ridge considered to be as a primary stress bearing area.

And it will produce the ridge fossa or groove in the impression or denture.



2. Maxillary tuberosity

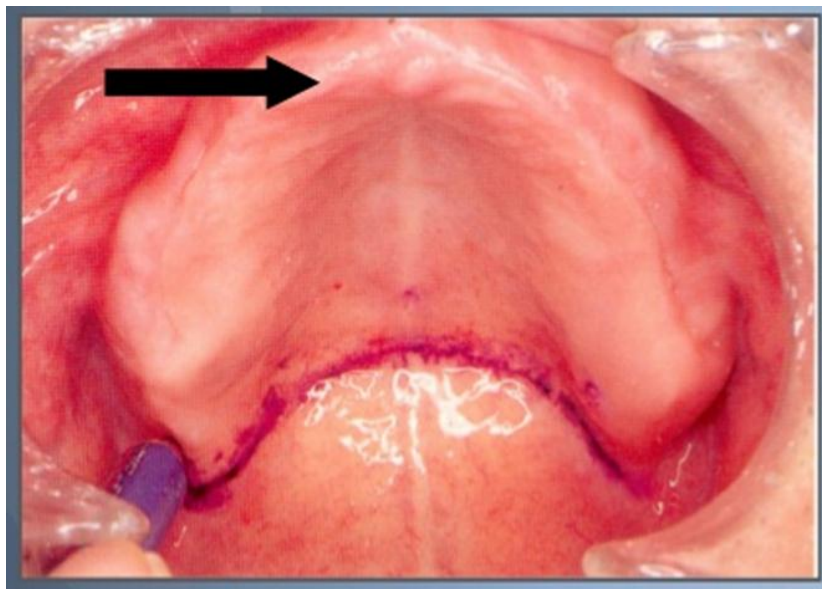
It is the area of the alveolar ridge that extends distally from the second molar to the hamular notch in some cases it may be very large in size and not allow for proper placement of the denture so may need surgical interferences.



Maxillary tuberosity may be oversized, resorbed or undercut areas; in case of oversized and undercut type surgical corrections may be needed.

3. Rugae area

These are raised areas of dense connective tissue in the anterior One-third of the palate. It aid in the formation of vocal sound also regarded as a secondary stress bearing area.



Relief Areas

These areas resorb under constant load or contain fragile structures within. The denture should be designed such that the masticatory load is not concentrated over these areas.

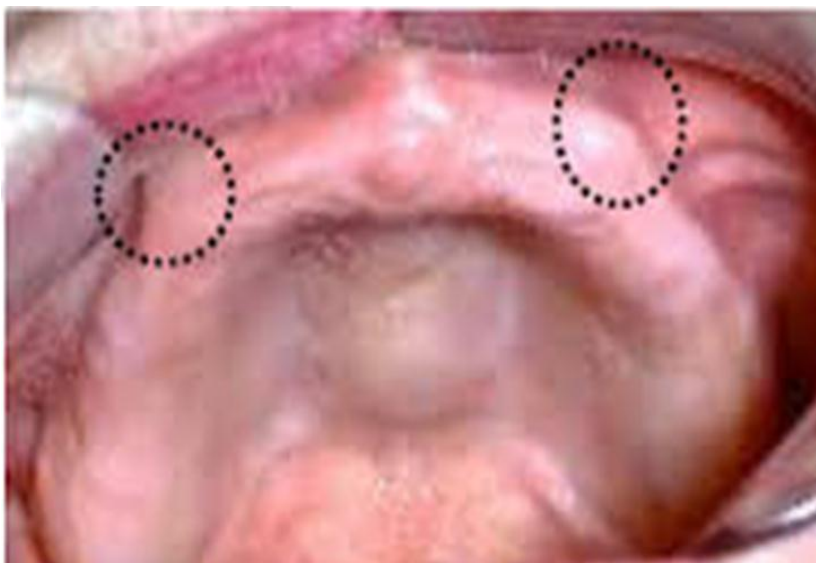
1.Incise papilla

It is a pad of connective tissues lies between the two central incisors on the palatal side overlying the incisive foramen of the nasopalatine duct where the nasopalatine nerves and vessels arise. In an edentulous mouth it may lies close to the crest of the residual ridge. Relief over the Incisive papilla should be provided in the Denture to avoid pressure on the nerve and blood supply.



2.Canine eminence

It is a round elevation in the corner of the mouth, it represent the location of the root of the canine which is helpful to be use as a guide for the arrangement of maxillary anterior teeth.



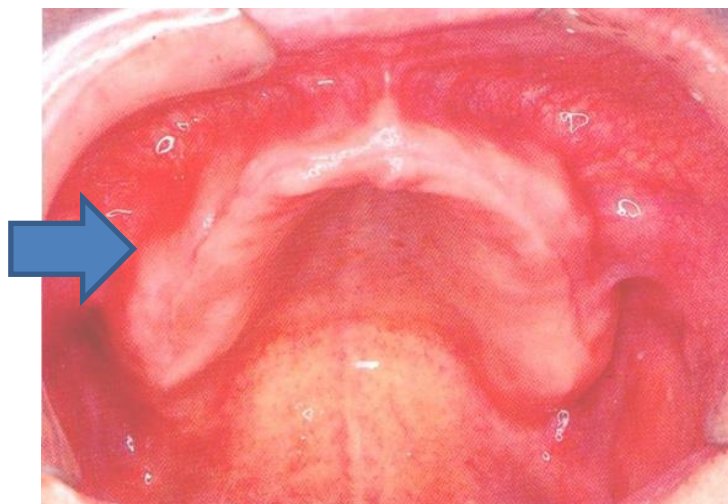
3. Median palatal raphe

It overlies the medial palatal suture; extend from the incisive papilla to the distal end of the hard palate. The mucosa over this area is usually tightly attached and thin, the underlying bony union being very dense and often raised, the palatal tori are located here if present.



4. Zygomatic process

It is located opposite to the 1st molar region, hard area found in the mouth that has been edentulous for long time. Relief over this area may be required to prevent soreness of the underlying tissues.



5. Torus palatinus

It is a hard bony enlargement occurs in the midline of the roof of the mouth (hard palate). It is found in 20% of some patient, surgical correction may be needed if the tori very large.



ANATOMICAL LANDMARKS IN THE MANDIBLE

They can be broadly grouped into:

Limiting Structures

- Labial frenum.
- Labial vestibule.
- Buccal frenum.
- Buccal vestibule.
- Lingual frenum.
- Alveololingual sulcus.
- Retromolar pads.
- Mylohyoid ridge.
- External oblique line.

Supporting Structures

- Buccal shelf area
- Residual alveolar ridge

Relief Areas

- Crest of the residual alveolar ridge.
- Mental foramen.
- Genial tubercles
- Torus mandibularis.

Labial Frenum

It is a fibrous band similar to that found in the maxilla. Unlike the maxillary labial frenum, it is active. The mandibular labial frenum receives attachment from the orbicularis oris muscle. Hence, it is quite sensitive and active. On opening wide, the sulcus gets narrowed.



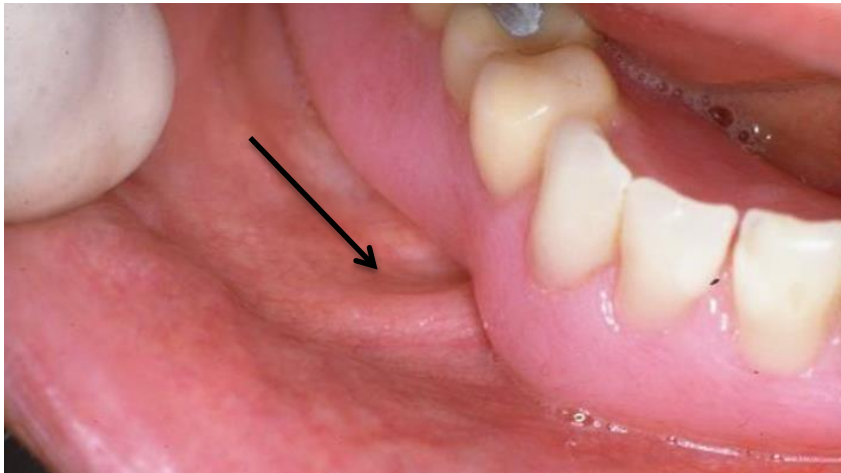
Labial Vestibule

This is the space between the residual alveolar ridge and the lips. The length and thickness of the labial flange of the denture occupying this space is important in influencing lip support and retention.



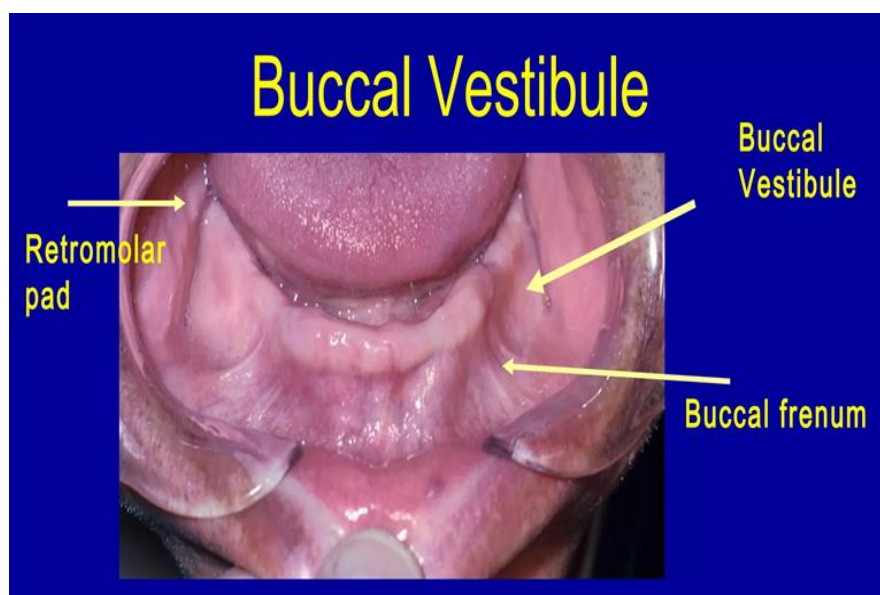
Buccal Frenum

The fibers of the buccinator are attached to the frenum. It should be relieved to prevent displacement of the denture during function.



Buccal Vestibule

It extends posteriorly from the buccal frenum till the retromolar region. It is bound by the residual alveolar ridge on one side and buccinator on the other side.



Lingual Frenum

It is a fold of mucous membrane can be observed when the tongue is elevated, extending along the floor of the mouth to the under surface of the tongue. It will produce the lingual notch in the denture. This frenum is activated when the tongue is moved therefore it must be molded well in the impression to prevent displacement of the denture or ulceration of the tissue.

The height and width of the frenum varies considerably. Relief should be provided in the anterior portion of the lingual flange. This anterior portion of the lingual flange is called *sub-lingual crescent area*



Alveololingual Sulcus

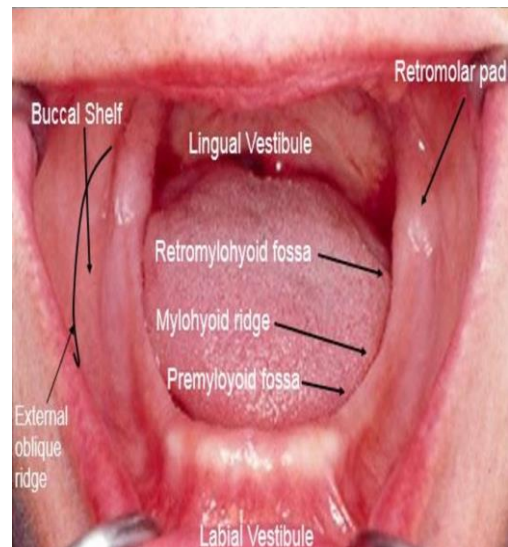
It extends from the lingual frenum to the retromylohyoid curtain. It is considered in three regions namely:

Anterior region It extends from the lingual frenum to the premylohyoid fossa, where the mylohyoid curves below the sulcus. The flange will be shorter anteriorly and it should touch the mucosa of the floor of the mouth when tip of the tongue touches the upper incisors.

Middle region It extends from the pre-mylohyoid fossa to the distal end of the mylohyoid ridge. This region is shallower than other parts of the sulcus. This is

due to the prominence of the mylohyoid ridge and action of the mylohyoid muscle.

Posterior region The retro-mylohyoid fossa is present here. The denture flange in this region should turn laterally towards the ramus of the mandible to fill up the fossa and complete the typical S-form of the lingual flange of the lower denture.



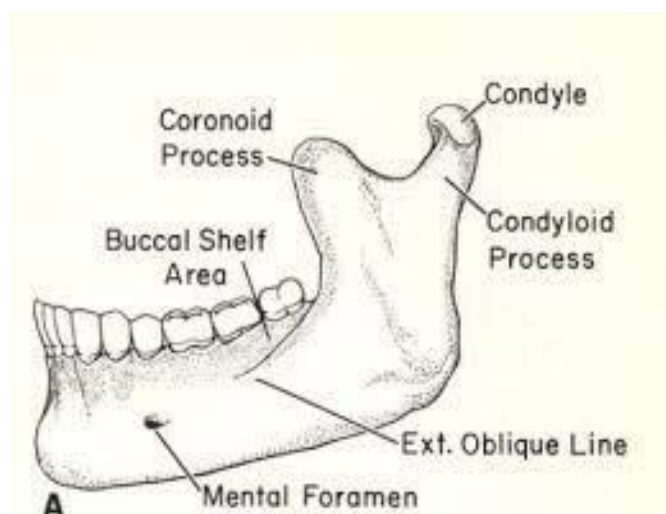
Retromolar Pad (Pear-Shaped Pad):

The retromolar pad, is soft elevation of mucosa that lies distal to the third molar. It contains loose connective tissue with an aggregation of mucous glands and is bounded posteriorly by the temporalis tendon, laterally by the buccinators and medially by the pterygomandibular raphe and the superior constrictor muscle. The retromolar pad is quite important for the support and the peripheral seal.



External oblique ridge:

It is a ridge of dense bone extended from just above the mental foramen superiorly and distally to be continuous with the anterior border of the ramus. In some patient this ridge becomes a guide for the termination of the buccal flange of the denture.



Relief area:

1. Mental Foramen:

It is located on the external surface of the mandible between the 1st and 2nd premolar area. In case of sever resorption of residual ridge, the denture should be relieved over the foramen to prevent pressure being applied on the mental nerves and blood vessels.



2. Genial tubercle:

These are a pair of bony tubercles found anteriorly on the lingual side of the body of the mandible. Due to resorption, it may become increasingly prominent making denture usage difficult.



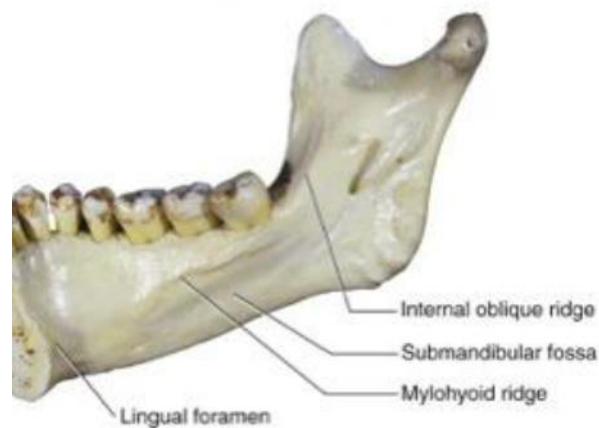
3. Torus Mandibularis:

It is an abnormal bony prominence found bilaterally on the lingual side, near the premolar region. It is covered by a thin mucosa. It has to be relieved or surgically removed as decided by its size and extent.



4- Mylohyoid ridge:

It is an irregular bony crest on the lingual surface of the mandible. This ridge is near the inferior border of the mandible in the incisor region but becomes higher posteriorly until it terminates near the 3rd molar area; it is the area where the mylohyoid muscle arises to the floor of the mouth. The border of the lingual flange may extend below the mylohyoid line if it slopes toward the tongue.



Supporting Structures:

The mandibular denture poses a great technical challenge. The support for a mandibular denture comes from the body of the mandible. The available denture-bearing area for an edentulous mandible is 14 cm² but for maxilla it is 24 cm².

Buccal Shelf Area:

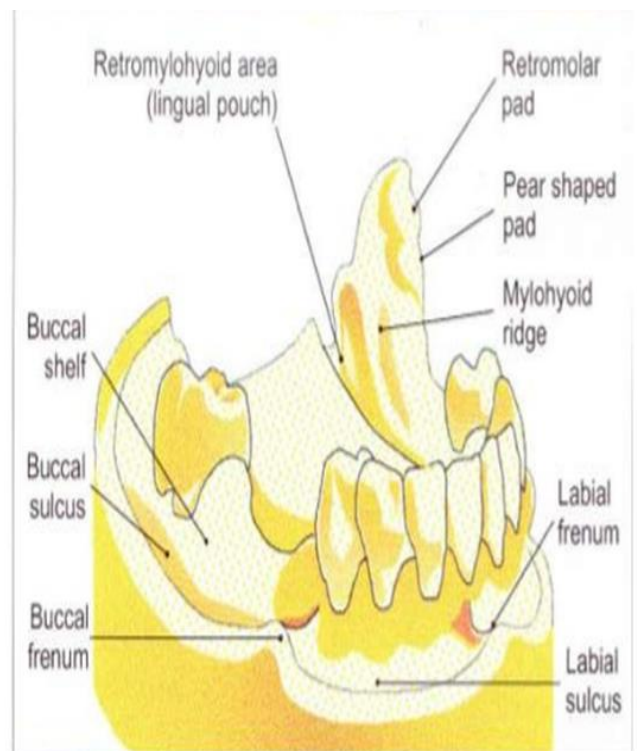
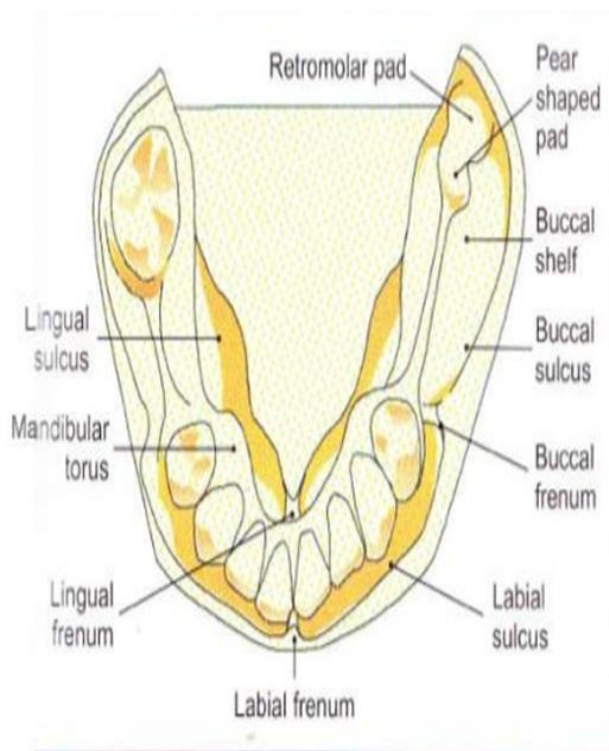
It is the area between the buccal frenum and anterior border of the masseter. Its boundaries are:

- Medially the crest of the ridge
- Distally the retro-molar pad
- Laterally the external oblique ridge.



Residual Alveolar Ridge:

The bony process that remains after loss of teeth is known as residual alveolar ridge bone. The size and shape of the ridge varies from one patient to another. The bone of crest of lower residual ridge being made of spongy bone therefore may not be favorable as a primary stress bearing area for the lower denture. It won't provide stability or support to the denture.



Complete denture impression

Impression Trays

In complete denture prosthesis we make two impressions for each patient, a primary impression and final or secondary impression. To make an impression we should have impression tray.

Impression tray: it is a device used to carry, confine and control the impression material from the patient's mouth while making an impression.

During impression making, the tray facilitates insertion and removal of impression material from the patient's mouth.

Parts of the impression tray:

Impression tray consists of two main parts:

1. Body: it is consisting of:

* Floor

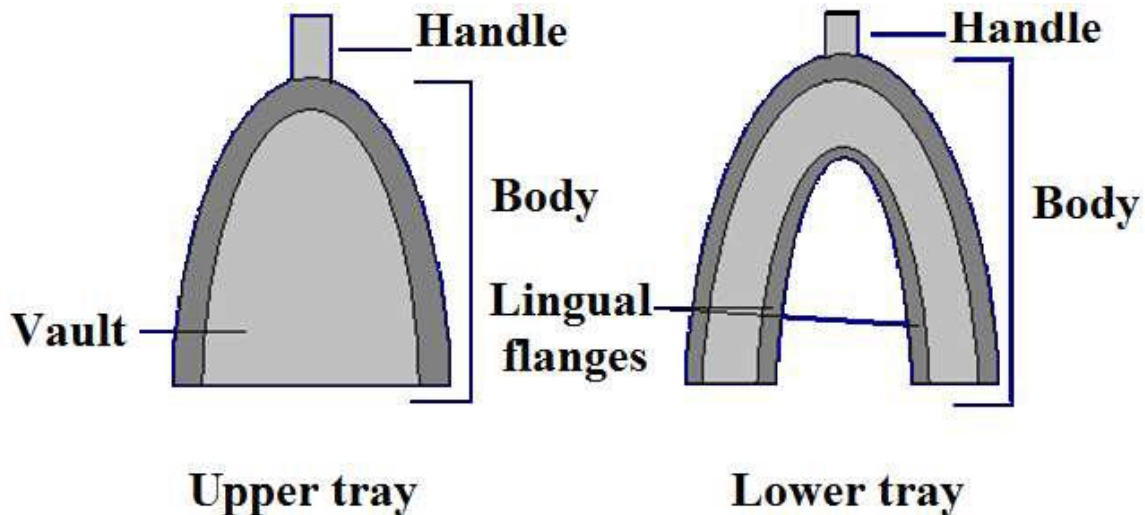
* Flanges

2. Handle:

The handle is an extension from the union of the floor and labial flange in the middle region (midline), it's (L) in shape so that it will not interfere with lip during impression procedure.

*There are upper tray to make impression of maxillary arch and lower tray to make impression of mandibular arch.

*The difference between them is that in the upper tray, there is the palatal portion we called (vault) and in the lower tray there is the lingual flanges.



Types of trays

There are 2 main types:

1. **Stock trays:** These are used for primary impression procedure.
2. **Special trays or individual trays:** These are used for final impression procedure.

1. Stock trays:

Impression trays serve to carry the impression material to the mouth and support it in the correct position while it is hardening. This type of the trays can be used for several patients and used for making primary impression.

They are made of different materials such as aluminum, stainless steel, tin, brass or Plastic, in variety of shapes, size was made to fit different mouths.

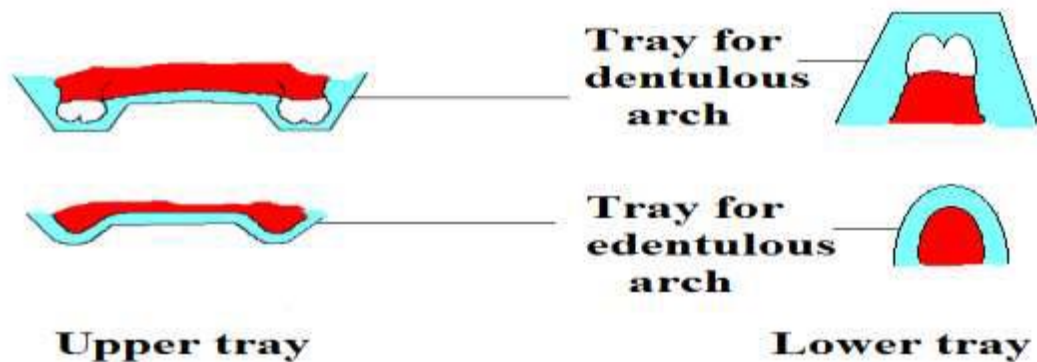
Types of stock trays

A. Stock tray for dentulous patient

B. Stock tray for edentulous patient

*We can distinguish between them by: stock trays for dentulous patient have long flanges, wide and flat floor, while the other have short flanges, oval and narrow floor.

*Tray with combination flat and oval floor is suitable for partial denture work.



Stock trays can be classified according to impression material in to two types:

1. Perforated stock tray. (These types used with alginate impression material)

a. Perforated stock tray without rim lock.

b. Perforated stock tray with rim lock (rim lock stock tray).

2. Non - perforated stock tray.

a. Non - perforated stock tray without rim lock used with impression compound.

b. Non - perforated stock tray with rim lock used with alginate impression material.

Factors effect in selection of stock tray

- 1.** The type of impression material used in the primary impression procedure. Example; with impression compound we used non-perforated tray because it will be stick on the tray. And if we use alginate impression material we should use perforated stock tray.
- 2.** Size of the arch.
- 3.** Form of the arch. (Round, square and taper).
- 4.** The stock tray must cover all the anatomical landmarks needed in complete denture and this is a most important point.
- 5.** Stock tray should give a sufficient space to impression material in all direction (the stock tray should leave sufficient room or space for impression material 4-5mm).

2. Special tray (Individual or custom tray):

An individualized impression tray made from a cast recovered from primary impression. It is used in making a final impression.

Special tray is constructed on the primary cast. As edentulous ridge show variations of shape and size (some have flattened ridges and other have bulky ridge), for this reason stock tray can fit the ridge only in an arbitrary manner, so special tray is constructed.

Advantages of special trays

- 1.** Economy in impression material (used less impression material required in special tray).
- 2.** More accurate impression.
- 3.** Special tray provides even thickness of impression material. This minimizes tissue displacement and dimensional changes of impression material and produce impression with correct extension.
- 4.** The work with special tray is easier and quicker than modifying stock tray to provide accurate impression.
- 5.** Special tray is more accurately adapted to the oral vestibules, this helps in better retention of denture.
- 6.** Special tray is less bulky than stock tray which is more comfortable for the patient.

Materials used for construction of special tray

The special tray can be constructed by the use of different materials; this is depending on the type or technique of impression taking. It can be constructed from:

- 1.** Cold cure acrylic resin or self-cure acrylic resin or auto-polymerizing acrylic resin (more common).
- 2.** Visible light cured acrylic resin (VLC).
- 3.** Shellac base plate.
- 4.** Impression compound (some time).
- 5.** Heat cure acrylic resin (rarely).

Types of special tray

We have two types of special tray:

1. Spaced special tray (with or without stoppers).
2. Closed fitted special tray.

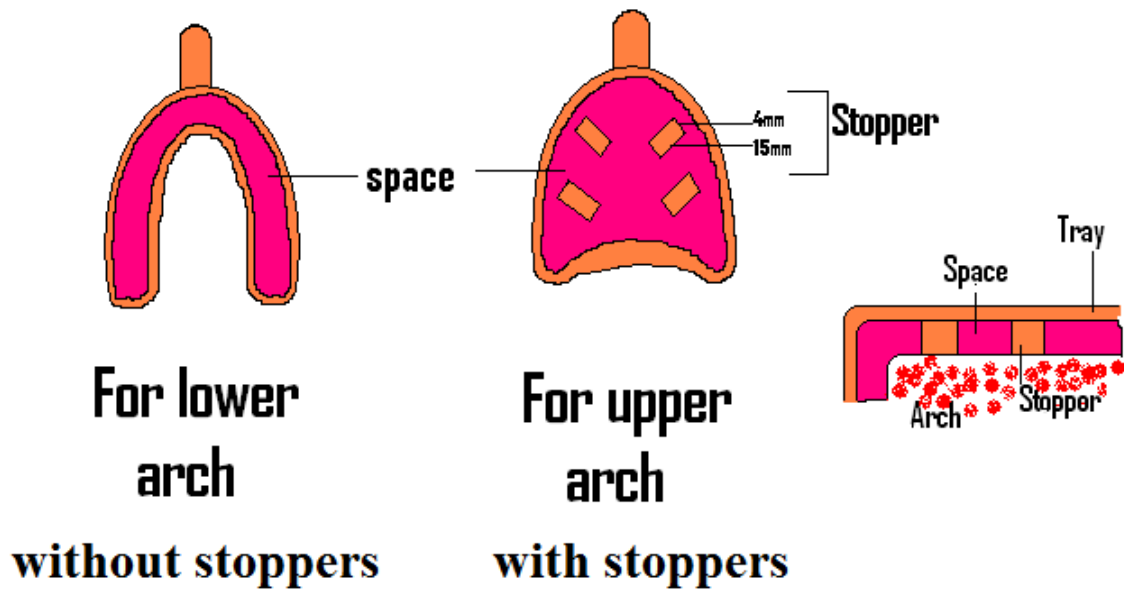
Techniques or methods for construction of special trays

1. Finger adapted dough method.
2. Sprinkle-on acrylic method.

Finger adapted dough method

*In **special tray with stoppers** we should have 4 stoppers, 2 at anterior area (canine area) and 2 at posterior area (first molar area) in both sides. A baseplate wax sheet 1mm in thickness is adapted on the cast (after heating the wax) and a window open on the wax sheet in area of stoppers by removing the wax to make the stoppers and then put a uniform layer of self cure acrylic resin upon it. When we remove the wax, there is a space with 4 stoppers which will stop the special tray in the mouth of the patient and stop the pressure on the material during make the impression.

*While **for spaced one without stopper**, a baseplate wax 1mm in thickness is adapted on the cast (after heating the wax) then put the acrylic resin on it, when the wax is removed there is space without stoppers.



Closed fit special tray we used only separating medium on study cast and a self-curing acrylic resin tray material is mixed and uniformly adapted over the cast, so that the tray will be about 2-3 mm in thickness.

Acrylic resin handle is attached in the anterior region of the tray to facilitate removal of the final impression.

Sprinkle- on acrylic technique

This technique used for construction of individualized impression tray.

1. Eliminate undercuts on the cast with a thin coat of wax.
2. Paint cast with separating medium (cold mold seal).
3. Place acrylic resin powder (polymer) in a container with a perforated top (Like a salt shaker). Place the (liquid) monomer in a dappen dish.
4. Shake the polymer on the border area. With a glass medicine dropper, add monomer to the saturation point. Continue to build this over the entire denture – bearing area to thickness that will yield a rigid tray (a minimum of 2.5 mm).

5. Just before the final polymerization, remove the tray, reseal on the cast and allow complete polymerization.
6. Reduce the borders to coincide with the outline on the cast (2 mm under extended).
7. Roughen the ridge area on the top of the tray anteriorly at the midline, then make a handle from acrylic resin and attach to the tray at this area.

Criteria for Special tray construction:

1. The impression tray must not impinge upon movable structures.
2. The borders must be under extended (2 mm).
3. The posterior limits of the impression tray should be slightly overextended to ensure inclusion of the posterior detail for development of the post-dam area in upper tray.
4. The tray should be rigid and of sufficient thickness that it will not fracture during its use.
5. The tray must have a handle for manipulation and the handle must not interfere with functional movement of the oral structures.
6. The tray must be smooth on its exposed surfaces, and should have no sharp edges which would injure the patient.

Finger adapted dough method

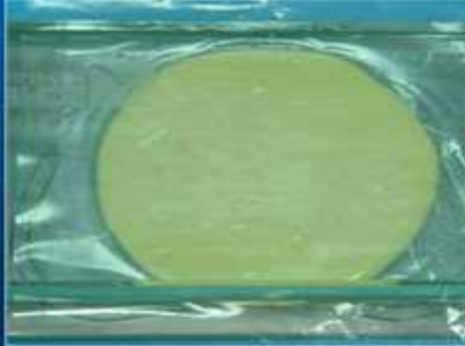

Main Menu

Mix approximately $\frac{1}{4}$ cup of tray resin for each tray.
Apply a thin layer of vaseline to your fingers.

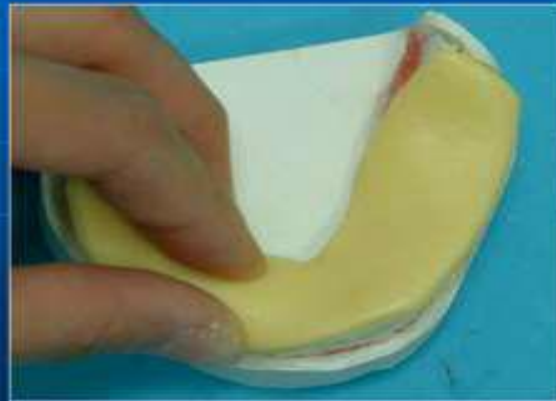


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Wait for the material to get to a doughy consistency before you apply it to the template. Press material with a glass slab to obtain the proper thickness.

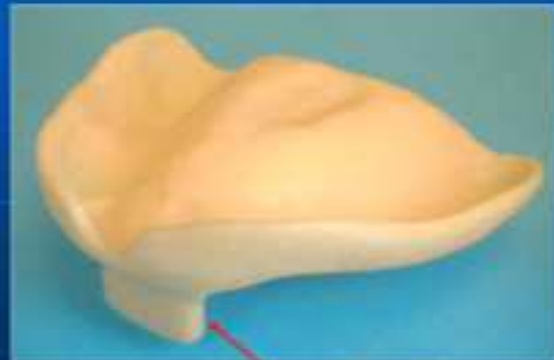
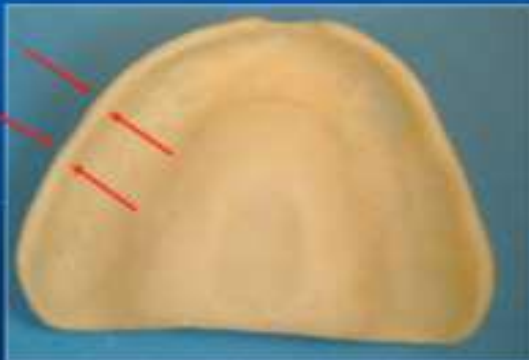


- Adapt the resin material to the cast as shown
- Trim excess with knife
- Place additional resin to create handles
- Allow resin to polymerize



Maxillary tray check list

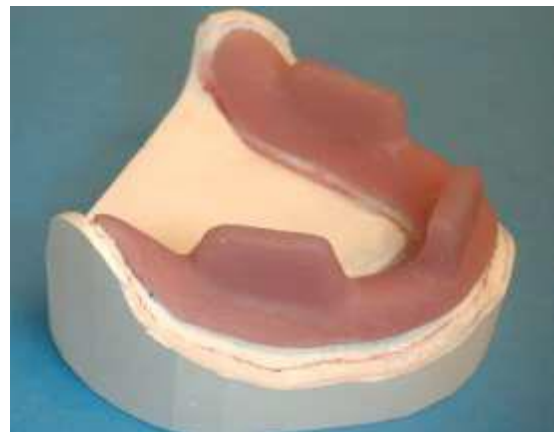
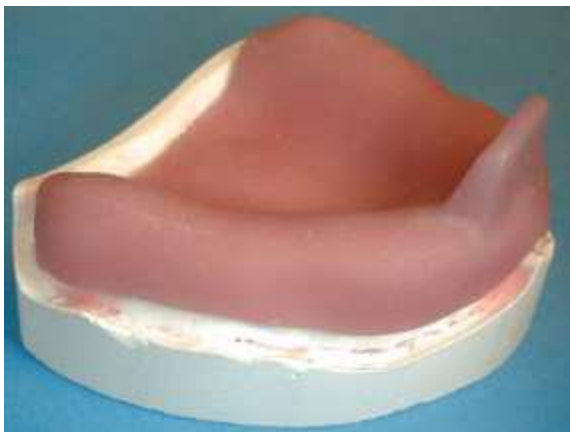
Tray periphery should be 2-3 mm thick. The edges should be rounded. The rest of the tray should be about 1-2 mm in thickness.



Tray handle - 10mm high

Sprinkle- on acrylic technique

Sprinkle-on technique of resin addition.



Complete denture impressions

Dental Impression: a negative imprint of an oral structure used to produce a positive replica of the structure to be used as a permanent record or in the production of a dental restoration or prosthesis .

Complete denture impression: it's a negative registration of the entire denture bearing, stabilizing and seal area of either the maxilla or the mandible .

Objectives of impression making :

Complete denture impression procedures must provide five objectives :

- 1 .Retention
- 2 .Stability
- 3 .Support for denture
- 4 .Aesthetic
- 5.Preservation of the residual alveolar ridge and soft tissue

Retention: Is the resistance of the denture to remove from the mouth by resisting displacement forces at right angle to the occlusal plane .

Stability: Is the quality of prosthesis to be firm, steady or constant to resist displacement by functional horizontal or rotational movement .

*Retention is the constant relation of the denture base to underlying soft tissues, while stability is the relation of the denture base to underlying bone .

These relations may be constantly changing .

***Retention must hold the denture in its position when it is set at rest.**

***Stability must resist displacement by rocking when a force is applied to teeth over a limited area .**

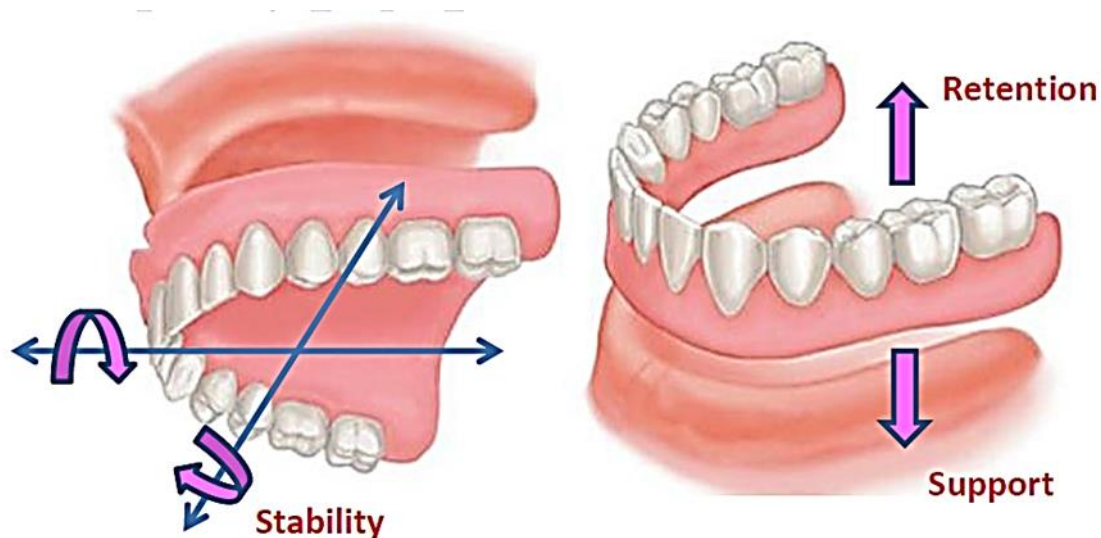
Support: Is the quality of prosthesis to resist displacement from the denture supporting foundation; therefore, the greater the amount of area covered the greater the support .

*The best support for denture is the compact bone covered with fibrous connective tissue .

***Retention = Denture base + Soft tissue.**

***Stability = Denture base + Bone.**

* **Support = Denture base + Bone + Soft tissue**



Aesthetics: Border thickness should be varied with the need of each patient in accordance with extend of residual ridge loss. The vestibular fornix should be filled, but not overfilled, to restore facial contour.

Preservation of the residual alveolar ridge and soft tissue: preservation of the remaining residual ridge is physiologically accepted that with the loss of the stimulation of the natural teeth, the alveolar ridge will atrophy or resorb,

Prosthodontics should keep in mind the effect of impression material and technique on the denture base and the effect of the denture base on the continued health of both the soft and hard tissues of the jaws.

Primary impression

Primary impression: it is a negative likeness made for the purpose of diagnosis, treatment planning, or the fabrication of a tray. It is the first impression made for the patient and from which the study cast was produced. This impression is obtained by a **stock tray**.

For the upper stock tray, the posterior border of the tray should cover the maxillary tuberosity and hamular notch, anteriorly should include the antero-alveolar ridge.

***For the lower stock tray** posteriorly should cover the whole area of retromolar pad area and anteriorly include the alveolar ridge.

Materials used for making primary impression:

1. Impression compound.



2. Alginate impression material.



3. Rubber base impression material (heavy body)



Primary cast (study model or diagnostic cast): a cast formed from a preliminary impression for use in diagnosis or the fabrication of an impression tray.

Production of study cast (primary cast)

The primary impression is poured or casted in plaster (after beading and boxing) to get the primary cast or study model which is the positive reproduction of the oral tissues.

The plaster mixed with water by the saturation method in the rubber bowl. When the plaster became hard, the cast is separated from the impression by the use of hot water (55-60 °C). When using very hot water, the impression compound will be sticky and it will be difficult to remove from the cast.

The special tray will be constructed on the primary or study cast which is used to make final impression. After construction of special tray, it is tried in the patient mouth and checked for proper extension and adaptation on the alveolar ridge, as good impression cannot be obtained unless this step is made. So a correct special tray is a primary fact in obtaining a good working impression.



Final or secondary impression Final impression in general:

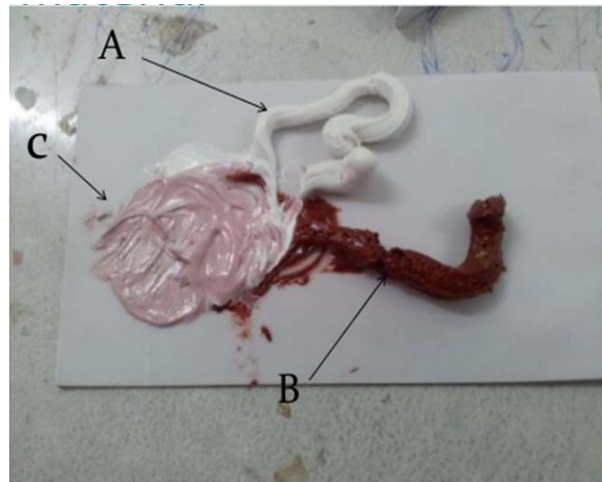
The impression that represents the completion of the registration of the surface or object. Final or secondary impression (for edentulous patient that use for complete denture construction): It is a negative likeness or registration of the entire denture bearing, stabilizing area and border seal area of the mandible and maxilla for the purpose of fabricating a prosthesis. The final impression is made with special tray and it is used for making master cast which must be poured with stone material.

Master cast (definitive or final cast): A replica of the tooth surfaces, residual ridge areas and or other parts of the dental arch and or facial structures used to fabricate a dental restoration or prosthesis.



Materials used for final impression:

1. Zinc oxide eugenol impression material (ZOE).



2. Alginate impression material.

3. Impression plaster.



4. Elastomers impression material:.

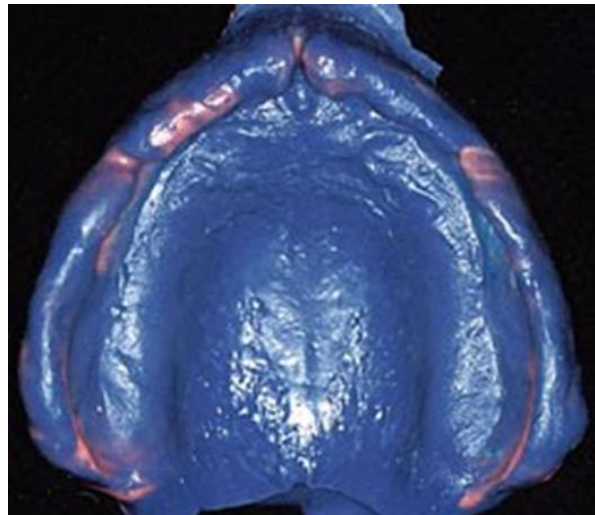
a- Polysulphide (rubber base).



b- Poly ether.



c- Silicon (light body).



5. Waxes

The Techniques Used For Making Final Impression

(THEORIES OF IMPRESSION MAKING)

- 1- Based on the amount of pressure used
 - 2- Open or closed mouth
 - 3- Hand manipulations or functional movements
 - 4- Type of tray.
- The open mouth technique is preferred because the operator can see whether the border molding is done properly.
 - The functional manipulation cannot be used routinely not all patients can truly move the impression materials as needed, some may use extreme movements and others may not.

1- based on the amount of pressure used:

a- Mucostatic

The impression is made with the oral mucous membrane and the jaws in a normal, relaxed condition. Border molding is not done here. the impression is made with an oversized tray. Impression material of choice is impression plaster. The mucostatic technique results in a denture, which is closely adapted to the mucosa of the denture bearing area but has poor peripheral seal.

b- Muco-compressive

This theory was proposed on the assumption that tissues recorded under functional pressure provided better support and retention for the denture. Record the oral tissues in a functional and displaced form. The material used for this technique include impression compound and wax. Dentures made with this

technique rebound back at rest, but at function constant pressure is applied can decrease circulation leading to residual ridge resorption.

c- Selective Pressure Technique

Impression extended as much denture bearing area as possible, except the limiting structures. Forces only on stress bearing area. Made by using special tray with use of relief wax.

- Two techniques were developed for the management of flabby ridge.

1st technique – it was of muco compressive type compound impression which displaced the flabby tissue partially.

2nd technique – it was advocated by Greene Brothers, which captured the tissue in its passive form.

2- Open and closed mouth technique

- open mouth technique

Impression are made with a tray that is held by the dentist, the impression is made with mouth made open wide.

- Closed mouth technique

Final impression is done with mouth closed, clenched with patient performing functional movement. Time saving but over extension can be created.

3- Hand Manipulation Or Functional Movement

- *Hand manipulation*

Border molding is done and impression is made with the hand of the dentist.

- *Functional movement*

Border molding is done by the patient like sucking, grinning and swallowing.

4- Type of tray:

Some dentist use a stock tray and an impression material such as alginate and impression compound. Such impressions are generally overextended and serves as primary impression. On casts made from these primary impression, special tray are fabricated. The tray is checked inside the patient mouth then final impression was making by using zinc oxide-eugenol or silicone

Boxing an impression and making the casts :

Is the enclosure of an impression to produce the desired size and form of the base of the cast and to preserve desired details. Boxing impression can be used for primary and final impression for complete denture. This procedure cannot usually be used on impression made from hydrocolloid materials (**e.g. alginate**) because the boxing wax will not adhere to the impression material and the impression material (**alginate**) will be distorted.

Advantages of boxing:

1. To facilitate pouring the impression with plaster or stone.
2. Produce the desired size and form of the base of the cast.
3. Provide adequate thickness of cast.
4. Preserve desired details and borders of the impression.
5. In the lower impression, boxing makes the reproduction of the lingual borders and tongue space easier.

Materials used for boxing impression:

1. Beading wax: A strip of wax is attached all the way around the outside of the impression approximately (2-3 mm) below the border and sealed to it with wax knife.

2. Boxing wax: A sheet of wax is used to make the vertical walls of the box and it is attached around the outside of the beading wax strip so that it does not alter the borders of the impression, the width of the boxing wax is about 10-15 mm above the impression.

3. Base plate wax: A sheet of wax can be used to fill the tongue space in the lower impression that is sealed to lingual border of the impression and should be located just below the lingual border of the impression.

Dental stone is mixed according to manufacturer's direction and sufficient stone is poured into the final impression so that the base of the cast will be from 10-15mm in thickness. The cast is called master cast.

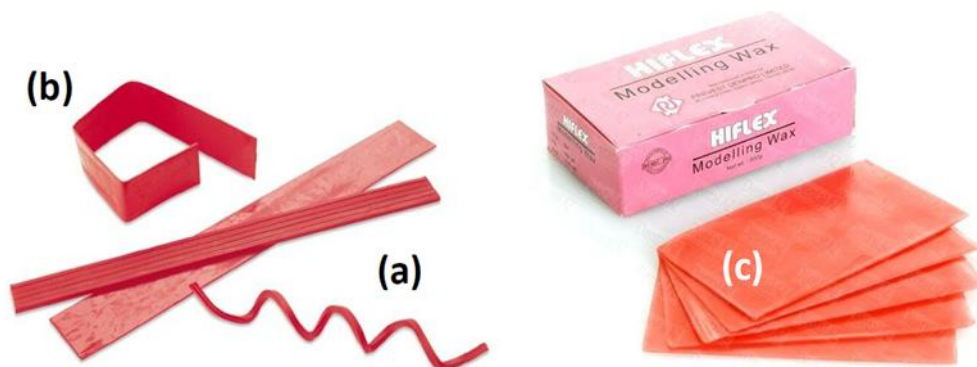


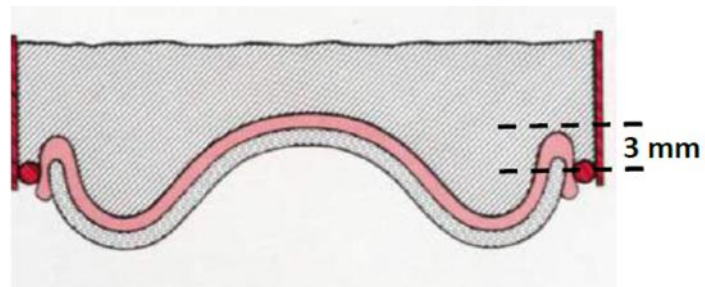
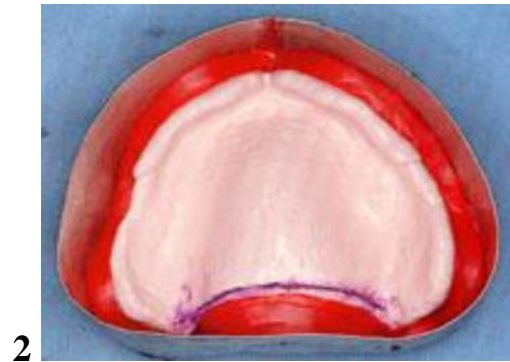
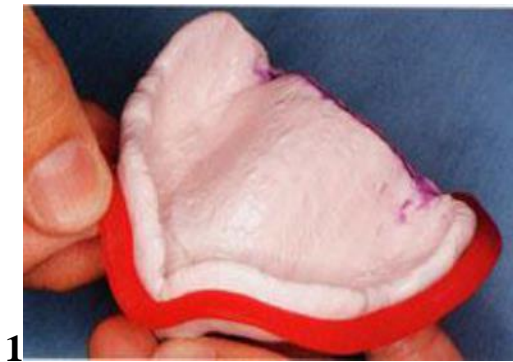
Figure (3-34): Beading wax (a), boxing wax (b), base plate wax (c).

Common faults in impression making:

1. Poor selection of the tray.
2. Insufficient material loaded in the tray.
3. Excessive material loaded in the tray.

4. Failure to press the tray completely to position (insufficient seating pressure)
5. Excessive seating pressure.
6. Incorrect position of the tray before final seating it (Un centralization).
7. Obstruction of the proper flow of the material by lips, cheek or tongue.

Boxing upper final impression and making the master cast





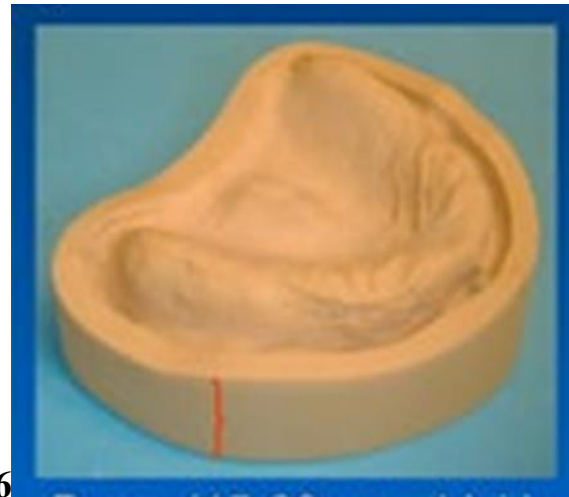
3



4



5



6

- 1-soften the beading wax and apply it to the sticky wax to form the land area.
- 2- Wrap a sheet of red boxing wax around the beading wax to form a container. All joints must be sealed with hot wax to prevent stone from leaking through
- 3-pouring the cast with stone using vibrator to avoid entrapment of air bubbles.
- 4-Trimming the cast.
- 5- Carefully separate the cast from the impression.
- 6- Completed master cast

Record Base and Occlusion Rims

Record base: an interim denture base (temporary form) used to support the record rim material for recording maxilla-mandibular records .



Requirements of record base :

1. The record base must have rigidity.
2. The record base must have accuracy and stability.
3. The borders should be developed in the same manner as borders of finished denture.
4. All surfaces that contact lips, cheek and tongue should be smooth, round and polished.
5. The crest, labial and /or buccal slopes should be thin to provide space for teeth arrangement.

The accuracy of maxillo-mandibular relation record is affected by :

- *Rigidity of record base.
- *Stability of record base.
- *The movability of the record bases.
- *The smoothness of the polished surfaces contributes to the comfort of the patient.

*The more comfortable and compatible the record bases are to the tissues, the more normal are the jaw movements.

Types and materials used in construction of record bases :

***Temporary record bases:** They are discarded and replaced by denture base material, once their role in establishing jaw relation, teeth arrangement and try in is complete .

Types of temporary record bases :

1. Shellac base plate.
2. Reinforced shellac base plate.
3. Cold cure acrylic resin.
4. Visible light cure acrylic resin.
5. Vacuum formed vinyl and polystyrene.
6. Base plate wax (rarely used because it lacks rigidity and dimensional Stability)

***Permanent record bases:** they are not discarded and become part of the actual base of the finished complete denture .

Types of permanent record bases :

1. Heat cure acrylic resin.
2. Gold.
3. Chromium-cobalt alloy.
4. Chromium-nickel alloy.

Occlusion rim:

the occlusal surfaces fabricated on record bases for the purpose of making maxillomandibular relationship records and/or arranging teeth - called also occlusion rim.



Requirements of occlusal rim :

1. The position should be in the anticipated position of the artificial teeth.
2. It must be securely attached to the base.
3. The occlusal surface must be smooth and flat.
4. It should be contoured to support the lip and cheeks accurately.
5. All the surfaces should be smooth.

Materials used in construction of occlusal rims :

1) Wax:

- a) Bite blocks wax (readymade occlusion rim).
- b) Paraffin wax or base plate wax sheets (handmade occlusion rim).

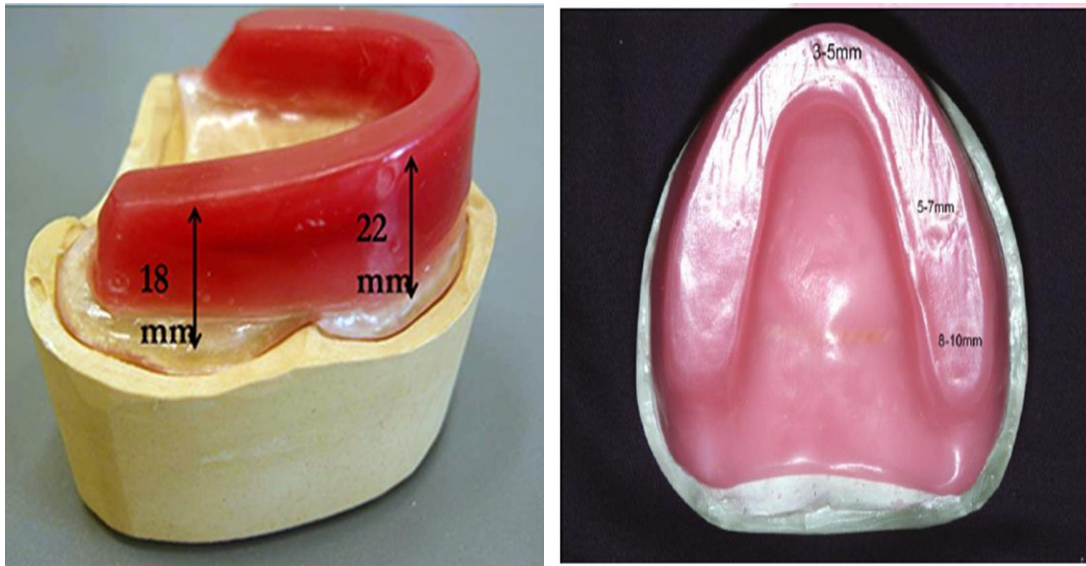
2) Modeling compound:

Wax is used more frequently, since it is easier to manage in the registrations and in the arrangement of teeth.

Measurements of maxillary occlusion rim :

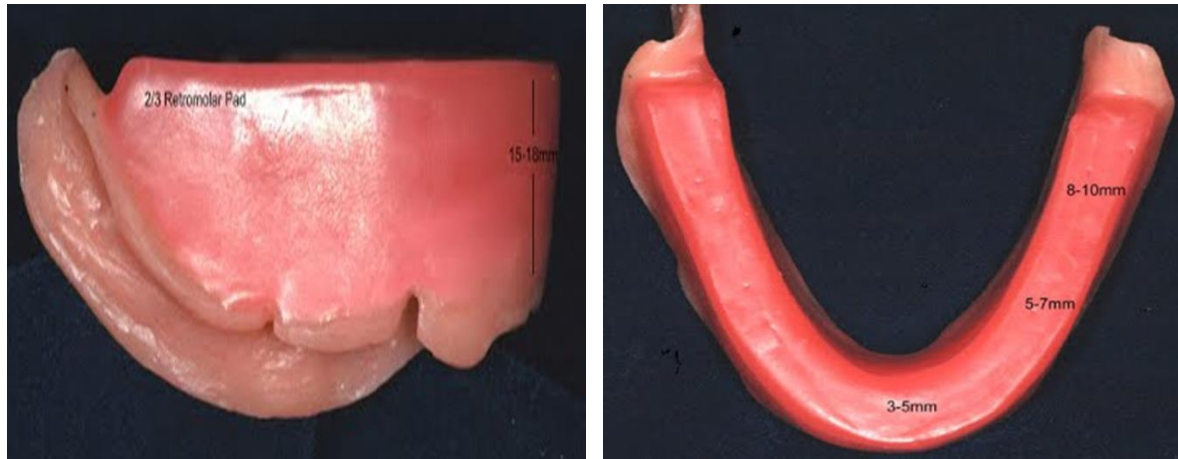
1. The maxillary rim should have a slight labial inclination and the maxillary labial surface should be 7 mm anterior to the line bisecting the incisive papillae .
2. The final wax rims should be 4 mm wide anterior and gradually, become wider posterior to measure 7 mm .

3. They should be directly over the crest of the residual ridges.
4. The occlusal height of maxillary rim should be 22 mm from the labial flange lateral to the labial frenum and 18 mm from the buccal flange to the tuberosity area.



Measurement of mandibular occlusion rims:

1. It should occupy the space over the crest of the residual ridge.
2. The occlusal height should be 18 mm from the labial flange lateral to the labial frenum and should be level with the acrylic base posteriorly.
3. The labio-lingual thickness should approximately 4 mm anteriorly and also increase posteriorly to be 7 mm in molars area.



All above points regards in the laboratory work, while in patient mouth we have other guides used in occlusion rims construction.

The best anatomic guides to aid in determining the proper contouring of anterior section of upper and lower occlusion rims:

1. The naso-labial sulcus.
2. The mento-labial sulcus.
3. The philtrum.
4. The commissure of the lips.



Uses of occlusion rims:**1. In determination of jaw relation which include:**

- a. Determination of the vertical dimension.
- b. Determination of the centric and eccentric jaw relation.

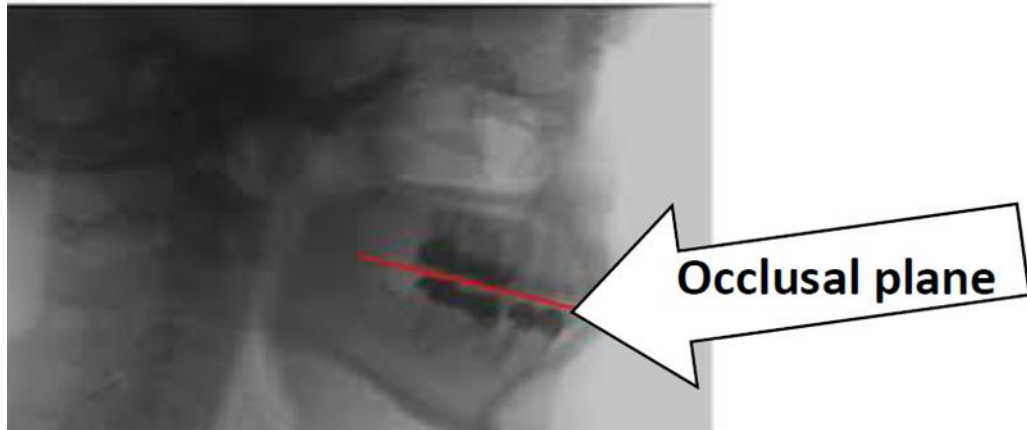
2. In selection of teeth:

- a. The position of midline can be determine
- b. Canine line (cuspid line) is drawn on occlusal rim at the corner of mouth on each side when occlusion rims seated in mouth and in occlusion.
- c. Width of 6 anterior teeth is equal to distance between the 2 canine lines.
- d. The width of posterior teeth is equal to distance between the canine line and end of wax rim posterioly.
- e. The high length of anterior teeth is determined by drawing high lip line (gum line, or smiling line) .When patient smiling; the whole of anterior incisor should be seen.
- f. The low lip line (speaking line, or relaxed lip line) is a line drawn on wax rim when lip is relax, in this case 2 mm of anterior teeth should be seen.

3. Setting up of teeth.**4. Orientation of occlusal plane.****5. Determination of shape of arch.****6. Support of the facial musculature.****Occlusal plane**

The average plane established by the incisal and occlusal surfaces of the teeth. Generally, it is not a plane but represents the planar mean of the curvature of these surfaces.

It's an imaginary surface which is related anatomically to the cranium and theoretically attached the incisal edges of the incisors and the tips of the occluding surfaces of posterior teeth.



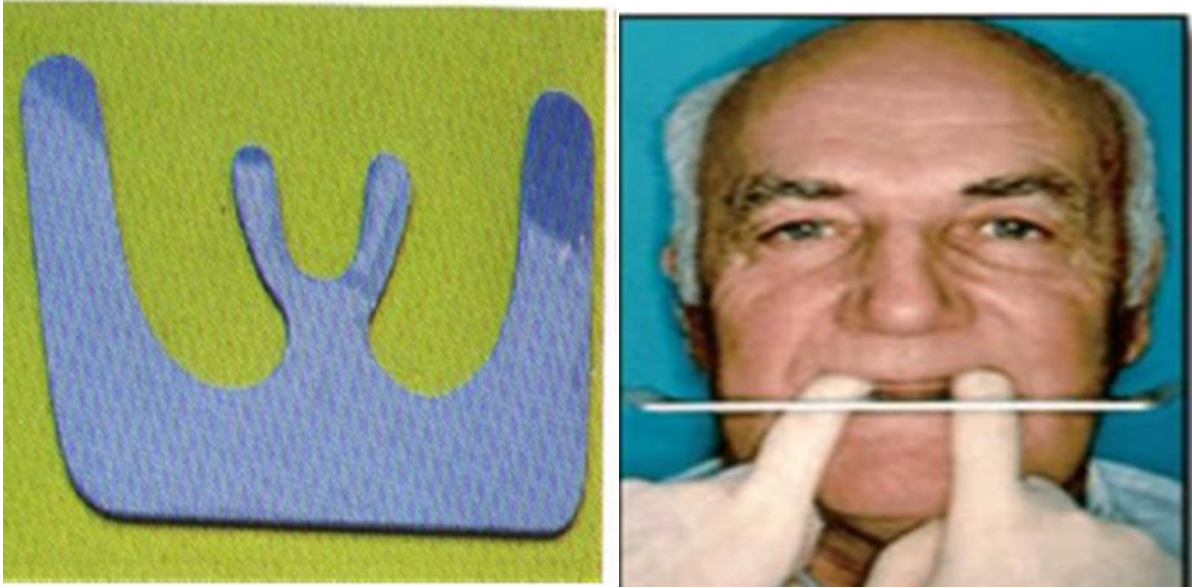
The height of the occlusal plane(the vertical length of maxillary occlusion rim anteriorly) should be 1-2 mm below the relaxed upper lip and this will be different from patient to other and affected by the age of the patient and type of the lip. Generally there are 1-2 mm showing from the incisors in the average dentulous patient but each case should be considered separately in relation to **the height of the lip, age of the patient and sex of the patient**, e.g. for the patient that have long lip the height of the occlusal plane should be with the border of the upper lip, while for the patient with short lip there is more than 2 mm showing from upper lip. So each case should be considered separately for best appearance.

Fox bite (Fox plane guide)

An appliance used to check the parallism of the wax occlusal rim anteriorly and posteriorly.

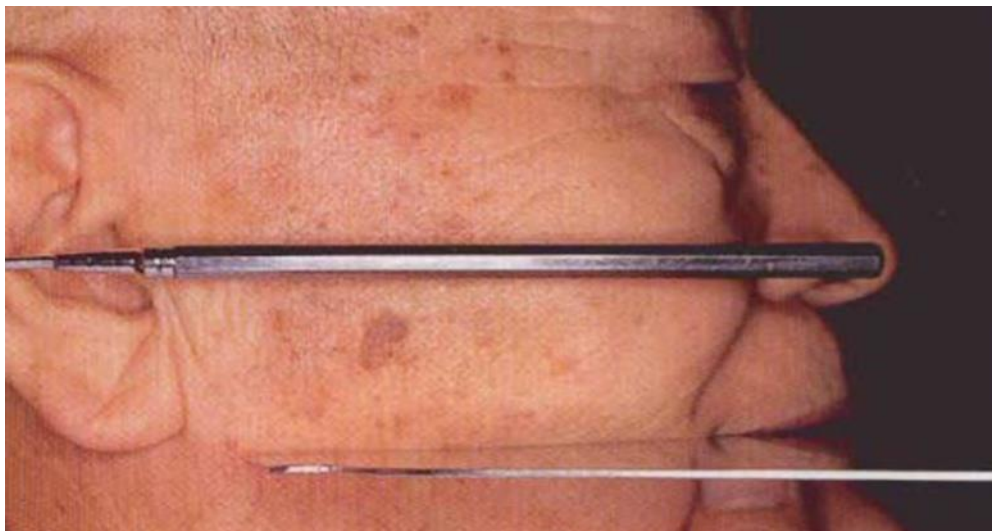
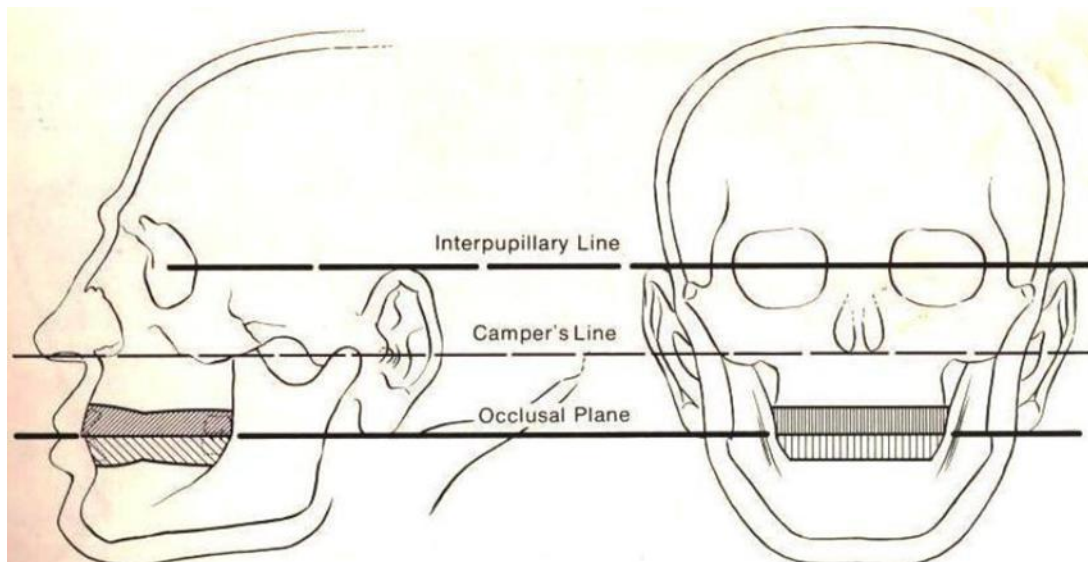
***The anterior** part of the wax rim should be parallel to the interpupillary line (this is an imaginary line running between the centers of the two pupils of the eyes when the patient is looking straight forward).

***Posteriorly** the occlusal plane starting from the canine region backward should be parallel to the (Camper's line), this is a line running from the ala of the nose to the superior border of the tragus of the ear (Ala-tragus line).



The vertical length of the maxillary occlusion rim

- Anteriorly extend 2mm below relaxed lip & oriented to be parallel to inter pupillary line.
- Posteriorly the vertical length and occlusal plane are made to coincide with (Camper's line).
- **(Camper's line, ala-tragus line)** line passing from the lowest point of the ala of the nose to the center of the tragus of the ear.



The vertical length of the mandibular occlusion rim

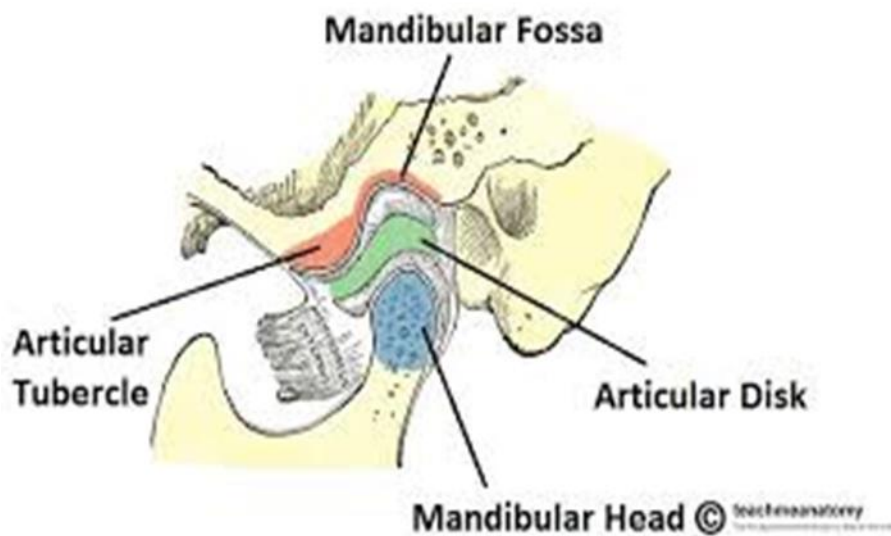
- Anteriorly the level of mandibular occlusion rim with the level of the lower lip & angle of the mouth.
- Posteriorly the vertical length of the rim with level of the retromolar pad.



ANATOMY AND PHYSIOLOGY OF TEMPOROMANDIBULAR JOINT

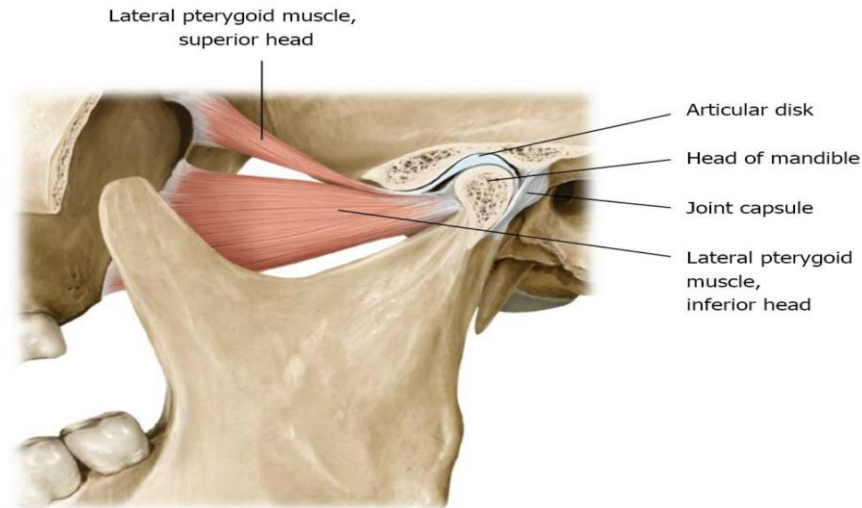
Temporomandibular joint (TMJ):

Is the articulation of the condyloid process of the mandible and the inter-articular disk with the mandibular (glenoid fossa) of the temporal bone.



The TMJ consists of the following parts:

1. The mandibular or glenoid fossa.
2. The condyle or head of the mandible.
3. The articular disc or "Meniscus" which is found between the condyle and the glenoid fossa. It divides the synovial joint or TMJ into upper (superior) and lower (inferior) compartments.
4. Synovial cavity.



The differences between TMJ and other Joints in the body are:-

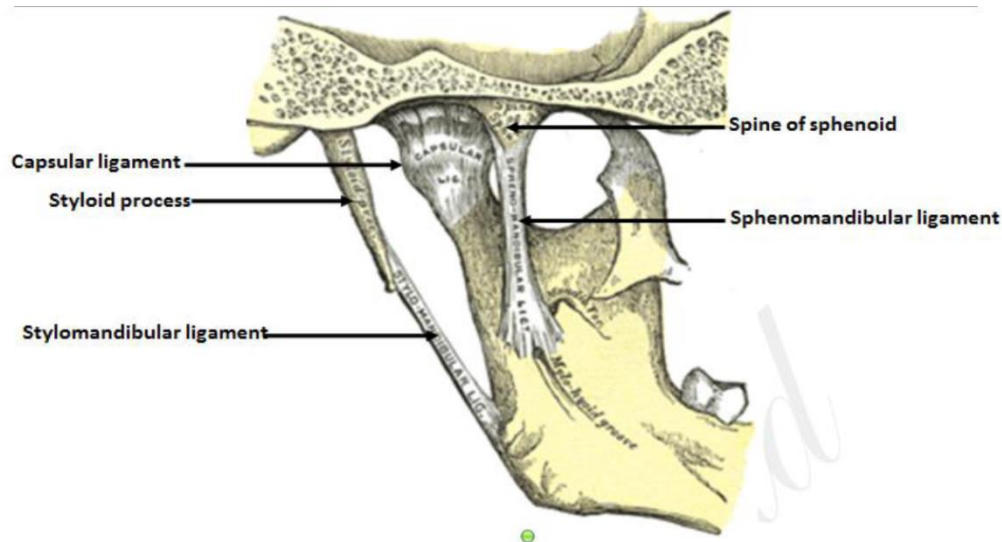
1. TMJ has an articular disc which completely divides the joint spaces into upper and lower joint compartments.
2. TMJ is Ginglymoarthrodial Joint.
 - a. Hinge action (Rotation)
 - b. Slide Action (translation)
3. Relationship of teeth affects the relationship of the articulating components.
4. The mandible is the only bone in the body hinged on both ends that is not capable of independent movement at one ends.

The ligaments that affect the movement of the mandible consist of:-

1. Temporomandibular and capsular ligaments.
2. Sphenomandibular ligament.
3. Stylomandibular ligament.

The mandibular bone has specific relationships to the bones of the cranium. The mandible is connected to the cranium at the two TMJ by the temporomandibular and capsular ligaments. The sphenomandibular and Stylomandibular ligaments also connect the bones in such a way as to limit some motions of the mandible.

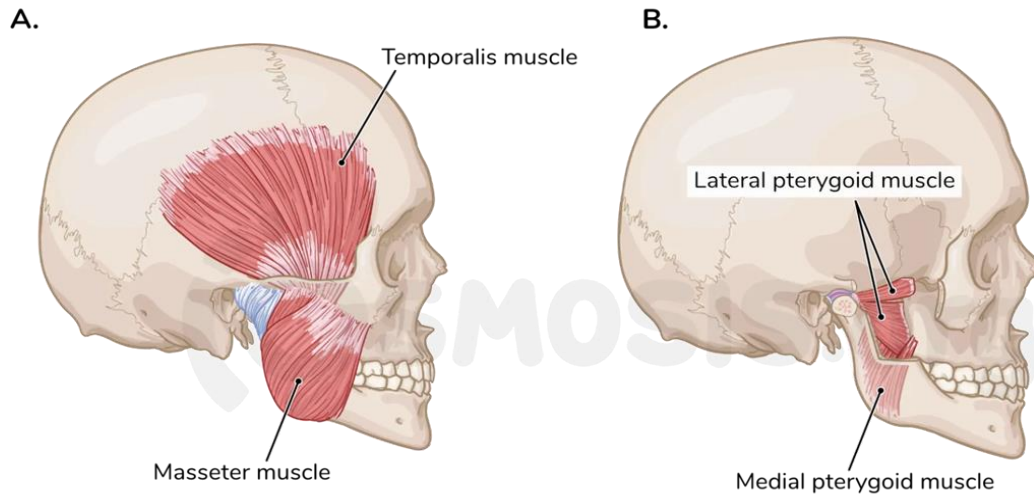
The function of the ligaments is to stabilize the joints by limiting the movements, ligaments do not stretched but it could be elongated and the elongation of the ligament could compromise normal joint function.



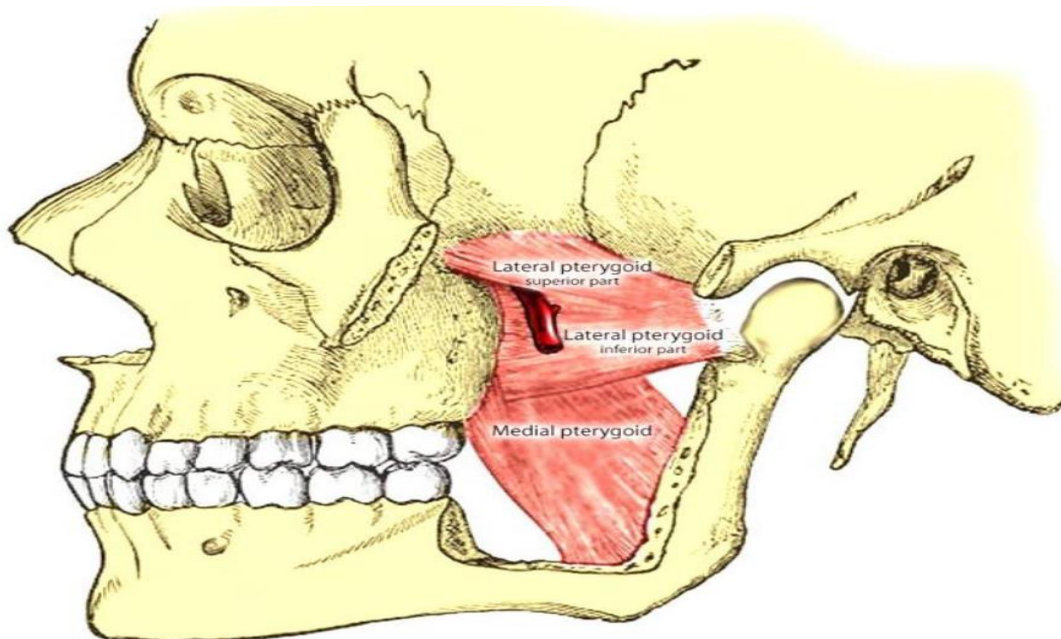
The muscles that control the movement of the mandible may be considered in 3 groups:

1. Closing muscles.
2. Gliding muscles.
3. Opening muscle.

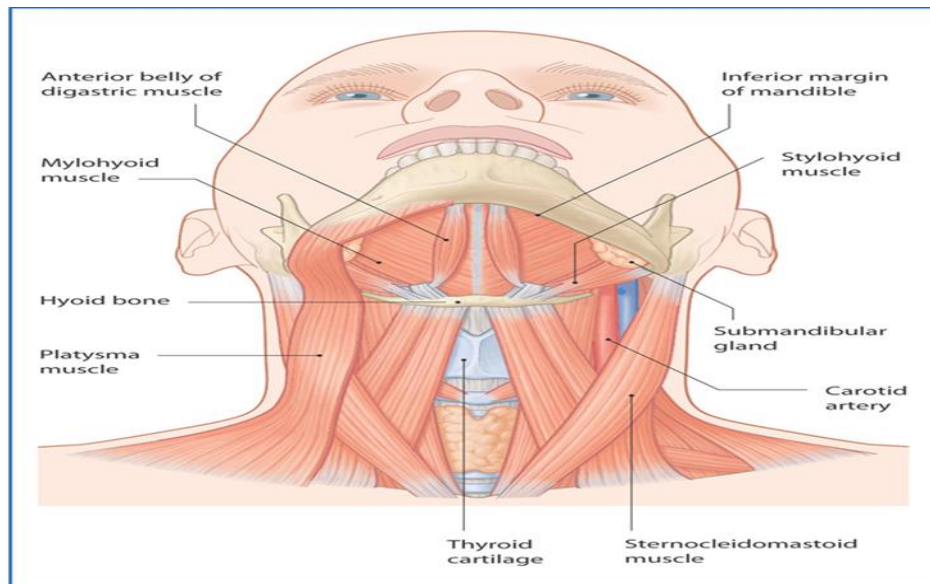
The masseter, temporalis and medial pterygoid muscles supply the power for pulling the mandible against the maxillae (elevating and closing mandible).



The lateral pterygoid muscles connect the mandible to the lateral pterygoid plate in such a way as to act as the steering mechanism for the mandible and act to protrude the jaw or to move it laterally.



While the muscles that depress the mandible (open) consist of four groups, suprahyoid muscle, platysma muscles, infrahyoid muscles, and lateral pterygoid muscles.



Good prosthodontic treatment bears a direct relation to the structures of the temporomandibular articulation, since occlusion is one of the most important parts of treatment of the patients with complete dentures. The TMJs affect the dentures and likewise the dentures affect health and function of the joints.

Muscular functions

Opening :- Lateral pterygoid, Digastric (ant.)

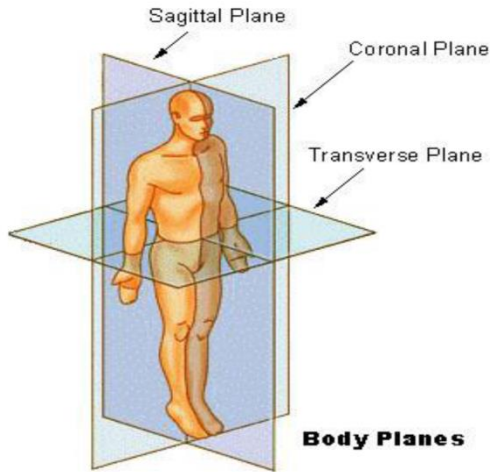
Closing:- masseter, Temporalis (ant.), Med. Pterygoid
Protrusion:- Masseter (Superf.), Lat. Pterygoid, med. Pterygoid

Gliding;- Masseter, Temporalis on same side, Med. & lat. Pterygoid on other side

Retrusion:- Temporalis (pos.), Digastric

Mandibular Axes & Mandibular Movements:

Mandibular axis: There are three axes around which the mandibular movements take place in horizontal, sagittal and frontal planes.



These axes include the followings:

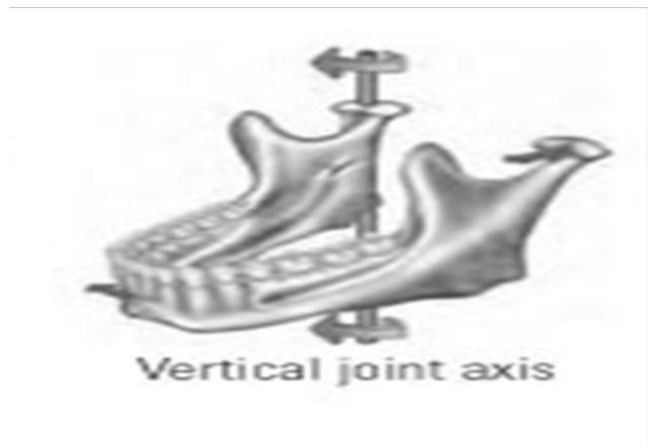
1. **Hinge axis:** or transverse horizontal axis: An imaginary line around which the mandible may rotate within the sagittal plane. (During the opening and closing movement).



2. **Sagittal axis:** of the mandible : An imaginary anteroposterior line around which the mandible may rotate when view in the frontal plane.



- 3. Vertical axis of the mandible:** An imaginary line around which the mandible may rotate through the horizontal plane.



Knowledge of Mandibular movements:

1. To understand various aspects of occlusion.
2. To arrange artificial teeth.
3. To select and adjust recording device articulator.

Mandibular Movements:

Classification of mandibular movement:

- 1. Based on the dimension involved in the movement.**
- 2. Based on the type of movement.**

1. Based on dimension

Mandibular movements are related to three planes of the skull the horizontal, frontal, and sagittal. The mandible rotates in each of the three planes of space. The point of intersection of the three axes is called the center of rotation.

2. Based on the type of movement:

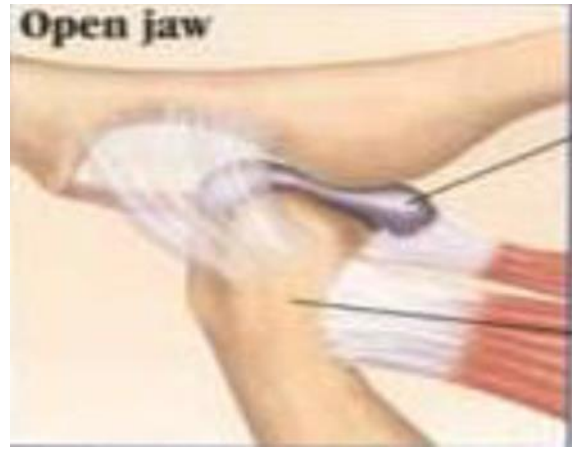
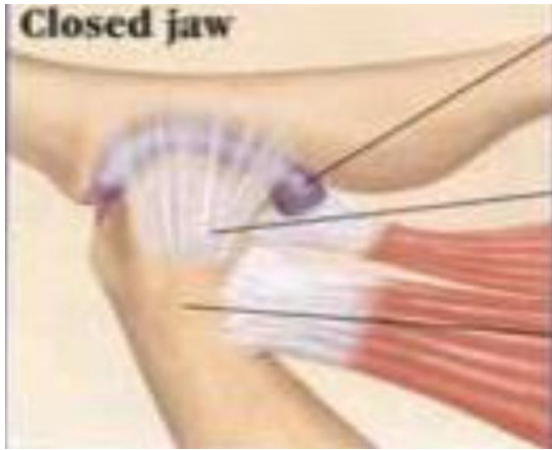
1. Basic movements: This movement occurs at the level of TMJ it may be divided into two types:-

a- Rotational movement: The rotational movement occurs between the condyle and the inferior surface of the articular disk, i.e. in the lower compartment of the TMJ.

b- Translatory or gliding movement: It takes place in the upper compartment of the TMJ, i.e. between the superior surface of the articular disk and the glenoid fossa.

2- Functional movement: All mandibular movements except the terminal hinge movement, they are a combination of rotational and transitional, most frequently and are referred to as being functional movement. They are including:

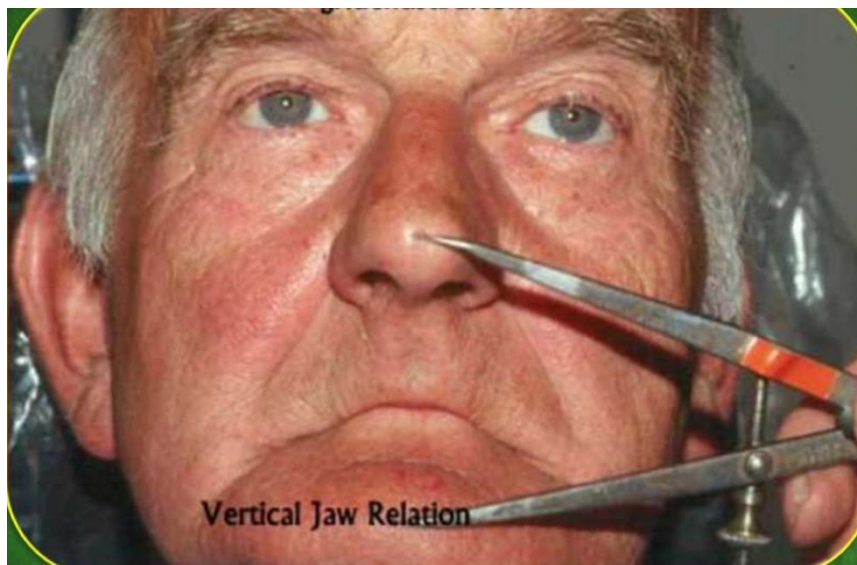
- Opening and closing movements
- Symmetrical forward and backward movements.
- Asymmetrical side wise movement or lateral movement



Maxillo-mandibular Relationship

It is also known as Maxillomandibular record or Maxillo-mandibular registration or Jaw relation.

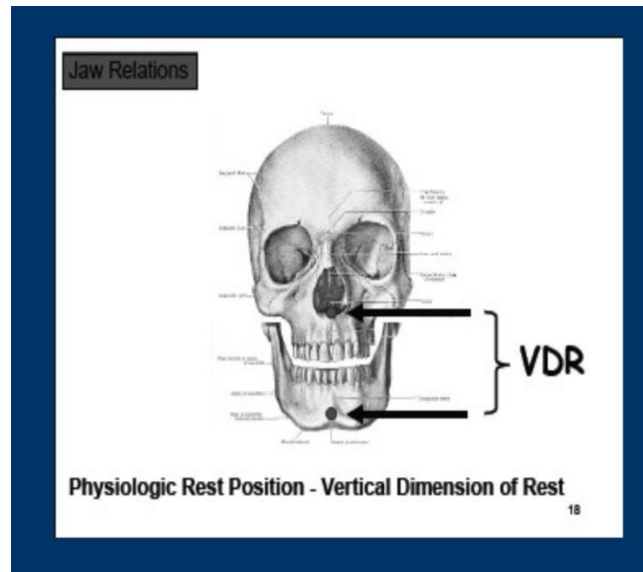
Vertical Relation: It is the relation between the maxilla and mandible in a frontal plane.



Vertical Dimension (VD): It is the distance between two selected points, one on a fixed and the other on a movable point.

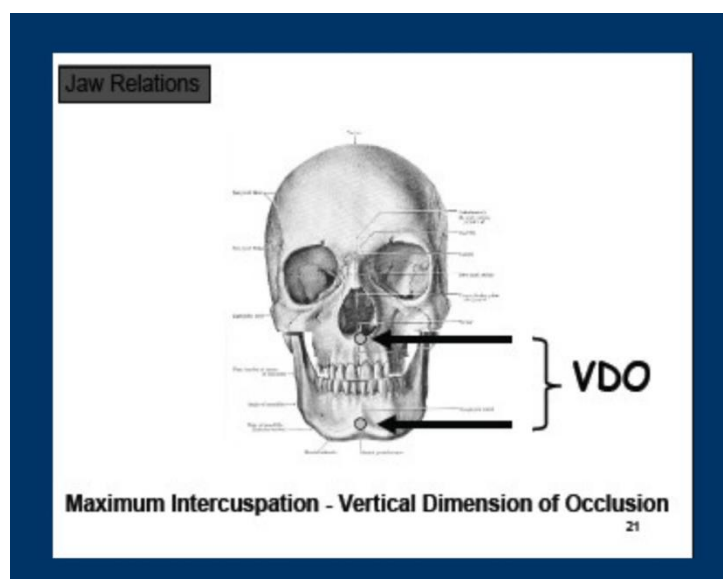
In general, the vertical measurement of the face could be recorded between any two arbitrarily selected points which are usually located one above the mouth (like at the tip of the nose) and the other below the mouth (like at the tip of the chin in the midline).

Rest Vertical Dimension (RVD): It is the distance between two selected points (one at the tip of the nose and the other at the tip of the chin (in the midline region) measured when the mandible is in the physiologic rest position.



Physiological Rest Position: It is the position of the mandible when a person is resting comfortably in an upright position, the mastication muscles are in an equilibrium contractual activity and the condyles are in a neutral unstrained position.

Occlusal Vertical Dimension (OVD): It is the distance measured between two points when the occluding members (teeth or occlusal rims) are in contact.

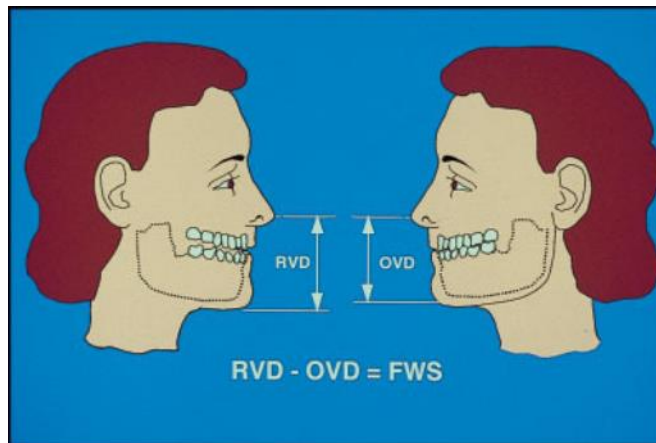


Inter-Occlusal Rest Space (Free-Way Space): It is the distance between the occluding surface of maxillary and mandibular teeth when the mandible is in its physiological rest position. It is the difference between the vertical dimension of rest and the vertical dimension of occlusion.

$$\text{RVD} - \text{OVD} = \text{Freeway space normally } \approx (2\text{mm})$$

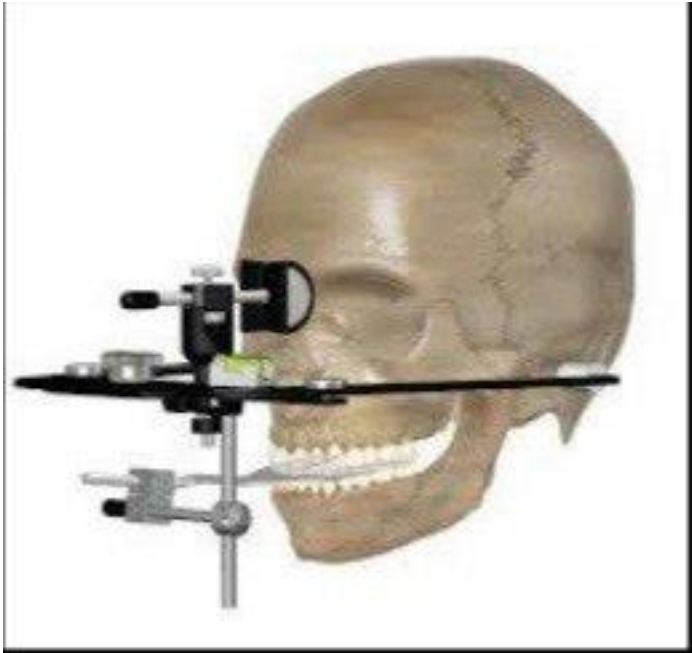
RVD=Rest Vertical Dimension

OVD=Occlusal Vertical Dimension



Classification of Jaw Relations:

- A- **Orientation Jaw Relation:** It is defined as the jaw relation when the mandible is kept in its posterior position. This record gives the angulation of the maxilla concerning the base of the skull use of a face bow device.

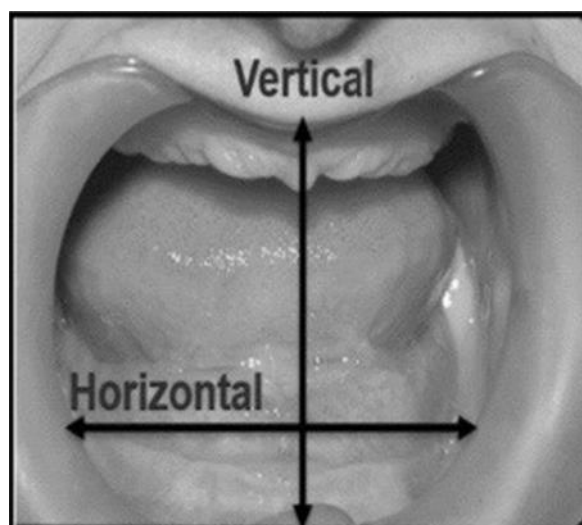


B- **Vertical Jaw Relation:** establish the amount of jaw separation that use for dentures

1. Vertical Jaw Relation at Rest Position (RVD)
2. Vertical Jaw Relation at Occlusion (OVD)

C- **Horizontal Relation:** establish front-to-back & side to side relations of one Jaw to the other

1. Centric Jaw Relation
2. Eccentric Jaw Relation
 - a- Lateral Jaw Relation
 - b- Protrusive Jaw Relation



Importance of vertical dimension:**A. Functional roles include:**

1. Mastication. 2. Deglutition (swallowing). 3. Phonetics. 4. Respiration.

B. Physiological roles: maintenance health of tissue (mucosa, bone, muscles and temporomandibular joint); also called Comfortable role.

C. Esthetic role.**D. Psychological role (stress, nervous)****Consequences of Increased Vertical Dimension:**

1. Increased trauma to the denture bearing area (acceleration of residual ridge resorption).

2. Inharmonious facial proportion (increased lower facial height).

3. Difficulty in swallowing and speech

4. Pain and clicking in the temporo-mandibular joint and muscular fatigue.

5. Loss of biting power.

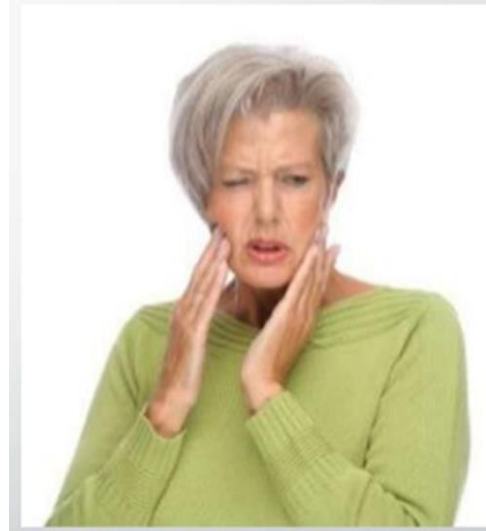
6. The sensation of a bulky denture.

7. Premature contact of upper and lower teeth.

8. Instability of dentures due to their excessive height

9. Clicking of teeth in speech and mastication.

10. Excessive display of artificial teeth and gum.



Consequences of Decreased Vertical Dimension:

1. Difficulty in swallowing and speech.
2. Pain and clicking in the temporo-mandibular joint and muscular fatigue.
3. Loss of muscle tone and presence of wrinkles and folds that is not due to age.
4. Decreased space of the oral cavity, and pushed the tongue backward.
5. Loss of biting power.
6. Naso-labial angle is less than 90°.
7. Angular cheilitis due to the folding of the corner of the mouth.
8. Cheek biting.
9. Thinning of the vermilion borders of the lip
10. The prominence of the lower jaw and chin



Methods of Recording Vertical Dimension at Rest (RVD):

1. Facial measurements In this method:

the patient sits in an upright position and his eyes look straight at some object, which is on the same level as the patient eyes, and then insert the maxillary record base with the occlusion rim. By an indelible marker, place a point as a reference on the top of the patient's nose and another one at the point of the chin in the midline. The patient was asked to perform functional movements like wetting his lips, swallowing and relaxing his shoulders (to relax the supra- and infra-hyoid muscles). When the mandible drops to the rest position, the distance between the two selected points was measured. Repeat this procedure until the measurements are consistent.



2. Tactile sense

The patient sit in an upright position and two points were marked as mentioned in the facial measurements method and then asked the patient to open his jaws wide until strain in the muscles of mastication occurred. When this opening becomes uncomfortable, ask a patient to close slowly until the jaws reach a comfortable, relaxed position. Measure the distance between the selected points as stated in the facial measurements method.

3. Phonetics

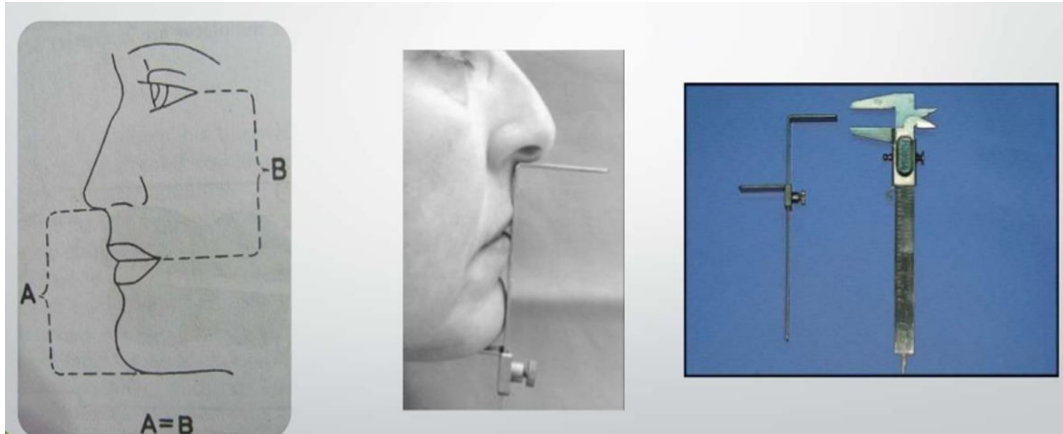
Ask the patient to pronounce the letter (m) and repeat it a certain number of times, like repeating mentioned names Mohammed or Fatima, etc... when the lips of the patient become in contact with the first syllable (m) pronounced ask the patient to stop all jaw movement. At this time measure the distance between the two points of reference as recorded in previous methods.

4. Facial expression

This method depends on the experience of the dentist to decide the relaxed facial expression when the patient's jaws are at rest then record the distance between two selected points. **The following facial features** indicate that the jaw is in its physiological rest position: The upper and lower lips should be even antero-posteriorly and in slight contact in a single plane. The skin around the eyes and over the chin should be relaxed; it should not be stretched, shiny, or excessively wrinkled. Furthermore, the nostrils (two openings of the nose) were relaxed and breathing should be unobstructed. These features are evidence of the rest position of the maxillamandibular musculature that is used to record the rest vertical dimension.

5. Anatomical landmarks (Willis method)

The Willis guide device was designed to measure the distance from the pupils of the eyes to the corner of the mouth and the distance from the anterior nasal spine to the lower border of the mandible. When these measurements are equal, the jaws are considered at rest. The measurement accuracy is questionable in patients with facial asymmetry.



6. Electro-Myographic method (EMG)

By using a special device, which measures the tone of masticatory muscles, when the tone is at least value, which indicated that the muscles and the jaws are at rest position.

Methods of Recording Vertical Dimension at Occlusion (OVD):

1-Mechanical methods

2-Physiological methods

• Mechanical Method:

(1) Pre-extraction records:

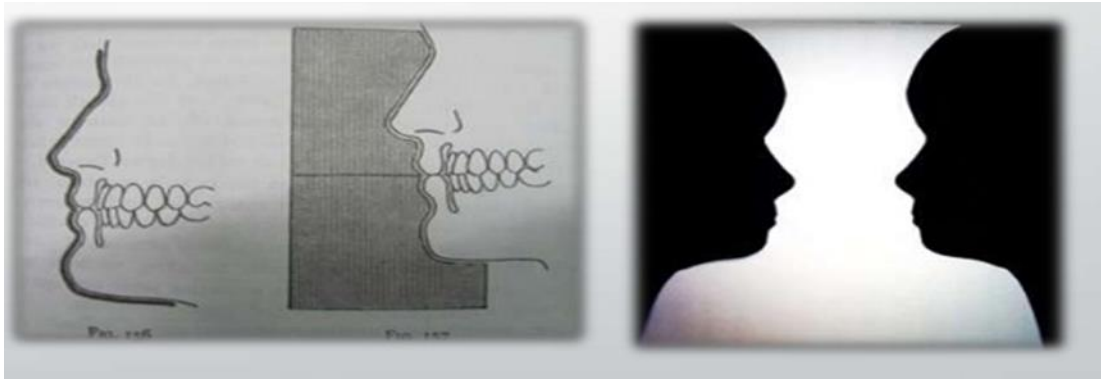
These records are made before the patient extracts all teeth and loses his occlusal vertical dimension; these records are:

A. Profile photographs:

The previous photograph is enlarged to the actual patient size. Measurements of anatomic landmarks in the photograph and compare with patient measurements using the same anatomic landmarks on the face. These measurements can be compared when the records are made and again when the artificial teeth are tried in. The photographs should be made with the teeth in maximum occlusion, as this position can be maintained accurately for photographic procedures.

B. Profile Silhouettes An accurate reproduction of the profile silhouette image can be cut out in cardboard or contoured in a wire. The silhouettes can be repositioned to the face after the vertical dimension has been established at the

initial recording and/or when the artificial teeth are tried in to compare if there is any space in the mandibular area.



C. Profile radiographs

It has been widely used by researchers to measure the vertical dimension of occlusion rather than used in prosthodontic treatment for edentulous patients. The two types of radiographs are advocated; the cephalometric profile radiograph and the radiograph of the condyles in the fossae. The disadvantages of this method are image distortion, radiation hazard and time consumption.

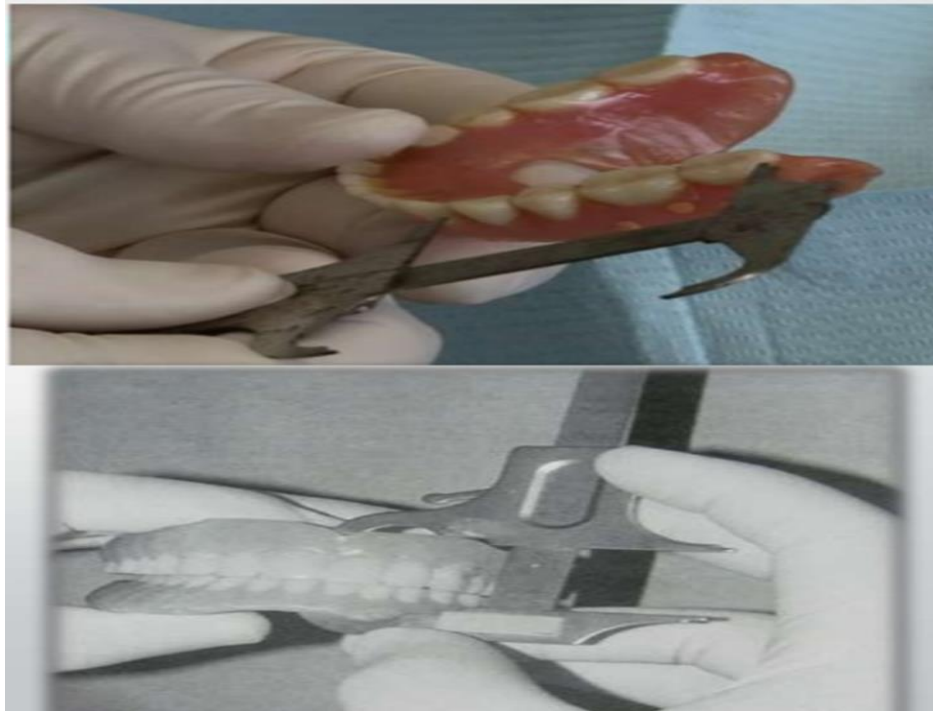
D. Articulated casts

An accurate diagnostic cast for the maxillary and mandibular arches which previously made. The occlusal record in centric relation is attained and then mount in the articulator. The teeth are removed and edentulous casts have been mounted on the articulator, the inter-arch measurements are compared. Generally, the edentulous ridges will be parallel one to another at the correct vertical dimension of occlusion. This method is valuable for patients whose ridges were not sacrificed during the removal of the teeth or resorbed during a long waiting period for denture construction

E. Facial measurements

Before extraction of natural teeth, the patient was instructed to close the jaws into maximum occlusion, then two tattoo points have been marked, one on the upper half of the face and the other on the lower half. The distance is measured; after extraction, these measurements are compared with measurements made between these points when the artificial teeth were tried in.

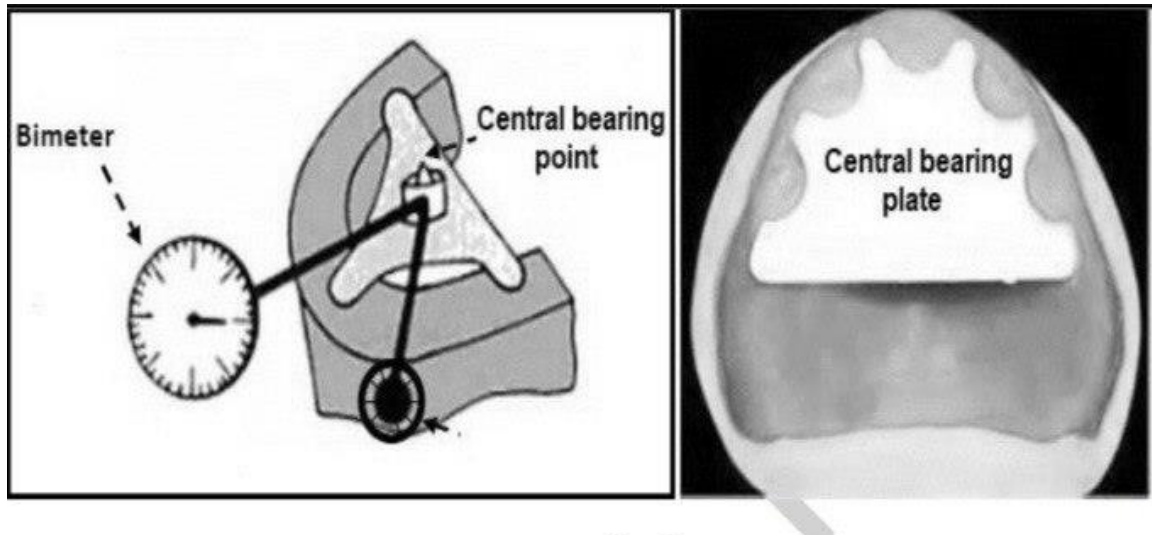
F. Measurements from former dentures the patient has been previously wearing dentures that can be used to measure the patient's facial dimension to determine the amount of change required and compared with new observation. With a Boley gauge, these measurements were made between the ridge crests in the maxillary and mandibular dentures. The distance from the incisive papilla to the mandibular alveolar ridge is measured and compared to the vertical distance of that of the upper and lower occlusion rims.



Physiological methods:

Including edentulous patients with no pre-extraction records:

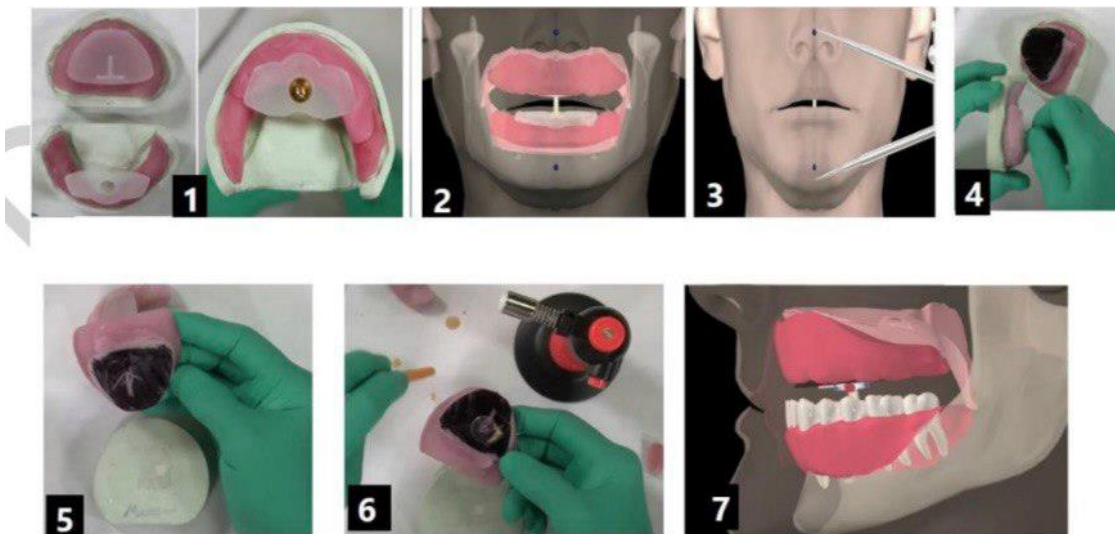
- 1. Boos method (power point):** A metal plate (central bearing plate) is attached to the maxillary record base. A bimeter (an oral meter that measures pressure) is attached to the mandibular record base. This bimeter has a dial, which shows the amount of pressure acting on it.



The record bases are inserted into the patient's mouth and the patient is asked to bite on the record bases at different degrees of jaw separation. The biting forces are transferred from the central bearing point to the bimeter. The highest value is called the Power Point which represents the occlusal vertical dimension.

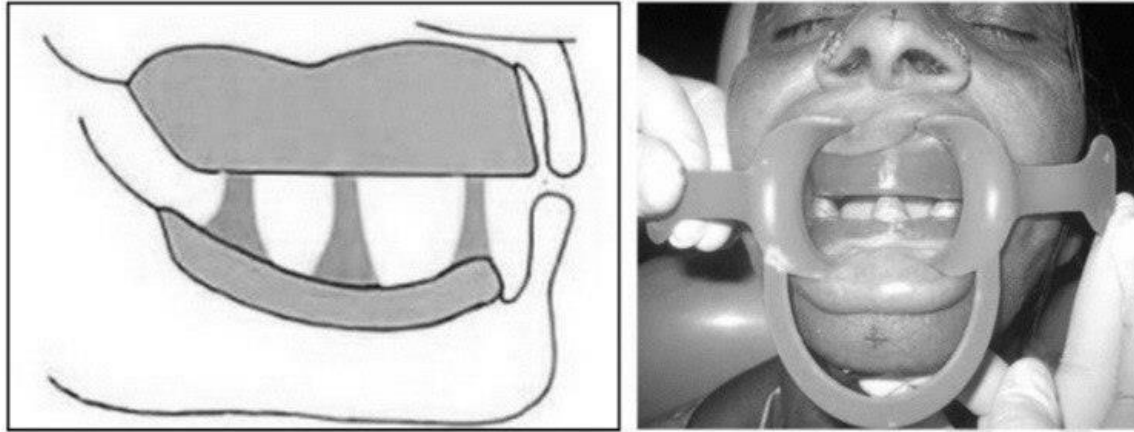
2. Tactile sense or neuromuscular perception:

A central bearing screw/central bearing plate apparatus is used and attached to accurately adapt record bases to permit the patient to experience through the neuromuscular perception the different vertical relations. The central bearing screw is adjusted downward and upward until the height of contact feels right to the patient and this represents the occlusal vertical dimension.



3. Swallowing threshold:

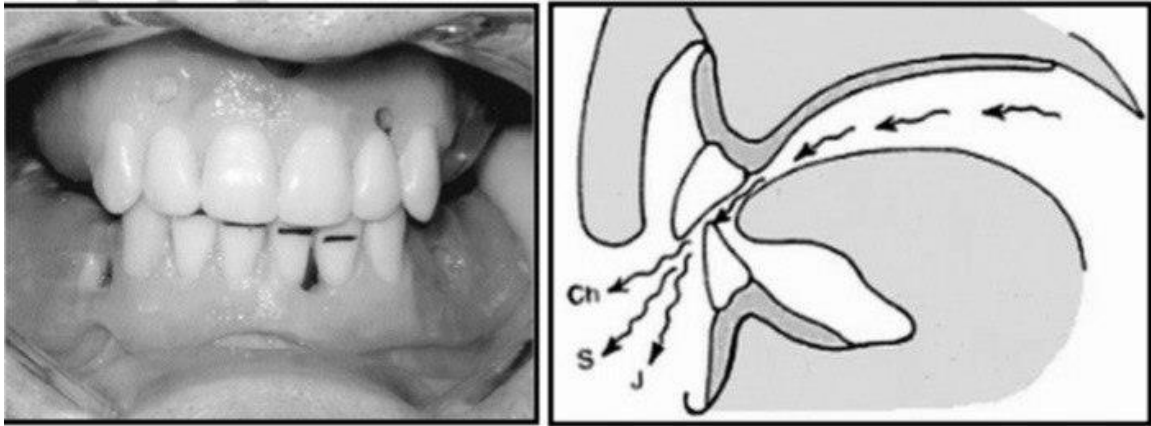
The technique involves the fabrication of cones of soft wax on the mandibular record base. The maxillary and mandibular record bases are inserted in the patient mouth. Salivation is stimulated and the patient is asked to swallow. The repeated action of swallowing the saliva will gradually reduce the height of the wax cones to allow the mandible to reach the level of the occlusal vertical dimension.



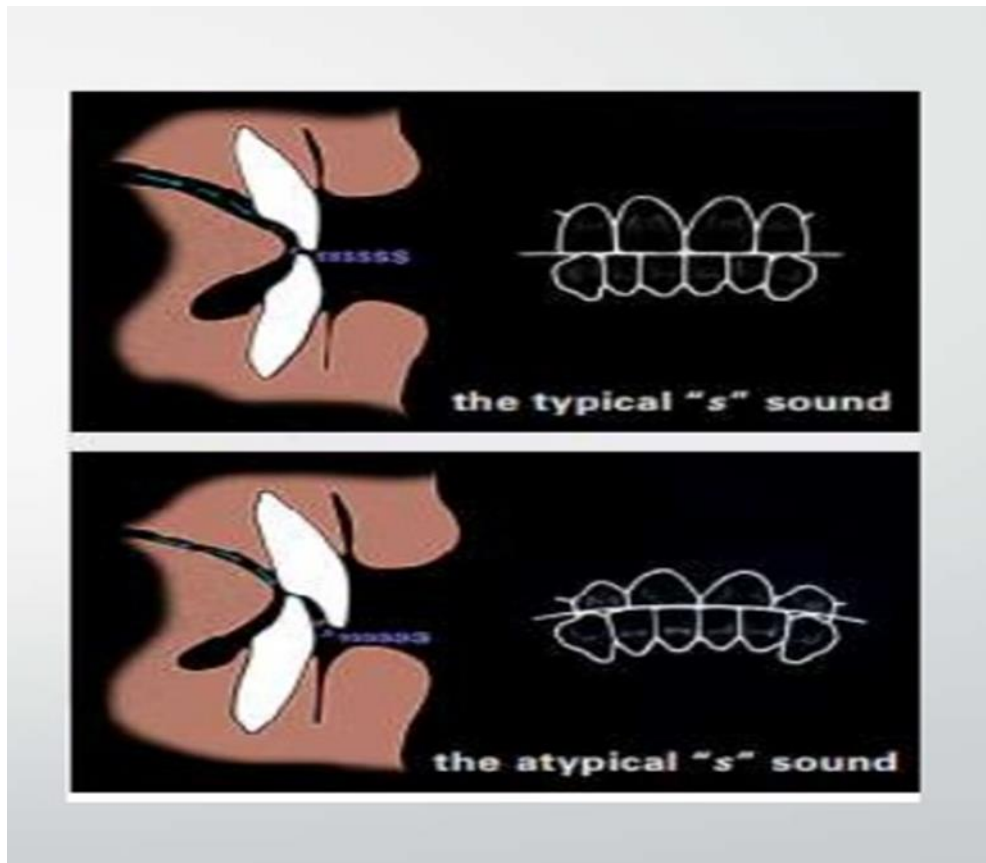
4. Phonetics:

Silverman's closest speaking space: It is the minimal amount of inter-occlusal space between the upper and lower teeth when sounds like ch, s, and j are pronounced.

The closest speaking space: is the closest relationship of the occlusal surface and incisal edges of the mandibular teeth to the maxillary teeth during function and speech, about 1-2 mm. Phonetic tests of the vertical dimension include listening to speech sound production and observing the relationships of teeth during a speech. The production of ch, s, and j sounds brings the anterior teeth closest together without contact.



Silverman's closest speaking space



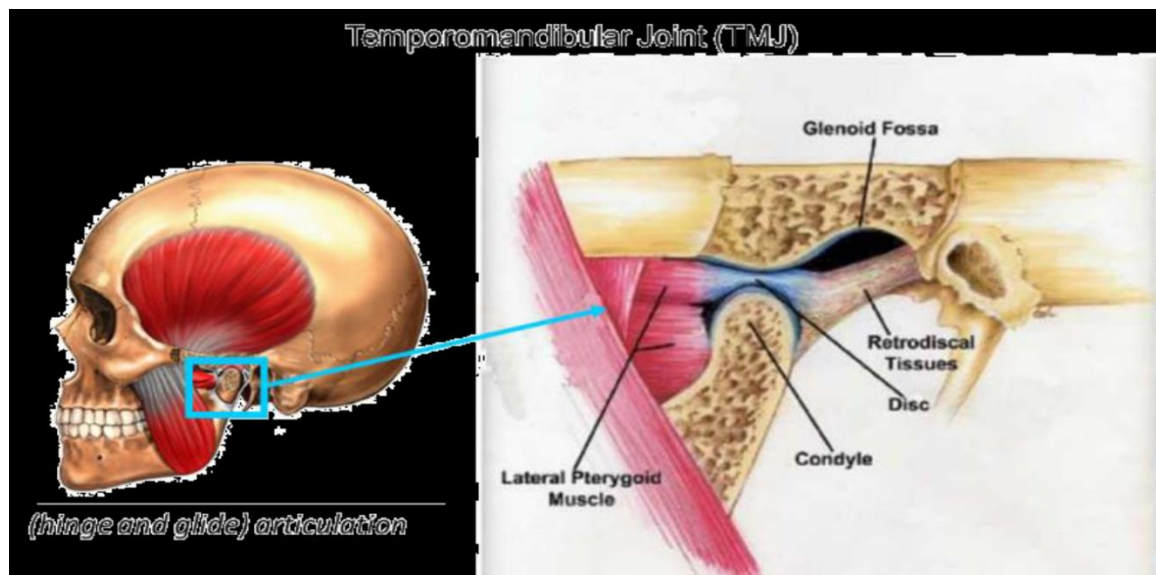
Horizontal Jaw Relation

It is the relationship of the mandible to the maxilla in a horizontal plane. It can also describe as the relationship of the mandible to the maxilla in an anteroposterior and side-to-side direction.

The Horizontal Jaw Relations include:

1. Centric jaw relation
2. Eccentric jaw relations
 - A. Protrusive or forward relation
 - B. Left or right lateral relation

1. Centric jaw relation: It is the Maxillo-mandibular relationship in which, both condyles head articulate with the thinnest avascular portion of their respective disks with its complex in the anterior-superior position against the shapes of the articular eminencies. This position is independent on teeth contact and can be noticeable clinically when the mandible is directed superiorly and posteriorly, from which the individual can make lateral movements at a given vertical dimension. Centric relation must be recorded at the vertical dimension determined. It is a clinically determined relationship of the mandible to the maxilla when the condyle disk assemblies are positioned in their most superior position in the mandibular glenoid fossae and against the distal slope of the articular eminence, (bone-to-bone relationship).



Centric occlusion: It is the contact between the occlusal surface of the maxillary teeth with the opposing mandibular teeth when the mandible is in centric relation.

Maximal Intercuspal Position: The most complete interdigitation of the teeth independent of condylar position. Hence, maximal intercuspation is a maxillo-mandibular relationship determined by the tooth-to-tooth relationship.

Importance of Centric Jaw Relation

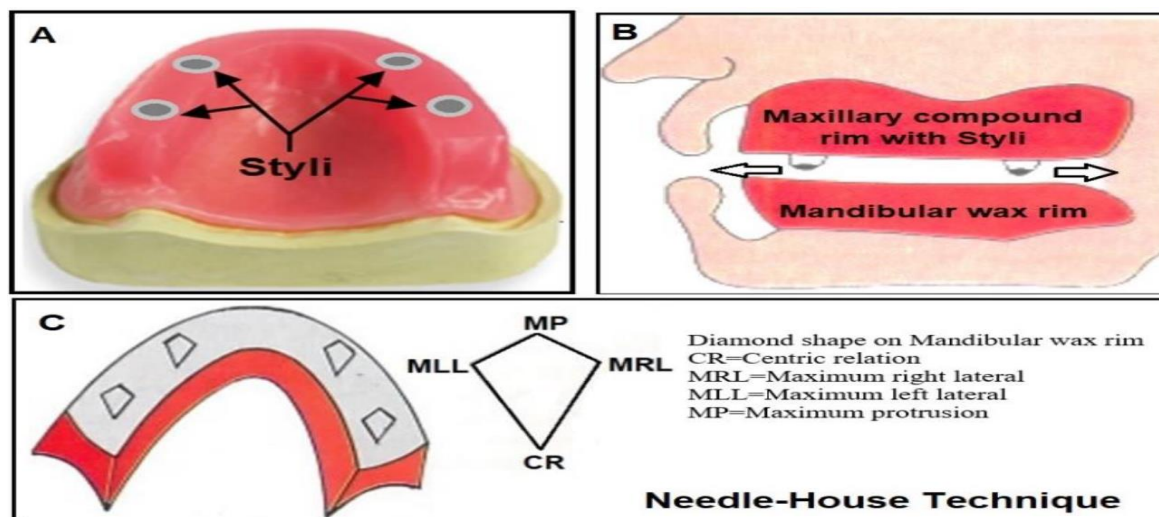
1. It is a reference position from which the mandible can move in any direction 2. It is a learnable, repeatable and recordable position.
3. It is the starting point for developing occlusion.
4. Functional movements like chewing and swallowing are performed in this position.
5. It is a reliable jaw relation because it is bone-to-bone relation.

Methods of Recording Centric Jaw Relation

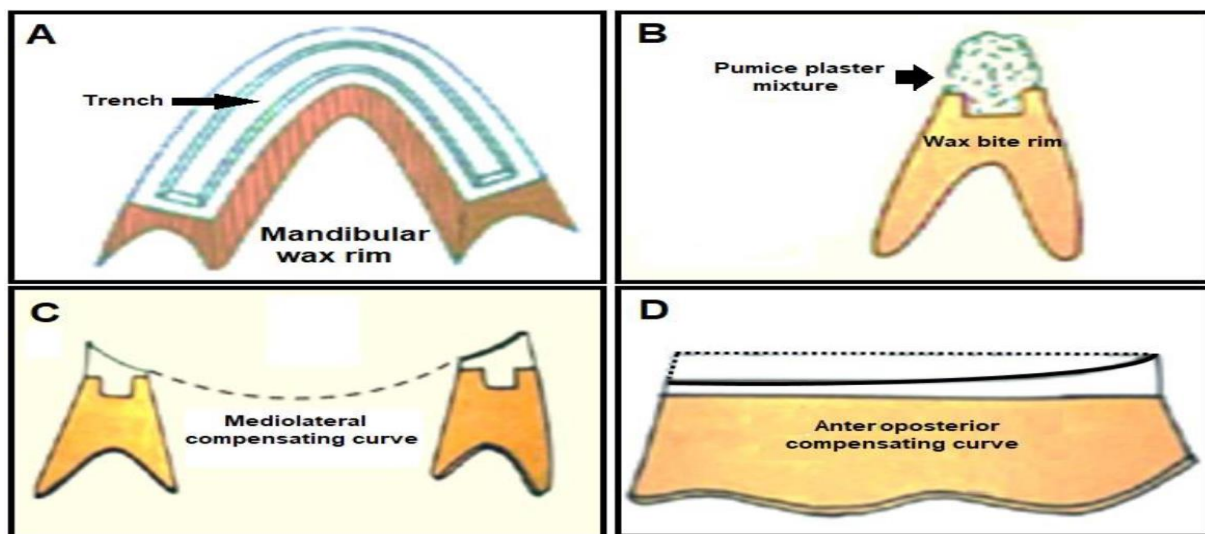
1. Functional (chew-in) methods.
2. Graphic method.
3. Tactile or interocclusal check record method.

1- Functional methods:

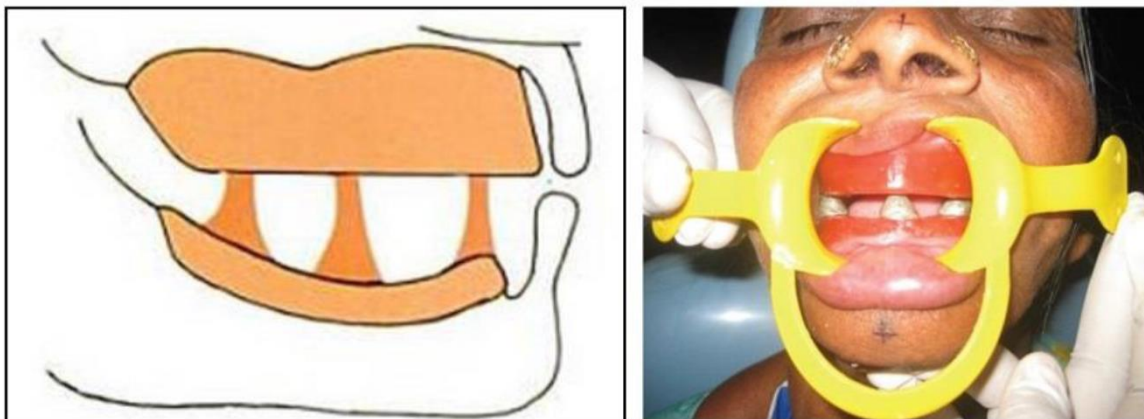
A- Needles-House Technique This method used impression compound occlusion rims with four metal styli placed in the maxillary rim. When the patient moves his mandible, the styli on the maxillary rim will create a marking on the mandibular rim, after movements of the mandibular completely; a diamond-shaped pattern is formed. The anterior most point of this diamond pattern indicates the centric jaw relation.



B- Patterson Technique In this method, a trench is made along the length of occluding part of the mandibular wax rim. A mixture of pumice and dental plaster with a ratio of 1:1 is loaded into the trench. When the patient moves his mandible, compensating curves on the mixture were formed due to the decreased height of the mixture. The patient was asked to continue with these movements until a predetermined vertical dimension was obtained. Finally, the patient asked to retrude his jaw and the occlusal rims fixed with metal staples. The disadvantages of functional methods involve lateral and anteroposterior displacement of the record bases concerning the supporting bone while the centric record is being made.



C- Swallowing Technique In this method, soft cones of wax are placed on the lower record base. The wax cones contact the upper occlusion rim when the patient swallows. This method is also used to record occlusion vertical dimensions.

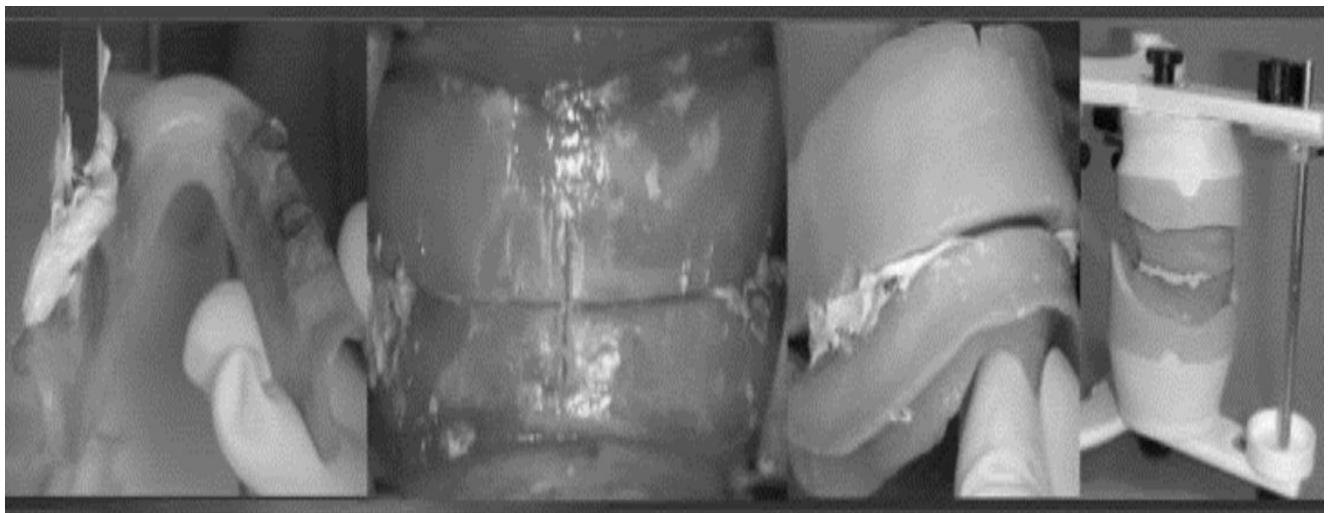


2- Graphic methods These methods used graphs or tracing (drawing) to record the centric relation. The general concept of this technique is that a pen-like pointer is attached to one occlusal rim and a recording plate is placed on the other rim. The plate is coated with carbon or wax on which the needle point can make the tracing, when the mandible moves in a horizontal plane, the pointer draws characteristic patterns on the recording plate. The characteristic patterns created on the recording plate are called arrow point tracing, also known as Gothic arch

tracing. The apex of the arrow point tracing gives the centric relation, with the two sides of the tracing originating at that point being the limits of the lateral movements. The apex of the arrowhead should be sharp else, the tracing is incorrect. The graphic methods are either intra-oral or extra-oral depending upon the placement of the recording device. The extra-oral is preferable to the intra-oral tracing because the extra-oral is more accurate, more visible and larger in comparison with the intra-oral tracing.

3-Tactile or interocclusal check record method

According to this method, the centric relation is recorded by placing a recording medium between the maxilla and mandible record bases when the jaws are positioned at centric relation. The patient closes into the recording medium with the lower jaw in its most retruded unstrained position and stops the closure at the predetermined vertical dimension. This method is simple because mechanical devices are not used in the patient mouth and are not attached to the occlusion rims. This method has the advantage of causing minimal displacement of the recording bases in relation to the supporting bone. This method is essential in making an accurate record, the visual insight, the sense of touch by the dentist in the making of a centric relation record, this phase developed with experience, and it is difficult to teach to another individual.



Materials that are commonly used for interocclusal check records include wax, plaster, zinc oxide eugenol, silicon and polyether.

An indication of the interocclusal check record method:

1. Abnormally related jaws.
2. Displaceable, flabby tissue.
3. Large tongue.
4. Uncontrollable mandibular movements.
5. It is used for patients already wearing a complete denture.

Methods used for assisting the patient to retrude the mandible:

1. Instruct the patient to let his jaw relax, pull it back, and close slowly on his back teeth”
2. Instruct the patient to contact with his tongue a piece of wax placed on the posterior palatal seal area and slowly close.
3. The patient asked to bring his upper jaw forward while occluding on the posterior teeth.
4. The head tilted backward, which makes protrusion more difficult
5. The patient asked to swallow and close slowly.
6. Instruct the patient to do routine jaw exercises.

Factors that complicate centric relation record

- 1- Resiliency of the tissues supporting the denture base.
- 2- Stability and retention of the record bases.
- 3- The TMJ and its neuromuscular mechanism.
- 4- Amount of pressure applied in making the record.
- 5- Technique employed in making the record.
- 6- The ability of the dentist.

2. Eccentric jaw relations: Any relationship between the jaws other than centric relation.

Lateral jaw relation: The relation of the mandible to the maxillae when the lower jaw is in a position to either side of the centric relation.

Protrusive jaw relation: The relation of the mandible to the maxillae when the mandible thrust forward.

Methods of Recording Eccentric Jaw Relations: The main reason for making an eccentric jaw relation is to adjust the articulator to simulate the eccentric movement of the mandible to the maxilla and establish balanced occlusion. The

methods are similar to that used for centric (functional, graphic and interocclusal records).

Interocclusal eccentric records (Protrusive, left and right lateral movement), can be made on the occlusion rim or the posterior teeth at the try-in appointment by Hanau articulator.

Hanau articulator is used to registering eccentric records according to the following formula to obtain lateral inclination:

$$L=H/8+12$$

L= lateral condylar inclination.

H= horizontal condylar inclination as established by the protrusive record.

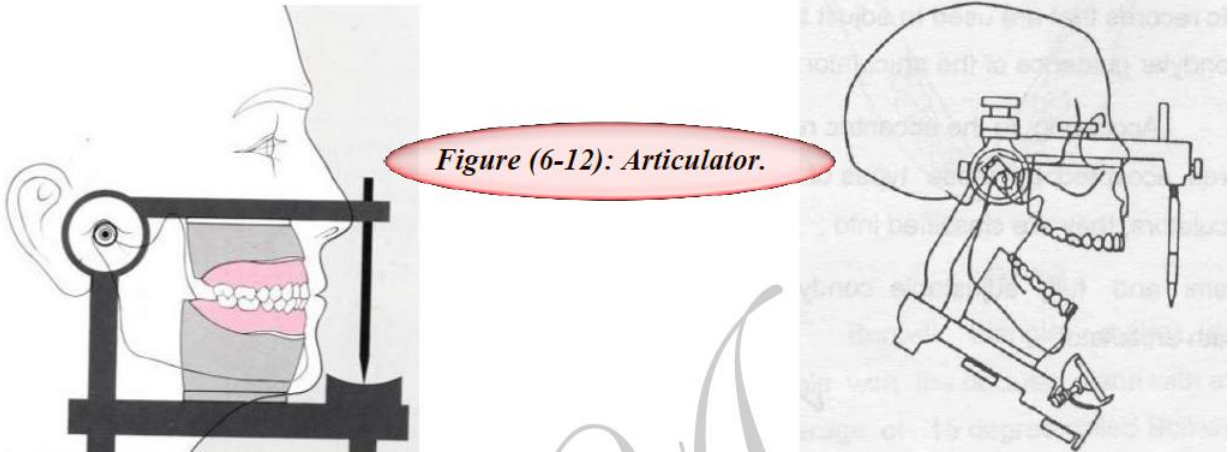
Factors considered during making eccentric jaw relation

1. The condylar path of the patient cannot be altered.
2. The condyles do not travel in straight lines during eccentric mandibular jaw movements.
3. Semi-adjustable articulators in which the condyles travel on a flat path cannot be used to reproduced eccentric movements exactly.
4. Fully-adjustable articulators, where the condylar and incisal guidance is fabricated individually with acrylic, can travel in the path of the condyle using pantographic tracings.

Articulators

Definition:

It is a mechanical instrument that represents the TMJ and jaw members to which the maxillary and mandibular casts are attached to simulate some or all mandibular movements.



Uses:

1. To diagnose the state of occlusion in both the natural and artificial dentitions.
2. To plane dental procedures based on the relationship between opposing natural and artificial teeth.
3. To aid in the fabrication of restorations and prosthodontic replacements.
4. To maintain the jaw relation record during arrangement of artificial teeth.
5. To correct and modify completed restorations (remounting the dentures after processing for correction of occlusal disharmony).

Requirements of an articulator:

1. It should hold the casts in the correct horizontal and vertical relationships
2. The casts should be easily removable and re-attachable
3. It should provide a positive anterior vertical stop (incisal pin)
4. It should accept face-bow transfer record

5. It should open and close in a hinge movement
6. It should be made of non-corrosive and rigid materials
7. It should not be bulky or heavy
8. There should be adequate space between the upper and lower members
9. The movable parts should move freely without any friction

Classification of Articulators:

1- Non-adjustable condylar path articulator

a- Simple hinge articulator (*Class I*).

b- Mean value or fixed condylar path articulator (*Class II*).

2- Adjustable condylar path articulator

a- Semi-adjustable condylar path articulator (*Class III*).

b- Fully-adjustable condylar path articulator (*Class IV*).

1- Non-adjustable condylar path articulators

A-simple hinge articulators (class I)

These are simple holding instruments capable of accepting a single static registration. Only vertical motion is possible. They orient the opposing casts to each other without reference to anatomical landmarks.

Design:

It consists of upper and lower members held apart at certain distance by a screw which acts at the back. The screw can increase or decrease the distance between the two members, and permits only a hinge like movement.

Possible movements:

This type of articulators gives only hinge opening and closing movement.

Records required for programming this type:

- 1- Vertical dimension of occlusion.
- 2- Centric relation records.

Disadvantage:

These articulators do not represent the temporomandibular joint and the dynamic mandibular movements.

**B- Mean value or Fixed condylar path articulators (Class II)**

These are an instrument that permits horizontal as well as vertical motion but does not orient the motion to the temporomandibular joints.

Design:

The two members of this type of articulators are joined together by two joints that represent the temporomandibular joints. The horizontal condylar path is fixed at certain angle that ranges from 30° which is the average (mean) of the most patients. The incisal guide table is also fixed at a certain angle from horizontal. The distance between the

condylar and incisal guide is derived from the average (mean) distance of the population. In the most fixed condylar path articulators, the upper member is movable and the lower member is stationary.

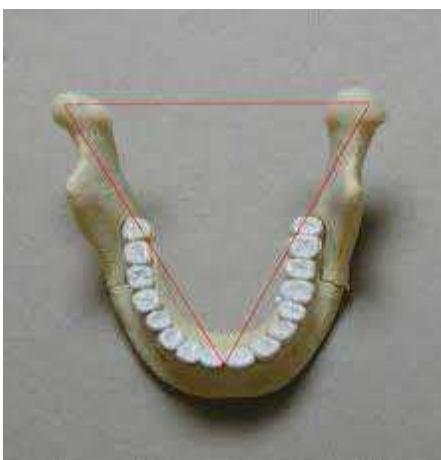
Possible movements:

- 1- Opening and closing.
- 2- Protrusive movement at a fixed condylar path angle.

Records required for programming this type:

- 1- Vertical dimension of occlusion.
- 2- Centric relation record.
- 3- Face-bow record: in some designs of these articulators, the upper cast can be mounted by a face-bow transfer. When the articulators do not accept face-bow record, the mounting is made according to **Bonwill triangle**.

Bonwill found in mandibles that the inter-condylar distance as well as the distance from each condyle to the contact point of the lower central incisors was 4 inches (**equilateral triangle**). An anterior pointer is attached to the incisal pin of the articulator to locate the tip of the occlusion rim labially and thus to orient cast in relation on the Bonwill triangle.



Disadvantage:

- 1- Most of these articulators do not accept face-bow record.
- 2- The condylar path moves to a fixed angle and it is successful only in patients whose condylar angle approximates that of the articulator.
- 3- No lateral movements.

2- Adjustable condylar path articulators (class III and IV)

These types of articulators differ from fixed condylar path articulators that have adjustable condylar and incisal guidance. They can be adjusted so that the movements of its jaw members closely resemble all movements of the mandible for each individual patient.

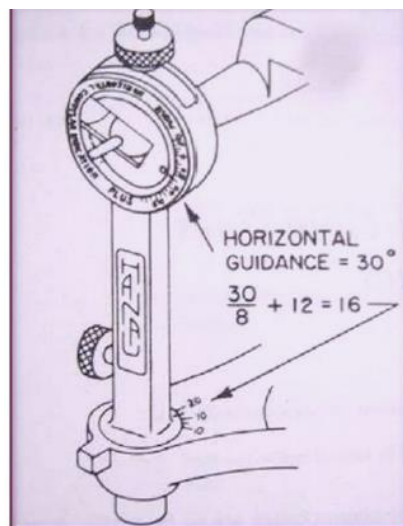
A- Semi adjustable condylar path articulators (class III)

An articulator that allows adjustment to replicate average mandibular movements and it may be arcon or non-arcon instruments.

Design:

In these articulators, the horizontal condylar path is adjusted by a protrusive record obtained from the patient, and the lateral condylar path inclination is adjusted according to the *Hanau's formula* when use Hanau type of semi-adjustable articulator.

$$\text{Lateral inclination} = \frac{\text{Horizontal inclination}}{8} + 12$$



They Classified as:

- 1- Arcon semi-adjustable articulator.
- 2- Non-arcon semi-adjustable articulator.

The term **arcon** comes from (mandibular **condyle**). It is commonly used to indicate an articulator that has its condyles on the lower member and the condylar guide on the upper member.

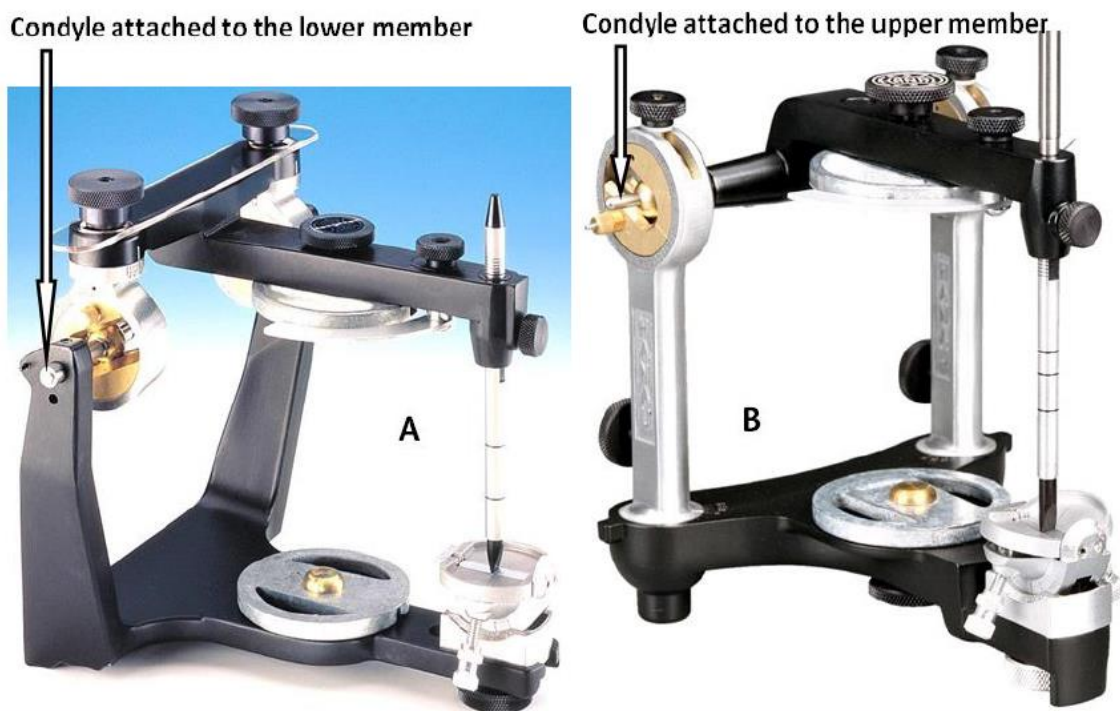


Figure (6-19): (A) Arcon semi-adjustable articulator. (B) Nonarcon semi-adjustable articulator.

Possible movements:

- 1-Opening and closing
- 2-Protrusive movement according to the horizontal condylar path angle determined from the patient.
- 3-Lateral movement to the angle estimated from the Hanau formula.
- 4-Some types have Bennett movement (immediate side shift).

Bennett movement: lateral movement of the mandible toward the working side as the non-working condyle moves forward.

Records required for programming this type:

- 1- A maxillary face bow record to mount the upper cast.
- 2- centric occluding relation record (vertical dimension and centric relation) to mount the lower cast.
- 3- protrusive record to adjust the horizontal condylar path inclination of the articulator.

**Disadvantage:**

- 1- The lateral condylar path angle is determined from a formula, not from the patient directly.
- 2- The condyles travel on a flat path cannot be used to reproduced eccentric movements exactly.
- 3- Most of these articulators have no **Bennett movement**.

B- Fully adjustable articulators (Class IV)

An articulator that will accept three dimensional dynamic registrations; these instruments allow for orientation of the casts to the temporomandibular joints and simulation of mandibular movements. They differ from the semi-adjustable articulators in that the lateral condylar path inclination is adjusted according to records taken from the patient.

Possible movements:

- 1- Opening and closing.
- 2- Protrusive movement according to the horizontal condylar path angle determined from the patient.
- 3- Lateral movement according to the lateral condylar path inclination determined from the patient.
- 4- Bennett movement. The same movements of the semi-adjustable type, in addition they have Bennett movement.

Records required for programming this type:

- 1- A maxillary face-bow record to mount the upper cast.
- 2- Centric occluding relation record to mount the lower cast.
- 3- Protrusive record to adjust the horizontal condylar path inclination of the articulator.
- 4- Right lateral record to adjust the left condylar path inclination.
- 5- Left lateral record to adjust the right condylar path inclination.

Disadvantage:

Multiple records are required with the possibility of errors.

3. Digital computerized articulator programming:

The virtual articulators are able to design prostheses kinematically. They are capable of:

- simulating human mandibular movements.
- moving digitalized occlusal surfaces against each other according to these

movements.

- correcting digitalized occlusal surfaces to enable smooth and collision-free movements.

There are two types of digital articulators. One is Completely Adjustable Articulators, another is Mathematically Simulated Articulator.

- **Completely adjustable articulators (motion analyzer):-** It was designed by Kordass and Gaertner. It records/reproduces exact movement paths of the mandible using an electronic jaw registration system called Jaw Motion Analyzer (JMA). Jaw Motion Analyzer is device for tracking the jaw of patient. It consists of face bow with receiver sensors, lower jaw and pointer sensor, occlusal adapter and software.

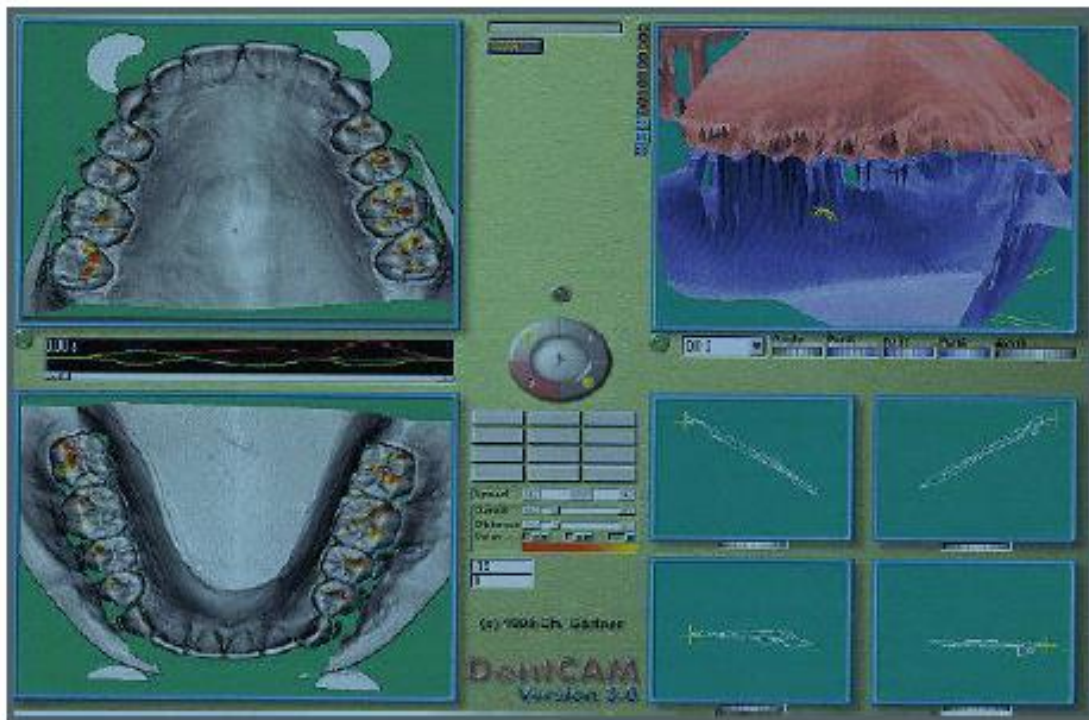


Figure 7: Kordass' Virtual Articulators

- **Mathematically simulated articulator (motion parameter):-** It is designed by Szentpétery. It is based on a mathematical simulation of the articulator movements. It is a fully adjustable three dimensional virtual articulator capable of reproducing the movements of a mechanical articulator.

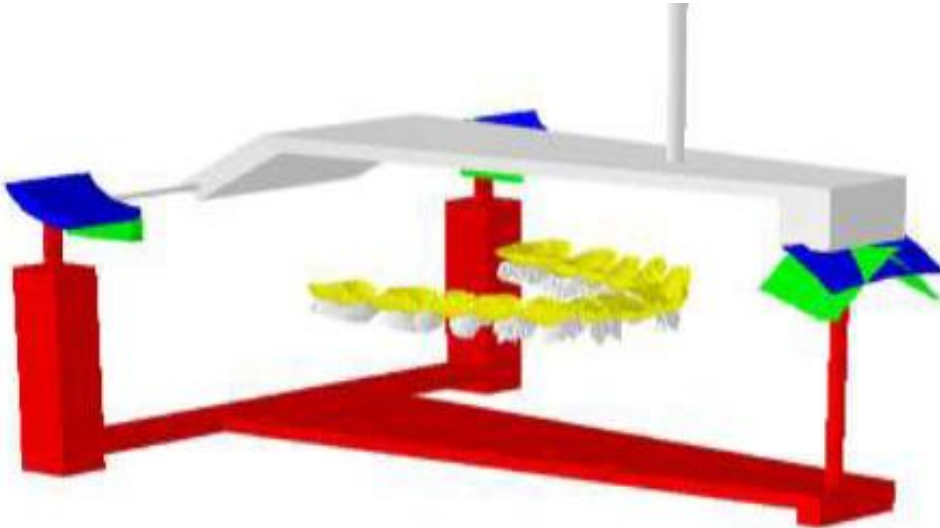


Figure 8: Szentpétery's Virtual Articulators

FACE-BOW

The face-bow is a caliper- like device that is used to record the relationship of the maxilla to the temporomandibular joints or the opening axis of the jaws and to orient the casts in this same relationship to the opening axis of the articulators.

The face-bow consist of :

1. U- shaped frame or assembly.
2. The condyle rods.
3. The fork.

Types of face-bow:

There are two basic types of face-bow; the kinematic, and the maxillary.

1. The kinematic (mandibular, hinge axis locator) face-bow:

It is used to locate the kinematic (true or terminal) transverse hinge axis. The transverse hinge axis is an imaginary line, in which the mandible rotates during opening and closing for about 20 mm.

2. The maxillary face-bow:

It is used to record the position of the upper jaw in relation to the hinge axis and transferring the relation to the articulator

The maxillary face-bow is oriented to the kinematic or arbitrary hinge axis. The arbitrary axis is positioned on a line extending from the outer canthus of the eye to the middle of the tragus of the ear and approximately 13 mm in front of the external auditory meatus.

The ear face-bows are designed to utilize an arbitrary axis by fitting into the external auditory meatus.

Important of the face-bow:

1. An arbitrary mounting of the maxillary cast without a face-bow transfer can introduce errors in the occlusion of the finished denture.
2. A face-bow transfer allows minor changes in the occlusal vertical dimension on the articulator without having to make new maxillomandibular records.
3. It is helpful in supporting maxillary cast while it is being mounted on the articulator.

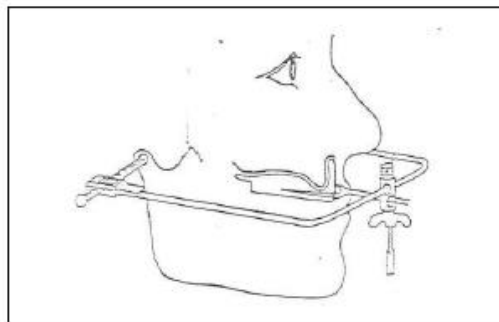


Figure 9: The maxillary face-bow on the patient

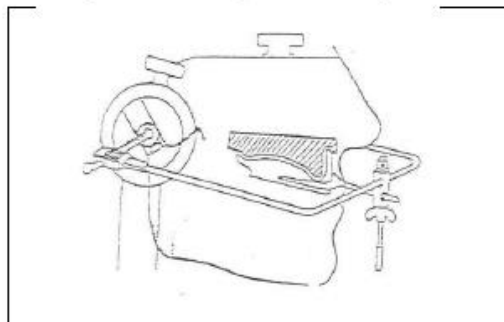


Figure 10: The maxillary face-bow on the articulator

Mounting

ZEROING OR RESETTING THE ARTICULATOR BEFORE MOUNTING:

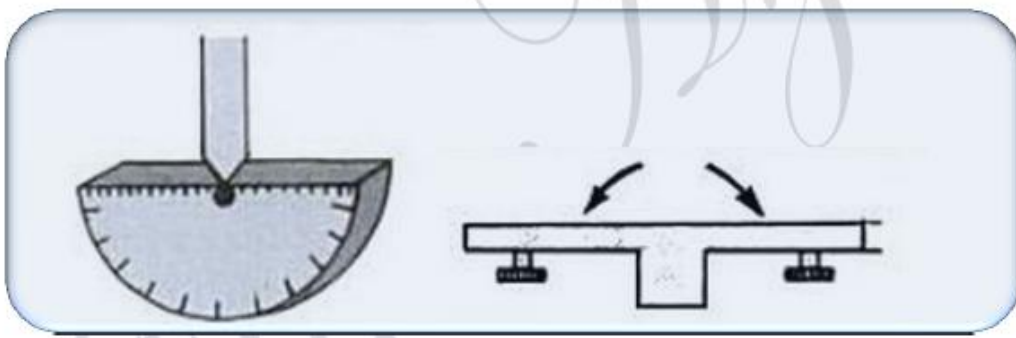
- **In mean value articulator (Class II articulator)**

1. The articulator should be clean from any remnant of previous plaster.
2. The movable surfaces of the articulator should move freely without any hindrance.
3. The incisal pin should be flushed with the top of upper member of articulator to give zero reading.
4. The mounting table should be properly fixed to the articulator. The mounting table used to support the maxillary occlusion rim in its accurate position during mounting

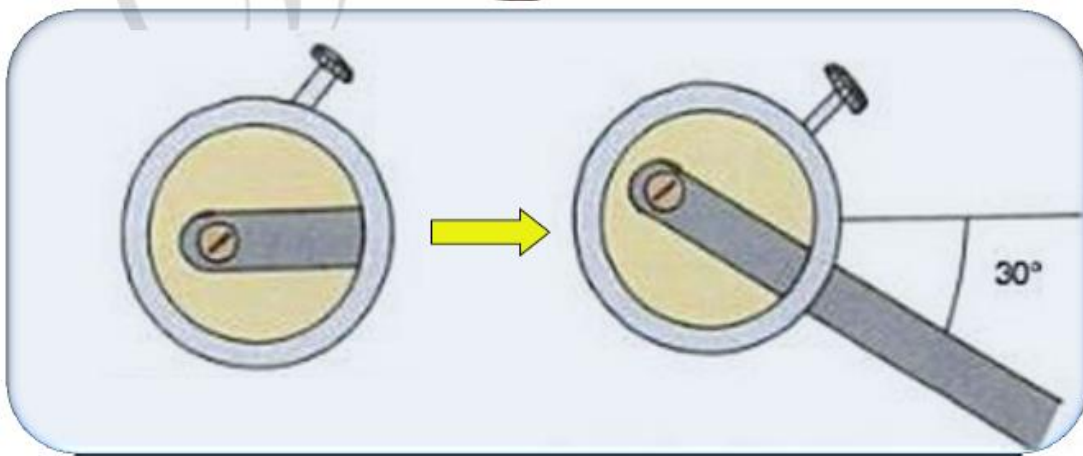


- **In semiadjustable articulator (Class III articulator)**

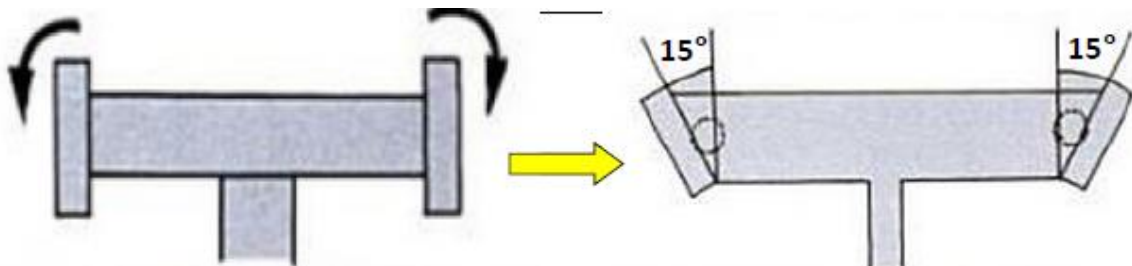
1. The articulator should be clean from any remnant of previous plaster.
2. The movable surfaces of the articulator should move freely without any hindrance.
3. The incisal pin should be flushed with the top of upper member of articulator to give zero reading.
4. Set the incisal guide table at 0° anteroposteriorly and laterally.



5. Set the condylar track in the horizontal condylar guidance at 30° bilaterally.



6. Set the lateral condylar guidance at 15° .

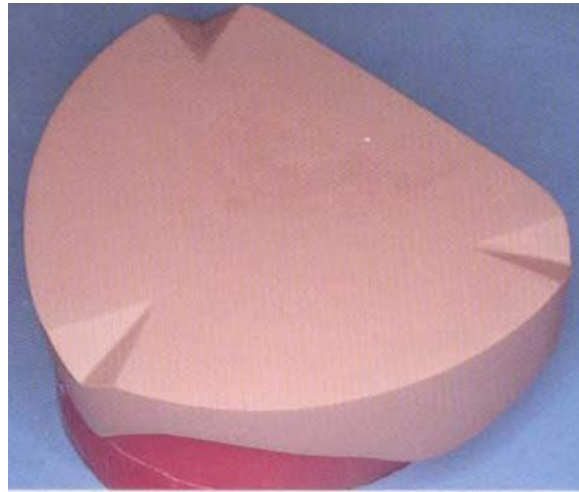


7. Lock the opening axis (hinge axis) of the articulator into centric position by placing the condylar ball element all the way forward and turning up the locking pin.



PREPARATION OF THE CASTS FOR MOUNTING:

1. Determine the midline of the cast according to the midline of incisive papilla and continue this line posteriorly all around the cast.
2. The casts should be placed in slurry water for better adhesion of the casts to the mounting plaster.
3. With wax knife, 3-4 V-shape cuts on the base of upper and lower casts, so as to facilitate the laboratory remounting. The cut should be approximately 1/4 inch depth and 1/2 inch width.
4. Lightly coated the base of the casts with Vaseline or any separating medium.
5. The base plate with occlusion rim should be sealed to the cast by wax.

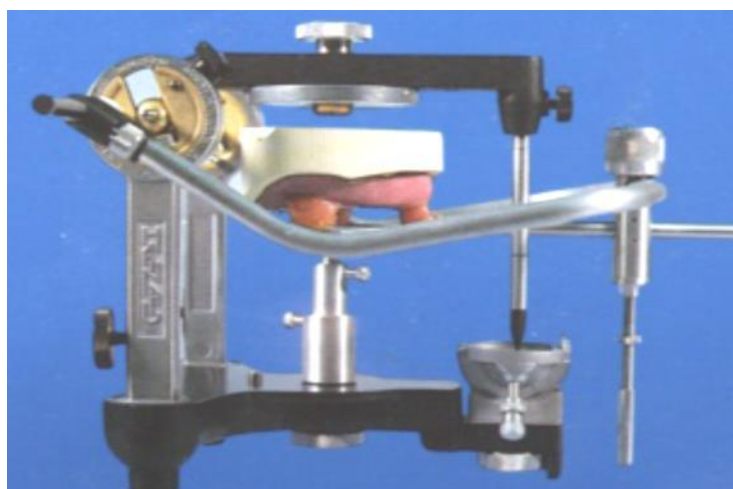


Mounting the maxillary cast:

The maxillary cast is first attached to the upper member of the articulator after orientation jaw relation by using the face-bow with adjustable type of articulators, while for the mean value articulator use the mounting table to support the maxillary occlusion rim in its position during mounting. The mandibular cast is articulated after recording the vertical and centric jaw relations

After recording the orientation jaw relation, the following steps are carried out

1. Enough space should be present between the base of the cast and the upper member of the articulator to accommodate for the plaster material over the cast. If there is not enough space trimming should be done to the base of the cast.

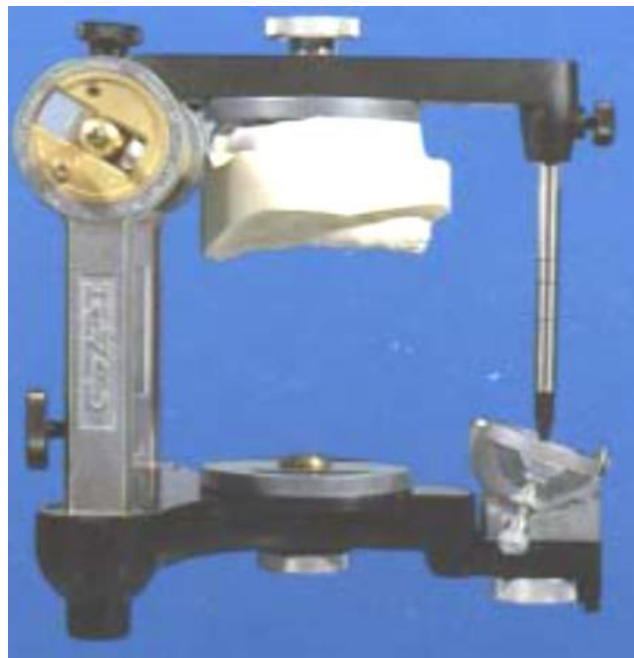


2. Alignment of the midline of the maxillary occlusion rim to the center of the cross midline which found on the mounting table anteriorly and posteriorly, so that the cast

will be centralized to the mounting table and the occlusal rim fixed to the mounting table by wax.



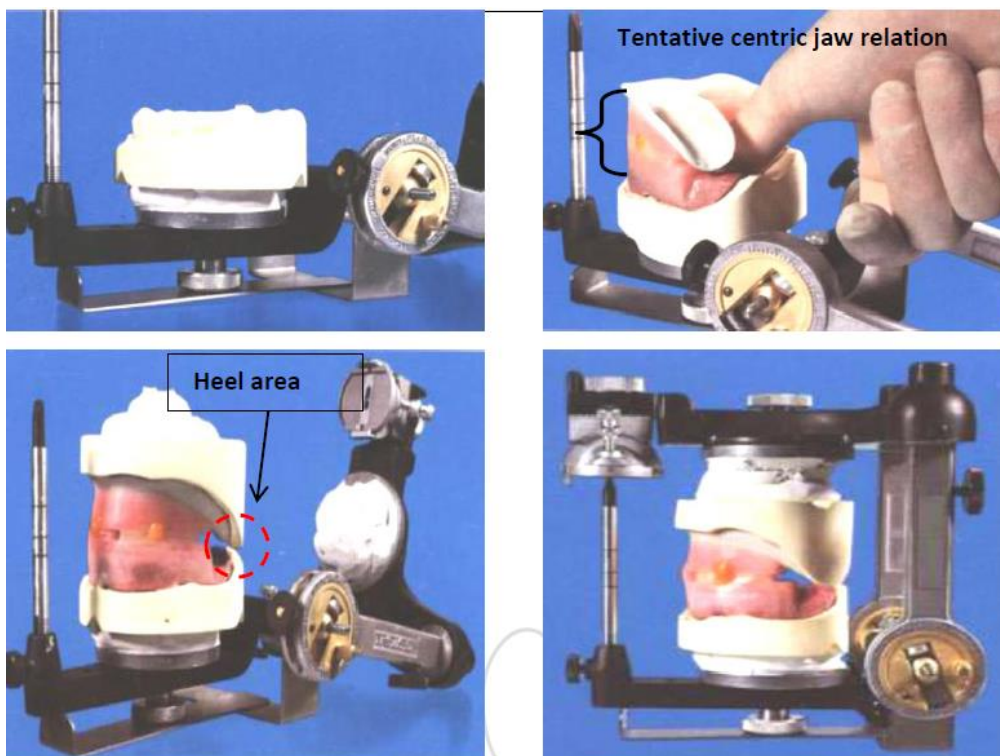
3. Plaster is mixed according to the manufacturer instruction then the plaster is poured over the base of the cast and the upper member is closed until the incisal pin touches the incisal table.
4. Smoothing and polishing of the plaster is done. The mounting should be cleaned and any debris removed from the articulator and mounting table.



Mounting the mandibular cast:

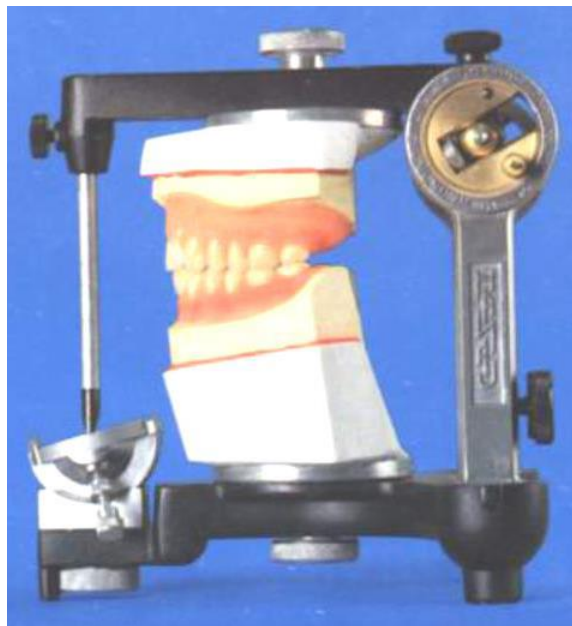
The mandibular cast is mounted after recording the tentative vertical and centric jaw relations.

1. The mandibular occlusion rim should be well secured to the mandibular cast with its record base by using wax, also sealing should be done between the maxillary and mandibular rims after making tentative centric jaw relation.
2. Care should be taken that there is no posterior interference between the maxillary and mandibular casts (Heel area).
3. The articulator with the mounted maxillary cast is inverted to aid in the mounting the mandibular cast.
4. The maxillary occlusal rim with mandibular occlusal rim (centric record) placed on the maxillary cast.
5. The mandibular cast is placed on the mandibular occlusal rim (It should be soaked in slurry water before mounting).
6. The plaster is mixed and poured over the base of the mandibular cast and the articulator is closed until the incisal table touch the incisal pin, then the plaster should be smoothed and polished.



The mounting should be checked for:

1. The midline of upper cast should be coinciding with the midline of lower cast and midline of articulator.
2. Centralization of upper cast with upper member of articulator then the centralization of lower cast which depend on accuracy of the upper cast.
3. Incisal pin checked if it does not touch the incisal table.
4. Healer's area checked if there is any contact.

***POSSIBLE ERRORS MIGHT OCCUR DURING MOUNTING:***

1. The record base is not properly secured to the cast.
2. Interference of the casts posteriorly.
3. The incisal pin does not touch the incisal table.
4. The incisal pin is not properly screwed.
5. Wrong transference of the midline of the articulator with that of the casts (shifting of the midline).
6. Movement of the casts during mounting.
7. Maxillary and mandibular rims are not properly fixed after making centric record.
8. Dimensional changes in the plaster material.
9. Face bow record defected.

SELECTION OF ARTIFICIAL TEETH

Teeth selection is very important as the selection of the appropriate shade, size, and form of the artificial teeth determines the esthetic and function of the denture.

OBJECTIVES IN TEETH SELECTION

- 1- The teeth should be in harmony with the surrounding tissues.
- 2- They should maintain the vertical dimension.
- 3- They should be efficient for mastication.
- 4- Anterior teeth are selected predominantly based on esthetic, whereas the posterior teeth should be selected based on the function.

Selection of artificial teeth includes:

1. Selection of anterior teeth.
2. Selection of posterior teeth.

Selection of anterior teeth

Anterior teeth are primarily selected to satisfy esthetic requirements, so the dentist's professional obligation is to give the patient adequate information, guidance, and opportunity to choose their teeth. Anterior teeth selection is the area of prosthodontic care in which the patient should be given a primary responsibility to determine the esthetic outcome.

Records of shade, size, and form of teeth could be obtained from pre-extraction records which include:

- 1- Preserved extracted teeth.
- 2- Previous diagnostic casts with natural teeth.
- 3- Pre-extraction radiograph.
- 4- Pre-extraction photograph.

- 5- Observation of teeth of close relatives.
- 6- The old denture might help in teeth selection by ask the patient, it (like or dislike) the teeth then and decide change or not.

Factors to be considered when pre-extraction records are not available

1- Shade

2- Size

3- Form

SHADE

It is the degree of darkness of the color. There are two basic shades, the yellow and grey, and the other shades vary in between.

Many patients will ask for very light shade, tell them that the proper shade gives more natural appearance, never force the patient to accept a shade that they do not want, they will never be satisfied with the denture.

The factors of shade selection:

1- Age

The younger the patient, the lighter the shade is preferred. The shade of natural teeth will be darkening with age ***because of***

- a) Deposition of secondary dentin.
- b) Consequent reduction in size of the pulp chamber.
- c) Wearing away of enamel.
- d) External staining of the exposed dentin from oral fluids, foods, or tobacco.

2- Gender

The gender may affect the shade; it seems that females are given lighter and brighter teeth than males.

3- Complexion

The color of the face should harmonize the shade of the teeth. Lighter teeth are suitable for lighter skin, while darker teeth are suitable for darker skin. Although people with dark skin seemed to have very light teeth, this is because of contrast in the skin and teeth color.

4- Patient Preference

Show the patient a complete shade guide and select the two tabs that are the lightest and the darkest, hold them against the patient lip and ask them to point to the one that they prefer this method called (method of pair comparison). More than two or three shades should be selected and comparison between them would help in final right selection.

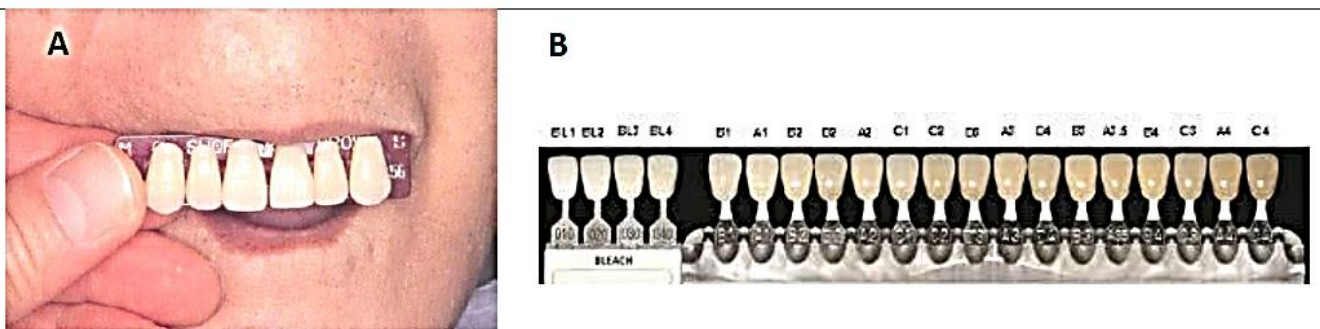


Figure (8-1): (A) Method of pair comparison. (B) Shade guide.

SIZE

To select the size of anterior teeth, we have to consider the following:

1- Length

a- Length of upper lip

- In short lip more than **2 mm** seen from the maxillary central incisors.
- In medium lip length **1.5-2 mm** seen from the maxillary central incisors.
- In long lip nothing can be seen from the maxillary central incisors.

b- Level of lower lip

Length of mandibular anterior teeth should be with the level of lower lip.

c- *Inter-Ridge distance*

When the space is available, it is more esthetically acceptable to use a tooth long enough to eliminate the display of the denture base (teeth are more attractive in appearance than denture base materials).

2- Width

- a- The width from the tip of left canine to the tip of right canine is almost equal to the width of the nose (interalar width) when measured by the caliper. (Width of six anterior teeth = interalar width + 7 mm)
- b- The width of maxillary central incisor equals approximately to 1/16 of bizygomatic width, and the width of maxillary anterior teeth equals to 1/3.36 of bizygomatic width.
- c- Width of the anterior teeth can be measured on maxillary occlusal rim depending on the intraoral anatomical landmarks like: (buccal frenum, corner of the mouth, and canine eminence).

3- Patient Preference

Use the method of pair comparison to assist a patient to decide what size of tooth they prefer. Set two different sizes of teeth on a piece of wax rope, place them under the upper lip, and find out which one the patient prefers. Two or three presentations may have to be made to reach a suitable decision.

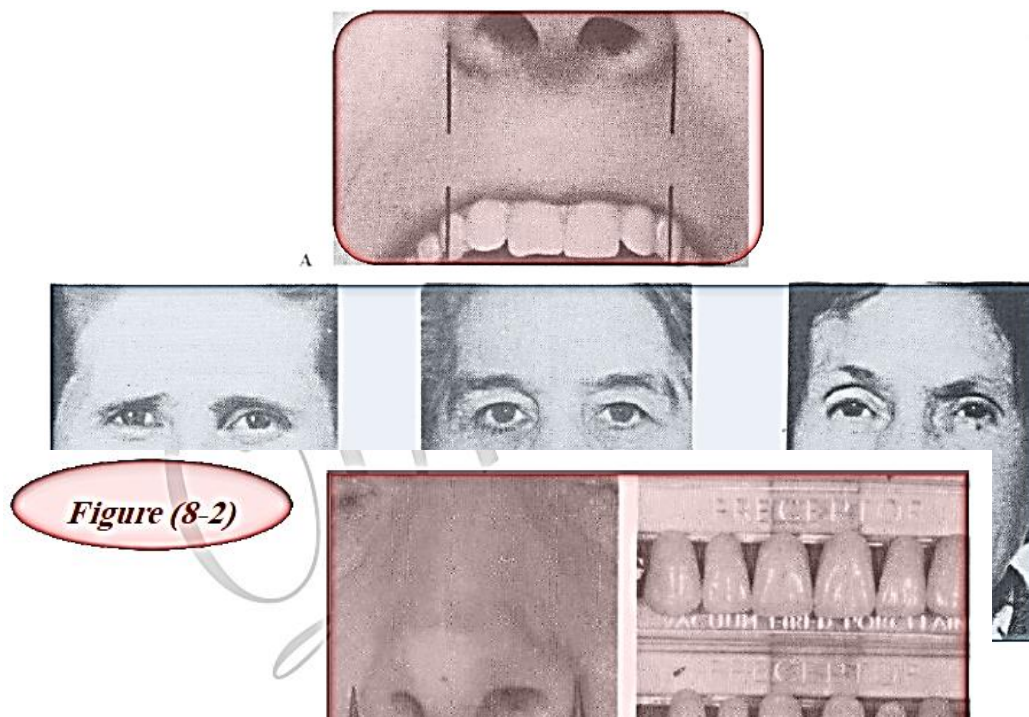
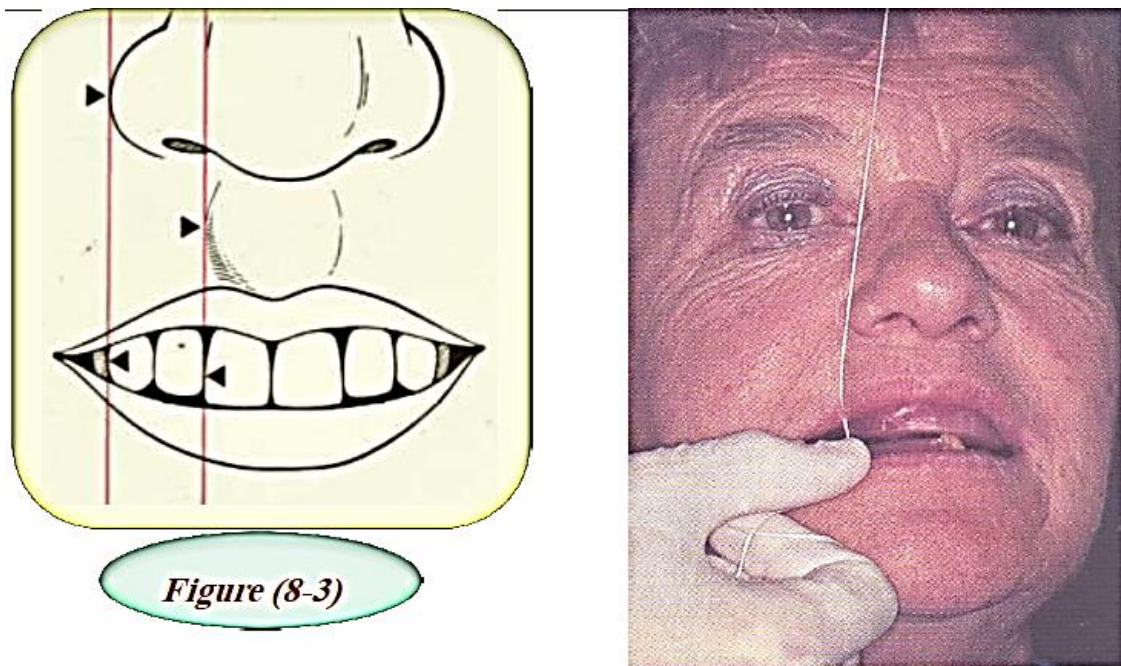


Figure (8-2)



FORM

The form or outline of anterior teeth depends on the following factors:

1- Facial form

- *According to frontal outline:*

The face could be classified into: *square*, *ovoid*, and *tapering*. The maxillary central incisor form should be in harmony with patient face.



- **According to Profile:**

The face could be classified into: **straight**, **convex**, and **concave**. The labial surface of maxillary central incisor viewed from mesial aspect should be in harmony with profile of face.

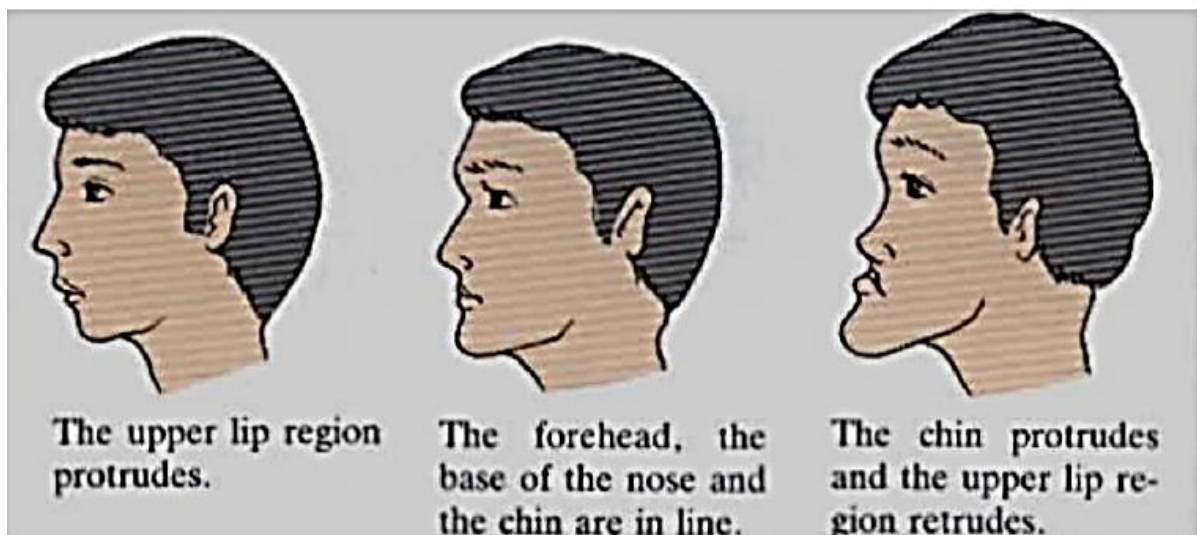


Figure (8-5)

2- Age

In old patients the teeth tend to have square form due to attrition, more round features disappear and line angle quite seen in those patients.

3- Personality

It seems reasonable that a large vigorous type of persons have teeth of more square, large teeth with prominent markings, different from those of delicate appearing persons.

4- Patient Preference

Allow the patient to select between the same size teeth but different forms. Set two different forms of teeth on the right and left sides of a piece of wax rope, and ask the patients which they prefer.

Selection of Posterior teeth

Posterior teeth are selected for:

- 1- Shade**
- 2- Size**
- 3- Occlusal Form**

SHADE

Shade of posterior teeth should be harmonized to the shade on anterior teeth, maxillary first premolars are sometimes used for esthetic more than function, so it is advisable to select premolar teeth with lighter color than the other posterior teeth, but not lighter than anterior teeth. Generally the shades of posterior teeth are slightly darker than anterior teeth.

SIZE

- ***Occlusogingival Height***

It is determined by the available interarch distance. The occlusal plane should be located at the midpoint of the interocclusal distance. The length of the maxillary first premolar should be comparable to that of maxillary canine to have the proper esthetic effect. The height of posterior teeth usually divided into long, medium, and short. Long posterior teeth are generally more esthetic in appearance than are shorter teeth.

- ***Buccolingual Width***

The buccolingual width of posterior teeth should be slightly narrower than natural teeth, because the broader occlusal surfaces which direct more stress during function to supporting tissue, leading to increase in the rate of ridge resorption. Broader teeth encroach into the tongue space leading to instability of the denture. Also, the teeth should not encroach into the buccal corridor space to avoid cheek biting.

The narrow artificial posterior teeth enhance the development of the correct form of the polished surfaces by allowing the buccal and lingual denture flanges to slope away from the occlusal surface.

- ***Mesiodistal Length***

The combined mesiodistal lengths of all maxillary posterior teeth in that side of the arch should be equal to the distance between canine line, and anterior border of maxillary tuberosity. For mandibular posterior teeth, the mesiodistal lengths should be equal to distance between the canine line and anterior border of retromolar pad.

If the residual ridge anterior to retromolar pad area slopes upward, smaller teeth or even fewer in number must be used. Placing a tooth on an inclined plane (***steep anteroposterior ridge slope***) should be avoided, otherwise this would lead to forward displacement of the denture and dislodgment of denture occurs. Similarly the teeth should not be placed over displaceable tissues like the retromolar pad as it will cause tipping of the denture during function. In case with inadequate mesiodistal length, the premolar can be omitted.

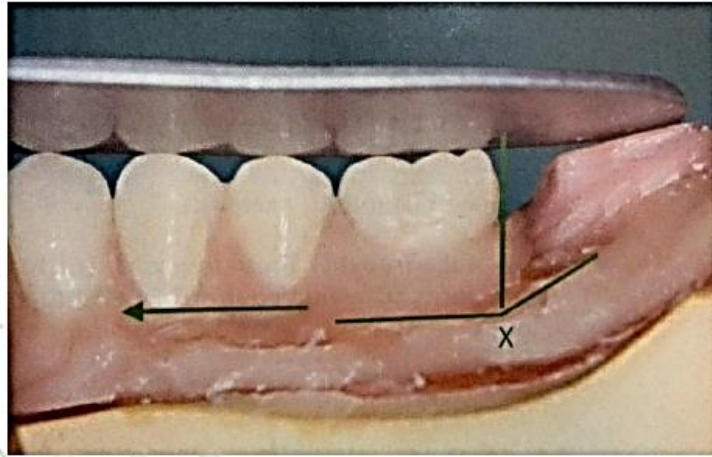


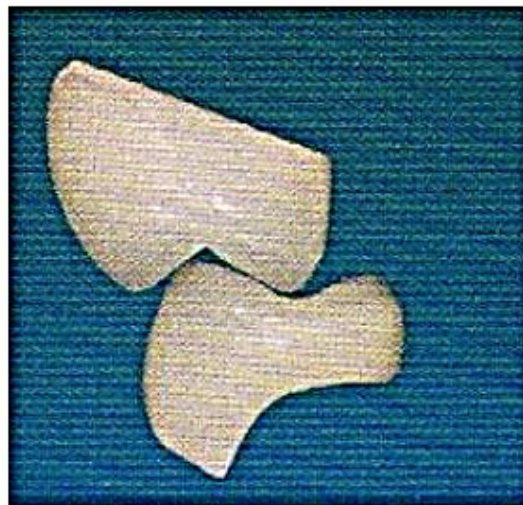
Figure (8-6): X indicates the beginning of the steep slope. The arrow indicates the potential movement of the denture during the function if the second molar were placed on the slope.

OCCLUSAL FORM

There are two forms:

- a- **Cusp Form (anatomical Teeth):** They have anatomical teeth have cusp angles 33; 20; 5; Figure (8-9).

Figure (8-7)



b- Non-Cusp Form (Cuspless Teeth): They also called *monoplane*, *flat plane*, or *zero degree*.

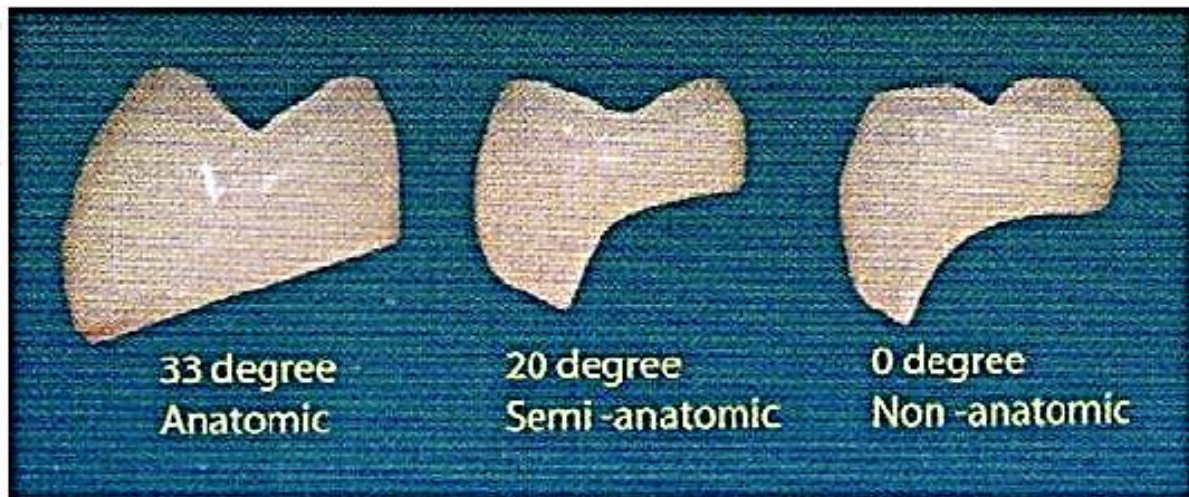
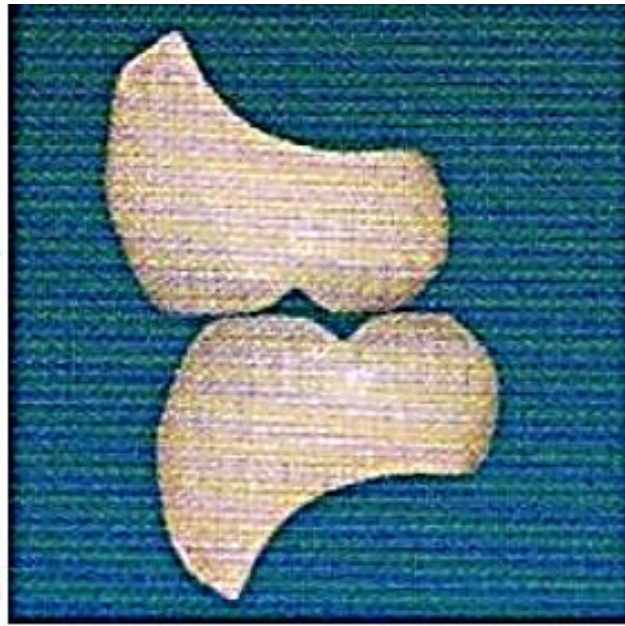


Figure (8-9)

ADVANTAGES OF CUSP FORM TEETH

- 1- More efficient in chewing.
- 2- They can be arranged in balanced occlusion in eccentric position.
- 3- The cusp fossa relationship between the maxillary and mandibular posterior teeth forms a definite point for return to centric occlusion.
- 4- More acceptable esthetically.
- 5- More compatible with surrounding oral environment.

ADVANTAGES OF NON-CUSP FORM TEETH

- 1- Offer less resistance in non-masticatory movement like (bruxism); therefore less damaging to the supporting structure.
- 2- More comfortable.
- 3- Offer less resistance to lateral forces therefore, they are indicated in excessively resorbed ridges.
- 4- Allow greater range of movement which is necessary in patient with malrelated jaws.
- 5- They can be used with less damaging effect than cusp form teeth in patient with uncoordinated neuromuscular control which jaw relation records are not repeatable.

Materials of Artificial Teeth

There are two main types, **acrylic** and **porcelain** teeth.

	ACRYLIC	PORCELAIN
1-	They are made from acrylic resin.	We have vacuum fired and air fired, the vacuum fired is better because they are harder and have luster.
2-	They are not brittle, but poor abrasion resistance, so they might become worn down with consequent loss of vertical dimension.	They are brittle and thus susceptible to fracture, more resistance to abrasion.
3-	Esthetic very good, but cannot maintain luster for long time.	Excellent esthetic, does not stained, and maintain luster for long time.
4-	Chemical bonding with denture base	Mechanical bonding by pins or undercut holes.
5-	Easily ground and polished.	Difficult to grind and polish.
6-	Transmit less force to mucosa because they have greater resilience, so they cushion the underlying supporting tissue from occlusal load.	More forces transmit to the mucosa.
7-	There is no clicking during contact.	There is clicking during contact.
8-	Thermal expansion same as that of acrylic denture base.	Thermal expansion is much lower than acrylic causes stresses in acrylic denture base and crazing may appear around teeth.
9-	Preferred when there are natural opposing teeth or gold bridge or when there is insufficient interocclusal distance where insufficient place to accommodate the holes and pins to secure the mechanical anchorage of porcelain teeth, and grinding become necessary.	Preferred for young patient, because it look more vital, smooth, and difficult to abrade, and maintain luster for long time.

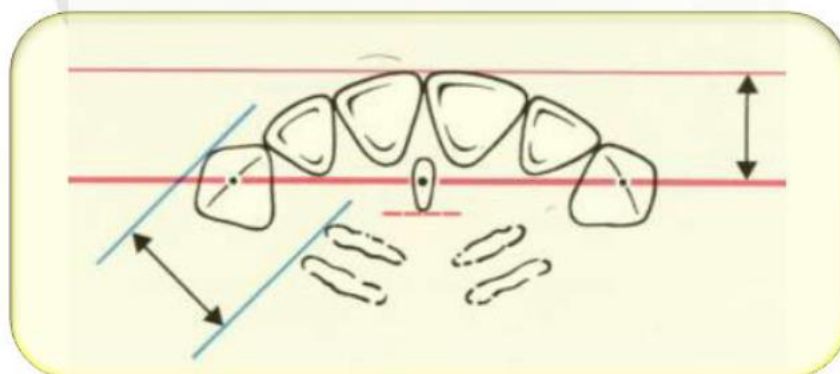
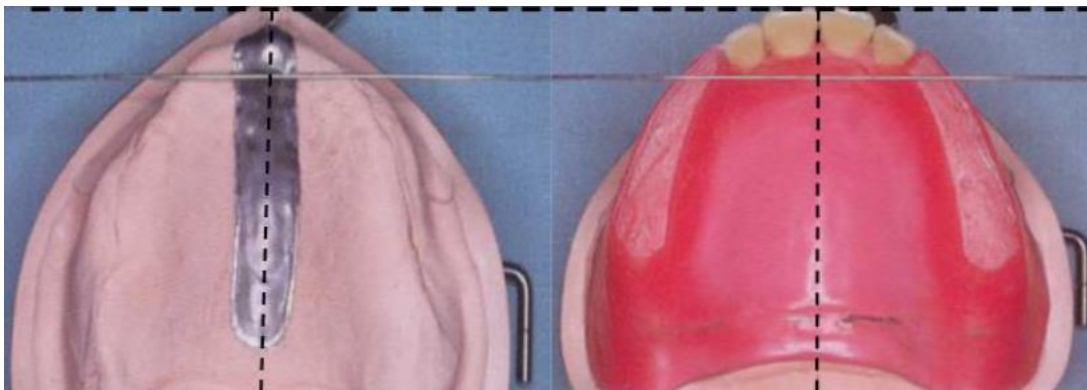
Arrangement of the Artificial Teeth

It is the placement of teeth on a denture with definite objective in mind, or it is the setting of teeth on temporary bases.

Guide Lines of Artificial Teeth Arrangement

Maxillary Cast:

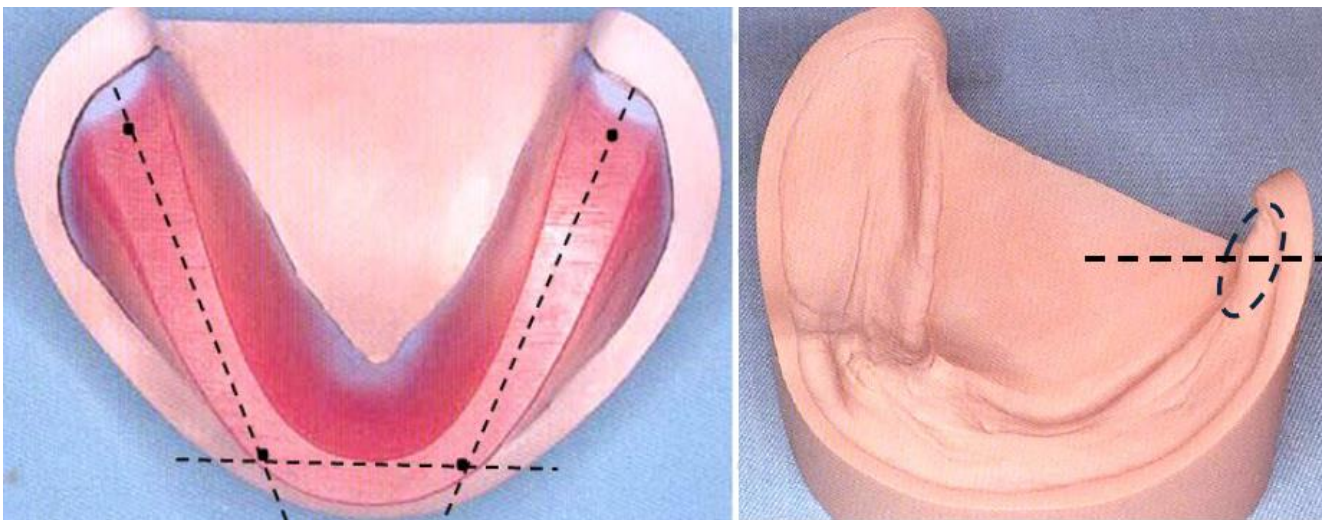
- 1- A line is drawn parallel to the frontal plane that touches the anterior margin of the incisive papilla aids in the positioning of the upper central incisors
- 2- The midline follows the mid palatal suture and bisects the incisive papilla this line is perpendicular to line 1.
- 3- The canine eminence line is recorded on the cast when its present.



Guide Lines of Maxillary Cast

Mandibular Cast:

1. A line is drawn parallel to the frontal plane bisecting the residual ridge, aids in positioning of the mandibular central incisors.
2. A point designates the distal of the mandibular canine.
3. A line follows the crest of the residual ridge from the canine point to the middle of retromolar pad, aids in the buccolingual position of the mandibular posterior teeth.
4. A line that bisects the vertical height of the retromolar pad aids in establishing the vertical position of the occlusal surfaces of the posterior teeth.



Guide Lines of Mandibular Cast

Sequence of Teeth Arrangement:

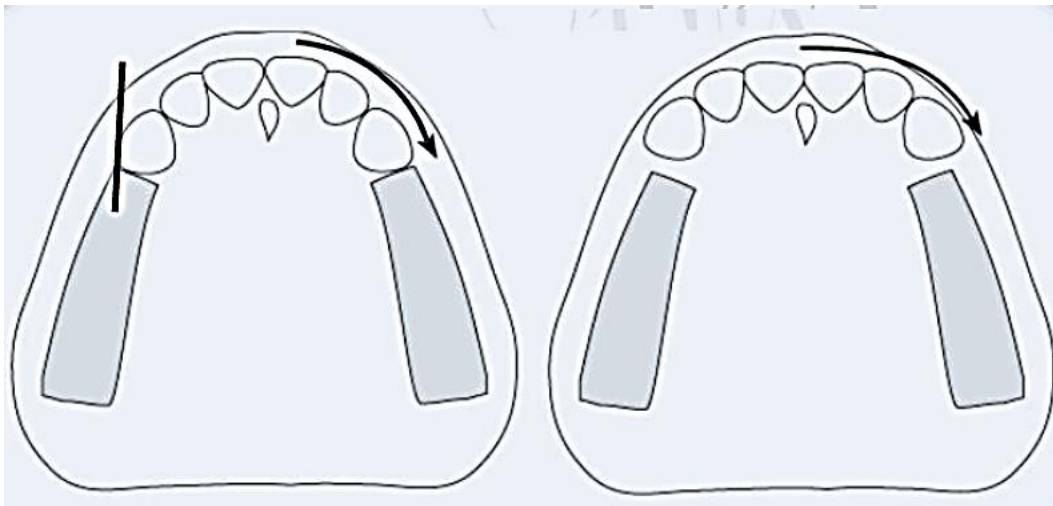
1. **Maxillary anterior teeth:** Following the maxillary occlusion rim.
2. **Mandibular anterior teeth:** Using the occlusion rims and maxillary teeth as guides.
3. **Mandibular posterior teeth:** Using the anterior teeth, retromolar pads, and residual ridges as guides.
4. **Maxillary posterior teeth:** Using the mandibular posterior teeth as guides.

The anterior teeth should be arranged to provide:

- 1- Proper lip support.
- 2- Permit satisfactory phonetic.
- 3- Pleasing esthetic.
- 4- To set the teeth in place where they grew.

The bone loss is **upward and backward** direction for the maxillary residual ridge; **downward and outward** for the mandibular residual ridge, therefore the maxillary artificial teeth should be arranged anteriorly and inferiorly to the residual ridge to occupy the space formerly occupied by the natural teeth.

In setting the maxillary teeth, make sure the central and lateral incisors are placed so they begin to turn along the curvature of the arch.

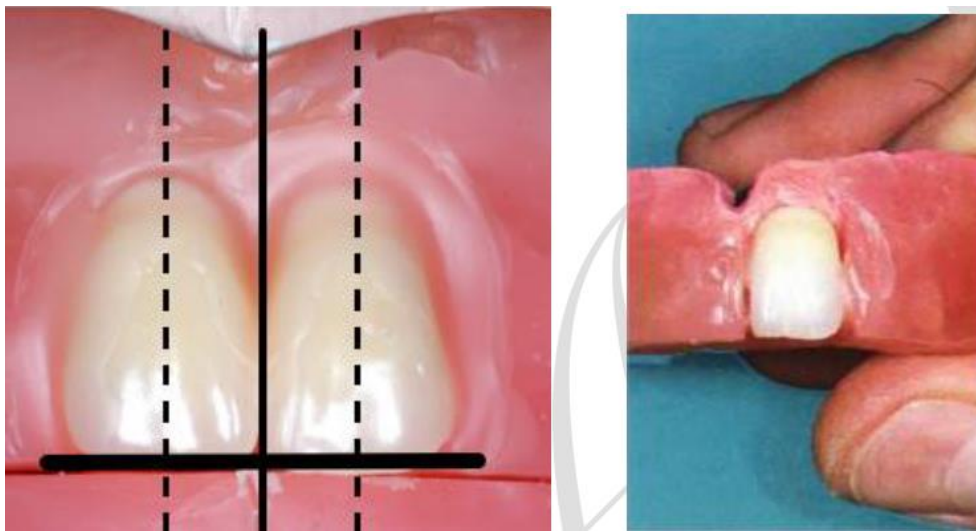


Arrangement of Maxillary Anterior Teeth

1. Maxillary Central Incisor

In frontal view

- The contact point between the right and left central incisors should be coinciding with the midline of cast.
- The incisal edge of each one should touch the occlusal plane.
- The long axis is perpendicular to the occlusal plane.



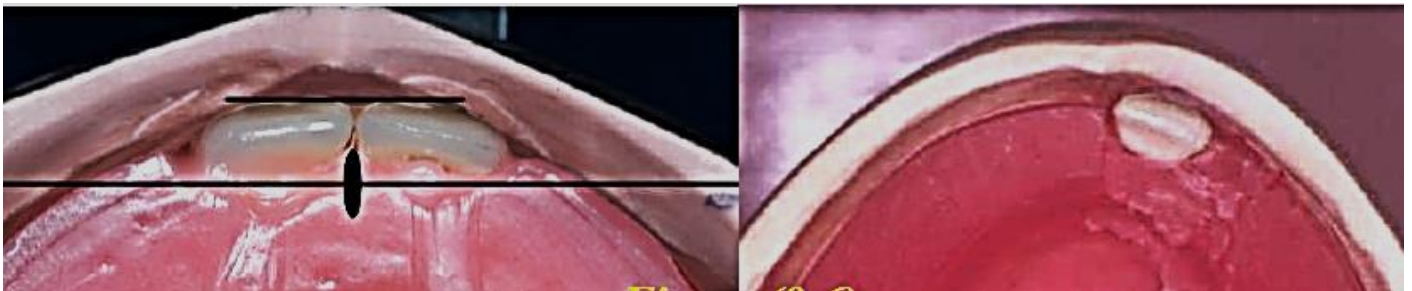
In sagittal view

The central incisors should have slight (*5 degrees*) labial inclination.



In horizontal view (occlusal plane)

The two central incisors should be placed to give the beginning of curvatures of the arch. Generally the labial surfaces of the two central incisors will be **8-10 mm** anterior to the center of the incisive papilla.



2. Maxillary Lateral Incisor

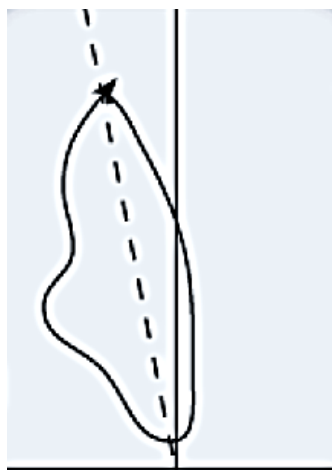
In frontal view

The incisal edge of the lateral incisor should be **1 mm** above the occlusal plane, and the long axis show little distal inclination.



In sagittal view

The upper lateral incisor should have slight labial inclination (**10 degrees**); the neck is slightly depressed .



In horizontal view

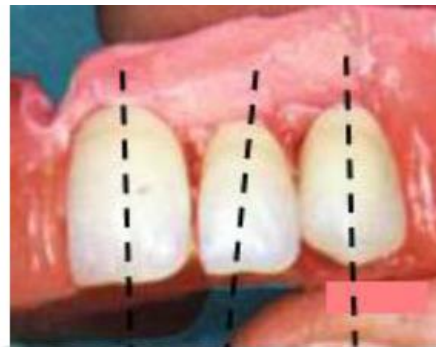
The cervical area is depressed more than the central incisor, and the distal edge should be rotated lingually to form the arch curvature.

**3. Maxillary Canine**

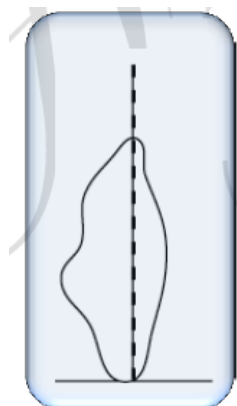
The maxillary canine represents the corner of the mouth, it is the turning point of the maxillary arch, and also it forms the transition from the anterior teeth to posterior teeth.

In frontal view

The tip of the canine should touch the occlusal plane, and the long axis is perpendicular to the plane, or tilted slightly to the distal.

**In sagittal view**

The long axis of canine is vertical.



In horizontal view

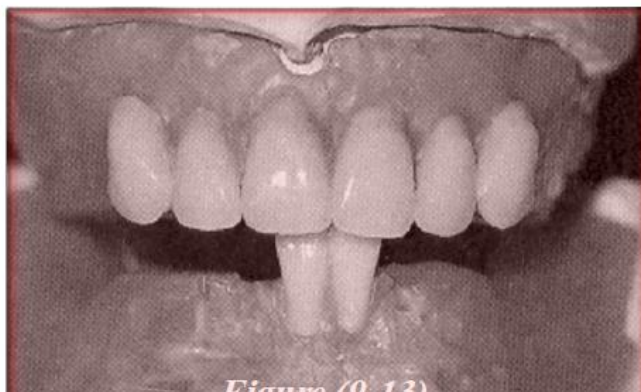
The cervical area of canine is prominent.

**Arrangement of Mandibular Anterior Teeth**

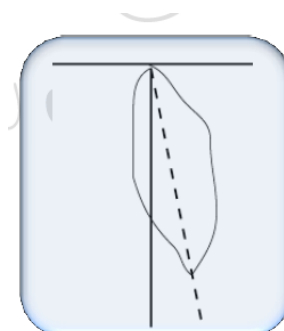
1. Mandibular Central Incisor

In frontal view

The long axis is vertical and the midline of the mandibular central incisors, coincide with the maxillary midline.

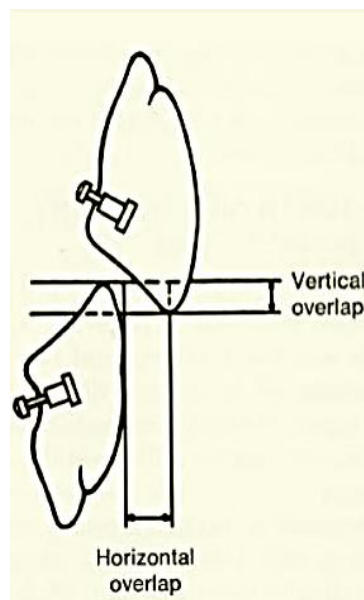
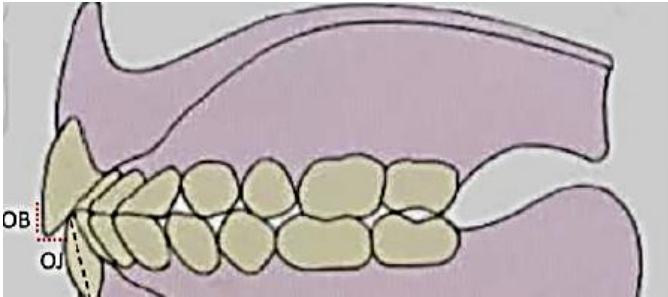
**In sagittal view**

The mandibular central incisors should have slight labial inclination. The incisal edge should have **1 mm** of vertical overlap (overlap), and **1 mm** of horizontal overlap (overjet) in respect to maxillary central incisors.



Overbite (vertical overlap): It is the vertical extension of the maxillary anterior teeth over the mandibular teeth in a vertical direction, when the opposing posterior teeth are in contact in centric occlusion.

Overjet (horizontal overlap): It is the projection maxillary anterior teeth beyond their antagonist in a horizontal direction.

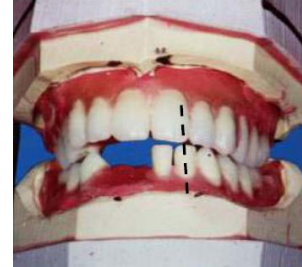


The incisal guide angle denotes the angle by the palatal surface of the maxillary anteriors against the horizontal plane. The incisal guidance can be raised by altering the labial proclination, overjet, and overbite of the maxillary anteriors.

2. Mandibular Lateral Incisor

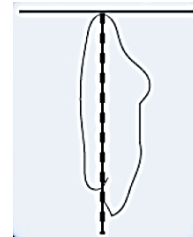
In frontal view

The long axis is slightly distal inclined to the occlusal plane.



In sagittal view

The lateral incisor is fairly upright, and the incisal edge should be *1 mm* of horizontal and vertical overlap in respect with the maxillary central incisor.



In horizontal view

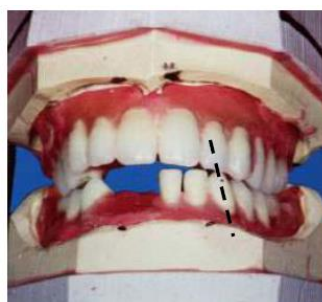
The distal edge rotated lingually to have the arch curvature.



3. Mandibular Canine

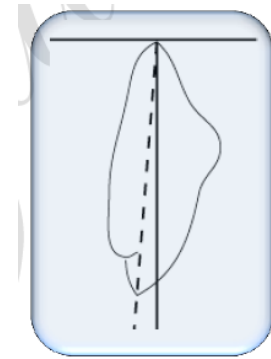
In frontal view

The long axis should have slight distal inclination, and the tip of the mandibular canine should be placed in the embrasure between maxillary lateral and canine.



In sagittal view

The long axis should have slight lingual inclination.

**In horizontal view**

The cervical area is prominent.



- The arrangement of anterior teeth should follow the form of the arch which is ovoid, tapered, or square.
- In complete denture fabrication the mandibular incisors should not touch the maxillary incisors in centric relation (the incisal guidance angle as low as possible) to allow free movement of the teeth in eccentric jaw movement without compromising the denture stability.

Arrangement of Posterior Teeth

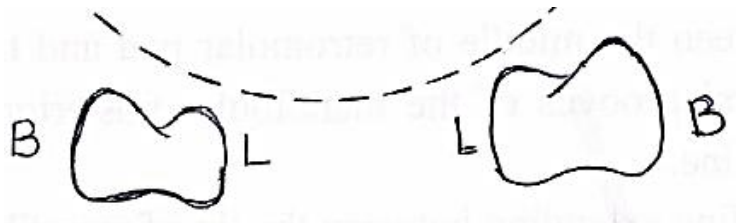
Importance of arrangement of posterior teeth (Significance)

Correct placement of posterior teeth is important for the retention and stability of both dentures.

Prior to arrangement of the posterior teeth, we must understand some of the definitions which are related to posterior teeth arrangement

Curve of Spee: It is an anatomical curvature of the occlusal alignment of teeth, beginning at the tip of mandibular canine and following the buccal cusps of the natural premolars and molars, continuing to the anterior border of the ramus of mandible.

Curve of Wilson: It is a curve extends mediolaterally from one side of the arch to the other side.



Compensating curve: It is the anteroposterior, and lateral curvature in the alignment of the occluding surfaces and incisal edges of artificial teeth, which is used to develop balanced occlusion. (It compensates the opening that occurs during forward and lateral movement of the mandible).



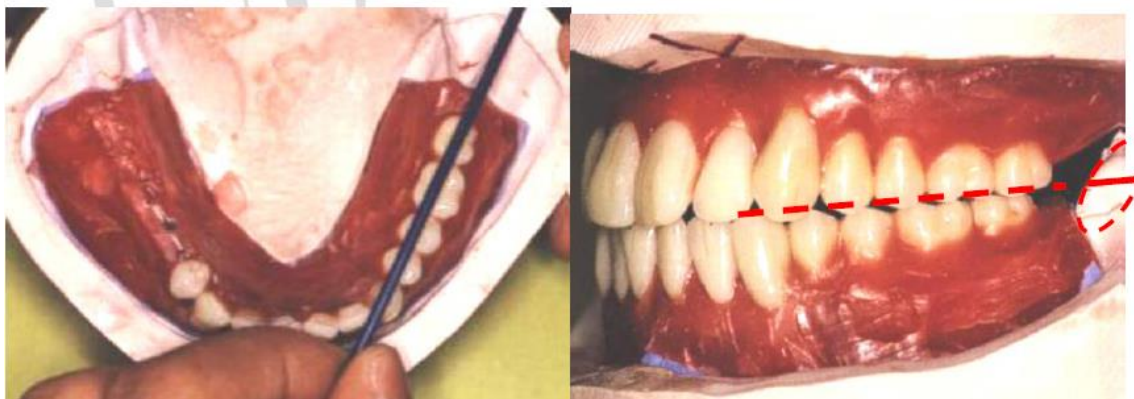
Christensen's phenomenon: This is the posterior opening of the dental arches or occlusion rims during forward movement of the mandible. To compensate for the posterior opening during forward or protrusive movement we incorporate the compensating curve.



Arrangement of Mandibular Posterior Teeth

The mandibular posterior teeth will be before the maxillary posterior, because there are more anatomical landmarks to locate the guidelines which are:

1. The line of the crest of the mandibular residual ridge, which extends between the middle of retromolar pad and tip of mandibular canine, the central grooves of the mandibular posterior teeth should coincide with this line.
2. The line extending between the tip of mandibular canine and upper 2/3 of retromolar pad will determine the height of mandibular posterior teeth.



1. Mandibular First Premolar

In buccal view

The tooth should be set perpendicular to the occlusal plane. The tip of its buccal cusp should be *1 mm* below the line is planed from the tip of canine and the 2/3 of the vertical height of retromolar pad.



In horizontal view

The central groove should be over the crest of residual ridge.

**2. Mandibular Second Premolar**

It should be arranged in the same way as mandibular first premolar.

3. Mandibular First Molar**In buccal view**

The mesiobuccal cusp should be **1 mm** below the line, and the distobuccal cusp should be $\frac{1}{2}$ **mm** below the line.

**In horizontal view**

The central groove should coincide with the crest of the residual ridge.

4. Mandibular Second Molar

In buccal view

The mesiobuccal cusp is $\frac{1}{2}$ mm below the line, and the distobuccal cusp should touch the line.

In horizontal view

The central groove should coincide with the crest of the residual ridge.



Arrangement of Maxillary Posterior Teeth

1. Maxillary First Molar

In order to get normal molar relation, the mesiobuccal cusp of maxillary first molar should rest in the buccal groove of the mandibular first molar, and the mesiopalatal cusp should seat into the central fossa of mandibular first molar.



2. Maxillary Second Premolar

The palatal cusp should seat into the embrasure formed between the mandibular second premolar and first molar.

3. Maxillary First Premolar

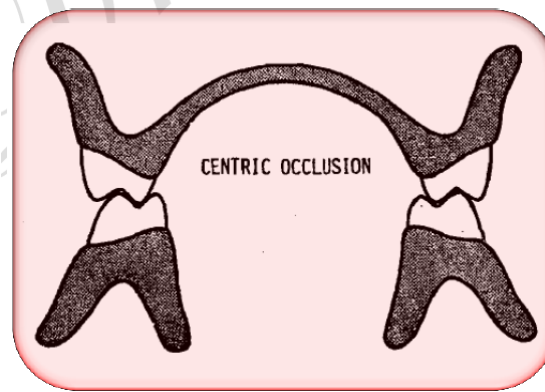
The palatal cusp should seat into the embrasure between the mandibular first and second premolars.

4. Maxillary Second Molar

The mesiobuccal cusp should rest in the buccal groove of mandibular second molar, and the mesiopalatal cusp should seat into the central fossa of the mandibular second molar.

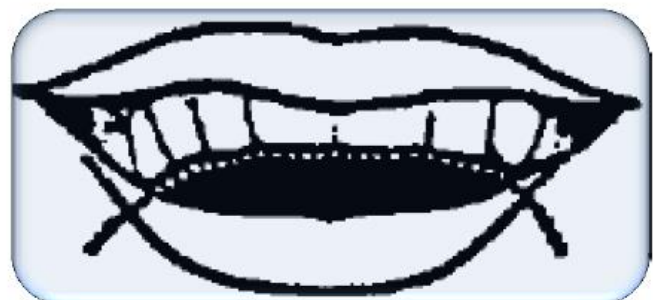


Maxillary teeth overlap the mandibular teeth horizontally; the overlap must be present posteriorly to prevent cheek biting. The long axis of each maxillary tooth is distal to that of corresponding mandibular tooth. Each tooth in both arches is opposed by two teeth, except the mandibular central incisor and the maxillary second molar. This arrangement of posterior teeth will provide maximum contact between the occlusal surfaces of mandibular and maxillary teeth in centric occlusion.



Common errors in arrangement of teeth:

1. Setting mandibular anterior teeth too forward in order to meet maxillary teeth.
2. Failure to make the canine the turning point of the arch.
3. Setting the mandibular first premolars to the buccal side of the canines.
4. Failure to establish the occlusal plane at the proper level and inclination.
5. Establishing the occlusal plane by an arbitrary line on the face. When it is too low or too high, it is not look natural and cause difficulty in the mastication.
6. The posterior teeth should not appear longer than those teeth when the patient smile, the patient will have (*reverse smile*).
7. Lack of lingual rotation of anterior teeth to give a narrow effect. Tooth arranged too wide posteriorly, appearance like many teeth in the mouth.
8. Setting the mandibular posterior teeth too far to the lingual side in the second molar region which cause tongue interference and mandibular denture displacement.
9. Teeth arranged too far toward the tongue or palate, there will be dark space between the cheek and teeth when patient talk or smile (*dark buccal corridors*).



WAXING UP AND GINGIVAL CONTOUR OF COMPLETE DENTURE FESTOONING

Is the process of carving the denture base to simulate the contour of the natural tissues which are being replaced by the denture.

Objective to:-

- 1- Produce natural contour and aid in retention .
 - 2- Restore the anatomy of that which is missing.
 - 3- The entire size , shape and contour of upper and lower denture.
-
- **POLISHED SURFACE:** The outer surfaces which will be in contact with oral tissues and developed by contouring the wax.
 - The form of the polished surface of the denture influence:
 - 1- RETENTIVE QUALITY.
 - 2- STABILITY.
 - 3- ESTHETIC.
 - 4- TISSUE TOLERANCE OF THE DENTURE .

REQUIREMENTS:-

- 1- Should duplicate the covered soft tissue as accurately as possible.
- 2- The border both buccal and lingual should full the vestibule.
- 3- Notches should provide to accommodate the frenum both size and direction.
- 4- The contour of the denture flange should be compatible with the drop of the cheek and lips.
- 5- The contour of the lingual flanges should be compatible with the tongue.
- 6- Palatal section of maxillary denture should be nearly production of the patient palate.



Procedure For Wax Contouring

- 1- The casts are removed from the articulator.
- 2- The palatal surface of the maxillary denture is covered with a layer of base plate wax if the trial base is a temporary.
- 3- Develop the margin by carving at a 45 degree angle to the neck of the tooth.
- 4- Wax the lingual flange of the mandibular denture thickly enough to fill all depressions and to slope down from the necks of the teeth inward toward the tongue. The slope of the flange should be free from undercut and very slightly concave at or near the lower border.
- 5- Stippling the gingival contour of the facial surface. It is the procedure of the reproduction of the minute crease and pits that occur in the natural gums which give the orange peel appearance can be easily accomplished by the application of a stiff brush.
- 6- After the wax has been contoured smooth it by flaming and then polish it with wet cotton.

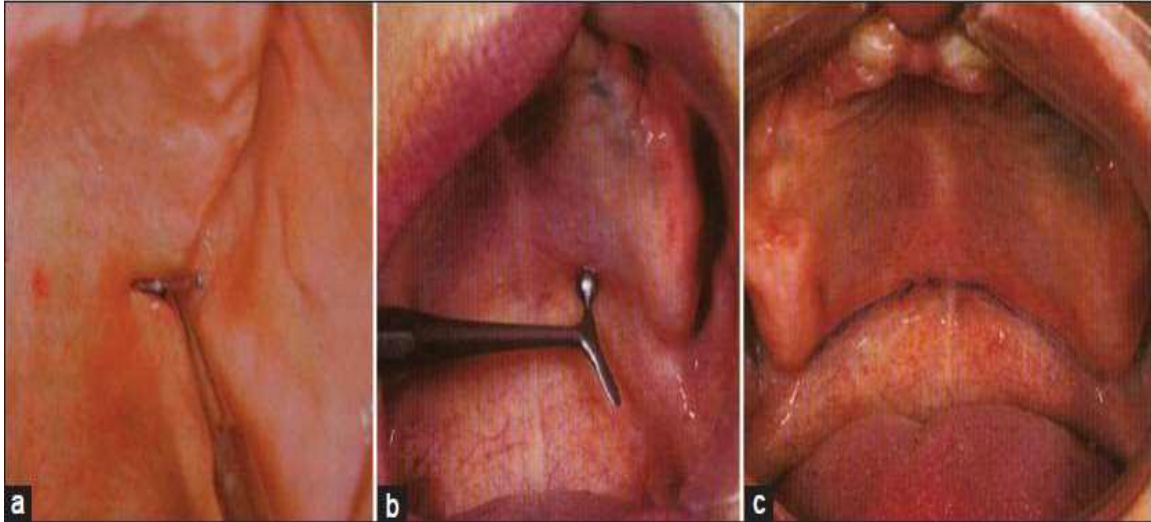




Posterior Palatal Seal area

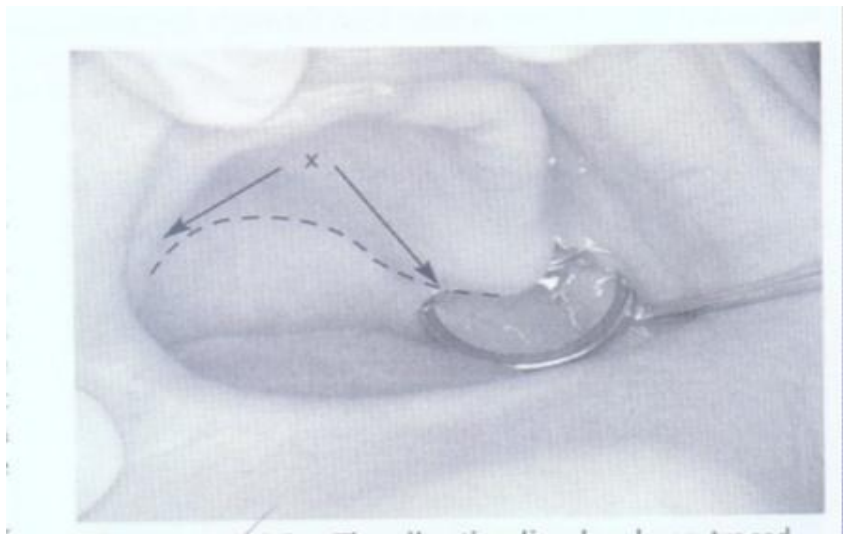
It defined as a soft tissue along the junction of the hard and soft palates on which pressure within physiologic limits of the tissue can be applied by a denture to assist in the retention of the denture.

It is determined inside the patient mouth and transferred onto the cast using indelible pencil by drawing a line which extended from the right to the left hamular notches.



The vibrating line of the soft palate normally used as a guide to the ideal posterior border of the denture, which determined according the following:

- 1-For anterior border of vibrating line , instructing the patient to say AH with vigorous burst.
- 2- The anterior vibrating is not a straight line, due to the projection of the posterior nasal spine.



3-For posterior border of vibrating line which separate the movable and immovable portions of the soft palate.

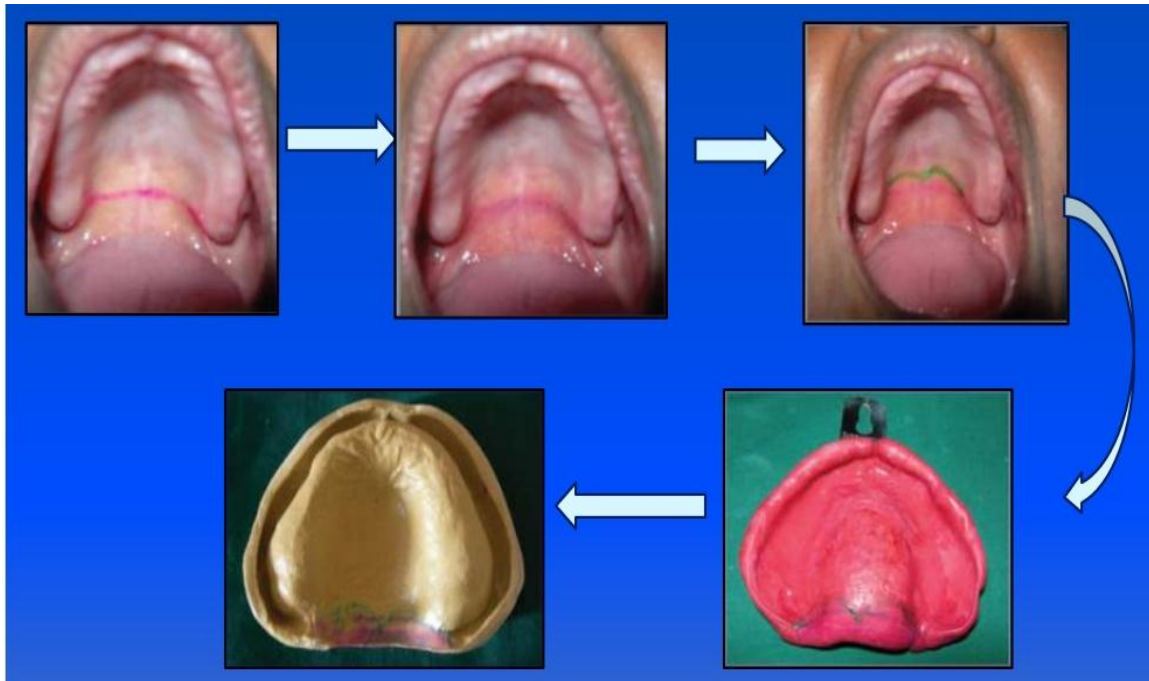


Technique for determination posterior palatal seal area

1-For conventional method, a line placed on vibrating line inside the patient mouth impression cast with pps.

2- For scarping of master cast, make points in the fovea palatine and the hamular notch and then connect these points to form solid line.

3- Place points in the glandular area of hard palate 1.5-2 mm anterior to the first line and about 2 mm anterior to the first line at the mid palatine suture and draw a second line to form a butterfly pattern.

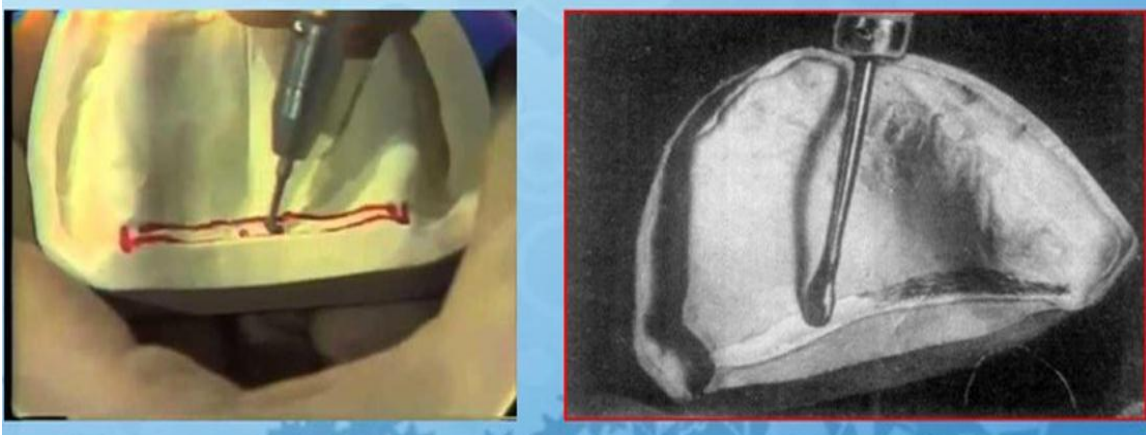


4- Carve the seal along the draw lines into the cast.

A- It should be 0.5 mm deep in the middle of PPS.

B- It should be 1 mm deep in hamular notch area and

C- It should be 1.5-2 mm width in the glandular area between the hamular notch and the middle of the posterior palate .



Advantages of PPS

- 1- Determine the posterior border of maxillary denture.
- 2- Compensate for the shrinkage during processing.
- 3- Provide good seal and increase retention .
- 4- Prevent food to enter under the maxillary denture.
- 5- Reduce the tendency for gag reflex.

Under post damming

It is possible to be insufficient at some points, it is resulted from recording the tissue when mouth was wide open during the final impression because the pterygomandibular fold becomes tight. Space will be present between the denture base and underlying tissue leading to enter air and loss retention of maxillary denture.

Remarking post dam on the cast and add new acrylic resin to the denture will correct this fault.

Over post damming

It is present when the master cast was scraped too aggressively which lead to displace too much PPS tissue. Over post damming cause tissue soreness and make patient have severe pain when wearing the denture.

Selective reduction of the denture border with post dam will solve this problem.

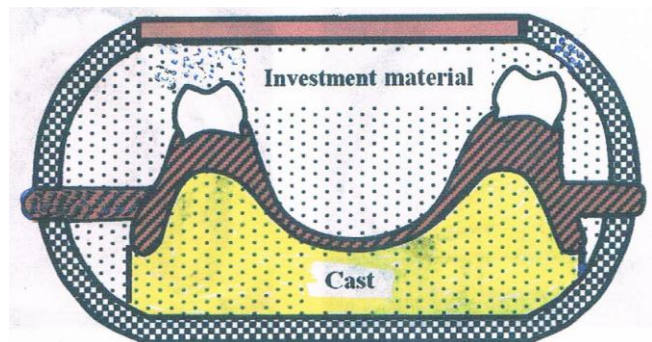
Processing of the complete denture (FLASKING , Dewaxing and Packing)

It is the process of investing the cast with its waxed denture in a flask to make a two sectional mold used to form the acrylic resin denture base.

FLASK: It is a metal case or tube uses the dental stone to invest the cast and trial wax denture to create the mold within it, or can defined as a sectional metal case in which a sectional mold is made of artificial stone for the purpose of compressing and processing dentures or other resinous restorations.

FLASK CONSIST OF:

1. Lower half: Drag (bottom), which contains the cast.
2. Upper half: Cope (ring), which captures the teeth of the denture.
3. The cover: Cap (lid).



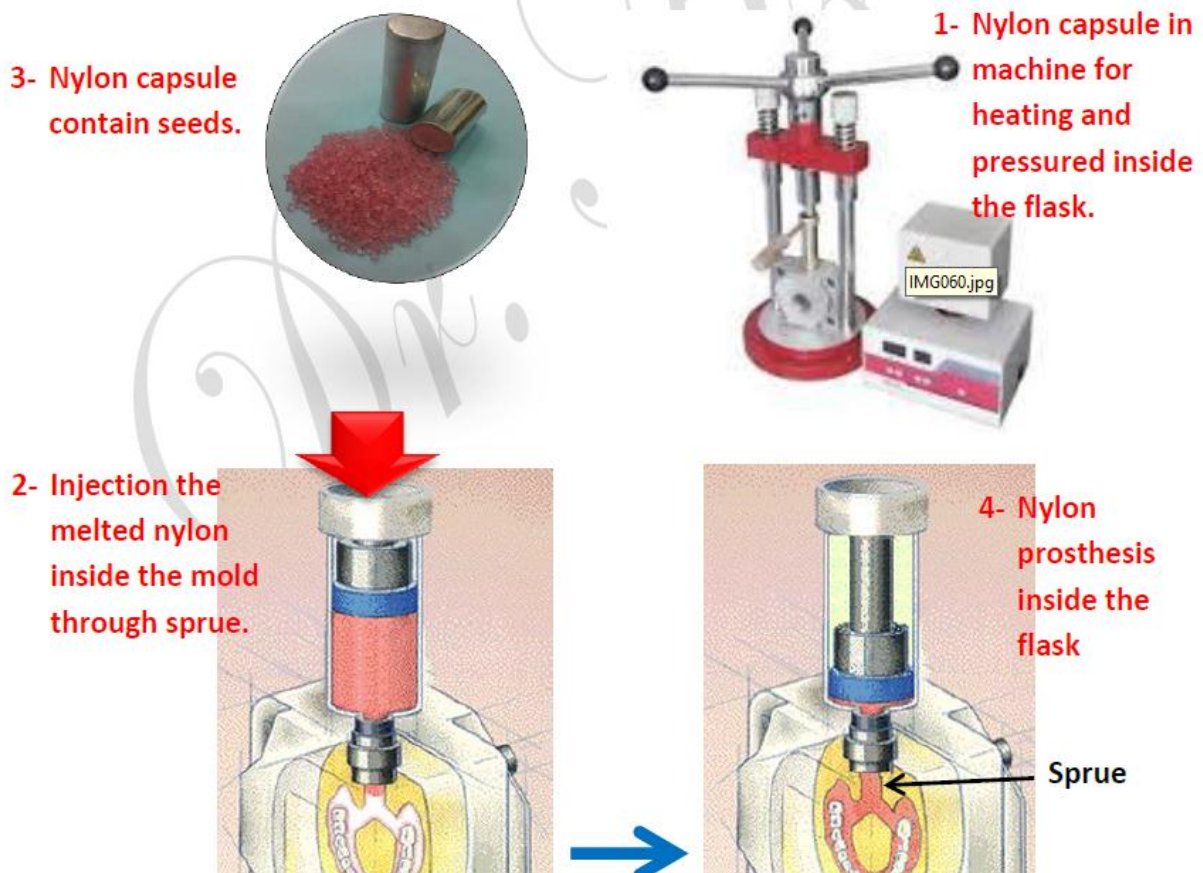
FLASKING TECHNIQUES:

1. Compression Technique

The master cast with the waxed trial denture is invested in the lower half of the flask with gypsum investment material. Then the upper half of the flask is put in place and gypsum is poured to the occlusal surfaces of the teeth. The top portion of the flask is poured with another layer of plaster or stone and the cover is placed on the flask.

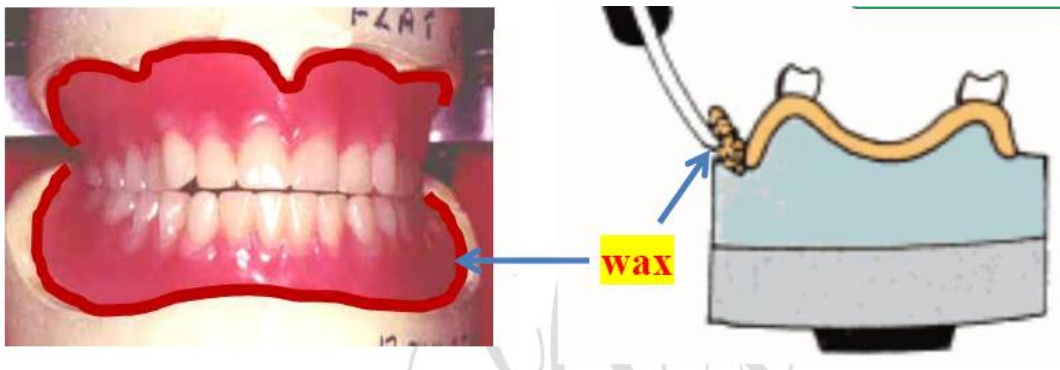
2. Injection Molding Technique

It is a complicated procedure required special flask and equipment. In this technique the wax pattern is sprued and the material is injected into the mold. This process allows injection of further material during processing to compensate for the polymerization shrinkage

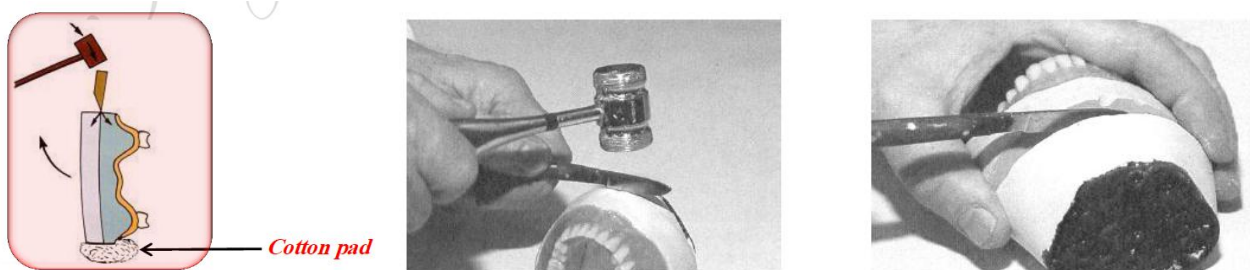


Compression Technique Steps:

1. Sealing the upper and lower trial denture all over the border until the margin of the cast while the casts still on the articulator.



2. Soak the casts and the mounting plaster in water a few minutes to separate the casts from the mounting plaster, save the plaster mounting as it will be used to reposition the casts on the articulator after the dentures have been processed.



3. Make sure that there is enough space between the incisal and occlusal surfaces of the teeth and the top of the upper ring about 3-6 mm, if there is no space then the cast base must be reduced in thickness.
4. Adapt a layer of tinfoil to the base of the casts, slightly overlapping the edges to insure clean removal from the investment, apply separating medium to the casts and flask.
5. Waxed denture painted with surface tension reducing agent to decrease likelihood of bubbles formation.

Investing The Lower Half Of The Flask First

Use the mixture of the plaster or stone and placed in the bottom of the flask. Center the cast in the lower half of the flask. The cast is pushed down to place until its rim is nearly level with the top edge of the bottom of the flask. Note that the posterior portion of the cast is level with the edge of the flask. Remove any undercuts in the stone. Undercuts will prevent the separation of the upper ring from the lower portion of the flask. The stone is smoothed and leveled between the edge of the cast and the rim of the flask, and then allows the stone to set. After the final setting of stone has occurred, it will be coated with separating medium.



Investing The Upper Half Of The Flask First

Position the ring of the flask. Mixing of stone is done, pouring of the mixture to flow and reach all surfaces of teeth without any air bubbles by putting the flask on the vibrator. The investment material must reach the incisal edge and the occlusal surfaces of the teeth. Separating medium is painted on the second layer of plaster after setting and smoothing of the plaster is done. A third mixing of stone is done and pouring it until the flask is filled with plaster and the flask is covered and some plaster enter through the holes in the cover and around the edges, this pour will easily be separated during divesting procedure, and will be aware of the position of the teeth when using any mechanical devices to break away the stone mold. The plaster is left to set completely for about 45 minutes.



BOIL OUT (WAX ELIMINATION)

After the complete set of the gypsum the flask is ready for the next step which is “*wax elimination*”

1. Place the flask on the ladle and lower it into boiling *water bath* for *5 minutes*. This will soften the waxed denture base, which can be easily removed from the mold when the flask is opened.
2. After 5 minutes, remove the flask from the boiling water and gently open it, insert a wax knife between the lower and upper halves and gently separate them.



3. Remove the semisolid pieces of the waxed denture base. All the teeth should remain in the upper half of the flask, using more hot (boiling) water to flush out all the remnants of the wax.



Wax solvent can be used with stiff brush to remove any remaining wax on teeth. As soon as possible flush the mold with clean hot water and detergent. The detergent will be flush out the wax residue from area that cannot be reached with the wax solvent. Immediately flush the mold with hot water to remove all traces of the detergent solution. It is essential to remove all wax residues, the acrylic resin will not adhere to a surface coated with wax. (Artificial teeth basal area). Stand the flask on its side and allow it to drain, dry, and cooled.



PACKING OF ACRYLIC RESIN

Separating medium is used on plaster or stone, care should be taken not to painting the teeth with separating medium. The mold is left to dry and another coat is painted on the flask and also left to dry. Heat cured acrylic is used polymer/monomer is mixed according to manufacturer instruction. Usually 10 cc of monomer and 30 cc of polymer will be enough to pack an average-sized denture, after mixing of the material on clean jar and reach dough stage, it is ready for packing. Packing the material in the upper half of the flask, being sure to press it well into the area around the teeth. Use enough material to insure overpacking on the first closure using nylon sheet. At least two trial closure are done and before the final closure

a thin layer separating medium is applied on the cast and the nylon sheet is removed and then the two halves of the flask are closed under pressure by bench press of about 100 kg/cm², then the flask is put in spring clamp and the clamp is closed tightly.



CURING OF ACRYLIC RESIN

polymerization of acrylic resin by heat, the amount of heat must be controlled while processing acrylic resin.

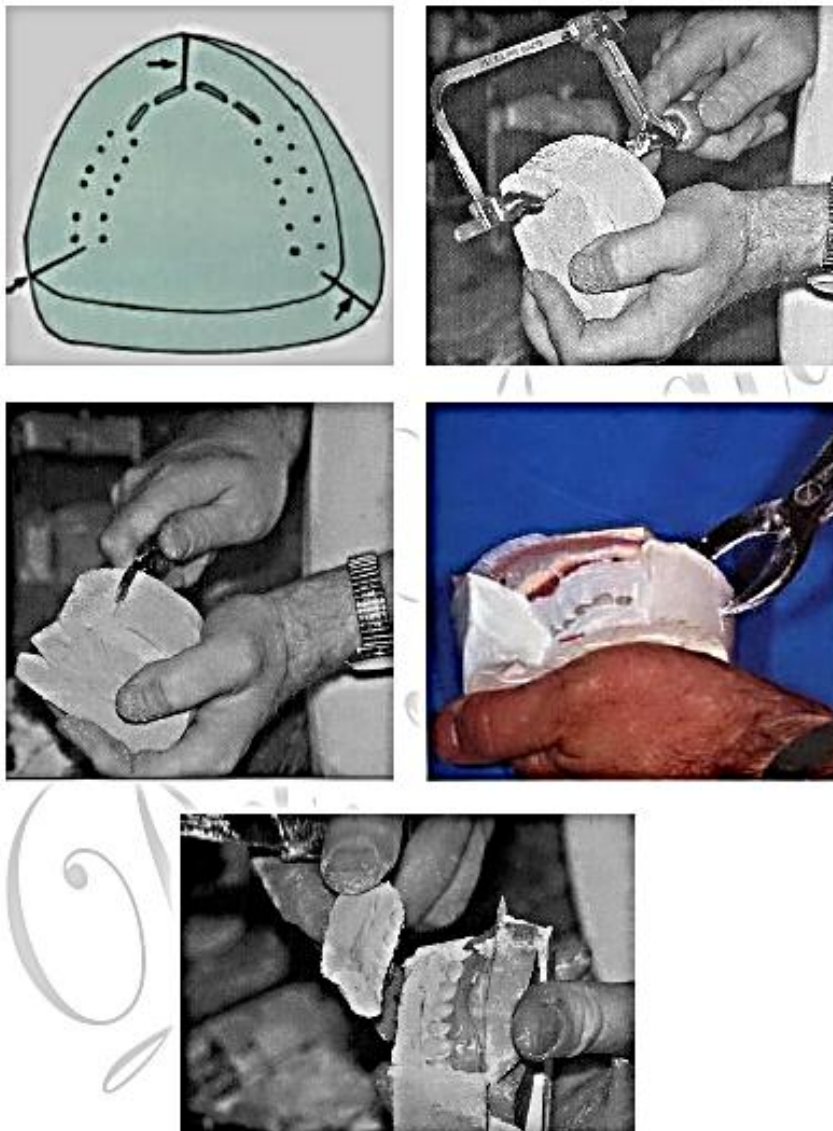
Types Of Curing Cycle

- **Long Cycle:** heat the flask in water at 60-70 °C for 9 hours.
- **Short Cycle:** heat the flask in water at 74 °C for 90 minutes, then boil for 1 hour for adequate polymerization of the thinner portions. The best curing cycle is the slow curing cycle because most of the conversion of monomer to polymer occurs during the period at 70°C and the rapid curing cycle may induce greater dimensional changes in the dentures than slow curing method.

After curing and before deflasking, the flasks must cool slowly to room temperature to allow adequate release of internal stresses and thus minimize the risk of warpage of the bases.

DEFLASKING OF DENTURES

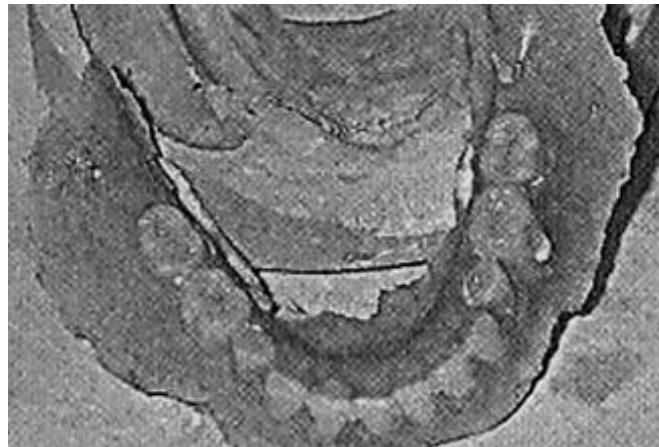
It is the removal of the mold from the flask and separates the denture and the cast from the mold (*divesting*). The flask is removed from the mold using a *flask ejector*, which is used to separate the flask from the mold after removing of the cover. By using a saw longitudinal and horizontal cuts are carefully made through the plaster or stone and the pieces are gently removed. The cured dentures and their casts have been removed from the mold.



Finishing and Polishing

Finishing of complete denture is the process of perfecting the final form of the denture by removing any flash, stone remaining around the teeth, and any nodules of acrylic resin on the surfaces of the denture base resulting from processing.

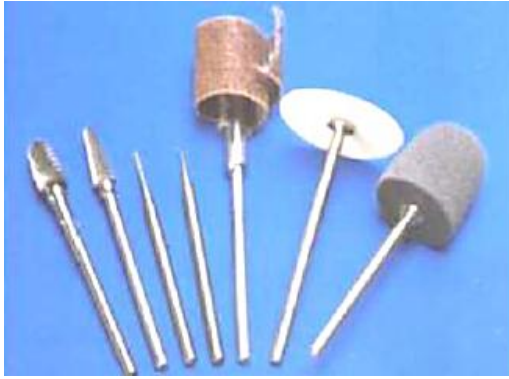
Flash It is the excess of acrylic resin at the denture border, the acrylic resin that was forced out between the two halves of the flask by the pressure applied during the processing procedure.



PROCEDURE OF POLISHING

Take care to preserve the border and contour of the denture during the finishing process. If the impression was correcting molded and boxed, and the trial denture was carefully waxed contoured into the form desired in the finished denture, little finishing will be necessary.

1. Carefully remove **remaining stone around the neck of teeth** with a small **sharp knife**.
2. To remove the flash of acrylic resin from the denture border, press the denture base lightly against a slowly revolving arbor band mounted on the dental lathe. An alternate but less satisfactory to use a large acrylic bur or stone bur mounted in a straight hand piece to remove the flash. Take care not to change the form of the denture border but only remove the excess resin on the border of denture.



3. Remove *nodules of acrylic* with *small stone or acrylic carbide burs*.
4. The *posterior area of the palate* has been thinned to its proper thickness.

Polishing is a process of removing scratches. Polishing consists of making the dentures smooth and glossy without changing the contours.

PRINCIPLES OF POLISHING:

1. The tissue surface of a denture is never polished as a polishing destroys the details necessary for good fit and retention.
2. The polished surface extends just over the border, but the borders are not reduced in height and width during polishing.
3. Care must be taken when using pumice (it should be used as wet slurry) as this material is very abrasive and may obliterate the details placed on the denture when they were waxes (festooned).
4. Resin teeth have approximately the same hardness as the denture base, so polishing a denture with resin teeth requires some precautions not necessary with porcelain teeth.
5. When polishing, only the denture base and not the teeth are polished.
6. During the finishing and polishing we should minimize the reduction of bulk because this cause warpage.

Procedure of polishing:

A-Smoothing

Polish *labial, buccal, lingual, and palatal external surfaces of the denture* with *wet pumice* on *rag wheel attached to dental lathe* running at slow speed. Keep plenty of pumice on the denture surface and keep the denture moving at all times; press the denture lightly against the wheel.



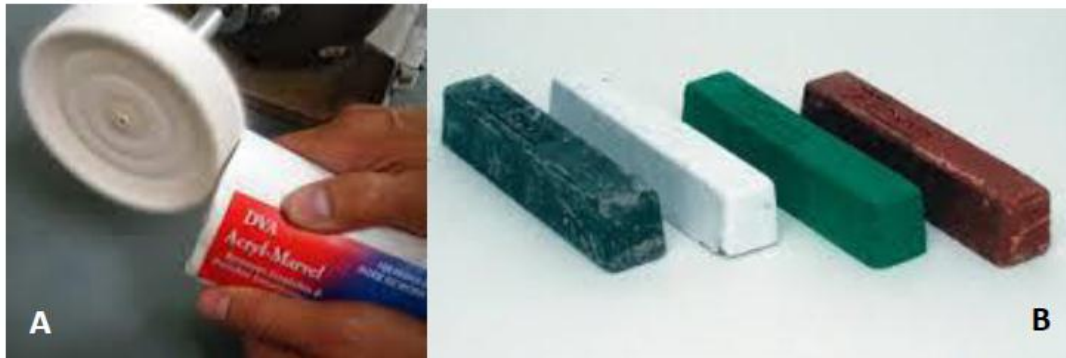
Polish *acrylic around the teeth* with *wet pumice* and a *brush wheel attached to dental lathe* moving at slow speed. Be careful not remove previously developed contours.



Polish the *border, lateral and palatal surfaces of denture* by using *wet muslin buffing wheel attached to dental lathe*.

B-Making Denture Glossy

Use **Rouge** (greasy material) this material is applied to ***dry muslin buffing wheel***, this differ in that the polishing compound is applied to the wheel not as pumice to the piece of work being polished.



After the denture completely polished with rouge, it is scrubbed thoroughly.



Final polish is obtained by placing high shine material on the denture. Store the polished dentures in water until they have been delivered to the patient. Store the dentures in water all the times otherwise they will undergo dimensional changes and shrinkage.

*Every new set of complete dentures should be tested in mouth for tissue adaptation and retention and any pressure area should be indicated by using **pressure indicating paste**, and overextended borders should be indicated by using **disclosing wax**.*

Occlusal Correction

Artificial teeth may move about to a minor degree during waxing and processing of the trial denture to a resin one (wax elimination, packing of acrylic resin, and curing).

This teeth movement is due primarily to dimensional changes in the waxed denture base, the investing material, and in the resin denture base during curing. Occlusal discrepancies caused by these dimensional changes ordinarily are removed before the dentures are polished.

Causes of Errors in Occlusion

1. Inaccurate maxillo-mandibular relation record by the dentist.
2. Errors made in the transfer of maxillo-mandibular relation to the articulator.
3. Failure to use the face-bow and subsequently changing in the vertical relation on the articulator.
4. Failure to seat the occlusion rims correctly on the cast (ill-fitting record bases).
5. Incorrect arrangement of posterior teeth.
6. Failure to close the flask completely during processing.
7. Warpage of the dentures by overheating them in polishing stage.
8. Dimensional changes of the denture base material (acrylic resin).

The errors that are a result of processing changes can be eliminated before insertion of the dentures in the patient's mouth, correcting occlusal surface of the teeth by *selective grinding*.

Selective Grinding

It is the modification of the occlusal forms of the teeth by grinding according to a plan. The modification of the occlusal forms of the teeth by grinding at selected places marked by

spots made by *articulating paper*, or marked by parts of the teeth cutting through a thin layer of *occluding wax* placed over the teeth.

Correction Of Occlusal Errors

Two methods are generally used in correcting errors due to processing changes, in both the occlusal surfaces of teeth are altered by selective grinding:

1. Intraoral (inside patient mouth, clinically).
2. Extraoral (on the articulator, in the laboratory).

Disadvantage Of Intraoral Correction

1. It is difficult to see the errors because the soft tissues will be distorted and obscure the errors.
2. The denture bases will be shift in relation to the underlying bone when there are errors in occlusion due to the resiliency of the soft tissue.
3. The articulating paper marks are likely to be incorrect due to the presence of the saliva.
4. The central of jaw position depends entirely on the ability of the patient to place and move jaw correctly.

Advantage Of Extraoral Correction

1. Easily visible.
2. Easily located.
3. Easily corrected by selective grinding.
4. The articulating paper marks can be quite easily made on dry teeth.
5. Make the correction away from the patient thus there is a psychological advantage.

Articulating paper and *occluding wax* can be used to detect the premature contacts, although it is preferable to use occluding wax because premature contact will cause the cusps to penetrate through the wax indicating heavy contact is present.

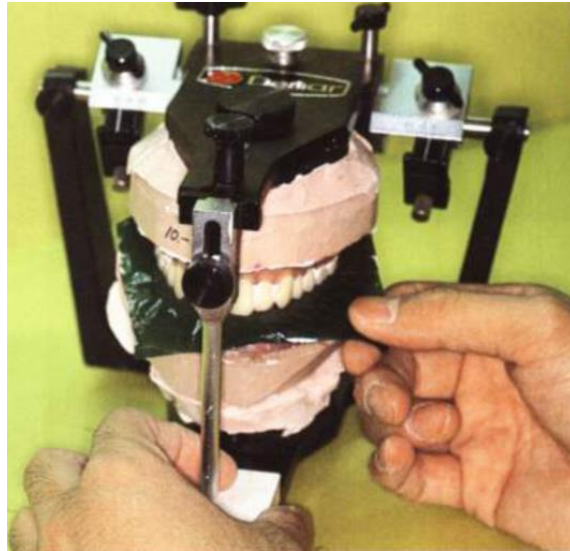


An alternate method to correct the occlusion before removal the dentures from the casts

1. Replace the upper and lower mounting casts and the dentures on the articulator. If processing changes in occlusion have occurred, they must be corrected.



2. Reestablished the vertical dimension of occlusion at this time, an opening in the vertical dimension can be noted by corresponding opening in the relationship of the incisal pin to the incisal table. The pin should contact the table.



- If excessive opening between incisal pin and incisal table, the flask do not correctly closed.
- If the incisal pin touches the incisal table, the denture may have been under packed.
- If there is **1-1.5 mm** of incisal pin opening, proper technique have been followed through the investing and packing procedures.



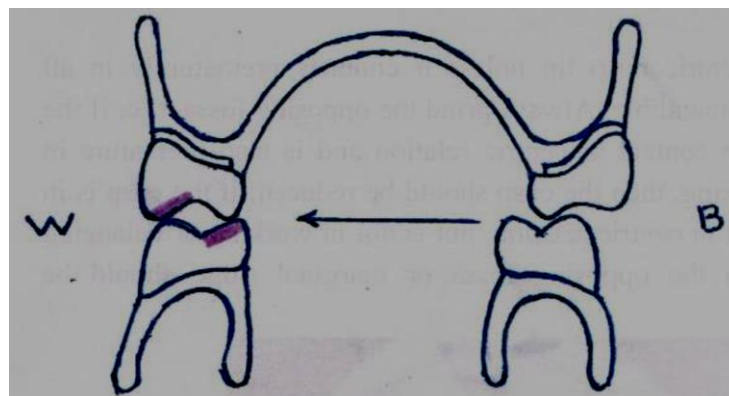
3. Refine and equalize the centric occlusion.
4. Perfect the working and balancing occlusions.
5. Correct the protrusive occlusion.

Rules Of Selective Grinding

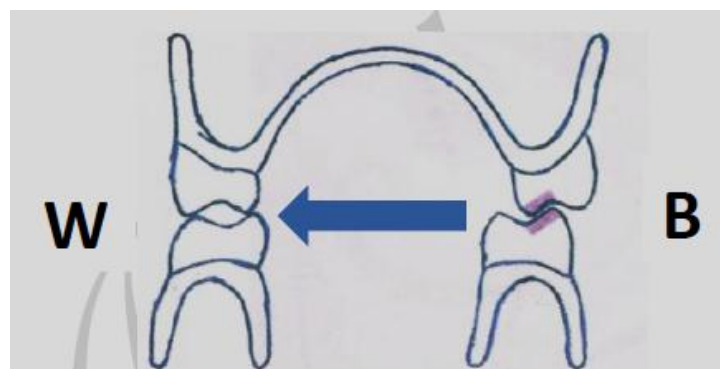
1. Never grind a centric cusp tip unless it contacts prematurely in all excursions of the mandible. Always grind the opposing fossa. (i.e. if the cusp is premature contact in centric relation and is also premature in balancing or working, then the cusp should be reduced; if the cusp is in premature contact in centric relation, but is not in working or balancing prematurity, then the opposing fossa or marginal ridge should be reduced).



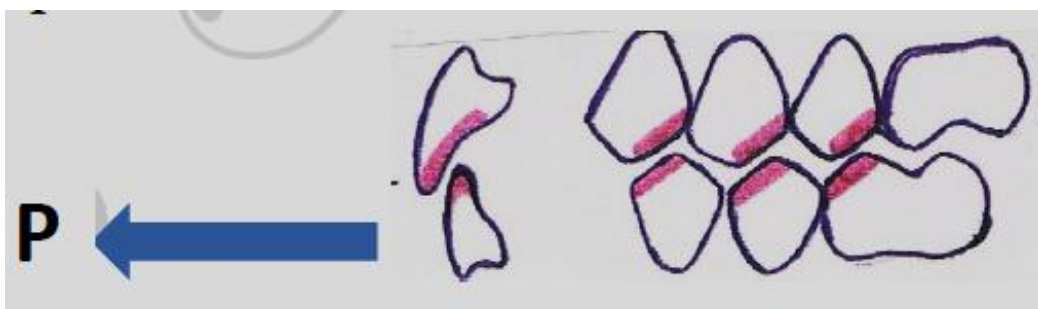
2. Utilize the **(BULL rule)** when perfecting working occlusion prematurity, grind the lingual incline plane of the **B**uccal cusps of the **U**pper teeth, or the buccal incline plane of the **L**ingual cusps of the **L**ower teeth. BULL rule applies working side only.



3. If there is a premature contact on the balancing side, then adjust the buccal incline plane of the lingual cusp of the upper teeth, or the lingual incline plane of the buccal cusp of the lower teeth. When grinding to perfect balancing occlusion prematurity, never grind the interfering cusp tips but grind the cusp inclines. Usually this done in the mandibular teeth, do not adjust both maxillary and mandibular teeth, the centric maintaining cusps should be preserved (they are the lingual cusps of maxillary second molars).



4. In correcting protrusive interference in the anterior teeth grind the labial portion of the incisal edges of the mandibular teeth and the lingual portion of the maxillary teeth. For protrusive interference in the posterior teeth, reduce the distal slopes of the upper buccal cusps, or the mesial slopes of the lower lingual cusps.



Note

- Selective grinding of *balanced lingualized occlusion* is similar to a fully balanced occlusion with exception that only the lingual cusps of the maxillary teeth or their antagonist surfaces are adjusted.

- Selective grinding of *non-anatomic teeth (lingualized occlusion)*: Excessive care to maintain the occlusal surfaces of the mandibular arch on a plane. The occlusal surfaces of the maxillary posterior teeth are altered to make harmonious contact on the right side and on the left side when the jaws are in centric relation. Smooth gliding movements from the centric position to the eccentric positions should be developed.

Repair Of Complete Denture Fracture

One of the advantages of using acrylic resin in denture base, it can be easy to repair.

The Fractures May Occur Either:

1. *Intraorally* (during function).
2. *Extraorally* (dropping the denture on hard surface).

Causes Of Complete Denture Fractures

1. Poor fit.
2. Lack of balanced occlusion.
3. Fatigue of material.
4. Dropping of denture and bad handling.

Types Of Complete Denture Fractures

1. Complete denture fractures when all broken parts are available.
2. Replacement of a broken or missing tooth or teeth.
3. Missing labial or lingual border.

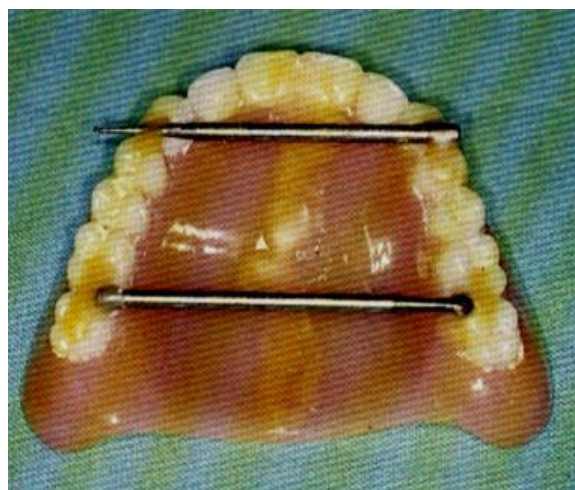
Repairing of Complete denture fractures when all broken parts are available

Clinical and Laboratory Procedures

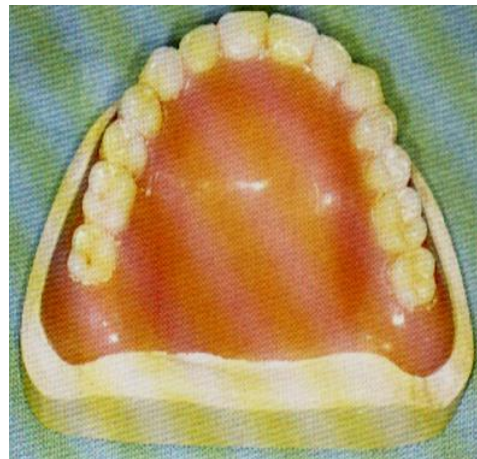
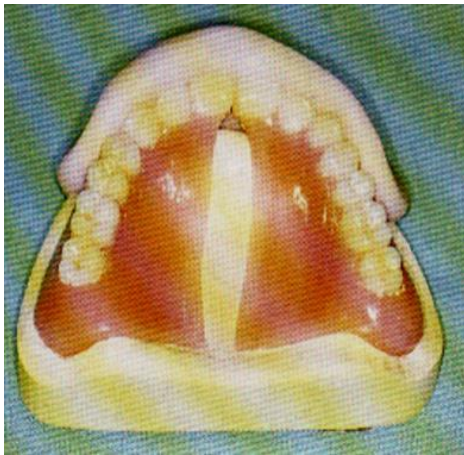
1. Accurate reassembly of the broken parts, if not, the denture will neither fit nor occlude properly.



2. Applied sticky wax to the fractured line to maintain the two pieces in correct position. Do not allow the sticky wax to flow into the fracture lines; only cover the fracture line from the polished surface.
3. Then reinforced the denture by attaching one or more wooden stick (or old bur) to the occlusal surfaces.



4. Block out any undercuts in the tissue side of the denture and apply separating medium.
5. A cast is poured into the denture using quick set plaster.
6. After setting remove the two pieces of the denture gently.
7. Coat the cast with tinfoil substitute (separating medium), set aside to dry.
8. The edges of the fracture are beveled toward the polished surface and the polished surface reduced to form a groove of **8-10 mm** in width along the fractured line.
9. The pieces of the denture are reassembled on the cast.



10. Self-curing resin repair material is used. An alternate application of monomer and polymer are made until the area to be repaired is filled. The area should be slightly overfilled to allow for finishing.
11. Porosity in the repair material can be prevented by using a pressure curing unit that will produce 30 pounds of pressure will enhance the density of resin as it cures, left in it for a minimum 10 minutes.
12. The denture is removed from the unit, then from the cast.
13. Finished and polished in a conventional manner.
14. Inserted in patient mouth.

Replacement of a broken or missing tooth or teeth



There are many techniques but the one which provides good results is:

1. The area lingual to the fractured tooth is reduced using a small bur.
2. The fractured tooth is then heated using flame to soften the area surrounding it then pushed out.
3. The mold and shade of the tooth is determined and selected.
4. Remove the denture base material lingual to the socket which must be large enough to accommodate the new tooth without interference. The labial portion of the tooth socket is left intact to aid in repositioning of the new tooth.
5. Placing the new tooth in position.
6. The tooth can be fixed labial by sticky wax or do a matrix of plaster labially. We do the plaster matrix by applying a layer of plaster on broken tooth, this should include one tooth on each side, and thin layer of Vaseline can be applied on the teeth before applying the plaster to facilitate removal of matrix.



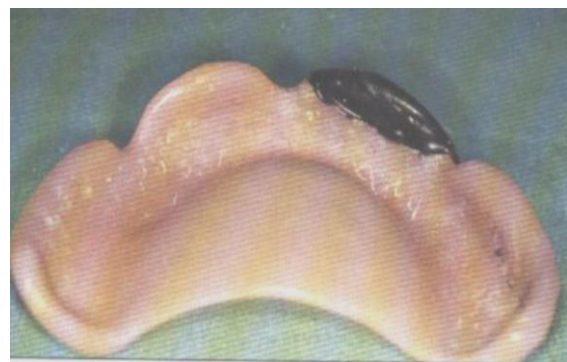
7. Self-cure resin is used to attach the tooth to the denture base.
8. Alternate application of monomer and polymer are made until the area overfilled.
9. Placed the denture in a pressure curing unit containing water of 100 °F for 10 minutes.
10. Remove, finish, and polish



Repairing of Complete Denture Fractures when there is Missing labial or lingual border

Often a piece of a broken denture may be lost or may be impossible to position. For this reason it may be necessary to replace this missing part.

- *If small piece broken of the border* can be fashioned by placing warmed molding plastic on the remaining border and then recontouring the missing area by placement in the patient mouth. After proper recontouring a cast is poured into the denture. The molding plastic is removed and self-cure resin is used to fill the area of the missing border. The resin is then cured and polished.



- *If borders are missing from several areas of the denture or if a large piece is missing*, it may be necessary to make an impression over the fractured denture. An oversized perforated tray is filled with irreversible hydrocolloid impression material and then the broken denture is placed in the patient mouth to make an impression over the denture. A cast is poured in the impression with the denture by stone. After setting of stone and the impression has been removed, the cast will reveal the area to be added. Self-cure resin is then used to replace these missing areas. Recently *a visible light cured resin* can be used in place of conventional self-cure resin to repair fracture denture.

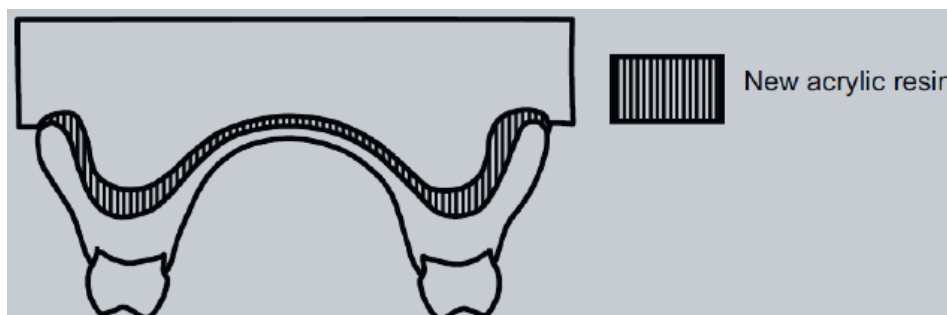
Advantages of Visible Light Curing Resin over Conventional Denture Resin

1. Visible light cure resin has superior strength and dimensional stability.
2. Complete polymerization without residual monomer.
3. Ease of manipulation.
4. The material well tolerated by patient.
5. Need minimum of time and effort.

Relining and Rebasing of complete denture

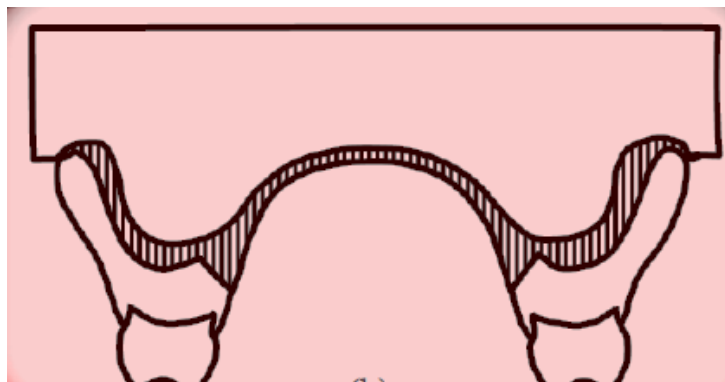
Relining

It is the procedures used to resurface the tissue-side of a denture with new material layer, thus producing an accurate adaptation to the denture foundation area. It is usually carried out when the fitness of the denture has been deteriorated and it is not necessary to construct a new one.



Rebasing

It is the laboratory process of replacing the entire denture base material on an existing prosthesis, without changing the dental arch, and the occlusal relationship.



Indication of Relining and Rebasing of complete denture

When observed clinical changes include:

1. Loss of retention and stability.
2. Loss of occlusal vertical dimension.
3. Loss of support for facial tissues.
4. Horizontal shift of dentures: in correct occlusal relationship.
5. Reorientation of occlusal plane.

Contraindications of Relining and Rebasing of complete denture

1. When there is increased vertical dimension (insufficient interarch space).
2. Poor esthetic and incorrect position of teeth.
3. Unsatisfactory jaw relationship in the denture.
4. Excessive resorption of residual ridge.
5. Severe osseous undercuts.
6. Dentures causing major speech problems.
7. Temporomandibular joint problems.

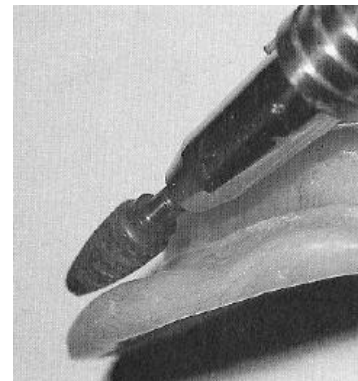
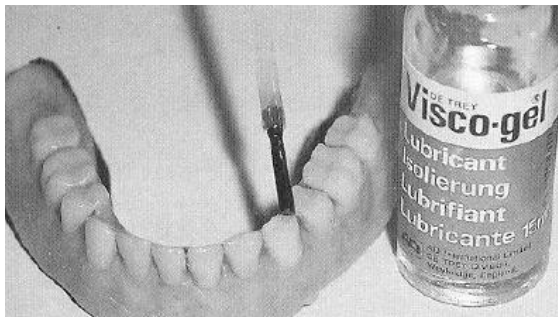
Relining can achieved in one of two ways:

1. Direct (chair side)
2. Indirect (laboratory)

Procedure of Direct Relining

Cold cured acrylic or tissue conditioner material is used, but are not very durable. Direct relining is less time consuming.

1. The fitting surface of the denture is cleaned, roughened, and slightly reduced.
2. The flanges are trimmed (to reduce danger of overextension) and the undercuts removed.
3. Put lubricant over polished surface to prevent the new resin material to adhere on it.
4. The new self-curing relining material is then mixed and applied to the fitting surface.
5. The denture is inserted and the patient asked to bite gently on the denture to ensure that the occlusion is not altered by the procedure.
6. Border molding can then be carried out.
7. The denture is kept in situ for about **5 minutes** after which it is removed and carefully examined.



Disadvantages of Cold Cure Acrylic as Relining Material

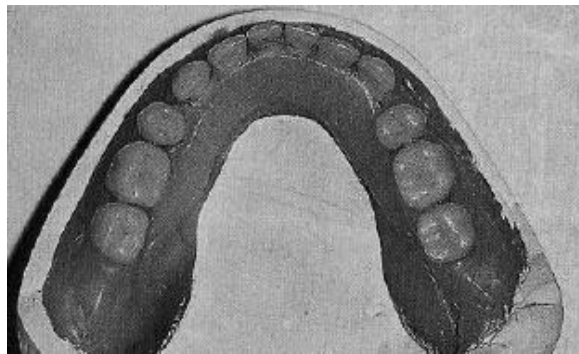
1. The material has often produced a chemical burn on the mucosa, and from exothermic reaction.
2. Color stability is very low and bad odor due to porosity of the material, since no flasking procedure is used.
3. Liability for errors and wrong positioning of the denture is great.
4. Improvement in the denture requirement is very little and low.
5. It is a short term solution.

Procedure of Indirect Relining

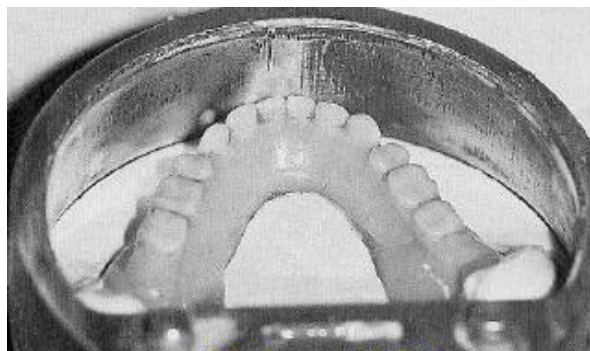
1. The fitting surface is cleaned, the undercuts are removed and the flanges are shortened.
2. Minor defects and extensions can be corrected.
3. A wash impression by zinc oxide eugenol is making with the old denture, with the patient in light occlusal contact.

Laboratory Procedure

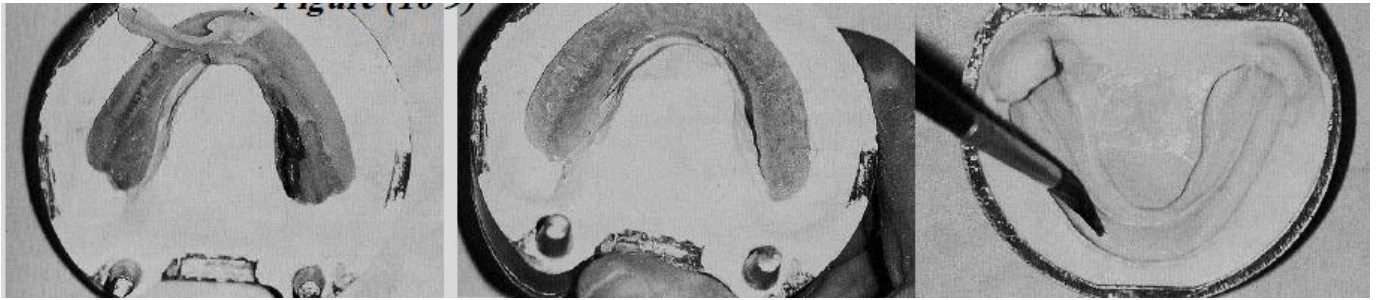
1. Beading and boxing of the impression, then pouring the boxed impression with stone material.



2. The denture and the cast are not separated, but any excess impression on the teeth or facial surfaces of the base is removed, then the denture flaked in the usual manner.



3. (Zinc oxide eugenol) elimination in hot water for **5 minutes**; then separated and all the impression material is cleaned from the cast and the denture base.
4. Painting the cast with a separating medium.
5. Paint the surface of the denture with cotton pellet moistened with monomer.

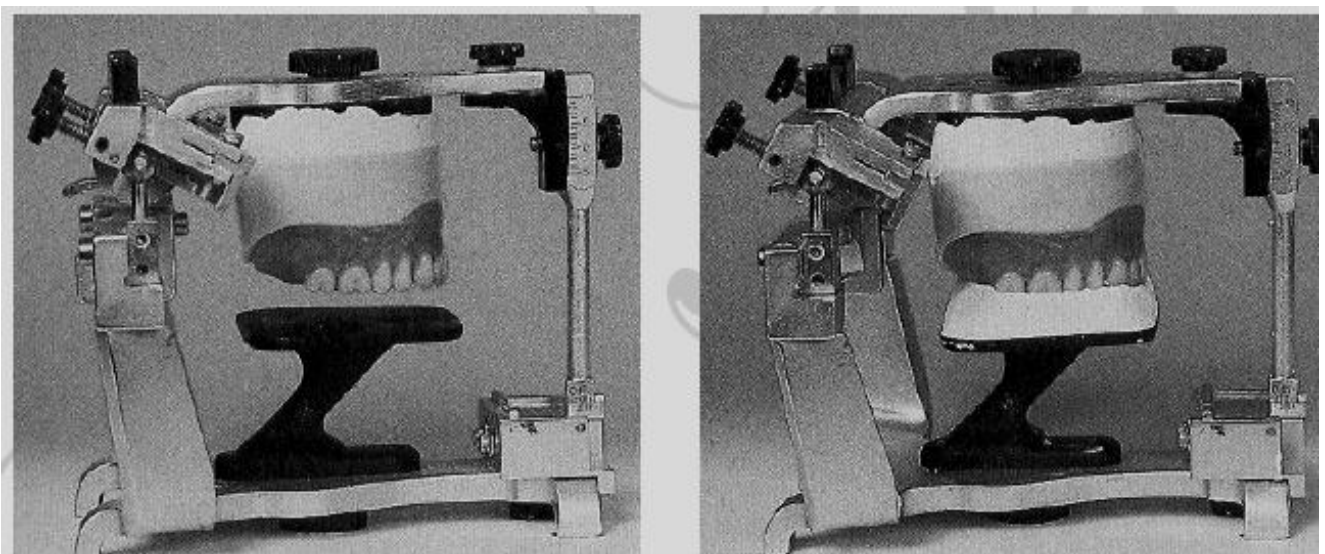


6. Mix the acrylic resin and place it in the flask (the new relining material should be compatible with the old denture base material chemically and esthetically).
7. Curing the heat cured resin.
8. The denture deflasked and the cast removed from the denture then polish the denture; the relined denture is ready to be inserted in the patient mouth.

Procedure of Rebasing

Rebasing procedure is the same as those for relining with some differences:

1. Impression is made and a cast is poured in the denture as in relining procedure.
2. The denture with the cast is mounted on an instrument as *Hooper duplicator* or *Hanau articulator with mounting jig* that maintains the relationship of teeth to the cast.



3. The old denture base is cut and removed.
4. The original teeth are re-waxed in their previous positions on the cast.
5. The denture is then processed in the laboratory as for relining.
6. The denture deflasked and the cast removed from the denture then finished and polish the denture; the rebased denture is ready to be inserted in the patient mouth.

