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REVIEW ARTICLE

Etiology, Diagnosis, Consequences and Treatment of Infraoccluded Primary Molars

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Abstract: Infraocclusion is a condition where teeth are found with their occlusal surface below the adjacent teeth, long after they should have reached occlusion. Many terms have been used to describe this condition; the most commonly used being submergence and ankylosis. Infraocclusion is classified as slight, moderate or severe. Studies have shown the commonness ratio of infraocclusion in kids being 1.3-8.9% with an equal male: female ratio. The frequency of infraocclusion of primary molars of mandible is 10-fold higher in contrast to those of the maxilla. Some studies showed that the first mandibular primary molars are most often affected, but others support the second one. Infraoccluded primary molars appear with an increase in 3 year-old children reaching a peak in 8-9 years of age. The main cause is ankylosis, followed by heredity, trauma, infection and various other theories. However, the etiology is still uncertain. Radiographically, an obliteration of the periodontal ligament can be seen using conventional methods and the CT-method can also be used to reveal greater detail. Clinically, other than submergence, a sharp, solid sound is heard on percussion, in contrast to a softer sound in the normal teeth. Infraoccluded primary teeth can cause occlusal disturbances, tilting of the adjacent teeth, supra-eruption of the antagonists, ectopic eruption or impaction of the successor premolars. A treatment decision must take into account whether there is a permanent successor or not. In the first case, patient monitoring is recommended, because these primary teeth usually exfoliate normally. However, in the second case, the therapeutic approach is not standard. The aim of this review of literature was to elucidate the available evidence concerning infraocclusion, its etiology, diagnosis, clinical characteristics, consequences and treatment.

Keywords: Infraocclusion, Submerged primary molars, Ankylosis, Occlusal plane, Submergence.

INTRODUCTION

The term 'infraocclusion' describes a condition, in which teeth are present with their occlusal surface below the neighboring teeth, and long after, they reach occlusion [1]. The term signifies the clinical condition where the affected tooth is enveloped in the growing tissues without indicating any etiology [2, 3]. Many terms have been used such as; 'half retention, arrested eruption, buried tooth, tooth depression, disinclusion, impaction, incomplete/suppressed eruption, shortened tooth, intrusion, secondary retention, reimpaction, and re-inclusion'. However, the most commonly used terms are infraocclusion, submerged tooth and ankylosed tooth [3]. Infraocclusion can be observed during eruption or after full eruption [1].

Many systems of classification have been described. Brearley has come up with a facile classification:

- Slight – occlusal surface located approximately 1 mm below the expected occlusal plane in the tooth.
- Moderate – occlusal surface approximately level with the contact point of one or both adjacent tooth surfaces.
- Severe – occlusal surfaces level with or below the interproximal gingival tissue of one or both adjacent tooth surfaces [4].

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There is a decrease in the frequency of infraocclusion in its least pronounced form with age, but a significant increase in the frequency of the moderate form (ages 8-10 years old) and severe form (11-13 years old) [1]. The last category of infra-occlusion affects 2.5–8.3% of all the infra-occluded primary molars [2]. Studies have shown the commonness proportion of infraocclusion in kids being 1.3-8.9% with an equal occurrence in males and females. Nevertheless, this proportion is reported to be between 18.1- 44% in the siblings of those children [5].

The most commonly affected teeth are deciduous second molar of mandible, but in other investigations, the primary mandibular first molars appear with an increased rate of infraocclusion. There is no difference in the phenomenon between the left and the right side. The frequency of infraocclusion of primary molars of mandible is 10-fold higher in contrast to those of the maxilla [1, 2].

In addition, age-dependence also exists because infraocclusion is closely associated to root resorption due to premolar eruption and the process of normal shedding. This is because the number of infraoccluded primary first molars shows an increase from 3 years of age and the number of infraoccluded primary second molars from 5 years of age, reaching a maximum in 8-9 year-old children. The primary mandibular first molar is more commonly affected in children below 9 years of age. After this age, infraocclusion of the primary second molar predominates [3].

Submersion is a clinical term describing a tooth depressed below the occlusal plane [6], as normal vertical tooth eruption appears to be inhibited, therefore, the affected teeth appearing to ‘submerge’ as the adjacent teeth continue to erupt around them [5].

Another anomaly, which often accompanies infra-occlusion, is called ‘ankylosis’. Ankylosis implicates the fusion of cementum to alveolar bone and involves almost all infra-occluded primary molars. Nonetheless, it may also develop subsequent to infra-occlusion. It is possible to happen at any time during eruption and can be a basis for submergence [7]. Ankylosis of the primary molar to the alveolar bone does not usually occur until after its root resorption begins. If ankylosis occurs earlier, the eruption of adjacent teeth may progress sufficiently for the ankylosed tooth to be far below the normal plane of occlusion and may even be partially covered with soft tissue [2]. The incidence of ankylosis of primary molars is found to be between 1.3 to 38.5 percent [8]. The term “tooth ankylosis” reflects one usual explication for the disability of the teeth to maintain their position level with the neighboring teeth in a growing child. There are not always clinical or histological evidences for ankylosed teeth located below the occlusal plane [3].

The aim of this review of literature was to elucidate the available evidence concerning infraocclusion of primary molars, its etiology, diagnosis, clinical characteristics, consequences and treatment.

ETIOLOGY

It is generally agreed that the principal etiology of infraocclusion is ankylosis between the roots of the infraoccluded tooth and the surrounding bone. As a result, the tooth involved remains in a state of static retention, whereas in the adjacent areas, eruption and alveolar growth continue. A patient with one or two ankylosed teeth is more likely to have more in the future. Ankylosis was found in the same family members with no gender difference. This appears to support a theory that the phenomenon follows a familial pattern [1, 6, 9]. Kuroi and Olson (1991) also suggested that ‘infraocclusion is a hereditary condition, proposing that it is inherited on a multi-factorial basis, either with polygenic inheritance or controlled by an environmentally-sensitive single gene’ [10]. Although the etiology of infraoccluded teeth is still unclear, the following factors, apart from ankylosis, may cause a tooth to submerge periodontal membrane disorders, disturbed local metabolism, local mechanical trauma, local infection, chemical or thermal irritation, local failure of bone growth, abnormal pressure from the tongue, disturbance in the normal hard tissue resorption and deposition, systemic diseases (congenital syphilis, endocrine disorders *etc.*), heredity, abnormal germ position and direction and lack of space [11, 12].

Traumatic theory proposes that ankylosis can be predisposed by deficiencies or any discontinuity within the periodontal ligament. Ankylosis may be the aftermath of an injury to bone or periodontal ligament causing repercussions in regenerative procedures. However, the local metabolism theory supports that the evanescence of the periodontal ligament follows the root resorption in deciduous teeth. Disruption in local metabolism leads to obliteration of the periodontal ligament first, with the resulting close contact of the bone to the tooth structure allowing union [13]. Age is weakly but significantly correlated with infraocclusion, in comparison with gender, which has no significant relation [14].

As far as ankylosis is concerned, the exact causes are not yet defined, but several theories have been proposed such as familial pattern, traumatic injury to Hertwig’s epithelial root sheath, deficiency in vertical alveolar bone growth,

localized problems with metabolism and inflammation, localized infection, and chemical or thermal irritations, disturbance in the interaction between normal resorption and the hard tissue repair occurring in primary molars during the eruption of the successor teeth and deficient eruptive force [13, 15]. In addition, changes have been reported in the position and appearance of the cell rests of Mallassez within ankylosed primary molars. This distribution of the cell rests has been thought relevant to the subsequent likelihood of the development of ankylosis and resorption [16].

Finally, the ankylosis of primary molars has been reported to be associated with various anomalies in permanent dentition, like taurodontism of the first permanent molar, the impaction of succedaneous tooth, ectopic eruption of premolars/canine, aplasia of second molars, tipping of the adjacent teeth and increased susceptibility to caries and periodontal disease [8, 17, 18].

RADIOGRAPHIC DIAGNOSIS

On conventional radiographs, obliteration of the periodontal ligament can usually be demonstrable, but may not appear if the ankylosed area is very small [2]. As the ankylosis progresses, the roots of the impacted teeth become less distinguishable from the surrounding bone because of reduced radiopacity of the roots [8, 15, 19]. Panoramic, occlusal, intraoral periapical radiographs and CT can be used to examine the space between the infraoccluded and the adjacent teeth. CT has been shown to be preferable to the conventional techniques in terms of visualization of the impacted teeth and the localization of the inferior alveolar nerve. For instance, by using CT, possible injury to the inferior alveolar nerve can be prevented during surgical procedures. Moreover, CT can provide significant information about the amount of bone volume for diagnosis and treatment planning [20], while Nasel *et al.* (1999) proposed taking dental magnetic resonance images (MRI) to define the location of the nerve [21].

CLINICAL DIAGNOSIS

Clinically, infraocclusion usually conveys ankylosed primary molars, since the condition leaves the deciduous molars at a steady occlusal level, while the adjacent teeth erupt constantly because of the vertical growth of alveolar bone [8]. Ankylosed teeth give out a sharp solid sound on a percussion test in comparison to a cushion sound heard in the normal teeth, however, this relies on subjective assessment and a higher-pitched tone is more likely when at least 20% of the root surface is ankylosed [15]. Thus, it should never be used as a conclusive diagnostic tool of ankylosis. Also, such teeth can present immobility, but only when more than 10% of the root surface is ankylosed. Nevertheless, widespread root resorption on an immovable tooth is very allusive of ankylosis [22].

HISTOLOGICAL EVIDENCE

Small or relatively large areas of resorbed root are replaced by cementum and bone in direct connection with the bone of the tooth socket, as well as periodontal ligament remnants that are fibrotic with very few cells, have been observed histologically. Fusion of bone with dentine does not necessarily occur along the entire periphery of an ankylosed tooth. Mucopolysaccharidase activity is essential for the physiological development of the root resorption, during the eruption of the permanent successor. However, such activity is not observable [8]. It has been shown that most ankylosed molars had osteoid tissue deposited in the furcation area with minimal osteoclastic activity [23, 24], while teeth without successors showed ankylosis in the vicinity of the apex [25].

CONSEQUENCES

An infraoccluded deciduous tooth can cause developmental anomalies, such as tooth agenesis, microdontia of maxillary lateral incisors, palatal position of maxillary canines, and distal angulation of mandibular second premolars. Furthermore, occlusal disturbances such as tilting of the adjacent teeth lead to reduced dental arch space, especially when severe ankylosis of the second primary molars occurs in early mixed dentition, and supra-eruption of the antagonists [14]. The most noticeable tipping was observed mesially and distally to an infraoccluded primary mandibular second molar [1]. Decreased arch length has been shown to occur in 28-43% of cases with submerged primary molars, with mandibular secondary molars being the most common tooth associated with space-loss [12].

Ectopic eruption or the impaction of the successor premolar, with additional increase in caries and periodontal disease susceptibility are some other manifestations [15, 26]. However, according to Dewhurst *et al.* (1997) the infraocclusion of primary deciduous molars does not menace the periodontal tissues of the upcoming first molars [5].

Retained roots are another possible aftermath of the submerged primary molars, although there is no evidence in the literature to suggest that the retained roots are a detrimental side-effect of infraocclusion [26].

The cemento-enamel junction (CEJ) alveolar bone distance is shorter than the normal, because the exfoliation of the primary tooth is abnormal followed by the termination of eruption. Therefore, severe ankylosis may harm the alveolar support for the premolar [1, 2, 13, 17].

In case of severe submersion, clinical disturbances may include incomplete alveolar process development, lack of normal mesial drift, non-response to orthodontic forces, retained primary teeth with or without a successor and impaction of the successor, a depressed tooth with tipping adjacent teeth, supra-eruption of opposing teeth, lateral open bite and higher frequency of crossbites, but according to Kurol and Thilander, these disturbances have no long-term effects on occlusion [27]. However, Becker and Shochat detected a significant deviation in the dental inter-incisor midline toward the affected side [28].

TREATMENT OF INFRAOCCLUDED PRIMARY MOLARS WITH SUCCESSOR

Majority of the cases where premolars exist have been shown to exfoliate normally by the erupting successor, resorbing the roots of the submerged teeth. However extensive bony ankylosis may prevent normal exfoliation, causing future alignment problems. A six-month delay in exfoliation has been described as acceptable in studies, with the degree of infra-occlusion to the extent of the delay. Thus, the first decision to be taken is to determine the time of onset. Kurol *et al.* (1984) recommend watchful waiting and patient observation [29].

Late onset cases usually are in slight infra-occlusion; hence, the treatment objectives are focused on the exfoliation of the ankylosed primary tooth. Early onset cases are divided into those who are diagnosed early and those diagnosed late. Late diagnoses of early onset conditions are likely to present with tipped adjacent teeth, supra-eruption of the antagonist and therefore, indicate orthodontic intervention followed by extraction [30]. The loss of space by tilted adjacent teeth can be regained by a removable space maintainer [26].

TREATMENT OF INFRAOCCLUDED PRIMARY MOLARS WITHOUT SUCCESSOR

Ankylosed primary molars without permanent successors do not exfoliate spontaneously and are also late to be shed [14]. However, very slow root resorption can be observed in those ankylosed teeth [1].

A specific association of aplasia of premolars was noted in 17% cases of infra-occluded deciduous molar teeth [17].

Early prophylactic removal is frequently indicated, after an assessment of root resorption and adjacent periodontal support loss as well as the age of onset. Sidhu *et al.* (2001) proposed that the cases of infra-occlusion with aplasia of the permanent successor should be described as unusual cases. Moreover, severe infra-occlusion only affects 2.5-8.3% of all infra-occluded deciduous molars, but has been found specifically to be related to the lack of a permanent successor. Thus, such cases should be approached with special caution [2], as aplasia can aggravate the progression of infra-occlusion. Patient's age, occlusal status, the development and condition of the affected tooth are the factors that should be considered in the therapeutic decision [27].

If the progression of infra-occlusion and root resorption is very slow and the deciduous molar is described as useful, it may be left in the dental arch and used as a natural space maintainer. Occlusal disturbances, caused by progressive infra-occlusion, can be prevented by amplifying the coronal height and approximal contacts with bonded materials, however; root resorption can lead to tooth loss. Thus, therapeutic extraction should not be delayed too long due the potential for the risk of additional loss of the alveolar bone. On the other hand, after extraction, a possible orthodontic intervention to close the gap or other possibilities should be considered to close the gap [29].

On the other hand, an ankylosed deciduous tooth without a succedaneous tooth can remain functional for more than twenty years, especially if slightly submerged, when the crown may be extended vertically by the fabrication of a stainless steel crown or the occlusal addition of posterior composite to re-establish acceptable occlusion, until a more suitable prosthesis can be constructed. Moreover, the placing of a crown preserves the mesiodistal dimension [27].

CONCLUSION

Taking all these factors into account, if an infra-occluded or ankylosed primary tooth is observed, it should not be neglected. The ratio of children affected by infra-occlusion is not negligible. Early recognition and the appropriate meddling at the right time will make for a much uncomplicated treatment plan with long-standing results.

CONFLICT OF INTEREST

Declared none.

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