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Etiology of Malocclusion (Part I)

Etiology of malocclusion is the study of its causes. The factors causing malocclusion can be widely classified into two broad categories: general etiological factors and local etiological factors. A given case of malocclusion may be a result of either a single or multiple local or general factors or be caused by a combination of local and general factors. An understanding of the etiology is essential in order to prevent, intercept and correct malocclusions.

▪ Classification of Etiology of Malocclusion

Etiologic factors of malocclusion are classified in a number of ways by different authors and the most commonly referred classifications are listed below given by Graber who divided the etiologic factors as general or local factors. General etiologic factors include the following:

1. **Hereditary**
2. **Congenital**
3. **Environmental**
4. **Predisposing metabolic climate and disease**
5. **Dietary problems (nutritional deficiency)**
6. **Abnormal pressure habits and functional aberrations**
7. **Posture**
8. **Trauma and accidents.**

1. Hereditary Factors

Hereditary cause of malocclusion includes genetic trait, inherited from the parents, which may contribute to the development of malocclusion. These genetic traits can be further influenced by prenatal or postnatal environmental factors. Since the offspring is a product of parent of dissimilar heredity, malocclusion can result, if the end product is disharmonious. Furthermore, studies show that the incidence of jaw size discrepancies and occlusal disharmonies is greater in population, where there has been a mixture of racial and ethnic strain. The hereditary factors causing malocclusion can be those influencing the following:

- **Dentition**
- **Skeletal structure**
- **Neuromuscular**
- **Soft tissues (other than the neuromusculature)**

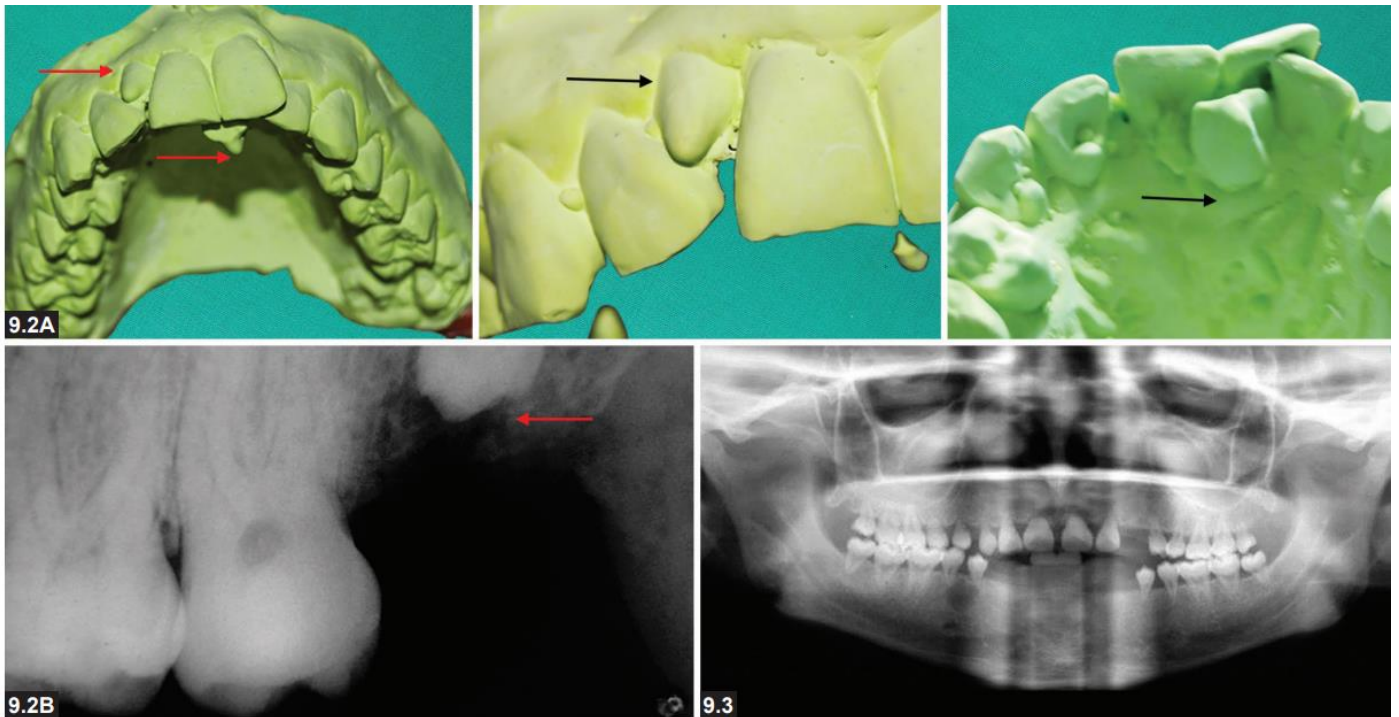


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□ Dentition

The following characteristics of dentition are influenced by heredity.

- **Shape and Size of the Tooth**
Abnormalities of the tooth size, such as macrodontia, microdontia and abnormalities of tooth shape such as peg lateral are attributed to heredity. Patients with ectodermal dysplasia exhibit conical shaped incisors and several congenitally missing teeth.
- **Number of Teeth**
Presence of supernumerary teeth or congenitally missing teeth is often hereditary.
- **Arch Dimension**
Dental arch length and width are believed to be inherited.
- **Crowding and Spacing**
Arch length-tooth material discrepancy is one of the most common causes of malocclusion and is the result of the disharmonious inheritance of the tooth size from one parent and that of the jaw length from the other parent.
- **Shedding Pattern of Deciduous Teeth and Sequence of Eruption of Permanent Teeth**
They are to some extent under the influence of heredity.
- **Inter-arch Variation**
- **Deviation in the transverse, sagittal and vertical plane relationship of upper and lower jaw can be inherited.**
- **Overjet**
The degree of horizontal overlap of the upper anteriors over the lower anteriors called overjet and it can be inherited.



Skeletal Structures

Skeletal malocclusion, resulting from the malposition or malformation of the jaws is often inherited. Mandibular Class III skeletal pattern with mandibular prognathism is commonly observed to show racial and familial tendencies.

Neuromuscular System

The anomalies that have been found to possess some inherited components include deformities in size, position, tonicity, contractility and in the neuromuscular coordination pattern of facial, oral and tongue musculature.

Soft Tissue

The following are some of the soft tissue abnormalities, which can be inherited:

- Size, shape and attachment of the labial frenum
- Ankyloglossia
- Microstomia.

2. Congenital Defects

Congenital defects are the developmental malformation at the time of birth. They may be caused due to local or general factors listed below:



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❖ **General Congenital factors:**

- Malnutrition
- Endocrinopathies
- Infectious diseases, such as congenital syphilis and maternal rubella infection
- Metabolic and nutritional disturbances
- Intrauterine pressure
- Accidents during pregnancy and childbirth
- Accidental trauma to the fetus by external forces, e.g. forceps delivery.

❖ **Local Congenital Factors**

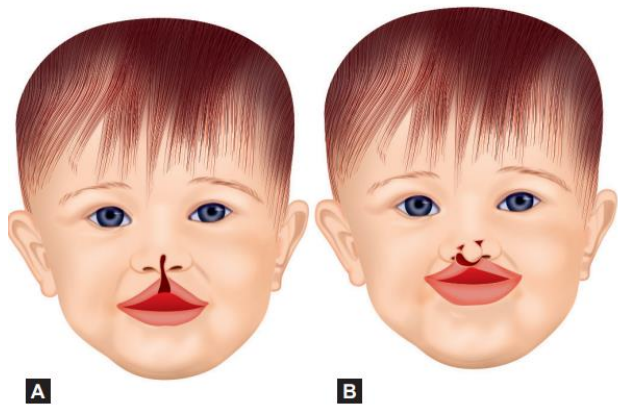
- Abnormalities of jaw development due to abnormal intrauterine position
- Cyst of the face and palate
- Macroglossia
- Microglossia
- Cleidocranial dysotosis.

Some of the commonly encountered and important congenital defects from orthodontist point of view are addressed below:

1. **Cleft Lip and Palate**

Cleft lip and palate , occurring separately or in combination are byfar the most commonly seen congenital deformities. Cleft lip and palate may have profound influence on the craniofacial development and may cause malocclusion of varying degrees of severity. It can be identified as early as the 18 to 20th week of pregnancy. Cleft palate may retard normal development of maxilla thereby causing class III malocclusion. Cleft palate may show a number of associated dental abnormalities, such as:

- Congenitally missing teeth in the cleft region
- Supernumerary teeth
- Microdontia and peg-shaped teeth, especially upper lateral incisor
- Crowding of teeth in the area of cleft
- Insufficient development of premaxilla
- Crossbite due to narrow maxillary arch
- Rotation of teeth
- Abnormal overjet and overbites.



A

B

Figs 9.4A and B: (A) Unilateral cleft lip and (B) Bilateral cleft lip



Fig. 9.5: Cleft palate



Fig. 9.6A: A patient with cleft palate showing a number of dental abnormalities (A) congenitally missing teeth in the cleft region

2. Cerebral Palsy

It is characterized by paralysis or the lack of muscular coordination, attributed to an intracranial lesion. The condition is often considered to be the result of a birth injury. The uncontrolled or aberrant activities upset the muscle balance that is necessary for establishment and maintenance of normal occlusion.

3. Cleidocranial Dysostosis

This condition is characterized by partial or complete absence of the clavicle on one or both sides. Various features that may lead to the development of malocclusion are:

- Maxillary retrusion and possible mandibular protrusion
- Retained deciduous teeth
- Retarded eruption of permanent teeth
- Numerous impacted supernumerary teeth.

4. Micrognathia

Micrognathia literally means “small jaw.” It can affect either of the jaws. The congenital variety is often seen associated with congenital heart disease and the Pierre Robin syndrome. Micrognathia of the maxilla is frequently due to a



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deficiency in the premaxillary region. Mandibular micrognathia is characterized by severe retrusion of the chin, with a practically non-existent chin button and a steep mandibular angle

3. Environmental Causes

Various prenatal and postnatal environmental factors can cause malocclusion.

Prenatal Environmental Factors

The following are some of the prenatal factors that can cause malocclusion:

- Abnormal fetal posture during gestation
- Maternal fibroids
- Amniotic lesions
- Maternal diet and metabolism
- Intake of certain drugs during pregnancy, for example thalidomide intake can cause congenital deformities, such as clefts.

Postnatal Environmental Factors

The following are some of the postnatal factors that can cause malocclusion:

- Traumatic injuries to the condyle and the TMJ area during birth can cause mandibular growth retardation.
- Ankylosis of the TMJ may lead to hypoplastic mandible and marked facial asymmetry in case of the unilateral ankylosis.
- Presence of scar tissue, caused by cleft palate surgery may cause malocclusion as they can restrict growth of maxilla.
- Milwaukee braces (Figure 3) used for the treatment of scoliosis derives support from the mandible, and thus can cause retardation of the mandibular growth.

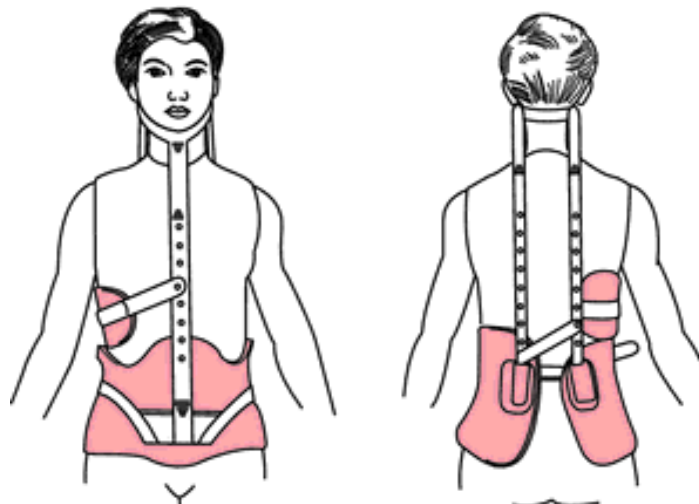


Figure 3: Milwaukee braces



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4. Predisposing Metabolic Climate and Diseases

Endocrinal imbalance

It may predispose to the development of malocclusion. Thyroid hormones play an important role in the normal development of bones and teeth. Parathormone, released from the parathyroid glands, has an active role in calcium metabolism and thus is directly involved in the development of teeth and bones.

Hypothyroidism

It may cause the following effects:

- Retardation in the rate of calcium deposition in bone and teeth
- Delaying tooth bud formation and eruption
- Prolonged retention of primary and delayed eruption of permanent teeth
- Irregularities in tooth arrangement and crowding of teeth may occur.

Hyperthyroidism

- This condition is associated with the increased metabolic rate and increased rate of maturation.
- Patient with hyperthyroidism may exhibit premature eruption of primary and permanent dentition.

Hypoparathyroidism

It is often associated with delayed eruption of teeth, altered morphology and hypoplasia of teeth.

Hyperparathyroidism

It causes an increase in blood calcium level by resorption of bone. Trabecular pattern of jaw may get disrupted due to the demineralization of the bone. In children, tooth development may become mobile due to the loss of cortical bone and resorption of the alveolar process. Osteoporosis in such parts contraindicates orthodontic tooth movement. Acute febrile disease during development years may cause disturbances in tooth eruption and shedding pattern and thus may predispose to malocclusion.

5. Dietary Problems (Nutritional Deficiencies)

Nutritional deficiencies may cause malocclusion primarily by upsetting the dental developmental timetable and resulting in the premature loss, prolonged retention and abnormal eruptive paths. Disturbances, such as rickets, scurvy and beriberi can produce severe malocclusion. Nutritional deficiencies during pregnancy have been associated with certain malformations in the child, including cretinism and



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cleft lip and palate.

6. Abnormal Pressure Habits and Functional Aberrations

Abnormal pressure habits, such as digit sucking, tongue thrusting, lip biting and functional aberration, such as mouth breathing may cause a variety of malocclusions. All aforementioned habits have one thing in common and that is they are all functional aberrations which produce forces that are abnormal. Since these forces are produced repeatedly over time they are capable of bringing about a permanent deformity in the developing musculoskeletal unit. The deformity produced depends upon the intensity, duration and frequency of the habit. The muscular elements of this unit are capable of being retrained, but if the underlying skeletal structures grow or reach abnormal proportions, the malocclusion may only be amenable to surgical correction following the resolution of the underlying habit/cause. All other corrections tend to camouflage the underlying skeletal component by orthodontic movement of the dentition. This explanation basically follows the functional matrix theory of growth as proposed by Moss—in its simplest form it says that “function creates form and normal function creates normal form”.

7. Posture

Mandibular retrusion has been observed in some stoop shouldered children with head hung so that the chin rests on the chest and in some children who rest their chin on the hand to support their head. However, poor posture as a cause of malocclusion is not proved. Nevertheless, it might accentuate an existing malocclusion.

8. Accidents and Trauma

Trauma and accidents can be further subdivided into three categories depending upon the time at which the trauma occurred, as:

- Prenatal trauma
- Trauma at the time of delivery
- Postnatal trauma
- Prenatal trauma

Prenatal intrauterine trauma is often associated with hypoplasia of the mandible and even facial asymmetries. The posture of the foetus and the exact kind, time and severity of the trauma play an important role in the resultant effects.



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- Trauma at the time of delivery

Trauma at the time of delivery or birth injuries as they are more frequently called, have reduced considerably in recent years. Previously forceps injuries to the TMJ could result in ankylosis of the joint, resulting in severely impeded mandibular growth.

- Postnatal trauma

Generally, Traumatic injuries to the dentofacial region are quite common during early years of life when child learns to crawl, walk and even while playing. Such traumatic experiences often go unnoticed and may result in the following problems predisposing to malocclusion:

- Nonvital deciduous teeth that do not resorb.
- Deflection of permanent tooth germs.
- Abnormal eruption path of permanent successors.