

# PROSTHESIS

## COMPLETE DENTURE



LEC. 7

Mandibular movement

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# Mandibular movements

## ➤ Factor regulate mandibular movement :

- 1) Initiating position (centric relation )
- 2) Anatomy and physiology of TMJ (shape of condyle and temporal bone )
- 3) Axis of rotation of the mandible
- 4) Muscles flexibility
- 5) ligament

## ➤ Masticatory system consist of

- 1) T.M.J
- 2) Muscles: they are motors of system
- 3) Teeth : for mastication
- 4) Jaw : maxilla and mandible

## Anatomy of Temporomandibular joint (TMJ) :

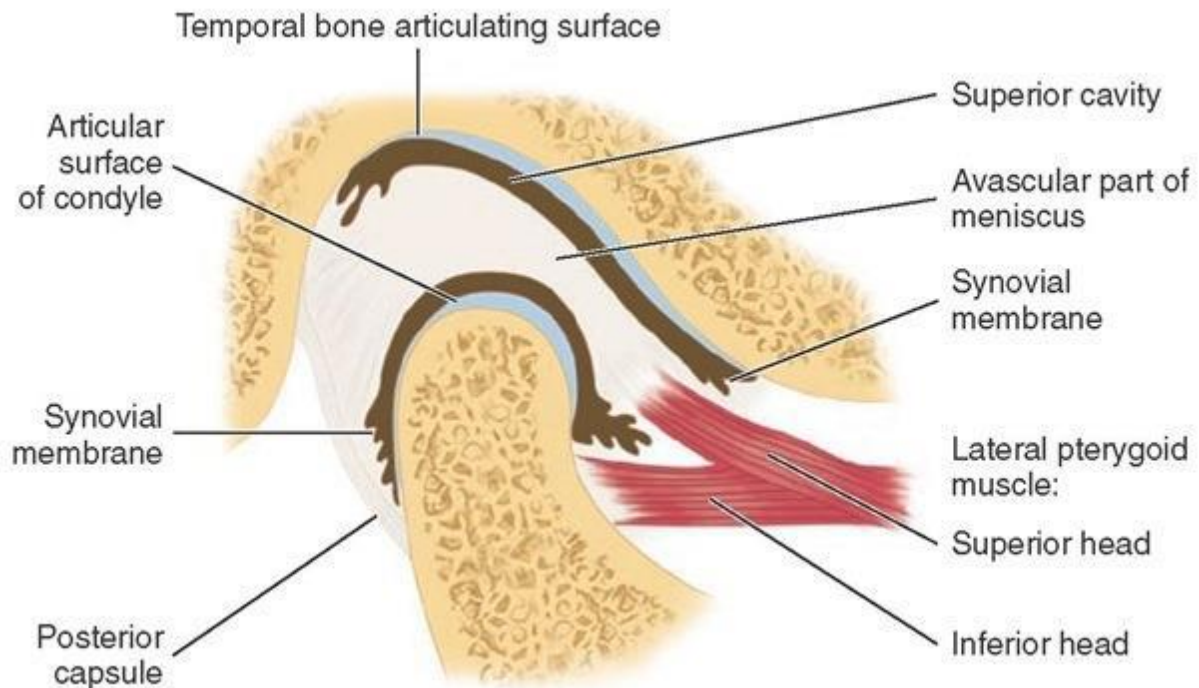
- It is a **synovial joint** but **differs from most synovial joint** in that the articular surfaces are **covered with dense fibrous connective tissue**, instead of hyaline cartilage.
- In addition, the TMJ has a fibrous articular **disc**, to which muscle fibers are attached.
- Articular disc is **biconcave bilaminar** ,its width **3mm posterior , 1 mm at the middle as presence of head of condyle ,2mm anterior (if thickness anterior 3mm and posterior 2 mm --- this mean anterior displacement of the disc)**
- The anterior band lie in front of the condyle and the junction of bilaminar zone and the disk lie at the superior part of condyle
- The posterior band and retrodiskal tissue are bet depicted in the open mouth (the retrodiskal area the **only part have nutrition and blood vessel** )
- The disk medially and laterally blend with the condylodiscal ligament
- The ligament on each side of the jaw is designed in two distinct layer
- **The lubrication of the joint made by synovial fluid which come from two source :**

1) From plasma by dialysis

2) From type A, B cell synoviocytes 0.05 ml volume

- Upper compartment can carry 12 ml of synovial fluid
  - Temporal bone divide into two part (**articular fossa , articular eminence** )
  - This disc divides the joint into two compartments, **upper and lower**.
- ✓ **Upper compartment (concavo –convex ) (saddle shape) (larger than lower)**
- ✓ **Lower compartment (convex )**

- The possible movement of the **lower compartment** is a **simple hinge movement (rotation)**, while that in the **upper compartment** is a **sliding movement. (translation)**
- The mandible during its function moves in all the three planes of space (**horizontal, frontal, and sagittal**).
- **Mandible condyle : convex in all direction but wider latero-medialy (15-20mm) than antero-posteriorly (8-10)**



### ➤ **Axis of rotation of the mandible**

- The mandible rotates in each of the three planes of space around centers of rotation (axes). (sagittal & horizontal & frontal)

#### **1. Horizontal axis :**

🕒 The two condyle of mandible rotate around it during slight opening of the mouth (mandible move in sagittal plane) (hinge movement) (rotational movement)

- Single axis
- Mandible move in arc of closure or arc of opening

#### **2. Vertical axis :**

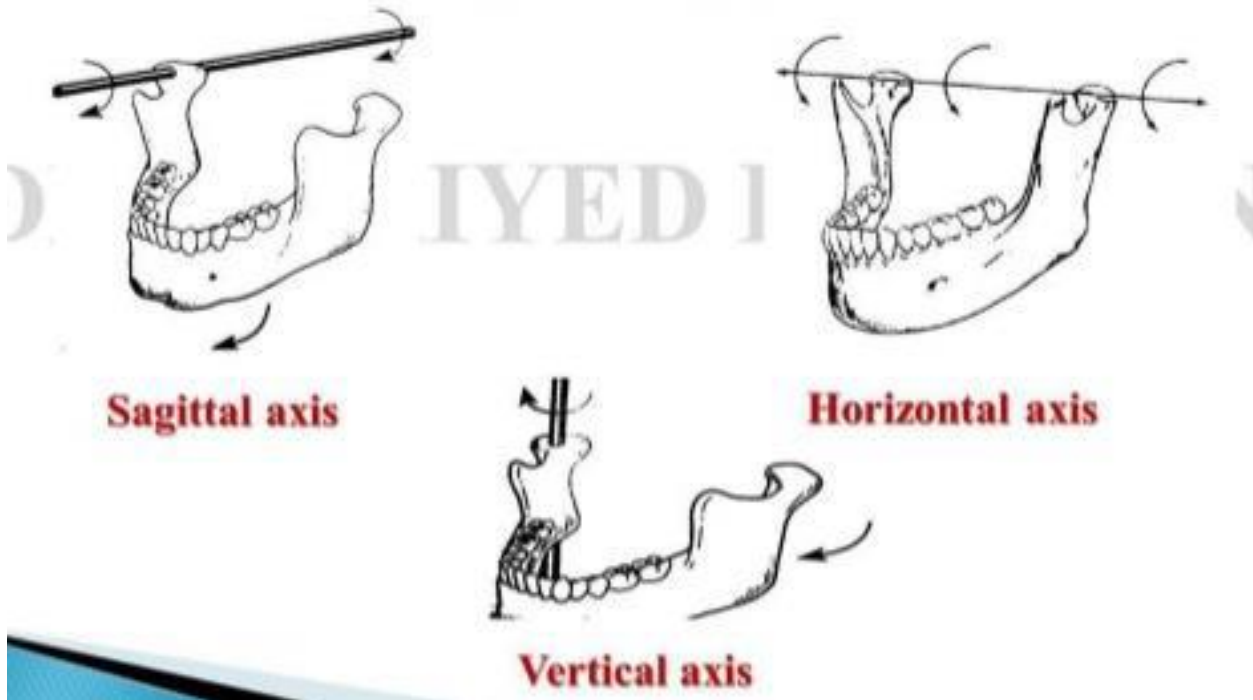
🕒 axis that the **condyle of working side** rotate around it during lateral movement (**bennet movement**)

🕒 while the **condyle in the balancing side** translate in forward , medially

#### **3. Sagittal axis :**

- ⌚ axis that **condyle of working side rotate** around it during **lateral movement** (**progressive side shift**)
- ⌚ while the **condyle in the balancing side** translate in **forward , medial , downward** direction .

## Rotational axes



### ➤ Mandibular positions in horizontal plane

- 1) Mandibular teeth position → C.O
- 2) Mandibular muscular position → C.R guided by muscles
- 3) Mandibular ligamentous → obtained by usage of muscle blocker then retruded mandible posterior to muscular position by 1mm not used with denture as it is border movement

### Muscles of Mastication:

- The muscles of mastication include the **Temporalis, masseter** and **medial pterygoids**. these are **elevators**.
- ⌚ **Lateral pterygoid** ..... **depression**
- ⌚ **Supra hyoid** muscles ..... **depression**
- ⌚ **Mylohyoid , stylohyoid ,geniohyoid** ..... **Depression**

### Masseter muscle

- **Function:**

- ✓ Elevation: of the mandible
- ✓ Retraction: of the mandible deep fibers
- ✓ Protrusion: of the mandible: superficial fibers

## Temporalis muscle

### ➤ Functions:

- ✓ Elevation of the mandible upwards by anterior fibers
- ✓ Retraction of the mandible backward by posterior fibers
- ✓ Elevation and retraction of the mandible: by middle fibers

## Lateral (external) Pterygoid muscle

### ➤ Function:

- 1- Upper (superior) lateral pterygoid (depression o the mandible)
  - 2- Lower (inferior) lateral pterygoid
- ✓ Bilateral contraction: protrude the mandible - depress the mandible together with digastric and mylohyoid muscles
  - ✓ Unilateral contraction: move the mandible medially (side movements)

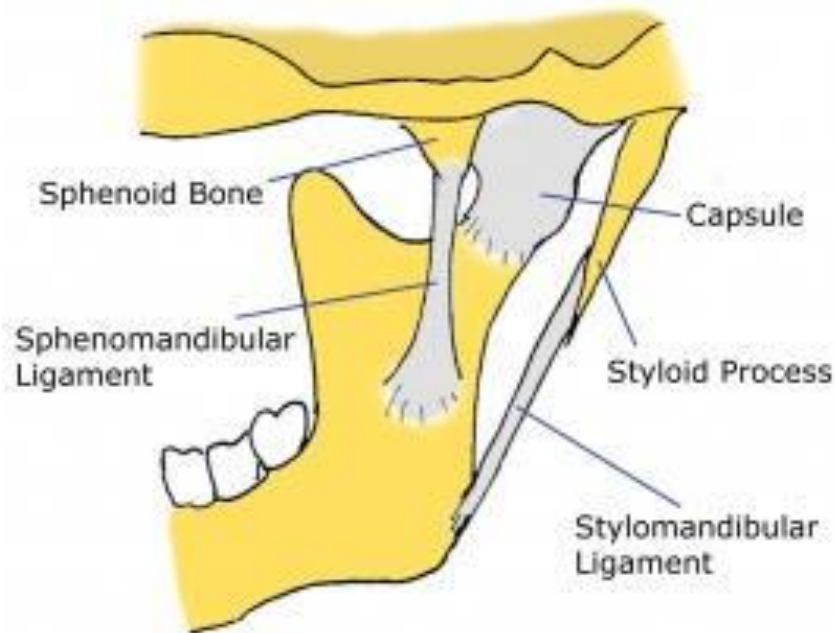
## Medial (internal) Pterygoid muscle

### ➤ Function:

- Elevate the hyoid bone
- Depress the mandible when the hyoid bone is fixed by infrahyoid muscle

**Ligaments:** They act as passive devices ,Mandible suspend to skull by them, limit and restrict mandibular movement

Ligament	Origin	Insertion
Temporomandibular ligament	Articular tubercle	Neck of the condyle
Sphenomandibular ligament	Angular spine of the sphenoid bone.	Mandibular lingual.
Stylomandibular ligament.	Styloid process.	Mandibular angle and posterior border of the ramus.



**The Temporomandibular Ligaments and Joint capsule (medial view)**

rest → action of muscle of elevation equal to action of depressor muscle so mandible in its place by ligaments

✓ When patient open → depressor muscle act

✓ When patient close → elevator muscle act

➤ Types of mandibular movements

a) Masticatory → for grasping, grinding, swallowing food

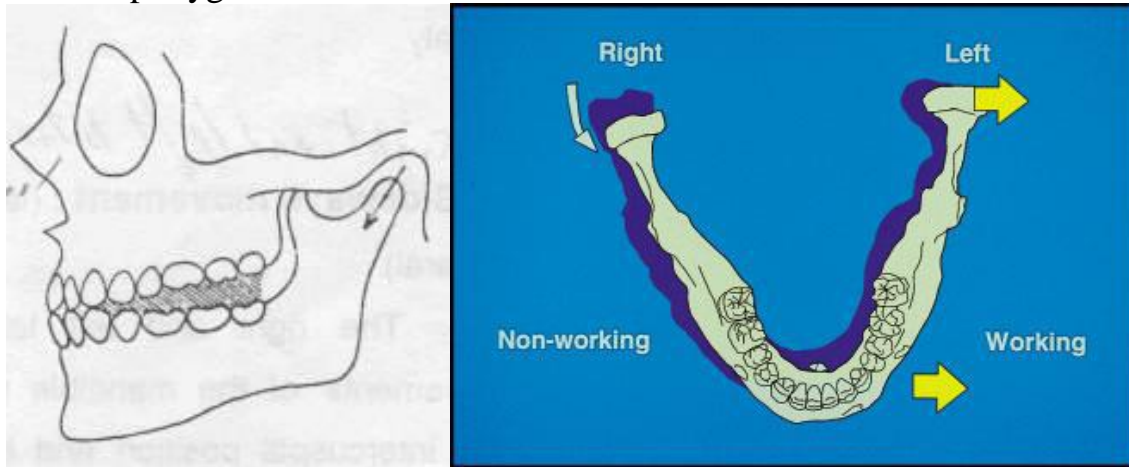
b) Non masticatory → speech, wetting lips, or abnormal movement as bruxism, clenching

## **BASIC MANDIBULAR MOVEMENTS**

### **1. Opening and closing : (vertical )**

- **First part of opening 25 mm hinge movement** occur around horizontal or transverse axis (the two condyle ) (terminal hinge axis)(lower compartment ) (reproducible)
- **Hinge axis** : imaginary line pass through 2 condyle during opening and closing movement awhile the condyle in centric relation
- **Opening more than 25 mm** lead to **translation movement** (sliding)(upper compartment) (both condyle move downward and forward)
- This movement starts from the intercuspal position (**centric occlusion**) to the **maximum opening position**. The condyles usually start to translate immediately when the teeth are separated from the intercuspal position.

- **Closing movement**, the mandible moves from the maximum opening position back to the intercuspal position by the contraction of the masseter and the medial pterygoid muscle.



## 2. Forward movement: (Protrusion of the mandible):

- ❖ The **condyles together with their articular discs** move as one unit **downwards and forwards** along the glenoid fossa and the articular eminence.
- ❖ The path traveled by the condyles in the protrusive movement is termed the **sagittal condylar path**, represented in articulator by **condylar guidance**.
- ❖ **Condylar path inclination depend on** (shape of fossa , thickness of disc , TMJ ligament and muscle )
- ❖ It forms an angle with the horizontal plane (occlusal plane) termed the **sagittal condylar angle**.
- ❖ It varies in individuals and also in the same individual from the left to the right sides. It ranges **between 30°-40°**.
- ❖ When the **mandible moves forward to an edge to edge position a separation occurs distally between the distal arches or occlusion rims**. This distal separation of teeth is the result of the forward and downward glide of the condyle on the articular eminence. This phenomenon is called **Christensen's phenomenon** .
- ❖ Registration of sagittal condylar path inclination from the patient to articulator by **use of wax (protrusive record)** between posterior teeth when mandible is protruded to edge to edge position
- ❖ **Incisal path** : path travelled by incisal edge of lower incisor on the palatal surface of upper incisor till edge to edge position .
- ❖ **Incisal angle** : angle formed between incisal path and horizontal plane (0-10)

## 3. Backward movement (Retrusion of the mandible):

- ❖ The retrusive movement of the mandible takes place by **similar movements as the protrusive** , but in the reverse direction, i.e. upward and backward along the same inclination.

- ❖ **Starting from the intercuspal position** (centric occlusion) mandible can **move slightly**
- ❖ **backward to centric relation** , this movement is brought about by the contraction of the temporalis muscles.
- ❖ **Centric occlusion** : (tooth to tooth relation) static contact between opposing occlusal surface of teeth (maximum intercuspation)
- ❖ **Centric relation** : (bone to bone relation ) (repeatable) relation of the mandible to maxilla when condyle is in the most retruded unstrained position in the glenoid fossa .
- ❖ **Centric occluding relation** : this done by setting of teeth in centric relation position .
- ❖ **Long centric (slide in centric)** : done by setting teeth in centric relation position and widening of fossa to prevent interference . (if centric relation and occlusion not the same position)

#### 4. lateral movement:

- ❖ The right and left lateral movements of the mandible from the intercuspal position and back again to the same position are **asymmetric**.
- ❖ When the mandible moves towards the right side, **the condyle on this side (working side) rotates** mainly with a **very slight bodily lateral translation (Bennett movement)**.
- ❖ The condyle on the left side (balancing side) **moves forward, downward and medially**.
- ❖ The side towards which the movement occurs, is called **working side** ,the other side is called the **non working, or the balancing side**
- ❖ **Condylar path** is path taken by the condyle in the temporomandibular joint during the various mandibular movements,

#### ➤ there are **two condylar paths** :

- ❖ **The lateral condylar path** is the path followed by the condyle in the glenoid fossa when a lateral movement is made.(bennet movement )... with horizontal plane make **lateral condylar angle**
- ❖ **Protrusive condylar path** is the path of the condyle when the mandible is moved forward from its centric position.... With **horizontal plane** make **protrusive condylar angle** .
- ❖ **Fisher angle** : **angle between the protrusive condylar path and lateral condylar path of balancing side when view from sagittal plane (6 degree)**

#### ➤ **Factor affecting angle:-**

1. **Slope of fossa:**
  - steep → large angle
  - flat → small angle
2. **Eminence:**
  - prominent → large angle
  - flat → small angle



3. **Condyle:**                   sharpe concavity → large  
  Flat → small
4. **Disc :**                        large concavity → large  
  Flat → small

### **Significance of studying mandibular movements:**

- 1) Designing, selection, and adjustment of articulator.
- 2) Arranging of artificial teeth
- 3) Developing tooth form for dental restorations.
- 4) Understanding the basic principles of occlusion.
- 5) Diagnosis and treatment of TMJ disturbances.

### **Methods of studying mandibular movements**

- **Pantograph** which is used to record graphically in one or more planes paths of the mandibular movement and provide information for the programming of an articulator.
- The resulting pantographic tracing is a graphic record of mandibular movement in three planes as registered by the styli on the mounting tables of the pantograph.

#### **☒ Border movement in sagittal plane (posselt diagram)**

##### **1. Posterior border movement :**

- Terminal hinge opening : from centric relation opening mandible 20-25 mm .
- Maximum opening by opening mandible more than 30 mm lead to translation movement in the upper compartment to the maximum opening .

##### **2. Anterior border movement :**

- From maximum opening to maximum protruding position

##### **3. Superior border movement :**

- From centric relation to centric occlusion
- From centric occlusion sliding of lower incisor over upper incisors till edge to edge position
- From edge to edge mandible become anterior to maxilla in maximum protrusion position

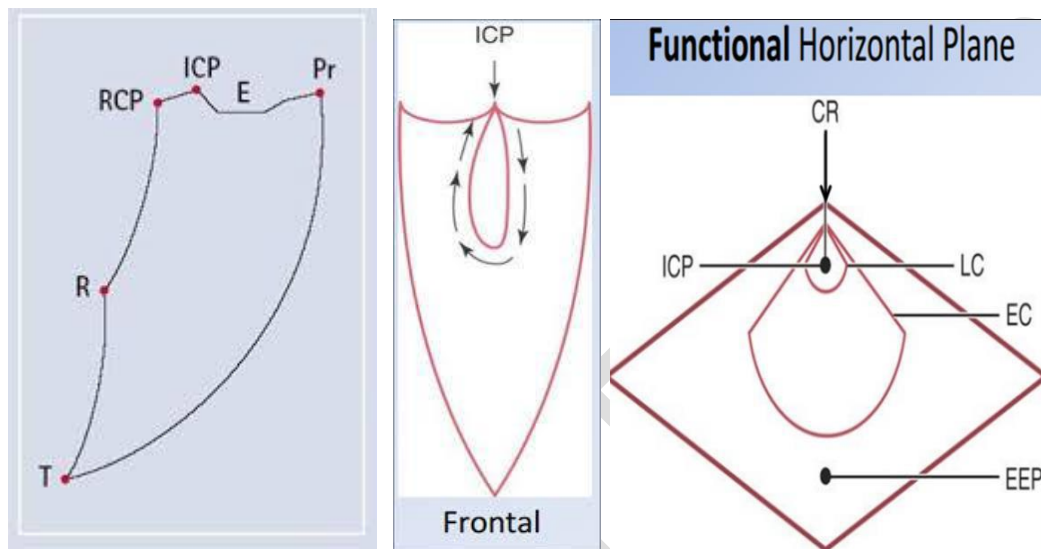
#### **☒ Border movement in frontal view :**

- From centric occlusion to mximum right position with a dip occur due to sliding of cusp of lower canine over upper canine.(bennet movement )
- From maximum right to maximum opening
- From maximum opening to maximum left .
- From maximum left to centric occlusion .

#### **☒ Border movement in horizontal plane :**

- From centric relation to maximum right
- From maximum right to maximum protrusion
- From maximum protrusion to maximum left
- From maximum left to centric relation

➤ **Envelope of motion** : 3-D registration of the border movement of mandible (sagittal , frontal , horizontal border movement )



➤ **Limiting factor for the movement :**

- ✓ Posterior & anterior opening border movement is determined or limited primarily by ligament and morphology of the TMJ
- ✓ Superior contact border movement are determined by occlusal and incisal surface of the teeth

➤ **Bennet movement :**

- ✓ 1908 lateral translation is studied as bennet movement

❖ **Def:** the bodily lateral movement / lateral shift of the mandible resulting from movement of the condyle along lateral incline of the mandibular fossa in lateral jaw movement

- ✓ During this lateral movement the orbiting or condyle on balancing side move forward , downward and medial ,, , this movement determined by morphology of medial wall of fossa , inner horizontal portion of TMJ ligament which attach to the lateral pole of rotating condyle

➤ **Bennet angle :** the angle formed between the sagittal plane and the average path of advancing condyle as view in the horizontal plane during lateral movement (average 7,5—12,8 degree)

➤ **Significance of bennet movement :**

- 1) Responsible for lateral chwing stroke
- 2) It is the movement during which the greater lateral force is exerted

3) For this reason it is extremely important that articulating surface are in strict harmony with the side shift

#### 4) Method used for recording mandibular movement :

- 1) Gothic arch tracing
- 2) Pantograph
- 3) Kinesiographs

#### Graphic method (Gothic arch tracing):

- ✓ Record centric & eccentric relation
- ✓ Record dynamic relation (contact between upper & lower in centric & eccentric & between them)
- ✓ Pointed metal stylus fixed to one record block and plate fixed on other block covered by blue inlay wax
- ✓ Result shape-----sharp pointed arrow head (CR , protrusive , lateral)
- ✓ Made in well-developed ridge and well attached and retentive record block

#### Types of tracer

##### A. Intra oral tracer:

- ✓ Tracing plate in the upper wax rim & stylus in the lower wax rim controlled by a locking nut to be adjusted for patient vertical dimension
- ✓ Ask patient to move lateral & protrusive movement while stylus contact to plate which carry thin layer of cording wax
- ✓ If stylus fixed to lower ----- arrow pointed posteriorly
- ✓ If stylus fixed to upper-----arrow pointed anteriorly
- ✓ Disadv-----small & invisible during tracing

##### B. Extra oral tracer:

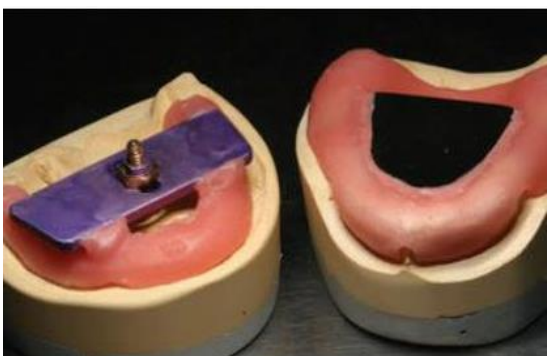
- ✓ Stylus & plate are outside patient mouth and attached to the rim by metal rod

##### ✓ Adv. :

- i. Visible
- ii. Can guide patient
- iii. Magnified Gothic arch tracing

##### ✓ Disadv. :

- i. High weight -----cause tipping (lever)
- ii. So should use with well-formed ridge





➤ **Limitation of mandibular movement :**

✓ Trismus limit the mandibular movement and restrict opening of mouth , limited oral opening restrict mastication , impair speech and deglutition and limit access for dental treatment

❖ **Acute factor :**

- 1) **Trauma :** can occur during inferior nerve block injection ---- muscle inflammation --- limit mandibular movement and pain
- 2) **Infection :** can occur as sequel of pericoronitis or oral surgery
- 3) **Tetanus :** is specific infection of bacterial origin that result in progressive muscular rigidity with restricted mandibular movement and dysphagia

➤ **Surgery :** the primary purpose of surgery in treating limited mandibular movement is to expose and remove an irritant or growth that physically restrict mandibular movement

✓ Surgery treatment of choice for removal of tumor , cyst or foreign bodies , may also indicated in TMJ ankylosis and scleroderma