ETIOLOGY OF MALOCCLUSION

Localized Factors Affecting the Development of The Occlusion

The local factors affecting the development of malocclusion include:

Anomalies of Tooth Number

- Supernumerary Teeth
- Congenitally Missing Teeth

Anomalies of Tooth Size

Anomalies of Tooth Shape

- Fusion, Gemination and Concrescence
- Dilaceration

Premature Loss of Deciduous Teeth

Retained Deciduous Teeth

Delayed Eruption of Permanent Teeth

Ankylosed Deciduous Teeth

Abnormal Eruptive Path

- Transposition

Abnormal Labial Frenum

Dental Caries

Gingival and Periodontal Diseases

Improper Dental Restorations

Bad Oral Habits

Anomalies of Tooth Number

Supernumerary Teeth

A supernumerary tooth is one that is additional to the normal series. This anomaly occurs in the permanent dentition in approximately 2 per cent of the population and in the deciduous dentition in less than 1 per cent, though a supernumerary in the deciduous dentition is often followed by a supernumerary in the permanent dentition. The etiology is not completely understood, but suggestions include an offshoot of the dental lamina of the permanent dentition or a tertiary dentition. This anomaly occurs more commonly in males than females. Supernumerary teeth are also commonly found in the region of the cleft in individuals with a cleft of the alveolus.

Supernumerary teeth can be described according to their morphology or position in the arch.

1. **Supplemental**

Position: This type resembles a tooth and occurs at the end of a tooth series, for example an additional lateral incisor, second premolar or fourth molar (Fig. 1).

Shape and properties: It is often impossible to distinguish between the supplemental tooth and the normal tooth.

Main effect: crowding and displacement of adjacent teeth



Figure 1: A supplemental lower lateral incisor.

2. Conical

Position: The typical conical supernumerary tooth occurs in the premaxilla, near the mid-line, and is often called the 'mesiodens' (Fig. 2).

Shape and properties: It is usually conical in shape, and may occur singly or in pairs, and occasionally more than two such teeth are present. It is sometimes inverted, in which case it does not erupt into the mouth.

Main effect: malalignment or rotation of the upper incisors, median diastema.



Figure 2: Conical supernumerary tooth.

3. Tuberculate

Position: It appears, characteristically, on the palatal aspect of the permanent central incisor (Fig. 3).

Shape and properties: This type is described as being barrel-shaped, but usually any supernumerary which does not fall into the conical or supplemental categories is included. It does not normally erupt in childhood, may be unilateral or bilateral, and rarely is associated with supernumerary teeth of other types. Because of its late development and its typical position, the tuberculate tooth has been regarded as representing a third dentition.

Main effect: delayed or failure of the eruption of the permanent upper central incisor.



Figure 3: Tuberculate supernumerary teeth.

4. **Odontome**

This variant is rare. Both compound (a conglomeration of small tooth-like structures) and complex (an amorphous mass of enamel and dentine) forms have been described. (Fig. 4).



Figure 4: Complex odontome.

Note: Supernumerary teeth can occur within the arch, but when they develop between the central incisors they are often described as a **mesiodens**. A supernumerary tooth distal to the arch is called a **distomolar**, and one adjacent to the molars is known as a **paramolar**.

Effects of Supernumerary Teeth and their Management

Effect on teeth	Management
Crowding	Remove the most poorly formed or more displaced tooth and may be followed by removable or fixed appliance treatment (**Usually cased by supplemental type**)
Displacement and rotation	Remove the supernumerary tooth and usually followed by fixed appliances to align the affected tooth or teeth. (**Can be caused by any type**)
Delayed or failure of eruption	Remove the supernumerary tooth and ensure that there is sufficient space for the unerupted tooth. Then it is either erupted unaided or need a fixed appliance treatment. (**Usually caused by tuberculate type**)
No effect	Usually detected by chance on a radiograph in the upper incisor region. If the supernumerary tooth will not interfere with any planned movement of the upper incisor, it can be left in situ under periodic radiographic observation, particularly if it is high in the jaw and inverted, or if its removal would involve damage to other teeth (**Usually caused by conical type**)

Congenitally Missing Teeth

Congenitally missing teeth are far more commonly seen as compared to supernumerary teeth. *Anadontia* is the total absence of teeth, while *oligodontia* is the congenital absence of many but not all teeth. *Hypodontia* is the absence of only few teeth (Fig. 5). The most common congenitally missing teeth are the third molars, maxillary lateral incisors, and madibular second premolars.

Causes: This could be due to:

- Disturbances during the initial stages of formation of a tooth.
- Inherited characteristic, though the precise genetic mechanisms responsible are not completely understood.
- Associated with an unusual but mild systemic abnormality, ectodermal dysplasia. Individuals with ectodermal dysplasia have thin, sparse hair and an absence of sweat glands in addition to their characteristically missing teeth (Anodontia or oligodontia).

Effects:

- Spaced dentition.
- Malposition and tilting of the adjacent teeth.
- Malformation of other teeth may be associated with hypodontia (e.g. peg shaped lateral incisor).
- Reduction in the growth of the alveolar bone in the affected area.

Management: This could be either space closure and correct teeth alignment with orthodontic treatment, or replace the missing tooth with an implant or prosthesis.



Figure 5: Congenitally missing lateral incisors.

Anomalies of Tooth Size

Only two anomalies of tooth size are of interest to an orthodontist; *microdontia* (small teeth) and *macrodontia* (large teeth).

The most commonly seen form of localized microdontia involves the maxillary lateral incisors. The tooth is called a "peg lateral" and exhibits a peg shaped crown with the mesial and distal sides converging incisally (Fig. 6). Treatment of microdontia is usually with building-up the affected tooth, while crowding due to macrodontia is usually treated orthodontically with extraction or interproximal reduction.



Figure 6: Peg shaped lateral incisor.

Anomalies of Tooth Shape

Fusion, Gemination and Concrescence

It is sometimes difficult to distinguish between fusion and gemination. True fusion is seen when the tooth arises through the union of two normally separated tooth germs. It might lead to spacing or sometimes it might complicate its movement by orthodontic means and there is reduction in the number of teeth (Fig. 7).

Geminated teeth are anomalies, which arise from division of a single germ by an invagination, leading to the formation of two incomplete teeth and there is normal number of teeth (Fig. 7).

The term concrescence refers to fusion of teeth which occurs after root formation has been completed (Fig. 8).

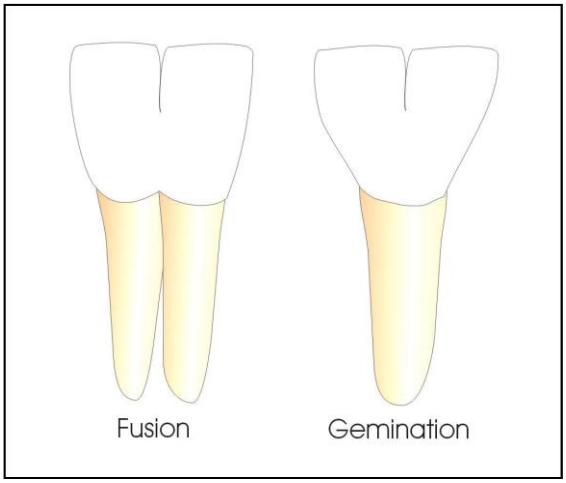


Figure 7: Fusion and gemination.



Figure 8: Concrescence.

Dilaceration

Is distortion or bend in the root of a tooth (Fig. 9). It usually affects the upper central and/or lateral incisor. The etiology is described in two categories:

a) ***Developmental:*** this anomaly usually affects an isolated central incisor and occurs in females more often than males. The crown of the affected tooth is turned upward and labially and no disturbance of enamel and dentine is seen.

b) ***Trauma:*** intrusion of deciduous incisor leads to displacement of the underlying developing permanent tooth germ. This causes the developing permanent tooth crown to be deflected palatally and the enamel and dentin forming at the time of the injury are disturbed giving rise to hypoplasia, both sexes are affected equally.

Management

Dilaceration usually causes failure of eruption, where the dilaceration is severe there is often no alternative but to remove the affected tooth, in milder cases it may be possible to expose the crown surgically and apply traction to align the tooth provided that the root apex will be sited within cancellous bone at the completion of crown alignment.

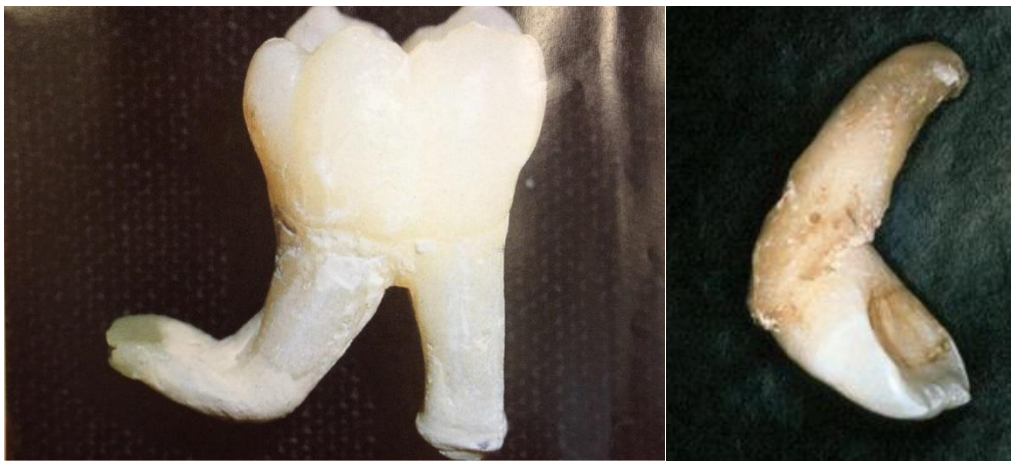


Figure 9: Dilaceration.

Premature Loss of Deciduous Teeth

Deciduous incisor: premature loss of a deciduous incisor has little impact, mainly because they are shed relatively early in the mixed dentition.

Deciduous canine: unilateral loss of a deciduous canine in a crowded mouth will lead to a centerline shift. As this is a difficult problem to treat, often requiring fixed appliances, prevention is preferable and therefore premature loss of a deciduous canine *should be balanced* in any patient with even the mildest crowding.

Deciduous first molar: unilateral loss of this tooth may result in a centerline shift. In most cases an automatic balancing extraction is not necessary, but the centerline *should be kept under observation* and space maintainer may be indicated.

Deciduous second molar: if a second deciduous molar is extracted the first permanent molar will drift forwards (Fig. 10). This is particularly marked if loss occurs before the eruption of the permanent tooth and for this reason it is better, if at all possible, to *try to preserve the second deciduous* molar at least until the first permanent molar has appeared. Otherwise, use *space maintainer* if it is prematurely lost. In most cases balancing or compensating extractions of other sound second deciduous molars is not necessary unless they are also of poor long-term prognosis.

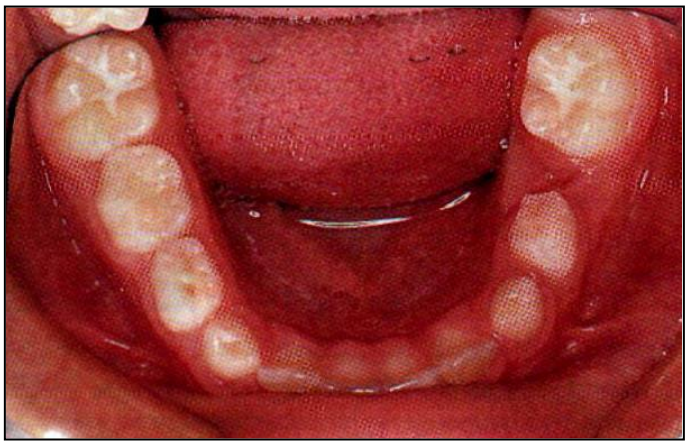


Figure 10: Loss of a lower second deciduous molar leading to forward drift of first permanent molar.

Early loss of deciduous tooth or teeth whether due to caries, premature exfoliation, or planned extraction results in drifting or tilting of the adjacent tooth into the edentulous space. This in turn results in decrease in the dental arch length and may be impaction of the unerupted permanent tooth.

Space maintainer is defined as the appliances that prevent the loss of the dental arch length and which in turn guide the permanent tooth into correct position in the dental arch. It may be removable like partial denture or fixed like band and loop and lingual arch. Whereas, ***Space regainer*** used to regain the lost space by applying orthodontic force to realign the tilted teeth.

Retained Deciduous Teeth

A difference of more than 6 months between the shedding of contralateral teeth should be regarded with suspicion. Provided that the permanent successor is present, retained deciduous teeth should be extracted, particularly if they may cause impaction or deflection of the permanent tooth that can result in irregularity, crowding, and crossbite (Fig. 11).

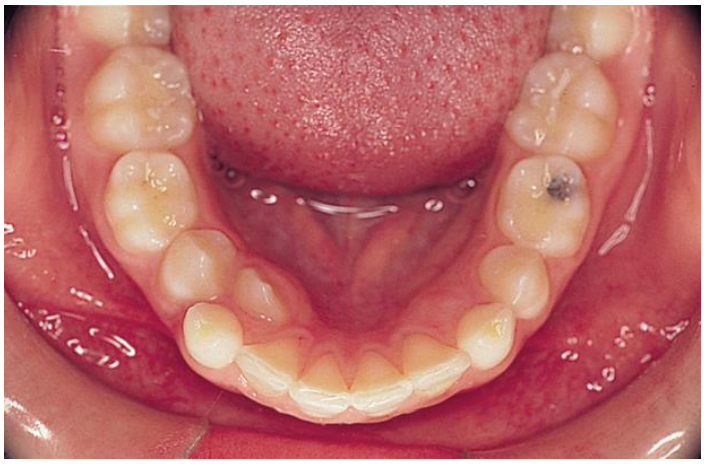


Figure 11: Retained deciduous tooth contributing to deflection of the permanent successor.

Delayed Eruption of Permanent Teeth

If a tooth on one side of the arch has erupted and 6 months later there is still no sign of its equivalent on the other side, radiographic examination is indicated and there is a likelihood of migration of other teeth into the available space. As a result, the tooth whose eruption has been delayed might get displaced or impacted. Whatever the reasons for the delay in eruption, it is important from a clinician's point of view *to maintain* and if required to *create space* for its eruption (Fig. 12). Extraction of the affected teeth is often necessary



Figure 12: Delayed eruption of maxillary central incisor.

Causes of Delayed Eruption

Generalized causes

- Hereditary gingival fibromatosis
- Down syndrome
- Cleidocranial dysostosis
- Cleft lip and palate
- Rickets
- Hypothyroidism

Localized causes

- Congenital absence
- Crowding
- Retained/Ankylosed/Premature loss of the primary predecessor
- Supernumerary tooth
- Dilaceration
- Abnormal position of crypt
- Primary failure of eruption

Ankylosed Deciduous Teeth

Ankylosis is a condition which involves the union of the root or part of a root directly to the bone, i.e., without the intervening periodontal membrane. It may be associated with past history of trauma or apicoectomy. Ankylosed deciduous teeth, especially ankylosed deciduous molars, constitute a potential alignment problem for the permanent teeth. This delays the erupting permanent tooth and can deflect it from the normal eruption path (Fig. 13). Treatment may involve surgical removal of the ankylosed tooth.

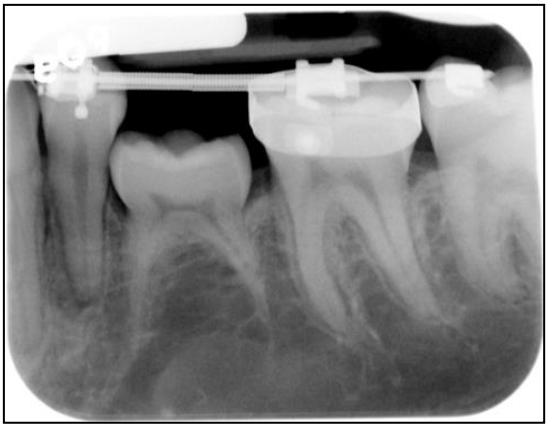


Figure 13: Ankylosis of second deciduous molar.

Abnormal Eruptive Path

Generally, each tooth travels on a distinct path since its inception to the location at which it erupts. It can deviate from this eruption path because of many reasons. The tooth that most frequently erupts in an abnormal location is the maxillary canine (Fig. 14). Various reasons have been attributed for this behavior. These include:

1. It travels the longest distance, from near the floor of the orbit.
2. It is the last anterior tooth to erupt and loss in arch length, anterior or posterior, may impinge on the space required for it to erupt.
3. Ideally it should slide along the distal aspect of the root of the lateral incisor. Any problem in the position of the lateral incisor may divert the erupting canine.

Note: Treatment of displaced canine has been mentioned in previous lecture.



Figure 14: Abnormal path of eruption of the maxillary canines.

Transposition

Transposition is a positional interchange of two adjacent teeth. There appears to be a genetic component to this problem as well. It usually occurs between the maxillary canine and first premolar, either partial or complete transposition (Fig. 15). Treatment of partial transposition needs fixed orthodontic appliance, while complete transposition may be left untreated.



Figure 15: Partial and complete transposition of the canine and first premolar.

Abnormal Labial Frenum

At birth the labial frenum is attached to the alveolar ridge with some fibers crossing over and attaching with the lingual dental papilla. As the teeth erupt, bone is deposited and the frenal attachment migrates superiorly with respect to the alveolar ridge. Some fibers may persist between the maxillary central incisors. These fibers which persist between these teeth are capable of preventing the two contralateral central incisors from coming into close approximation, in such cases surgical removal of the frenum may offer little advantage (Fig. 16).

The *'blanch test'* is used to determine the role of frenum as a causative factor.

Step 1: The lip is pulled superiorly and anteriorly

Step 2: Any blanching in the interdental region is indicative of the fibers of the frenum crossing the alveolar ridge.

Step 3: The blanch test can be collaborated with an intraoral periapical radiograph of the region which shows a slight radiolucent wedging/notching in the interdental alveolar ridge region (Fig. 17).



Figure 16: Thick labial frenum.



Figure 17: Notch in the interdental alveolar bone due to frenal insertion into the incisive papilla.

Dental Caries

Proximal caries is especially to blame for the reduction in arch length. It can cause:

- *Migration* of adjacent teeth (Fig. 18).
- *Tilting* of adjacent teeth into the space available (Fig. 19).
- *Overeruption* of the teeth in the opposing arch (Fig. 19).
- *Premature loss* of deciduous or permanent teeth. A substantial reduction in arch length can be expected if several adjacent teeth involved by proximal caries are left unrestored.

Treatment of caries is necessary to avoid the above problems.



Figure 18: Loss of space due to grossly decayed deciduous first molar.



Figure 19: Tilting and over-eruption of the teeth in the space available due to premature extraction of carious tooth.

Gingival and Periodontal Diseases

Infections and other disorders of the periodontal membrane and gingivae have a direct and highly localized effect on the teeth. They may cause *loss of teeth*, *changes in the closure patterns* of the mandible to avoid trauma to sensitive areas, *ankylosis* of the teeth, and other conditions that influence the position of the teeth.

Improper Dental Restorations

Malocclusions can be caused due to improper dental restorations.

- Under contoured proximal restoration can lead to a significant decrease in the arch length especially in the deciduous molars.
- Over contoured proximal restorations might bulge into the space to be occupied by a succedaneous tooth and result in a reduction of this space.
- Overhang or poor proximal contacts may predispose to periodontal breakdown around these teeth.
- Premature contacts on over contoured occlusal restoration can cause a functional shift of the mandible during jaw closure.
- Under-contoured occlusal restorations can lead to the overeruption of the opposing dentition.

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