Determinants of Occlusion

By Associate prof. Manal Rafei Hassan
A Successful restoration should restore:

1. **Function**
   (mastication, phonetics, arch stability).

2. **Appearance** (esthetics).

3. **Patient’s occlusal scheme**.

**HARMONY IS THE KEY WORD**
Important definitions

• **Centric relation:**

• Most retruded physiologic relation of the mandible to the maxilla to, and from which, the individual can make lateral movements.

• Rearmost, uppermost, and midmost position of the condyle in the glenoid fossa
• **Maximum intercuspation:**
• Maximum occlusion of teeth regardless of the condylar position
• **Centric occluding relation:**
• Coincidence of the MI and CR
• **Vertical dimension of occlusion**
• Vertical height of the lower third of face when teeth are in contact
**Centric occlusion**

- It is defined as being the occlusion of teeth as the mandible closes in centric relation.
- It is a reference point from which all other relations are eccentric.

**Maximum intercuspsation**

- It is the most closed complete interdigitation of mandibular & maxillary teeth irrespective of condylar centricity.
- Habitual.
- A little bit forward & at a lower vertical dimension.
CONDYLE:

The mandible is a U shaped bone that articulates with the temporal bone by means of the articular surface of its condyle.

The head is covered with fibrocartilage and articulates with temporal bone to form TMJ.
Temporomandibular Joints

The major components of the temporomandibular joints (TMJs) are the cranial base, the mandible, and the muscles of mastication with their innervation.
Ligaments

The body of the mandible is attached to the base of the skull by muscles and also by three paired ligaments (Table 4-1): the temporomandibular (also called the lateral), the sphenomandibular, and the stylomandibular. Ligaments cannot be stretched significantly, and so they limit the movement of joints. The temporomandibular ligaments limit the amount of rotation of the mandible and protect the structures of the joint, limiting border movements.¹ The sphe-
The three paired muscles of mastication provide elevation and lateral movement of the mandible. These are the temporal, the masseter, and the medial pterygoid muscles. The lateral pterygoid muscles, each with two bellies (which probably should be considered as two separate muscles), function horizontally during opening and closing; the inferior belly (or inferior lateral pterygoid) is active during protrusion, depression, and lateral movement; the superior belly (or superior lateral pterygoid) is active during closure. The latter muscle is thought to assist in maintaining the integrity of the condyle-disk assembly by pulling the condylar process firmly against the disk, because the superior belly has been shown to attach to the disk and the neck of the condyle.
Functional Muscles of Mastication

- Temporalis
- Lateral Pterygoid
- Medial Pterygoid
- Masseter
Fig. 4-6
Reference planes.
These determinants are the anatomic structures that dictate or limit the movements of the mandible. The anterior determinant of mandibular movement is the dental articulation. The posterior determinants of mandibular movement are the temporomandibular articulations and their associated
structures. The posterior determinants (Fig. 4-14)—shape of the articular eminences, anatomy of the medial walls of the mandibular fossae, configuration of the mandibular condylar processes—cannot be controlled, and it is not possible to influence the neuromuscular responses of the patient unless it is done by indirect means (e.g., through changes in the configuration of the contacting teeth or by the provision of an occlusal appliance). If a patient has steeply sloped eminences, there is a large downward component of condylar movement during lateral and protrusive excursions. Similarly, the anatomy of the medial wall of each fossa normally allows the condyle to move slightly medially as it travels forward (mandibular side shift, or transtrusion). The side shift becomes greater as the extent of medial movement increases. However, the anatomy of the joint dictates the actual path and timing of condylar movement. Movement of the laterotrusive or working condylar process is influenced predominantly by the anatomy of the lateral wall of the mandibular fossa. The amount of the side shift is, of course, a function of the mediotrusive or nonworking condyle; on the working side, however, it is the anatomy of the lateral aspect of the fossa that guides the working condyle straight out or upward and downward. The amount of side shift does not appear to increase as the result of a loss of occlusion.\(^6\)
Intercondylar distance

- Distance between the rotational center of one condyle to the rotational center of the other side of condyle is called as intercondylar distance.
- Larger the distance, more distal positioning of oblique ridges and grooves on mandibular teeth and mesial positioning of ridges and grooves of maxillary teeth.
- Smaller the distance & vice-versa.
• Digital palpation.

• Sounds.

• Joint restriction.

• Dental examination
  - Mobility
  - Widening of period. Space.
  - Osteosclerosis
  - Hyper cementosis

• TMJ Imaging
Fig. 4-14
<table>
<thead>
<tr>
<th>POSTERIOR DETERMINANTS</th>
<th>Variation</th>
<th>Impact on Restoration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inclination of articular eminence</td>
<td>Steeper</td>
<td>Posterior cusps may be taller</td>
</tr>
<tr>
<td></td>
<td>Flatter</td>
<td>Posterior cusps must be shorter</td>
</tr>
<tr>
<td>Medial wall of glenoid fossa</td>
<td>Allows more lateral translation</td>
<td>Posterior cusps must be shorter</td>
</tr>
<tr>
<td></td>
<td>Allows minimal lateral translation</td>
<td>Posterior cusps may be taller</td>
</tr>
<tr>
<td>Intercondylar distance</td>
<td>Greater</td>
<td>Smaller angle between laterotrusive and mediotrusive movement</td>
</tr>
<tr>
<td></td>
<td>Lesser</td>
<td>Increased angle between laterotrusive and mediotrusive movement</td>
</tr>
<tr>
<td>ANTERIOR DETERMINANTS</td>
<td>Increased</td>
<td>Reduced</td>
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<tr>
<td>--------------------------------</td>
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<tr>
<td>Horizontal overlap of anterior teeth</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vertical overlap of anterior teeth</td>
<td>Increased</td>
<td>Reduced</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>OTHER</th>
<th>More parallel to condylar guidance</th>
<th>Less parallel to condylar guidance</th>
<th>Posterior cusps must be shorter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Occlusal plane</td>
<td></td>
<td></td>
<td>Posterior cusps may be longer</td>
</tr>
<tr>
<td>Anteroposterior curve</td>
<td>More convex (shorter radius)</td>
<td>Less convex (larger radius)</td>
<td>The most posterior cusps must be shorter</td>
</tr>
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<td></td>
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• **Principle(1):** Neuromuscular harmony depends on structural harmony between the occlusion and the tempromandibular joints.

• **Principle(2):** Determination of the correct physiologic jaw relationship must always be determined before we can determine the correct alignment and occlusal relationship of the teeth. i.e. the teeth must fit into harmony of jaw relationship-not vice versa.

• That is why we mount casts in centric relation on an articulator, so we can see the correct mandible to maxilla relationship regardless of how the dental arch align. (teeth alignment)
Primary requirements for successful occlusal therapy

• Comfortable and stable TMJs: the jaw joints must be able to function and accept loading forces with no discomfort. This is always the starting point for any dental treatment that involves the occlusal surfaces of the teeth.

• Anterior teeth in harmony with the envelope of function and in proper relationship with lips, the tongue, and the occlusal plane.

• Non-interfering posterior teeth: posterior teeth should contacts without interference with the TMJs in protrusion or retrusion.
The anterior determinants (Fig. 4-15) are the vertical and horizontal overlaps and the maxillary lingual concavities of the anterior teeth. These can be altered by restorative and orthodontic treatment. A greater vertical overlap causes the direction of mandibular opening to be more vertical during the early phase of protrusive movement and creates a more vertical pathway at the end of the chewing stroke. Increased horizontal overlap allows a more horizontal jaw movement.

Although the posterior and anterior determinants combine to affect mandibular movement, no correlation has been established; that is, patients with steep anterior guidance angles do not necessarily have a steep posterior disclusion, and those with a steep posterior disclusion do not necessarily have steep guidance angles.
Fig. 4-15
Anterior determinants of occlusion. Different incisor relationships with differing horizontal and vertical overlaps (HO and VO) produce different anterior guidance angles (AGA). A, Class I. B, Class II, Division 2 (increased VO; steep AGA). C, Class II, Division 1 (increased HO; flat AGA).
**VERTICAL AND HORIZONTAL OVERLAP OF ANTERIOR TEETH**

- Greater the vertical height, greater will be cusp height.

- Greater the horizontal overlap, lesser will be cusp height.
Position of teeth in relation to rotational centers of condyle and to horizontal cranial reference plane is transferred to articulator by means of facebow.

Interocclusal records made in centric relation are used to place mandibular cast in proper relation to rotational centers and cranial reference planes.
Occlusal plane

- The more plane of occlusion diverges from path of non working condyle, greater is allowable cuspal height.
- The more nearly parallel occlusal plane to path of non working condyle the shorter is allowable cuspal height.
Faulty occlusal contours of dental restorations may also produce deflective occlusal contacts causing mandible to move away from centric relation closure in order to allow maximal intercuspal position of teeth. This maximum intercuspal position is an eccentric closure. Premature contacts occurring on the inclines of cusps produce lateral forces on teeth that create undesirable lateral pressure and tension on periodontal tissue. While occlusal forces do not cause periodontal disease, it produces increased tooth mobility because of compensatory widening of periodontal ligament space.
The craniomandibular articulation allows changes in relation of its parts in order to accommodate guiding influence of tooth inclines during mandible’s attempt to reach the position of maximal intercusping. The accommodation produces an eccentric maximal intercusping of teeth. The repeated demands resulting from this intercusping can produce hypertonicity in associated muscle beyond their capacity to adapt and myofacial pain develops.
Disharmony between condylar centricity and maximal intercusping may also produce excessive wear of the teeth that are responsible for the deflective interferences.
Cusp ridge pattern of occlusion

• Development of occlusion can result in fitting one stamp cusp into fossa and fitting another stamp cusp into embrasure area of two opposing teeth.
• It is also called as tooth to two teeth occlusion or cusp embrasure occlusal pattern.
## Types of Cusps

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<th>Centric (Function) Cusps</th>
<th>Non Centric (Non-Function) Cusps</th>
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<tr>
<td>Palatal of uppers + Buccal of lowers.</td>
<td>Buccal of uppers + lingual of lowers.</td>
</tr>
<tr>
<td>Called <strong>Stamp Cusps</strong>: because they stamp in the opposing fossae.</td>
<td>Called <strong>Shear Cusps</strong>: because they shear the food.</td>
</tr>
<tr>
<td>Constitutes about <strong>60%</strong> of the bucco-lingual dimension of a molar.</td>
<td>The shear cusp constitutes the remaining <strong>40%</strong>.</td>
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## TYPES OF CUSPS

### Centric (Function) Cusps
- Palatal of uppers + Buccal of lowers.
- Called **STAMP CUSPS**: because they stamp in the opposing fossae.
- Constitutes about **60%** of the bucco-lingual dimension of a molar.

### Non Centric (Non-Function) Cusps
- Buccal of uppers + lingual of lowers.
- Called **SHEAR CUSPS**: because they shear the food.
- The shear cusp constitutes **the remaining 40%**.
DURING THE 1970’S, ANDREWS SIX KEYS TO NORMAL OCCLUSION CAME FORWARD AFTER STUDYING MODELS OF 120 PATIENTS WITH IDEAL OCCLUSION.

ANDREWS CONSIDERED THE PRESENCE OF THESE FEATURES ESSENTIAL TO ACHIEVE AN OPTIMAL OCCLUSION.
Tight Contacts
Curve of Spee
Rotation
Crown Angulation (Tip)
Crown Inclination (Torgue)
Tight Contacts
Curve of Spee
Molar Relationship
1. Molar inter-arch relationship:

1- The MB cusp of upper 6 should occlude in the groove between M & MB cusps of lower 6.

2- The ML cusp of upper 6 should occlude in the central fossa of lower 6.

3- The crown of upper 6 must be angulated so that the distal MR Occludes with the mesial MR of lower 7.
2- Mesio-distal crown angulation:

-Long axis of the clinical crown:

A line passes along the long axis of the crown through the most prominent part in the center of the labial or buccal surface.

For the occlusion to be considered normal, the gingival part of the long axis of the crown must be distal to the occlusal part of the line.
3. Labio-lingual crown inclination: 
crown inclination (Torque)

It is determined from a mesial or distal view.

The resulting angle between a line perpendicular to the occlusal plane & a line that is tangent to the middle of the labial or buccal clinical crown.

The upper incisors usually have +ve torque;
The lower incisors usually have slight –ve torque. 
From the canines distally, the torque becomes –ve.
There should be tight contact between adjacent teeth.

Rotated posterior teeth occupy more space in the dental arch.

A normal occlusal plane should be flat.

Absence of Rotation

Tight contacts

Curve of Spee

Anterior teeth ???
STATIC OCCLUSION
Cusp fossa pattern of occlusion

• It produces an interdigitative relation of cusps and fossa of one tooth with cusps and fossa of only one opposing tooth.
• This arrangement is also called as tooth to one tooth occlusion.
1- Cusp-Ridge Pattern of occlusion:

One stamp cusp fits in a fossa & another stamp cusp of the same tooth fits into the embrasure area of two of the opposing teeth.

Called “tooth-to-two-tooth” occlusion or “cusp-embrasure” occlusal pattern.

2- Cusp-Fossa Pattern of occlusion:

Most or all stamp cusps fit into fossae.

Producing interdigitive relation of the cusps & fossae of one tooth with the cusps & fossae of only one opposing tooth.

Called “tooth-to-one-tooth” occlusion.
“A TRIPODE IS THE MOST STABLE SYSTEM IN MECHANICS”
Cusp-Fossa vs. Cusp-Marginal Ridge?

1- Giving **maximum support** in centric occlusion.

2- The forces are closer to the long axis of each tooth, giving a more efficient chewing apparatus.

3- The occlusal forces are along the long axis of teeth: **less tipping**.

4- There is **elimination of food impaction** between marginal ridges.

5- The teeth are **more stable**, with **more stable occlusion**.

6- **lesser wear of the cusp tips**; because the cusps make their contact with their ridges not their tips.
DYNAMIC OCCLUSION
There are 3 recognized occlusal concepts that describe the manner in which teeth should & should not contact in the various functional & excursive positions of the mandible:

- Bilaterally balanced occlusion
- Unilaterally balanced occlusion
- Mutually protected occlusion
1. Bilateral balanced occlusion

- All teeth in contact
  "in centric & all eccentric mandibular movements".
- There is cross-mouth & cross-tooth contacts.
- In 5% only of population.
- Only used with complete removable dentures as it aids in denture stability
  (cross tooth & cross arch stability).
- In natural dentition & fixed prosthodontics:
  - it is very hard to accomplish.
  - causes high occlusal wear, pdl breakdown,
    neuro-muscular disturbances.
2. Unilateral balanced occlusion (group function)

- 20-25%
- On the working side .... canine & post canine teeth are in contact,
- while on the non-working side .... no contacts exist between teeth.
- Advantageous if pdl support of canine is compromised.
3. Canine guided (mutually protected)

- 60-70%
- Posterior teeth are in contact in centric position.
- Anterior teeth guide the mandible in protrusive movements.
- Canines guide the mandible in lateral movements.
- i.e.: posterior teeth are separated & not in contact in ALL eccentric movements.
Organic occlusion

- Given by stallard and stuart
- In protrusive movement two or more mandibular anterior teeth occlude with maxillary incisors.
- All mandibular teeth occlude simultaneously with maxillary teeth in centric relation.
- Maxillary palatal cusp occlude in fossa of each mandibular opponent. Mandibular buccal cusp occlude in fossa of each maxillary opponent.
- The mandibular anterior teeth relate to lingual surface of maxillary anterior teeth as stamp cusps into fossa.
- In lateral closure only canines on the working side occlude.
- In lateroprotrusive closure, the lateral incisor may share closure contacts with canines.
- The stamp cusps of premolars and molars occlude with opposing fossa with 3 point contact in centric relation.
DIAGNOSIS OF PATIENTS WITH PROBLEMS RELATED TO OCCLUSION
Most common signs

- **05** Ear pain & headache
- **04** Muscle & TMJ pain
- **03** Tooth mobility
- **02** Pulpitis
- **01** Tooth wear
History Taking
Clinical Examination

1- Muscle examination
Clinical Examination

2- Maximal inter-incisal distance

a. Maximum comfortable mouth opening.
   b. Maximum mouth opening.
   c. Examining for lateral movement of the mandible.
Clinical Examination

3- T.M.J

TMJ dysfunction:
- Joint sounds
- Joint restrictions
Our Target (selective adjustment treatment)

1. From 3 to 4 contact points on molars.
2. From 2 to 3 contact points on premolars.
3. Very light or no contact on anterior teeth in centric contact
Occlusal adjustments

Adjustment of occlusion can be done by-

- Selective reshaping of ridges of cusps.
- Changes can be made at angles of marginal ridge.
- Reduction of cusp height can be done.
- Reduction of sulcus by reducing angles of triangular and oblique ridges.

While reduction do not create flat areas, always maintain rounded contours polished surface of cusps and ridges.

All eccentric interferences should be removed first then only centric relation interferences should be removed.
Eliminate contact on any posterior incline that mark in lateral or protrusive excursive movements.
1st Step: Articulating Paper

Examining the occlusion using Bausch Articulating Paper with progressive color transfer 200 µm or Bausch PROGRESS 100° Articulating Paper with progressive color transfer 100 µm

Differences between paper and foil

**Progressive Paper**
- Marks under pressure
- Larger contact marks
- Shows different pressure forces
- To check static occlusion
- Marks extremely well on wet surfaces

**Articulating Foil**
- Marks on stroke
- Contacts are pin points
- Marks high spots precisely
- To check static and dynamic occlusion

The blue contacts show the pressure distribution. Dark marks show a higher pressure than light marks.
What is the T-Scan?

- The T-Scan is a diagnostic device that records your patient's bite force dynamics, including occlusal force, location and timing.
Advantages:

1- Reproducible marks.

2- Easier & more convenient in patient education.

3- Facilitates communication between dental staff.
Finally ..................
Occlusal Principles affect ……

Anterior esthetics
Posterior masticatory function
Phonetics
General health
Survival of tooth-borne & implant-borne prosthesis.
Occlusion influences the ability of an individual to chew & swallow effectively & thus influences a person’s diet.

Occlusion may also influence an individual’s susceptibility to sleep apnea if it’s associated with restricted airway, linking it to an increased risk of CV. diseases.
Thank you