In the name of GOD
Etiology of Malocclusions

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Reference:

* Contemporary Orthodontics

Chapter 5

Malocclusion is a developmental condition

On most instances, malocclusions are caused, not by some pathologic process, but by moderate distortions of normal development.
Etiologic factors for malocclusion

• Specific causes
• Hereditary influences
• Environmental influences
Specific causes of malocclusion
Disturbances in embryologic development

• as many as 20% of early pregnancies terminate because of lethal embryologic defects

• only a small number of recognizable conditions that produce orthodontic problems are compatible with long term survival

• chemical and other agents capable of producing embryologic defects if given at the critical time are called teratogens

• teratogens cause specific defects if present at low levels; but if given in higher doses, do have lethal effects
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Skeletal growth disturbances

Fetal molding and birth injuries

1- intrauterine molding

2- trauma to the mandible during the birth process
Intrauterine molding

• on rare occasions an arm is pressed across the face in utero, resulting in severe maxillary deficiency at birth

• occasionally a fetus head is flexed tightly against the chest, preventing the mandible from growing forward normally.
  
  This is related to a decreased volume of amniotic fluid

The result is an extremely small mandible at birth

Usually accompanied by a cleft palate
Extreme mandibular deficiency at birth

- multiple causes can lead to the same events
- reduced volume of the oral cavity
- respiratory difficulty at birth
- early mandibular advancement is needed
- there is a possibility of normal growth after birth
- about one third of patients have a defect in cartilage formation (stickler syndrome)
- catch-up growth is most likely when the original problem was mechanical restriction

Pierre Robin anomaly
Birth trauma to the mandible

- injury to the mandible during a traumatic delivery appears to be rare and unusual
- mandibular deformities are much more likely to be a congenital syndrome
- The use of forceps to the head to assist in delivery might damage either or both the TMJs → internal hemorrhage, loss of tissue → under-developed mandible
- the condylar cartilage is not critical for proper growth of the mandible
Childhood fractures of the jaw

- The fractures of the condylar neck of the mandible are relatively common.

- The condylar process tends to regenerate well after early fractures (about 75% normal mandibular growth after early fractures).

- The prognosis is better the earlier the condylar fracture occurs.
when a problem arises:

- if there is enough **scarring** in the area, the normal growth movement will be restricted

- **asymmetric** growth, with the previously injured side lagging behind (5% of patients with severe mandibular deficiency)
there would be little if any advantage from surgical open reduction of a condylar fracture in a child because of the additional scaring.

the best therapy is conservative management at the time of injury and early mobilization of the jaw to minimize any movement restriction.

an old condylar fracture is the most likely cause of asymmetric mandibular deficiency in a child.

But other destructive processes such as rheumatoid arthritis or a congenital absence of tissue as in hemifacial microsomia, also can produce this problem.
Muscle dysfunction

the facial muscles can affect jaw growth in two ways:

• the bone formation at the point of muscle attachments depends on the muscle activity

• the muscles are an important part of the total soft tissue matrix

Damage to the motor nerves or other unknown causes

Muscle atrophies and underdevelopment of the part of the face
Excessive muscle contraction \(\rightarrow\) Growth restriction

**Torticollis**: excessive tonic contraction of the **neck muscles on one side** (primarily the sternocleidomastoid) and twisting of the head

**Facial Asymmetry**
A major decrease in tonic muscle activity (as in muscular dystrophy, some forms of cerebral palsy, and various muscle weakness syndromes)

Allows the mandible to drop downward away from the rest of the facial skeleton

Increased anterior face height, distortion of facial proportions and mandibular form, excessive eruption of the posterior teeth, narrowing of the maxillary arch and anterior open bite
Acromegaly

• is caused by an anterior pituitary tumor that secretes excessive amounts of growth hormone

• excessive growth of the mandible may occur, creating a skeletal class III malocclusion

• often (but not always) mandibular growth accelerates again to the levels seen in the adolescent growth spurt

• the condylar cartilage proliferates
Hemimandibular hypertrophy

• **unilateral** excessive growth of **mandible** occurs in individuals who seem metabolically **normal**

• the cause is entirely **unknown**

• most likely in **girls** between the ages of **15** and **20**

• the condition formerly was called **condylar hyperplasia**, but because the **body of mandible** also is affected, hemimandibular hypertrophy is considered a more accurate descriptive term

• the excessive growth **may** stop spontaneously, but in **sever** cases removal of the affected condyle and reconstruction of the area is necessary
Disturbances of dental development

Are most significant as contributors to isolated class I malocclusion
Congenitally missing teeth

• resulting from disturbances during the *initial stages* of formation of a tooth

• **anodontia**: the total absence of teeth

• **oligodontia**: congenital absence of many but not all teeth

• **hypodontia**: the absence of only a few teeth

• there will be no *permanent* tooth if its primary predecessor was missing

• anodontia or oligodontia is usually associated with a *systemic abnormality*
Ectodermal dysplasia:

- thin, sparse hair
- absence of sweat glands
- missing teeth
• hypodontia is a relatively common finding

• a polygenic multifactorial model of etiology is the best explanation of etiology

• the most distal tooth of any given type is most likely to be missed
  third molar
  second premolar
  lateral incisor
Malformed and supernumerary teeth

• abnormalities in tooth size and shape result from disturbances in developmental stages of tooth formation

• the most common abnormality is a variation in size, particularly of maxillary lateral incisors and second premolars

• about 5% of population have a significant “tooth size discrepancy”

• the most variable teeth, the maxillary lateral incisors, are the major culprits
• occasionally, tooth buds may **fuse** or **geminate** during their development

• the differentiation between gemination and fusion is usually confirmed by **counting** the number of teeth in an area

• normal occlusion is all but **impossible** in the presence of malformed teeth
• the **supernumerary** teeth result from disturbances during the **initial stages** of tooth development

• the **most common** supernumerary tooth appears in the maxillary midline: **meisodens**

• the supernumerary tooth has great potential to **disrupt** normal occlusion
• **early intervention** to remove the supernumerary tooth is usually required

• **multiple** supernumerary teeth are most common in the congenital syndrome of **cleidocranial dysplasia**
Interference with eruption

• supernumerary teeth, sclerotic bone, and heavy fibrous gingiva can obstruct eruption

• all of these interferences are present in cleidocranial dysplasia

• less severe interferences that cause delayed eruption of some permanent teeth → drift of the other teeth to improper position → malocclusion

• ankylosed primary molars → delayed eruption of the permanent successor → drift of other permanent teeth into the space of the delayed tooth → significant malocclusion
Ectopic eruption

• malposition of a permanent tooth bud $\rightarrow$ eruption in the wrong place $\rightarrow$ ectopic eruption

• it is most likely to occur in the eruption of maxillary first molars:
  - too mesial path of eruption $\rightarrow$ permanent molar is unable to erupt
  - the root of the second primary molar may damaged
  - the arch will be crowded
Early loss of primary teeth

• when a unit within the dental arch is lost, the arch tends to contract and the space to close

• the major reason that the permanent molars move mesially when a space opens up is their mesial inclination, so that they erupt mesially as well as occlusally

• a permanent molar is likely to drift mesially more rapidly in the absence of occlusal contacts than if they are present
Mesial drift of the permanent first molar after a primary second molar is lost prematurely can significantly contribute to the development of crowding in the posterior part of the dental arch.
When a primary first molar or canine is lost prematurely, the space closure occurs primarily by distal drift of incisors, not by mesial drift of posterior teeth.

Active contraction of transseptal fibers more consistent

pressure from the lips and cheeks variable component
Traumatic displacement of teeth

• dental trauma can lead to the development of occlusion in three ways:

  (1) damage to permanent **tooth buds** from an injury to primary teeth
      defect in the **crown**
      short or dilacerated **root**

  (2) drift of permanent teeth after **premature loss of primary teeth**

  (3) direct **injury to permanent teeth**

• traumatic displaced permanent teeth in children should be repositioned **as early as possible**
Genetic influences
• certain types of malocclusion run in families, the *prognathic mandible* in the Hapsburg family is the best known example

• tow major possibilities of genetic influences on producing malocclusions:
  
  inherited disproportion between the **size of the teeth** and the **size of the jaws**

  inherited disproportion between the **size or shape of the upper and lower jaws**
• Stockard’s experiments indicated that dramatic malocclusions did occur in crossbred dogs, more from jaw discrepancies than from tooth size-jaw size imbalances.

• Most of the unusual malocclusions produced in Stockard’s breeding experiments can be explained not on the basis of inherited jaw size but by the extent to which achondroplasia was expressed in that animal.
Achondroplasia in human:

- is rare
- short limbs
- short cranial base
- midface deficiency
The heritability of craniofacial (skeletal) characteristics is relatively high, but that of dental (occlusal) characteristics is low.

For skeletal characteristics, the heritability estimates increased with increasing age; for dental characteristics, the heritability estimates decreased, indicating an increasing environmental contribution to the dental variation.
Class III (mandibular prognathism)

- one third of the children who presented with severe class III malocclusion had a parent with the same problem
- one sixth of them had an affected sibling

Long face pattern
Environmental influences
An object subjected to unequal forces will be accelerated and thereby will move to a different position in space.

If any object is subjected to a set of forces but remains in the same position, those forces must be in balance or equilibrium.
Equilibrium effects on the dentition

- the **duration** of a force, because of the biological response, is **more important** than its magnitude

- as long as the **periodontal apparatus is intact**, forces from **occlusion**, **swallowing** or **speaking** are **rarely** prolonged enough to permanently move the tooth to a new position

- **very light forces** (pressure from lips, cheeks, and tongue) are successful in moving teeth, if the force is of **long enough duration** (threshold is **between 4 and 8 hours** in humans, with **6 hours as the best guess**)

- another possible contributor to the dental equilibrium is the **periodontal fiber system**, both in the gingival tissue and within the periodontal ligament
• the effect of force duration is not as clear for equilibrium effects on the jaws as for the teeth. It appears that the same principle applies: the magnitude of force is less important than its duration

• it is improbable that a child’s masticatory effort plays a major role in determining dental arch dimensions

• there is no reason to believe that how a patient bites is a major determinant of either dental arch size or vertical dimensions
Sucking and other habits

• sucking habits during the primary dentition years have little if any long-term effect.

• prolonged sucking habits beyond the time that the permanent teeth begin to erupt can lead to malocclusion.

• the malocclusion characterized by:
  - flared and spaced maxillary incisors
  - lingually positioned lower incisors
  - anterior open bite
  - narrow upper arch
• the malocclusion arises from a combination of direct pressure on the teeth and an alteration in the pattern of resting cheek and lip pressures

• how much the teeth are displaced should correlate better with the number of hours per day of sucking than with the magnitude of the pressure

• mild displacement of the primary incisors is often noted in a 3 or 4 years old thumb sucker, but if sucking stops at this age, normal lip and cheek pressures soon restore the teeth to their usual position
when a finger is placed between the anterior teeth:

- **interference** with normal eruption of incisors
- **excessive eruption** of posterior teeth

1mm of elongation posteriorly opens the bite about 2mm anteriorly

- **mandible downward** position

- the **tongue** must be lowered → **decreased pressure** by the tongue against the lingual of the upper posterior teeth

- **cheek pressure** against these teeth is increased as the buccinator muscle contracts

- cheek pressure greatest at the **corners** of the mouth → **V-shaped** maxillary arch
Tongue thrust

- individuals with an anterior open bite (nearly always) and/or upper incisors protrusion and increased overjet (often), place the tongue between the anterior teeth when they swallow.
- in these patients it is more difficult to seal off the front of the mouth during swallowing to prevent food or liquids from escaping → physiologic adaptation.
• a tongue thrust swallow should be considered the **result** of displaced incisors, not the cause

• **correcting the tooth position** should cause a **change** in swallowing pattern, and this usually happens

• in a child who has an **open bite**, **tongue posture** may be a factor, but the swallow itself is not
Respiratory pattern

- respiratory needs are the primary determinant of the posture of the jaws and the tongue

- mouth breathing → lower the mandible and tongue
  extend (tip back) the head
  ↓
  increased face height
  posterior teeth super eruption
  vertical growth of the ramus
  mandibular down and backward rotation → Adenoid face
  anterior open bite
  increased overjet
  narrow maxillary arch
• total nasal obstruction is highly likely to alter the pattern of growth and lead to malocclusion in experimental animals and humans

individuals with a high percentage of oral respiration are over-represented in the long face population

• the majority of individuals with the long face pattern of deformity have no evidence of nasal obstruction and most therefore have some other etiologic factors as the principal cause
Malocclusion, after all, is a developmental problem. Conclusion about the etiology of most orthodontic problems are difficult, because several interacting factors probably played a role.
Thanks for your attention