Determinants of Occlusion Morphology
Structures control mandibular movement

- Posterior controlling factor: TMJ
- Anterior controlling factor: anterior teeth

- Posterior teeth
  - are positioned between these two controlling factors
  - can be affected by both to varying degrees
Posterior controlling factors

Condylar guidance

– is the angle at which the condyle moves away from a horizontal reference plane from CR along the articular eminence of the mandibular fossa

– depends on the steepness of the articular eminence

– considered to be fixed factor, unalterable
CG angle when the mandible move laterally is greater than when mandibule protrudes straight forward due to medial wall of the mandibular fossa is generally greater than articular eminenece anterior to condyle.
Anterior controlling factors

- Anterior guidance
  - the incisal edges of the mandibular teeth occlude with lingual surface of the maxillary teeth as mandible protrude or move laterally
  - The steepness of these lingual surface determines the amount of vertical movement of mandible
  - The anterior guidance consider to be a variable rather can be altered during by dental procedure
• The morphologic characteristics of each posterior tooth must be in harmony with those of its opposing tooth to teeth during all eccentric mandibular movements.

• Therefore the exact morphology of the tooth is influenced by the pathway it travel across its opposing tooth to teeth.

• Nearer the tooth is to the TMJ, the more the more joint influences its movement.
PCF 4 units forward
4 units downward

HRP

ACF 4 units forward
4 units downward

HRP
Occlusal surface of posterior teeth can be effected by the significance of the anterior and condylar guidance in two manners:

- **factors influences vertical components (Height)**
- **factors influences horizontal components (Width)**
Vertical determinants of occlusal morphology

Influences the heights of cusps and the depths of fossae

1. The anterior controlling factor of mandibular movement (i.e., anterior guidance)

2. The posterior controlling factor of mandibular movement (i.e., condylar guidance)

3. The nearness of the cusp to these controlling factors.
Posterior centric cusps

• are generally developed to contact in the intercuspal position but to disocclude during eccentric mandibular movements

• must be long enough to contact in the intercuspal position but not so long that they contact during eccentric movements.
Angle of articular eminence

(Effect of condylar guidance on cusp height)

• Protrusion: the condyle descends along the steepness of the articular eminence.

• more steepness
  – more the condyle is forced to move inferiorly as it shifts anteriorly
  – greater vertical movement of condyle, mandible, mandibular teeth
45° & 45°
Fig. 6-4  A. The posterior and anterior controlling factors are the same, causing the mandible to move away from the reference plane at a 45-degree angle. B. For premolar A to be disoccluded from premolar B during a protrusive movement, the cuspal inclines must be less than 45 degrees.
Fig. 6-5  A. Posterior and anterior controlling factors are identical and cause the mandible to move away from the reference plane at a 60-degree angle. B. For premolar A to be disoccluded from premolar B during a protrusive movement, the cuspal inclines must be less than 60 degrees. Thus it can be seen that steeper posterior and anterior controlling factors allow for steeper posterior cusps.
Effect of anterior guidance on cusp height

• Anterior guidance is a functional relationship between the maxillary and mandibular anterior teeth.

• Anterior guidance is consisted of
  – vertical overlap of anterior teeth.
  – horizontal overlaps of anterior teeth.
Examples of anterior guidance

Same vertical overlap, varying horizontal overlap
Increase in horizontal overlap leads to a decreased anterior guidance angle, less vertical component to mandibular movement, and flatter posterior cusps.
Same horizontal overlap, varying vertical overlap
Increase in vertical overlap produced an increased anterior guidance angle, more vertical component to mandibular movement, and steep posterior cusps.
Effect of plan of occlusion on cusp height

- Plane of occlusion is an imagination line touching incisal edges of maxillary anterior teeth and the cusps of the posterior teeth.

- The relationship of the plan to the angle of the articular eminence influences the steepness of the cusps.
Fig. 6-7  A. The anterior and posterior controlling factors create a mandibular movement of 45 degrees from the horizontal reference plane. B. The tooth moves at a 45-degree angle from the horizontal reference plane (HRP). However, if one plane of occlusion (POA) is angled, the tooth moves away from the horizontal reference plane at only 25 degrees. Therefore the cusp must be relatively flat to be disoccluded during protrusive movement. When the angle at which the tooth moves during a protrusive movement is compared to another plane of occlusion (POB), a much greater discrepancy is evident (45 + 15 = 60 degrees). This allows for taller and steeper posterior cusps.
Effect of curve of Spee on cusp height

- The curve of Spee is an anteroposterior curve extending from the tip of the mandibular canine along the buccal cusp tips of mandibular posterior teeth.
- Its curvature can be described in terms of the length of the radius of the curve.
A short radius the curve is more acute that with a longer radius
Orientation of curve of Spee
To be continued
Effect of mandibular lateral translation movement on cusp height

• **Bennett movement:** Mandibular lateral translation movement is a bodily sideshift of the mandible that occurs during lateral movements.

• **During a lateral excursion the orbiting condyle moves downward and forward, and inward**

• **Opposite condyle rotate around axes in mandibular fossa (rotating condyle)**
• **TM ligament of the rotating condyle is very tight** and the *medial wall is close to the orbiting condyle*

• **a pure arcing movement is made around the axis of rotation condyle**
Degree of inward movement of condyle for lateral translation

Determined by 2 factors

– morphology of the medial wall of the mandibular fossa

– inner horizontal portion of the TM ligament, which attaches to the lateral pole of the rotating condyle.
- looseness of the TM ligament & the medial wall of the mandibular fossa lies medial to an arc around the axis of the rotating condyle.

- condyle is moved inwardly to the medial wall and produces a mandibular lateral translation movement.
Fig. 6-13 The more medial the wall from the medial pole of the orbiting condyle, the greater is the amount of lateral translation movement.
Fig. 6-14 The direction of the lateral translation movement is determined by the direction taken by the rotating condyle.
Effect of mandibular lateral translation movement on cusp height

- Effect of the amount of lateral translation movement on cusp height
- Effect of the direction of lateral translation movement on cusp height
- Effect of the timing of lateral translation movement on cusp height
Effect of the amount of lateral translation movement on cusp height

The greater the lateral translation movement, the shorter is the posterior cusp.
The greater the lateral translation movement, the shorter is the posterior cusp.
**Effect of the direction of lateral translation movement on cusp height**

- determined by the morphology and ligamentous attachments of the TMJ undergoing rotation
  - Movement occurs within a 60-degree (or less) cone whose apex is located at the axis of rotation
  - More superior the lateral translation movement, the shorter is the posterior cusp
movement occurs within a 60-degree (or less) cone whose apex is located at the axis of rotation
More superior the lateral translation movement, the shorter is the posterior cusp.
Effect of the timing of lateral translation movement on cusp height

- lateral translation movement
  - occurs early, a shift is seen even before the condyle begins to translate from the fossa. This is called an immediate lateral sideshift
  - it occurs in conjunction with an eccentric movement, the movement is known as a progressive lateral translation movement or progressive sideshift.
1. Immediate sideshift, shorter posterior cusp
2. Progressive sideshift, longer cusp
Horizontal determinants of occlusal morphology

- distance from rotating condyle on ridge and groove direction
- distance from midsagittal plane on ridge and groove direction
- distance from rotating condyles and from midsagittal plane on ridge and groove direction
- Effect of mandibular lateral translation movement on ridge and groove direction
- intercondylar distance on ridge and groove direction
- relationship between anterior and posterior controlling factors
Effect of distance from rotating condyle on ridge and groove direction

- The greater the distance of the tooth from the rotating condyle, the wider is the angle formed by the laterotrusive and mediotrusive pathways.
Fig. 6-19  The pathway that the cusp of a tooth follows in passing over the opposing tooth is a factor of its distance (radius) from the rotating condyle. A represents medio-trusive pathways; B, laterotrusive pathways.
Mandibular teeth

A = Mediotrusive pathway, B = Laterotrusive pathway
Maxillary teeth

A = Mediotrusive pathway, B = Laterotrusive pathway
Effect of distance from midsagittal plane on ridge and groove direction

- The greater the distance of the tooth from the midsagittal plane, the wider the angle formed by the laterotrusive and mediotrusive pathways. (both maxillary and mandibular teeth)
Fig. 6-21 The greater the distance of the tooth from the midsagittal plane, the wider the angle formed by the laterotrusive and mediotrusive pathways. This is true for both mandibular, A, and maxillary, B, teeth. A represents mediotrusive pathways; B, laterotrusive pathways.
Fig. 6-21 The greater the distance of the tooth from the midsagittal plane, the wider the angle formed by the laterotrusive and mediotrusive pathways. This is true for both mandibular, A, and maxillary, B, teeth. A represents mediotrusive pathways; B, laterotrusive pathways.
Effect of distance from rotating condyles and from midsagittal plane on ridge and groove direction

• More anterior the tooth in the dental arch, the wider is the angle formed by the laterotrusive and mediotrusive pathways
Effect of mandibular lateral translation movement on ridge and groove direction

• As the amount of lateral translation movement increases, the angle between the mediotrusive and laterotrusive pathways generated by the centric cusp tips increases. (both maxillary and mandibular teeth)
Fig. 6-23 As the amount of lateral translation movement increases, the angle between the mediotrusive (A) and laterotrusive (B) pathways generated by the centric cusp tips increases. This is true for both mandibular, A, and maxillary, B, teeth.
Fig. 6-23 As the amount of lateral translation movement increases, the angle between the mediotrusive (A) and laterotrusive (B) pathways generated by the centric cusp tips increases. This is true for both mandibular, A, and maxillary, B, teeth.
Effect of anterolateral and posterolateral translation movement of the rotating condyle

- The more anteriolateral the movement of the rotating condyle, the smaller is the angle formed by the mediotrusive and laterotrusive pathways.

- The more posterolateral the movement of the rotating condyle, the wider is the angle formed by the mediotrusive and laterotrusive pathways.

- (both maxillary and mandibular teeth)
Fig. 6-24 Effect of anterolateral and posterolateral translation movement of the rotating condyle. The more anterolateral the movement of the rotating condyle, the smaller is the angle formed by the mediotrusive and laterotrusive pathways ($A_3$ and $B_3$). The more posterolateral the movement of the rotating condyle, the wider is the angle formed by the mediotrusive and laterotrusive pathways ($A_1$ and $B_1$). This is true for both mandibular, A, and maxillary, B, teeth.
Fig. 6-24 Effect of anterolateral and posterolateral translation movement of the rotating condyle. The more anterolateral the movement of the rotating condyle, the smaller is the angle formed by the mediotrusive and laterotrusive pathways (A3 and B3). The more posterolateral the movement of the rotating condyle, the wider is the angle formed by the mediotrusive and laterotrusive pathways (A1 and B1). This is true for both mandibular, A, and maxillary, B, teeth.
Intercondylar distance on ridge and groove direction
Fig. 6-25 The greater the intercondylar distances, the smaller the angle formed by the laterotrusive and mediotrusive pathways.
**Relationship between anterior and posterior controlling factors**

**Table 6-1**

**Vertical determinants of occlusal morphology (cusp height and fossa depth)**

<table>
<thead>
<tr>
<th>Factor</th>
<th>Condition</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Condylar guidance</td>
<td>Steeper the guidance</td>
<td>Taller the posterior cusps</td>
</tr>
<tr>
<td>Anterior guidance</td>
<td>Greater the vertical overlap</td>
<td>Taller the posterior cusps</td>
</tr>
<tr>
<td></td>
<td>Greater the horizontal overlap</td>
<td>Shorter the posterior cusps</td>
</tr>
<tr>
<td>Plane of occlusion</td>
<td>More parallel the plane to condylar guidance</td>
<td>Shorter the posterior cusps</td>
</tr>
<tr>
<td>Curve of Spee</td>
<td>More acute the curve</td>
<td>Shorter the most posterior cusps</td>
</tr>
<tr>
<td>Lateral translation movement</td>
<td>Greater the movement</td>
<td>Shorter the posterior cusps</td>
</tr>
<tr>
<td></td>
<td>More superior the movement of rotating condyle</td>
<td>Shorter the posterior cusps</td>
</tr>
<tr>
<td></td>
<td>Greater the immediate sideshift</td>
<td>Shorter the posterior cusps</td>
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## Relationship between anterior and posterior controlling factors

**Table 6-2**

<table>
<thead>
<tr>
<th>Factor</th>
<th>Condition</th>
<th>Effect</th>
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<tbody>
<tr>
<td>Distance from rotating condyle</td>
<td>Greater the distance</td>
<td>Wider the angle between laterotrusive and mediotrusive pathways</td>
</tr>
<tr>
<td>Distance from midsagittal plane</td>
<td>Greater the distance</td>
<td>Wider the angle between laterotrusive and mediotrusive pathways</td>
</tr>
<tr>
<td>Lateral translation movement</td>
<td>Greater the movement</td>
<td>Wider the angle between laterotrusive and mediotrusive pathways</td>
</tr>
<tr>
<td>Intercondylar distance</td>
<td>Greater the distance</td>
<td>Smaller the angle between laterotrusive and mediotrusive pathways</td>
</tr>
</tbody>
</table>
Thank you