Anatomy of the Teeth
Cephalometric Landmarks
Occlusal Surfaces

on behalf of Márton Krisztina
presenting Székely Melinda
All of the teeth in the mouth together are referred to as the **dentition**.

Humans have **two dentitions** throughout life, "dyphiodont" being: one during childhood, called the **primary dentition**, and one called the **permanent** (also known as **secondary** dentition).
Permanent maxillary and mandibular arches

The teeth in the upper jawbones (called the maxillae) collectively form an arch shape known as the maxillary arch and those teeth in the lower jawbone (called the mandible) collectively form the mandibular arch.

Each arch can further be divided into the left and right halves also known as left and right quadrants since each quadrant contains one fourth of all teeth in that dentition.
Dental characteristics of the human

- **20 primary (deciduous or milk) teeth**
  - divided into *three classes*, in a quadrant:
    - 2 incisors
    - 1 canine
    - 2 molars

- **32 permanent teeth**
  - divided into *four classes*, in a quadrant:
    - 2 incisors
    - 1 canine
    - 2 premolars
    - 3 molars
Primary Dentition
viewed from the left
Mixed Dentition (primary and permanent teeth) *viewed from the left*
Permanent Dentition viewed from the right
Fig. 4. The human dentition
Tooth Identification Systems
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<th>Primary teeth</th>
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<tr>
<td><strong>I</strong> = incisor (<em>incisivus</em>)</td>
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<td><strong>C</strong> = canine (<em>caninus</em>)</td>
<td><strong>c</strong> = canine</td>
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<td><strong>P</strong> = premolar (<em>praemolaris</em>)</td>
<td><strong>m</strong> = molar</td>
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<td><strong>M</strong> = molar (<em>molaris</em>)</td>
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In index

| 1  = central, first | 1  = central, first |
| 2  = lateral, second | **II** = lateral, second |

For example: **P**$_2$ second premolar; **m**$_{II}$ second primary molar
A formula can be used to represent the teeth in the human primary dentition, upper and lower quadrant, as follows:

$$\frac{2}{2} i; \frac{1}{1} c; \frac{2}{2} m$$

A formula can be used also to represent the teeth in the permanent dentition, upper and lower quadrant, as follows:

$$\frac{2}{2} I; \frac{1}{1} C; \frac{2}{2} P; \frac{3}{3} M$$
Zsigmondy (1861) System
Zsigmondy’s cross
[Palmer (1891) System]

Permanent teeth

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Primary teeth

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FDI System (1957)
(Federation Dentaire Internationale)
World Dental Federation

Permanent teeth

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Primary teeth

|    |    |    |    |    |    |    |    |
|----|----|----|----|----|----|----|
| 5.5| 5.4| 5.3| 5.2| 5.1| 6.1| 6.2|
| 8.5| 8.4| 8.3| 8.2| 8.1| 7.1| 7.2|

This system uses two digits:

The **first digit** denotes the **quadrant** (right or left) **and arch** (maxillary or mandibular) **and dentition** (permanent or primary) as follows:

**PERMANENT DENTITION**

1 = maxillary, right quadrant  
2 = maxillary, left quadrant  
3 = mandibular, left quadrant  
4 = mandibular, right quadrant

**PRIMARY DENTITION**

5 = maxillary, right quadrant  
6 = maxillary, left quadrant  
7 = mandibular, left quadrant  
8 = mandibular, right quadrant

The **second digit** denotes the **tooth position** in each quadrant relative to the midline.
American System
(Universal Numbering System, 1975 ADA)

Permanent teeth

Primary teeth

A B C D E F G H I J
T S R Q P O N M L K
Basic anatomy

- **Dental crown** – *Corona dentis*
- **Dental root** – *Radix dentis*

  The **anatomic crown** is that part of the tooth covered by an enamel layer, and the **anatomic root** is the part of a tooth covered by cementum.

- **Dental neck** – *Cervix dentis*

  A **cervical line** (or **cementoenamel junction**) separates the anatomic crown from the anatomic root.
Nomination of the tooth surfaces

- **Vestibular:**
  - Surface, looking at the oral vestibulum
- **Labial:**
  - Surface, contacting the lips
- **Buccal:**
  - Surface contacting the cheeks
- **Oral:**
  - Surface, looking at the oral cavity
- **Lingual:**
  - On the mandible
- **Palatal:**
  - On the maxilla
Nomination of the tooth surfaces

- **Proximal:**
  Tooth surfaces contacting with each other:
  - **Mesial**
    - Surface looking at the midline
  - **Distal**
    - Surface looking at far from the midline

- **Occlusal:**
  Occluding surfaces
Figure 3.3. Maxillary dental arch and the bones of the hard palate. Remember that the labial surface of an anterior tooth and the buccal surface of a posterior tooth are both referred to as facial surfaces. Also, the mesial and distal sides or surfaces are correctly called proximal surfaces.
Maxillary first incisor (1.1, 2.1)

The **maxillary central incisor** is a human tooth in the front upper jaw, or maxilla, and is usually the most visible of all teeth in the mouth. It is located mesial (closer to the midline of the face) to the maxillary lateral incisor.

As with all incisors, their function is for **shearing** or **cutting food during mastication**. The surface area of the tooth used in eating is called an **incisal ridge** or **incisal edge**.
Maxillary central and lateral incisors
Mandibular central incisor (4.1, 3.1)
Mandibular central and lateral incisors
1. GENERAL SIMILARITIES OF MOST INCISORS FROM THE FACIAL VIEW

- All **incisor crowns**, when viewed from the facial, have a relatively *straight incisal edge* (vs. all other teeth that have one or more pointed cusp tips).

Maxillary central incisors

Maxillary lateral incisors
- Their crowns are relatively *rectangular*, longer incisogingivally than wide mesiodistally.
- They taper (narrower) from the widest mesiodistal areas of proximal contact toward the cervical line, and are therefore *narrowest* in the *cervical third* and *broader* toward the *incisal third*.

Mandibular central incisors

Mandibular lateral incisors
2. CHARACTERISTICS OF ALL INCISORS FROM THE ORAL VIEW

- **Incisor crowns**, when viewed from the oral, have a *narrower surface* because the mesial and distal surfaces converge orally.

- **Oral fossa** that is concave just incisal to the *cingulum*.

![Maxillary central incisors](image1.png)

![Maxillary lateral incisors](image2.png)
The mesial and distal marginal ridges converge toward the cingulum and the crown outline tapers from proximal contact area toward the cingulum.
3. CHARACTERISTICS OF ALL INCISORS FROM THE PROXIMAL VIEWS

- **Incisor crowns**, when viewed from the proximal, are *wedge shaped* or *triangular*.
- They have a facial outline that is more *convex cervically* than incisally.

![Maxillary central incisors](image1)

![Maxillary lateral incisors](image2)
The lingual height of contour is also in the cervical third, on the cingulum, but the contour of the incisal two thirds of the lingual surface is concave from cingulum area to the incisal edge.

Therefore, the lingual outline is **S-shaped**, being **convex over the cingulum and concave** from the cingulum nearly to the incisal edge.

Mandibular central incisors

Mandibular lateral incisors
ARCH TRAITS THAT DISTINGUISH MAXILLARY FROM MANDIBULAR INCISORS

- Mandibular incisors are generally smaller than maxillary incisors.
Mandibular central and lateral incisors look more alike and are more nearly the same size, compared to greater differences between maxillary central and lateral incisors.
- **Mandibular incisor** crowns are flatter than maxillary incisor crowns on the mesial and distal surfaces and have contact areas located closer to the incisal ridge than maxillary incisors.
- Mandibular incisor crowns are relatively wider faciolingually than mesiodistally compared to maxillary central incisors, which are wider mesiodistally.

- Mandibular incisor crowns also have smoother lingual surfaces with less prominent anatomy than maxillary crowns, which have deeper fossae and more pronounced marginal ridges.

- Mandibular incisor roots are longer in proportion to their crowns than are maxillary incisor roots.
Canines
• Both the maxillary and mandibular canines are called the "**cornerstone**" of the mouth because they are all located three teeth away from the midline, and separate the premolars from the incisors.

• The location of the canines reflect their dual function as they **complement** both the **premolars and incisors** during mastication or chewing. The most common action of the canines is **tearing of food**.

• The canine teeth are able to **withstand** the tremendous **lateral pressure** caused by chewing.
Figure 3.5. A. Labial surface of the maxillary right canine pictured in B. The root axis is determined by bisecting the root at the cervix. B. Mesial side of a maxillary right canine. The root axis line bisects the root in the cervical area. Customarily, other parts of the tooth are located or described relative to this line. In this case, for instance, the cusp tip is labial to the root axis line.
Mandibular Canine (lingual view)

1. Cusp Tip
2. Mesial Cusp Ridge
3. Distal Cusp Ridge
4. Lingual Ridge
5. Cingulum
6. Mesial Marginal Ridge
7. Distal Marginal Ridge
• The name **canine** is of Greek origin and is found in the writings of Hippocrates and Aristotle of 2350 years ago.

• Aristotle first described canine anatomy, stressing the intermediate nature of it between incisors and molars.

• Celsus was the first writer to mention the roots of teeth, saying the canine was monoradicular (that is, normally having one root).

• Although it is rare, the mandibular canine may have the root divided, results in labial and lingual roots and may be split only in the apical third, or it may extend into the cervical third of the root.
GENERAL CHARACTERISTICS (SIMILARITIES) OF CANINES

- **Size**: on average, canines are the longest teeth in each arch, and the **maxillary canine** is the *longest tooth* in the mouth even though the **mandibular canine crown is longer than the maxillary canine crown**.
The incisal ridges of a canine, rather than being nearly straight horizontally like on incisors, are divided into *two inclines* called the **mesial and distal cusp ridges** (also called *cusp slopes* or *cusp arms*).

Subsequently, canine crowns from the *facial view* resemble a **fivesided pentagon**.

Maxillary canine

Mandibular canine
- The **labial surface** of a canine is prominently convex with a **vertical labial ridge**.
- Canines are the only teeth with a labial ridge, although premolars have a similar-looking ridge called a buccal ridge.
- The measurement of a maxillary or mandibular canine crown is greater labiolingually than it is mesiodistally.
From the **proximal views**, canine crowns are wedge, or *triangular*, shaped.

The **height of contour** on the facial surface is in the **cervical third** and on the oral surface is also in the cervical third on the cingulum.

- Maxillary canine
- Mandibular canine
Maxillary First Premolar (1.4, 2.4)

- The function of this premolar is similar to that of canines in regard to tearing being the principal action during mastication (chewing).
- There are two cusps (bicuspids) on maxillary first premolars, and the buccal (closest to the cheek) cusp is sharp enough to resemble the prehensile teeth found in carnivorous animals.
Figure 3.6. A. Maxillary right first premolar, occlusal surface. Notice proximal contact locations. B. Maxillary right first premolar, mesial surface. The sulcus is the occlusal depression between cusps (valley) that is seen on all posterior teeth. The space between the two roots is the furcal region, and the root area between the cervical line and root bifurcation is the root trunk.
Occlusal surface of a maxillary premolar

(1) mesial, (2) distal outer aspects of the buccal cusp (B);
(3) mesial, (4) distal outer aspects of the lingual cusp (L);
(5) mesial, (6) distal inner aspects of the buccal;
(7) mesial, (8) distal inner aspects of the lingual cusp;
(9) mesial, (10) distal marginal ridges.
Maxillary Second Premolar (1.5, 2.5)

The function of this premolar is similar to that of first molars in regard to **grinding** being the principal action during **chewing** (mastication). There are **two cusps** on maxillary second premolars, but both of them are **less sharp** than those of the maxillary first premolars.
Mandibular First Premolar (3.4, 4.4)

• The function of the premolar is similar to that of canines in regard to **tearing** being the principal action during chewing.
• Mandibular first premolars have **two cusps**. The one **large** and **sharp** is located on the **buccal** side (closest to the cheek) of the tooth. Since the **lingual cusp** (located nearer to the tongue) is **small** and nonfunctional (which refers to a cusp not active in chewing), the mandibular first premolar resembles a **small canine**.
Mandibular Second Premolar

- The function of this premolar is assist the mandibular first molar during mastication. Mandibular second premolars have **three cusps**. There is one **large cusp** on the **buccal** side of the tooth. The **lingual cusps** are well developed and functional (which refers to cusps assisting during chewing). Therefore, the mandibular second premolar is **more alike to the first molar**.
Maxillary Molars (1.6, 1.7, 1.8, 2.6, 2.7, 2.8)

The function of this molar is similar to that of all molars in regard to **grinding** being the principal action during **mastication**.

There are usually **four cusps** on maxillary molars, **two** on the **buccal** and **two palatal**. In maxillary first molars (less in second molars) there may also be a **fifth smaller cusp** on the palatal side known as the **Cusp of Carabelli** (*Karabély György*).
Two maxillary right first molars with differences in the mesial part of the palatal surface:

- Molar A has a *very large cusp of Carabelli*, but
- Molar B has a *slight depression* in the same location.
Three maxillary left molars showing variation in the size (or absence) of the **distopalatal cusp**.
A. Maxillary molar with moderate size D-P cusp.  
B. Maxillary second molar with small D-P cusp.  
C. Maxillary second molar with only one oral cusp.
Interactive, visual display of three different image protocols of the same actual tooth specimen. Photograph, 3-D computer model and x-ray data side-by-side to give a rich display of data and information about a particular specimen. Also, view slice by slice the internal anatomy of the specimen using photographic images as well as density/x-ray images.
Mandibular First Molar (3.6, 4.6)

The **mandibular first molar** or *six-year molar* is located on the mandibular (lower) arch of the mouth, and generally opposes the maxillary (upper) first molars and the maxillary 2nd premolar in normal class I occlusion. The function of this molar is similar to that of all molars. There are usually **five** well-developed **cusps**: **three buccal** and **two lingual** (two buccal, two lingual and one distal).

There are great differences between the deciduous (baby) mandibular molars and those of the permanent mandibular molars, even though their function are similar.
Mandibular second molars (37,47)

The **mandibular second molar** is the tooth located distally (away from the midline of the face) from both the mandibular first molars of the mouth but mesial (toward the midline of the face) from both mandibular third molars. Though there is more variation between individuals to that of the first mandibular molar, there are usually **four cusps** on mandibular second molars: **two** on the **buccal** (side nearest the cheek) and **two lingual** (side nearest the tongue).
Wisdom Teeth (1.8, 2.8, 3.8, 4.8)

Wisdom tooth, in humans, is any of the usual four third molars.

Wisdom teeth usually appear between the ages of 16–25y. Most adults have four wisdom teeth, but it is possible to have fewer (hypodontia), or more, in which case they are called supernumerary teeth. Wisdom teeth commonly affect other teeth as they develop, becoming impacted or "coming in sideways." They are often extracted when this occurs.
Figure 3.9. A. Major cusps on a variety of molars, premolars and incisors.
Figure 3.9. B. Examples of a variety of ridges on molars, premolars and incisors.
Figure 3.9. C. Examples of various fossae (often with associated pits) on molars, premolars, and incisors.
Figure 3.9. D. Examples of developmental grooves on molars and premolars.
Cephalometric landmarks:

TA: Terminal hinge axis
O: Orbitale
P: Pogonion
N: Nasion
Sn: Subnasale
Gn: Gnathion
Craniofacial planes:
Axis-orbitale plane: AOP
Facial plane: **Fac. P** (NP)
Frankfort plane: **FP** (O-Po)
Occlusal plane: **OP** mesial edge of the mandibular first incisors – distobuccal cusptips of the last mandibular molars
Maxillomandibular relationship or the jaw relation refers to the position of the mandible relative to the maxillae and can be described as a *tooth-to-tooth relationship* between maxillary and mandibular teeth.
Classical anatomical relationship

**Lingual cusps** of the maxillary teeth and the **Buccal cusps** of the mandibular teeth have **maximal** and **simultaneous contact** on both sides of the arch.

**Cusp contacts with marginal ridge** except distobuccal (DB) cusps of the lower and mesiobuccal (MB) cusps of the upper molars (they occlude with the central fossae of their antagonists).
Supporting and guiding cusps

1: Supporting cusps
2: Guiding cusps

Buccal upper and Lingual lower cusps do not support occlusion they are the guiding cusps.
Functional Unit

- Occlusal surfaces
- Periodontium
- TMJ
- Muscles

Temporomandibular Joint (TMJ)
1: capsula articularis; 2: tuberculum articularis;
3: discus articularis; 4: caput mandibulae;
5: ligamentum stylomandibulare
The Temporomandibular Joint (TMJ)

39  Sagittal relationships
Macroscopic anatomical preparation showing the relation of the fossa, disk, and condyle to one another in the sagittal plane. Because the shapes of fossae and condyles vary so greatly, it is not possible to determine a universally applicable measurement of the condylar position. Although the physiological (i.e. centric) condylar position is defined as the most anterosuperior position with no lateral displacement (arrows), this position depends upon the basic neuromuscular tonus.
Theoretically Ideal Occlusion

Inter arch relationship of teeth

1. All components of the masticatory system are present.

2. "Classical" anatomical relationships exist among all maxillary and mandibular teeth.

3. In centric occlusion (CO) posterior teeth keep vertical dimension of occlusion, anterior teeth are in a slight contact.
4. The dentition is in harmony with its basal bone and with other craniofacial structures.

5. The long axes of teeth are aligned so that functional occlusal surfaces act through, or close to the axes.

6. The periodontium is intact, there is no detectable fremitus or tooth mobility.
7. The occlusion is stable – teeth do not migrate or change position, only slow compensatory movements.

8. The teeth do not exhibit additional wear beyond what would be expected for the age of the individual.

9. The muscular contact position is coincident with the ICP, that is, the individual can voluntarily close the mandible in CO accurately and consistently with the head erect.

10. CO is in harmony with CR, that is the two position are coincident, or CO is a short distance (1mm<) to the anterior of CR in the midsagittal plane.
11. During protrusion the posterior teeth disclude so as not to interfere with the ability of the opposing incisor teeth to occlude and function properly.

12. During lateral movements, the teeth on the non working side disclude so as not to interfere with the ability of the opposing working side teeth to contact and function properly.

13. During lateral movements, there is occlusal contact between the opposing canines on the working side, either alone or together with one or more pair of adjacent posterior teeth.
14. A postural rest position that provides for an adequate interocclusal distance.

15. All masticatory, deglution, speech articulation, esthetic and respiratory requirements are met and are satisfactory to the patient.

16. Tonic activity of the masticatory muscles can be reduced to low levels at times of repose.

17. Minimal parafunctional activity, that is little phasic muscle activity, occurs.
18. Self perpetuating structural and functional adaptation to aging and to altered conditions.

19. Multidirectional masticatory function can be accomplished satisfactorily with a wide variety of food.

20. No signs or symptoms of pain or dysfunction from any component of the masticatory system can be detected.

21. The patient has an aura of unawarness of the occlusion and masticatory system.
Physiologic occlusion

- Usually found in adults.
- Deviates in one or more ways from the theoretically ideal.
- Yet it is well adapted to its particular environment.
- Is esthetically satisfactory to the patient.
- And has no pathological manifestations or dysfunctional problems.
Non physiologic occlusion

- Dysfunction of one component out of the four, causes the disorder of the others.
Loss of tooth substance (tooth wear)

1. Attrition
   - The physiologic wearing of tooth substance as a result of tooth to tooth contact, as in mastication.

2. Abrasion
   - Pathological wear of the tooth substance through mechanical processes.

3. Erosion
   - Chemically induced loss of tooth substance mainly through acidic attacks.
Attrition

The **physiologic wearing** of tooth substance as a result of *tooth to tooth contact*, as in mastication.

- On occlusal and incisal surfaces:
  - Small polished facets;
  - Flattening of the occlusal surfaces.
Typical examples of individuals in the attrition group. (A) 21 year old man with marked attritional wear facets matching between opposing teeth in lateral excursion. (B) 26 year old woman with an almost perfect match between maxillary and mandibular incisors during protrusive movement. Note also the sharply demarcated wear facets extending into dentin on lower incisor teeth.
Abrasão

Pathological wear of the tooth substance through mechanical processes.

- Excessive tooth brushing exposed root surfaces.

- Poorly made dentures on occlusal surfaces of the antagonists.

- Parafuction: clenching, bruxism, oral habits.
Erosion

Chemically induced loss of tooth substance mainly through acidic attacks.

**Extrinsic:** consumption of citrus foods and drinks.

**Intrinsic:** regurgitation of gastric acids (GERD, anorexia).
Thank you for your attention!
Waxing up

Occlusal Surface of the Mandibular First Molar
Mandibular First Molar

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The occlusal surface of the lower first molar is said to be trapezoidal in outline.
Occlusal anatomy and outline of a mandibular right first molar.
Number and size of occlusal cusps

- Most **mandibular first molars** have five cusps: three on the buccal (mesiobuccal, distobuccal, and the smallest distal cusp closest to the distal marginal ridge) and two on the lingual (mesiolingual and distolingual).
- The two mesial cusps (mesiobuccal and mesiolingual) are larger than the two distal cusps (distobuccal and distolingual) and the fifth, distal cusp is the smallest.
All cusps are basically a gothic pyramid

The cuspal gothic pyramid produces 4 ridges:
1. Mesial cusp ridge
2. Distal cusp ridge
3. Buccal cusp ridge
4. Triangular ridge
Mandibular right first molar, occlusal view, showing how the triangular ridges of two cusps (mesiobuccal [MB] and mesiolingual [ML]) align to form one transverse ridge in the mesial half of the mandibular molar, and another two triangular ridges of the distobuccal (DB) and distolingual (DL) cusps align to form another transverse ridge in the distal half.
Mandibular First Molar (occlusal view)

1. Mesio-Buccal Cusp
2. Disto-Buccal Cusp
3. Distal Cusp
4. Mesio-Lingual Cusp
5. Disto-Lingual Cusp
6. Buccal (Developmental Groove)
7. Central Sulcus
8. Supplemental Groove
9. Mesial Marginal Ridge
10. Distal Marginal Ridge
11. Mesial Triangular Fossa
12. Distal Triangular Fossa
13. Central Fossa
14. Disto-Buccal Triangular Ridge (Distal Incline)
15. Disto-Lingual Triangular Ridge (Crest)
16. Tranverse Mesial Ridge
17. Mesial Cusp Ridge
18. Distal Cusp Ridge
Mandibular first molar, occlusal view

- The buccal height of contour (crest of curvature) is located close to the middle. There are three fossae.
- Note that the central groove zigzags in its course from mesial to distal pit, and the mesiobuccal and lingual grooves are not continuous from buccal to lingual.
Fossae

- There are three fossae on the first mandibular molar: the largest central fossa (approximately in the center of the tooth), a smaller mesial triangular fossa (just inside the mesial marginal ridge), and the smallest distal triangular fossa (just inside the distal marginal ridge).
- There may be a pit at the junction of grooves in the deepest portion of any of these fossae.
Groves

- Major grooves on the mandibular first molar separate five cusps.
- The central groove passes from the mesial triangular fossa through the central fossa to the distal triangular fossa.
- The lingual groove starts at the central groove in the central fossa and extends lingually between the mesiolingual and the distolingual cusps.
The mandibular first molar has two buccal grooves.

*Mesiobuccal groove* separates the mesiobuccal and distobuccal cusps.

Distobuccal groove starts at the central groove between the central fossa and the distal triangular fossa, extends between the distobuccal and the distal cusps onto the buccal surface.
Outline shape and taper

- Mandibular molars are wider M-D than B-L.
- On the first molar the widest portion of the tooth may be located in the middle third on the prominent buccal bulge of its distobuccal cusp, so the outline would be more like a five-sided pentagon.
- The crown outlines of mandibular molars taper lingually, so they are wider mesiodistally on the buccal half than on the lingual half.
- Mandibular molar crowns also taper narrower from mesial to distal, so they are wider buccolingually on the mesial half than on the distal half.