

Volume Abnormality: Gemination and Fusion

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Abstract

Review Article

Fusion is the union of two embryologically separate developing teeth. Gemination is the incomplete division of a single tooth bud. They are also called a double teeth and count among the developmental abnormalities and anomalies. Although the prevalence of double tooth is low in the general population, patients with this anomaly are often embarrassed by its potential side effects and implications on the other teeth mainly the aesthetic and functional problems. Not to mention that the treatment of this anomaly can be more than complex due to its unusual coronary and radicular morphology. This chapter is going to focus on how a careful clinical and radiographic examination is essential to find the right diagnosis. It's also aim to highlight the different therapeutic approaches which remain very challenging and needs a proper multidisciplinary approach.

Keywords: Developmental tooth disorder- Gemination –Fusion.

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INTRODUCTION

Tooth development or odontogenesis is a complex process by which teeth form from embryonic cells, grow, and erupt into the mouth. This development follows several predetermined stages.

During the development, many factors can alter the metabolic and physical conditions around the germ, causing dental abnormalities to appear.

These anomalies constitute a large group of dental variations, whether morphologically, structurally or variation in the eruption sequence.

Fusion and gemination count among the complex morphological ones since it involve several dental elements and can affect both temporary and permanent dentures.

In the literature, the terms "double teeth", "joined teeth", "dental twinning" are used to describe these two anomalies.

These abnormalities are usually related to hereditary factors or can be the consequences of a developmental or a metabolic disorder [1, 2].

The main reason bringing the patients to a dental office is the unsightly appearance of the affected tooth (s). The dentist may feel helpless in the front of this kind of anomalies.

The aim of this chapter is to clarify dental fusion and gemination.

First we will define it and describe its clinical forms. Then we will discuss their etiologies and epidemiological data.

We will then discuss the diagnostic process, which is essential in order to better understand these dental anomalies and their side effects (caries, endodontic, orthodontic, periodontal problems, etc.). The therapeutics approaches are often complex with several aesthetic and functional issues need to be solved.

We will discuss the several different therapeutic approaches described in the literature which are mostly multidisciplinary.

This work will enlighten and guide the dentists to put the correct diagnosis of the condition which will guide the choice of a suitable treatment and then implicates a better prognosis for the patient.

Définitions

The term double tooth is used by many authors to describe and define two united teeth.

Sometimes it's hard and very difficult to make a differential diagnosis between two fused teeth and two geminated teeth, especially if we suspect a fusion between a normal germ and a supernumerary one. This is why many authors find it suitable to use the term double tooth to describe both fusion and gemination [3-5].

Germination: Is an anomaly that appears when the tooth bud of a single tooth tries to divide. The result can be either a complete division leading to the formation of one normal tooth and another supernumerary tooth, or it will lead to an incomplete division resulting in a larger with an increased diameter. In the second case, the pulp chamber is generally single, enlarged and may be partially split.

Fusion: Is a developmental anomaly similar to gemination, resulting from the union, most often by dentin, of two tooth buds at the time of their formation.

Description of the anomaly [6]:

Cases of dental fusion appear like there is teeth agenesis, while in cases of gemination, all teeth are present (with a supernumerary tooth in case of complete dividing tooth bud).

These single, large or split teeth can be the result of the union of two adjacent tooth buds or the partial splitting of a tooth bud in half.

Geminated teeth have a bifid crown and usually a common root and canal, whereas fused teeth are the union of two teeth, usually originating from two separate tooth buds that join together to form a single tooth.

Fusion and gemination affects both temporary and permanent teeth.

Classification d'Aguilo: Aguilo et coll. ont étudié 50 cas de patients présentant des dents doubles en denture temporaire. Ils les ont classées en quatre catégories selon leur morphologie:

Type I: bifid crown, single root. A large crown with a notch on the incisal edge and a bifid pulp chamber, with

normal dimensions of the root and radicular canal and cervical widening

Type II: large crown, large root.

A large crown, usually lacking a groove or notch, with single, shared, large root canal and pulp chamber and a wider than normal root

Type III: two fused crowns, double conical root.

Two fused crowns with a partial or total vertical groove extending cervically; the crowns may be symmetrical or show distinct differences, and the pulp chambers may be separate. One large conical root. The coronal and radicular portions of the pulp canal may be fused, or the coronal portion may be shared and end in two radicular canals.

Type IV: two fused crowns, two fused roots.

Two crowns as mentioned in type III and two distinct, joined roots with separate root canals

According to Aguilo *et al.*, It appears that:

The type I involve only one tooth of normal dentition which is the lateral maxillary incisor. This can be the result of a complete fusion between a normal tooth and a supernumerary tooth germ. It can also correspond to a gemination,

The types II, III and IV: are found when two teeth of normal dentition are involved. This could be the result of full or partial fusion between two normal teeth. Combinations of agenesis with gemination, or agenesis and fusion with a supernumerary tooth can also be incriminated in those cases.

Type IV: is also found when a single tooth of normal dentition is involved. This can be considered as a partial fusion of a normal tooth and a supernumerary one.

In fusion, the fused tooth usually has a large crown marked with a vertical groove extending to the gingival sulcus. It has two independent root canals or, less often, a single root with only one canal associated to one or two pulp chambers.

The fusion gives an "unbalanced" appearance to the crown leading to a rudimentary coronary part smaller than the other part.

Fused teeth are generally united by dentin and / or enamel, however fusion at the level of enamel alone is rare. Fusion can be complete (total) or incomplete (partial).

It depends on when the force causing the narrowing of the space between the tooth germs occurs. Thus, in the case of total fusion, we'll have a tooth with both a single canal and a single pulp chamber. Whereas in the case of a partial fusion, the channels will be

totally or partially divided. Likewise, if the fusion between two germs occurs in early stages, the result will be a tooth of almost normal size (complete fusion). If the fusion occurs in a late stage, at the result will be a tooth with almost a double size (partial fusion).

Fusions are most often unilateral, but a few cases of bilateral fusions have also been described.

Etiology of geminations or dental fusions [7-9]

The etiopathogenesis of double formations remains relatively unclear, although several hypotheses have been made.

During odontogenesis, any factor that changes the metabolic and physical conditions around the tooth germ can interfere with its development. Although no aetiology is clearly demonstrated, several hypotheses are incriminated.

1-Proximity to germs

When two teeth are developing they can be source of pressures and physical forces which produce close and prolonged contact between them.

A maxillary or mandibular hypodevelopment causes congestion responsible for pressure on the dental developing germs. Thus, germs can meet, interpenetrate resulting in their fusion. The persistence of the dental lamina between the germs seems to be also a possible etiology.

2-Trauma

Many authors consider bone trauma to be a causative factor. Thus a trauma occurring during the development of the tooth germ could be responsible for the dental fusion.

3-Genetic factors

Some authors highlight a hereditary / genetic component of double teeth. They are also found in some systemic disorders, such as chondro-ectodermal dysplasia, achondrodysplasia (Ellis Van Creveld syndrome), otodontal dysplasia, focal dermal hypoplasia or Russel-Silver syndrome.

4-Environmental factors

Fetal exposure to alcohol or thalidomide, as well as hypervitaminosis A in pregnant women, may play a role in the formation of double teeth.

Epidemiology

Although the prevalence of double tooth is low in the general population, patients with this morphological abnormality can often be embarrassed by the aesthetic problems it causes, mainly when localized in the anterior areas. The prevalence of double teeth varies according to the studies [2].

In temporary dentition the prevalence of this anomaly is ranging from 0.1 to 2.5% versus 0.1 to 0.2% in permanent dentition. There is an equal distribution between the two sexes, and there are no significant differences in its location, affecting the maxillary or mandibular arches. Racial differences have been reported to show a higher frequency in the Japanese population compared to the Caucasian one. The most affected teeth are the canines and incisors.

Gemination occurs much more in the temporary dentition with a prevalence of 0.5% in children than in permanent dentition where the prevalence is 0.1% in adults [9-11].

The anomaly affects the maxillary temporary incisors and canines more, but unlike fusion, it is more present in the maxilla than in the mandible.

The frequency of bilateral gemination is (0.02%) in both dentitions and is more frequent in the Mongolian (5%) compared to the Caucasian (0.5%).

Fusion like gemination is found more in temporary dentition than the permanent one, it more often affects the mandibular incisors unlike the other teeth. Fusion is found in less than 1% of the general population, it ranges from 0.1% to 0.85% [12-16].

Diagnosis

Every morphological abnormality, even the minor one if it's visible, should automatically lead the dentist to do a proper radiographic examinations. These examinations may reveal the existence of another root abnormalities or complications associated with the morphological abnormality such as root resorptions

The positif diagnosis of double formations is essential in order to avoid some complications that could arise if its not treated. These complications can be several such as: the development of caries in the notch between the double teeth, cosmetic and periodontal problems.

Usually there is a groove of varying depth, which may or may not extend over the entire crown and root. This groove indicates the line of adhesion between both tooth germs. X-rays help to demarcate the layers involved in fusion / gemination and to check whether the fusion is total or just limited to the crown.

Tooth fusion can occur in dentin, enamel, or both. The x-ray shows that these teeth have one or more root canals and one or two pulp chambers. In contrast, geminated teeth have a single root and a single root canal.

The X-ray examination helps to assess the possibility of keeping the tooth and the feasibility of the chosen treatment.

The retro-alveolar radiography makes it easy to confirm the diagnosis of geminated tooth. However, it doesn't give precise information on root morphology.

Panoramic radiography can provide additional information in the diagnosis of double teeth and can reveal possible root abnormalities associated to the possibility of getting the dental formula.

3D radiography, also called CBCT, allows the acquisition of small fields in high resolution, essential in the understanding of such complex anatomies [17-19].

Treatment [10, 20-23]

Whenever it's possible, it's better to begin by a conservative approach in order to maintain the double tooth on the arch and thus avoid considerable bone loss compared to extraction. For the therapeutic approach, an exact differentiation between fusion and gemination may not be of great importance.

A great variation in the treatment plans of double formations is found in the literature. This ranges from therapeutic abstention to overall restoration, depending on: the oral disorders caused, the symptomatology and the goals of treatment.

1-Therapeutic abstention

In the case where the double formation doesn't present aesthetic or functional discomfort, therapeutic abstention and monitoring are recommended.

It's necessary to regularly reassess the double formation because of its particular anatomy, especially in the case where the formation has a groove in the enamel, exposing the tooth to the risk of caries.

2-Conservative treatments

In the case where the double formation presents decay that doesn't reach the pulp chamber, a conservative approach should be taken. However, it's necessary to first check the vitality of the double tooth. If the double formation responds positively to the vitality test, caries curettage followed by restoration is performed.

The restoration can also be a prosthetic one if the aesthetics cannot be perfectly mastered with a composite resin.

The restoration can also be considered as an aesthetic solution, in the case where the canal system is not communicating at the coronary level of the double formation. Then it's necessary to make subtractive corrections by milling.

Separation of fused or geminated teeth should be done when possible. It is necessary to be guided by x-rays taken under different views, in order to know the

extent of the fusion. These subtractive corrections are followed by an additive correction by bonding composite, in order to give the double tooth an anatomy in line with the aesthetic demand of the patient.

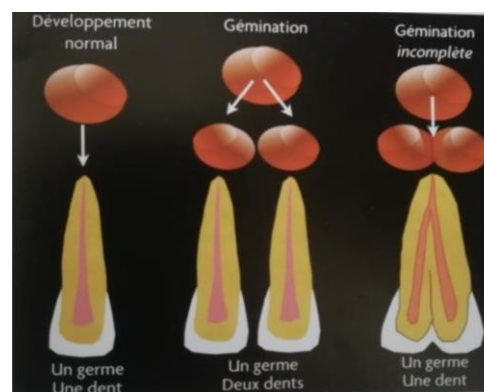
3-Endodontic treatment

Endodontic treatment will be done in front of a diagnosis of pulp necrosis or when a hemisection of the tooth is chopped to be performed, involving the root canal system.

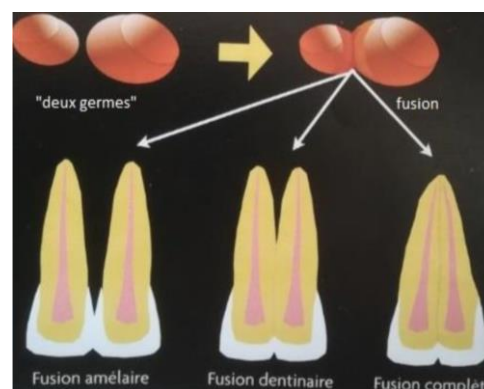
To perform this treatment, it's essential to precisely locate the root canal system of the double formation before performing the root canal treatment. Endodontic treatment is performed under a rubber dam to isolate the double formation from the oral environment, with abundant irrigation by 2.5% sodium hypochlorite constantly renewed. It's necessary to do a large access cavity in order to be able to access both canals.

4-Radical treatment

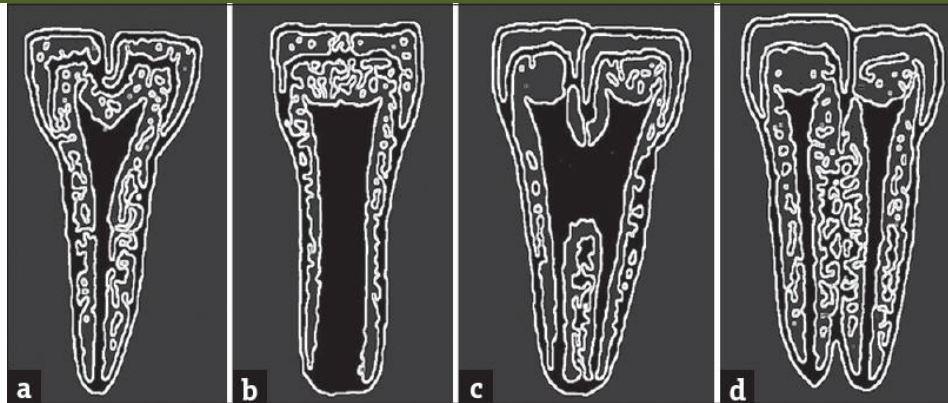
The removal of the double formation is considered when no conservative treatment can effectively save the tooth or correct the aesthetic damage. It is necessary to ensure the maintenance of the space between the remaining adjacent teeth, in order to reduce functional disorders and to improve the prognosis in the framework of a future prosthetic rehabilitation.



Schematic representation of gemination [24]



Schematic representation of fusion [24]



Aguilo et al., Studied 50 cases of patients with double teeth in temporary dentition. They classified them into four categories according to their morphology [6]

CONCLUSION

Dental fusions and geminations, otherwise called double formations, are complex and rare morphological abnormalities. Although their etiology is uncertain, it seems that several factors may explain their development.

The treatment of these complications often requires a multidisciplinary approach and subsequent regular monitoring.

The dentist who finds himself confronted with such anomalies must know how to propose an appropriate therapy after the examination of the different treatment alternatives.

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