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To Extract or Not To Extract? Management of **Infraoccluded Second Primary Molars without** **Successors.**

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Abstract

Infraocclusion is a term used to describe a tooth which has stopped its relative occlusal growth into the arch after the period of active eruption; as a result, they become depressed below the occlusal plane. Although many aetiological mechanisms have been proposed, ankylosis is considered the primary cause of infraocclusion. Complex cases benefit from multidisciplinary management. This paper concentrates on the diagnosis and management of infraoccluded second primary molars without permanent successors and without significant malocclusion and provides clinicians with a treatment decision tree to aid in treatment planning.

“In-brief points”

- Early clinical and radiographic diagnosis of infraoccluded teeth.
- A treatment decision tree to aid in treatment planning infraoccluded primary molars in cases with missing permanent successor and without significant malocclusion.

Introduction

Infraocclusion is a term used to describe a tooth which has stopped its relative occlusal growth into the arch after the period of active eruption; as a result they become depressed below the occlusal plane^{1,2}. Traditionally, the term ‘submerged’ was used to describe these teeth, however numerous other terms have also been used in the literature; some examples are listed in Table 1. The authors prefer the term infraocclusion and have used it throughout this paper. The prevalence of infraoccluded primary molars varies between studies. Bjerklin (1992) stated that 55% of retained primary second molars show some degree of infraocclusion⁹. Kuroi³ (1981) in a study of 1059 Swedish children reported the prevalence figure at 8.9%, however other studies have given figures between 1.3% and 38.5%^{4,8}. In all of these studies, the subjects had a mixture of permanent successor’s presence or absence.

Despite the wide variation between population groups many studies have identified a familial occurrence of infraocclusion with a significantly higher incidence between siblings^{3, 5, 7, 8, 10}. The distribution based on gender is reported to be equal^{8, 11, 12}. Andraesen¹³ (2007) stated that infraocclusion is most often registered at the interval of 6-11 years^{4, 8, 11} but has been described in patients as young as 3 years old^{6, 8, 14}.

This phenomenon tends to occur bilaterally¹ with the most commonly affected teeth being the mandibular primary molars^{3, 8, 11}. The occurrence of infraocclusion can occur in the presence or absence of a permanent successor tooth. There are no clear guidelines to the general dental practitioner on the management of infraoccluded primary molars when the adult premolar is absent, which, importantly is the most common presentation of mild hypodontia as second premolars are commonly developmentally absent. Clinicians can often find the decision-making challenging on whether to extract the infraoccluded teeth or to retain them. The aim of this article is to give a brief overview of the current literature surrounding infraoccluded primary molars and to provide clinicians with an understanding of treatment options available when managing infraoccluded second primary molars with absent permanent successors.

Ankylosis
Impaction
Incomplete Eruption
Infraoccluded
Infra-occluded
Reimpaction
Submerged
Submergence
Submerging
Secondary Retention

Table 1 – Terminology used to describe infraoccluded teeth.

Aetiology

Although many aetiological mechanisms have been proposed (Table 2), ankylosis is considered the main cause of infraoccluded primary molars^{1, 3, 15, 16}. Noble (2007) describes ankylosis of the infra-erupted primary molar as one that has “stopped its vertical movement relative to others along the occlusal plane such that marginal ridges are not at the same height as adjacent teeth”¹⁷. This is due to failure of the periodontal ligament to separate cementum and dentine from the bone during resorption, causing fusion of the tooth to alveolar bone¹¹. This results in the primary tooth remaining static whilst eruption of adjacent teeth continues with vertical growth and occlusal development^{12, 18}. Two main theories have been proposed to explain why infraoccluded primary molars become ankylosed.

The first of these theories considers local factors as the main cause and second is based on genetic factors, although to date no genes have been identified.

Biederman suggested that ankylosis may be due to a change in metabolism caused by local disturbance in the periodontal ligament¹⁹. Bone turnover is a complex process involving the close interaction of osteoclasts and osteoblasts along with periodontal ligament cells²⁰. Studies have identified that disturbances in this process could also cause tooth ankylosis²⁰.

The second theory based on genetic factors is well supported. A study of monozygotic twins and another study assessing prevalence of infraoccluded teeth in different races, have both shown evidence of a genetic aetiology and familial occurrence of infraoccluded teeth¹⁸.

It has been suggested that “infraocclusion and other dental anomalies including those of shape, texture, number, and eruption may all represent microsymptoms of an inheritable disturbance because of a general disruption of the tooth developmental structures”¹⁸.

Although these theories do have evidence to support them within the literature, the exact cause of ankylosis of primary molars remains unknown. Other reported, but less common causes of Infraocclusion in the literature are listed in table 2.

For teeth with permanent successors, the ankylosed condition of the primary tooth usually, but not always, disappears concurrently with the physiological resorption process, which is delayed, indicating that ankylosis is usually a transient phenomenon²². However, there are cases where deciduous molars with a permanent successor remain ankylosed²³.

<u>Ankylosis</u>
Other less common causes:
Disturbed local metabolism
Gaps in the Periodontal Membrane
Local Mechanical Trauma
Local Infection
Chemical or Thermal Irritation
Local Failure of Bone Growth
Abnormal Tongue Pressure
Disturbance in Interaction between normal resorption and hard tissue repair
Radiation

Table 2 – Causes of infraocclusion identified in the literature.

Clinical features

Developmental anomalies are often identified by the general dental practitioner during routine examination²² and infraocclusion of primary teeth is one such condition that is usually diagnosed on clinical examination. As the name signifies, typically, the infraoccluded tooth appears depressed below the occlusal plane at varying levels of severity (Figure 1)^{3, 8, 11}.

Other clinical findings that can be associated with infraoccluded teeth are listed in Table 3. Tipping of adjacent teeth is often noted, owing to the tension in the transeptal fibres between the infraoccluded and non-infraoccluded teeth as the infraoccluded tooth sinks below the occlusal plane²¹.

A high-pitched percussive tone has been described due to the ankylosis of the tooth to the surrounding bone, but this is a largely a subjective measure as it only occurs when at least 20% of the root surface is ankylosed²². Other clinical features include an apical position of the gingival margin, overeruption of opposing teeth, lateral open bites and incomplete alveolar process development²⁴.

Root resorption detected radiographically without expected increase in mobility may occur, which suggests ankyloses of the tooth¹. A loss of mobility with infraoccluded teeth occurs when more than 10% of the root becomes ankylosed²².

- Tipping of adjacent teeth (Figure 2)
- Apically positioned gingival margins
- Lateral open bite
- Supraeruption of opposing teeth (Figure 3)
- High pitch sound on percussion
- Incomplete alveolar process development (Figure 4 and 5)
- Increase caries²⁵
- Periodontal disease susceptibility^{15, 28}

- Lack of normal mesial drift
- Significant deviation in midline shift towards the affected side²⁶

Table 3 - Clinical findings associated with infraoccluded molars



Figure 1 –Severe Infraocclusion of ULE and LLE. The teeth are significantly depressed below occlusal plane almost to gingival level.



Figure 2 – Tipping of UL4 distally adjacent to infraoccluded ULE.



Figure 3 – Overeruption of UR4 against infraoccluded LRE.



Figure 4 and 5 – Occlusal view shows a horizontal bony defect. Right side buccal view shows a vertical defect in the same patient.

Use of Radiography in Management of Infraoccluded Primary Molars

The presence of a non-mobile primary molar with a pronounced degree of physiological root resorption may be a sign of ankylosis and warrants further investigation.

The use of radiographs enables the clinician to identify if there is a successor present; in addition, radiographs facilitate the diagnosis of dental pathology including caries and root resorption.

Periapical radiographs may show periodontal ligament space obliteration which is an indicator of ankylosis and differences in occlusal heights can also be seen. Other features that can be seen radiographically include oblique interproximal bone levels “bone-notching” that slope down towards the infraoccluded tooth (figure 6).

However, conventional radiographs only offer a two-dimensional view of the infraoccluded tooth and given that ankylosis is microscopic³², it is unsurprising that radiographic interpretation is limited. Some histological studies including Raghoobar²² and Henderson²⁷ have reported that most ankylosed molars had osteoid tissue deposited in the furcation area. Thornton et al²⁸ and Krakowiak¹¹ found

that teeth without successors showed ankylosis in the vicinity of the apex. However, despite these conclusions radiographic presentation is of limited value to the majority of clinicians.

Cone beam computer tomography scans (CBCT) have shown that there is obliteration of the periodontal ligament in cases of ankylosis²⁹. CBCT is also useful in managing complex cases requiring surgical removal of infraoccluded teeth as it enables the surgeons to identify and localise the anatomical structures such as the inferior dental nerve ²⁴. However, CBCT should only be used in selective cases where the benefit outweighs the risks associated with this technique.



Figure 6 – Orthopantomogram showing 3 quadrants of infraoccluded teeth with evidence of ankylosis at the apex, lack of alveolar development and bone notching in between the deciduous mandibular right second molar and the first permanent molar.

Classification

There are numerous classification systems in the literature. Two most frequently used are Kjaer (2008), where primary molar eruption is classified according to the distance from the occlusal level of the primary molars to the adjacent teeth in millimetres¹³.

The other frequently used classification is by Brearley⁸ (1973) as shown in table 4. For the purpose of this article, the authors have chosen to use Brearley classification.

<u>Degree of Infraocclusion</u>	<u>Clinical Features</u>	<u>Example</u>	<u>Radiograph</u>
None	No infraocclusion present between the occlusal level and the interproximal contact point of the premolar		
Mild	Infraocclusion between the occlusal level and the interproximal contact point of the premolar		
Moderate	Infraocclusion at the interproximal contact point of the premolar (Note tooth in image shown is restored with onlay)		

<p>Severe</p>	<p>Infraocclusion below the interproximal contact point of the premolar (note that the adjacent tooth in this image is a canine)</p>		
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Table 4 - A simple classification of Infraocclusion with respective clinical examples and radiographs.

Prognosis of infraoccluded molars.

Studies have shown that ankylosed mandibular and maxillary second primary molars have a better prognosis than ankylosed first primary molars³⁰. Due to the increased incidence of permanent second molar absence there is more available literature regarding their longevity. Bjerklin (2000) analysed 41 subjects longitudinally from age 11 years into adulthood who all had retained lower second primary molars of which 55% had some degree of infraocclusion³⁰. Out of 59 teeth in 41 subjects only 7 retained primary second molars were lost, of which none were lost after the age of 20²⁵. This suggests that if primary molars are retained past the age of 20 then the prognosis is good and other studies have drawn a similar conclusion³⁰.

As previously stated, decision making around infraoccluded primary molars can be complex and confusing. The next part of this paper provides a simplified summary of the literature and a flow chart to aid the clinicians in treatment planning cases of infraoccluded primary molars with missing permanent successors.

Treatment Planning

Management of infraoccluded teeth is influenced by several factors such as timing of diagnosis, age of the patient, type and degree of malocclusion, the degree of ankyloses and whether there is a permanent successor present.

Management of pathology free ankylosed primary second molars with a missing permanent successor in a child without any significant malocclusion depends on the timing of diagnosis. Mildly ankylosed teeth diagnosed prior to the child's pubertal growth spurt should be monitored biannually to ensure that the ankylosis is not getting worse. If the ankyloses worsens over time or is diagnosed as severe at the time of diagnosis, the clinicians should consider extracting the tooth ideally prior to the child's growth spurt. This is done in order to avoid a significant vertical bone defect³³. This will prevent greater challenges in future management of these cases where continued infraocclusion results in lack of alveolar bone development.

Pathology free mildly ankylosed primary molar teeth with missing underlying permanent successor that are diagnosed after the child's growth spurt could be retained. Progression of infraocclusion is shown to be slower in children aged 15-17 years old with a mean increase of 0.5mm per year³⁹.

However, it is important to retain the integrity of the occlusal table. The infraoccluded primary molar could be built up to the correct occlusal plane with direct composite or with an indirect restoration like a ceramic or composite onlay. An onlay may be more suitable to build up to the occlusal table and establish a contact point with the adjacent first premolar⁴⁰. The primary molars could also benefit from placement of a preformed metal crown (PMC) which prevents tipping of the adjacent teeth and restores the occlusion to the correct height and prevent over-eruption of the opposing teeth³⁴. Clinicians must be careful when selecting the size of the PMC, as PMC have the risk of being oversized which may compromise the leeway space³⁴. These treatment strategies also act as alveolar ridge maintainers in children, should this tooth need to be extracted and restored in the future with a fixed/removable prosthesis³⁴.

There is often a restorative challenge in replacing lower second deciduous molars as the mesiodistal width of the tooth is greater than a premolar width. Some clinicians advocate interproximal reduction (IPR). This is carried out using either hand files or rotary files or discs and over a few appointments removing up to 2.5mm of interproximal width. This procedure must be undertaken with caution as the relatively large pulp horns that place the primary teeth at a risk of pulpal inflammation and could stimulate premature root resorption and sensitivity³⁴. In addition, discing of primary molars may alter contact point height, which leads to food packing and increases caries risk. However, there is a lack of long-term studies on retained second primary molars that have been reduced with IPR³⁴, therefore it should be used with caution in selected cases.

Pathology free severely ankylosed primary molars, with missing underlying permanent successor, that are diagnosed after the pubertal growth spurt often need to be referred to secondary care services. Guidance can be sought from an Orthodontist regarding the timing of extraction of the infraoccluded primary molar and if orthodontic space closure would be possible³⁴. Early removal of the infraoccluded molars is often required and facilitates efficient tooth movements.

A majority of severely infraoccluded teeth need to be surgically extracted which may necessitate use of General anaesthesia in anxious children. Concerns involved with extraction of the severely ankylosed primary second molars is the potential alveolar bone loss, which could be critical if the future management plan includes implant-supported prosthesis³⁶. Ostler (2006) and Kokich (1994) showed that 25% of the bucco-lingual width would be lost in the first 3 years post extraction of mandibular 2nd primary molars^{35, 36}. Potentially, ridge preservation techniques could be considered to maintain soft and hard tissue volume. Sandor (1993) described a technique to place coral granules in the primary 2nd molar extraction site³⁷ which had a 93.5% success rate in preserving the alveolar process that meant implants were placed without the need for bone grafting³⁷. An alternative ridge preservation technique described by Smalley in 2008 involves decoronating the crown of the primary 2nd molar leaving the roots within the alveolus³⁸. This technique is used for

ankylosed primary molars where a traumatic surgical extraction would be required resulting in significant bone loss. The decoronation technique helps to preserve the bone until an implant can be placed in the future³⁸.

When assessing the patient orthodontically, lower incisor position can influence the treatment plan and the decision to extract or maintain the retained primary molars. If the lower incisors are at the correct angulation then space closure should be avoided as excessive retroclination can be detrimental to the patient's profile. In addition, patients with minimal crowding, deep overbites, , reduced anterior face height and flat mandibular plane angles are often treated with a non-extraction approach³⁴. In patients with these non-extraction characteristics, providing the roots of the mandibular second molars are favourable with mild or no infraocclusion present then these teeth should be retained and maintained with a fixed prosthesis such as a ceramic onlay or full coverage crown. However, if the ankylosis is severe then extraction and space maintenance or closure may be indicated³⁴.

In patients where the space left by the extraction of the infraoccluded second molar would be too large to be closed orthodontically, then extraction of the infraoccluded molar followed by implant placement is a long-term treatment option to consider. The benefits of an implant retained prosthesis having a reliable long-term solution needs to be weighed against the longer treatment times, surgical operation and higher treatment fees³⁴ and ongoing costs for patients.

If the space is not adequate for restorative or implant rehabilitation, then orthodontists can place temporary anchorage devices to help protract posterior teeth to avoid lower incisor retroclination and eliminate the need for restorative replacement³¹. Excessive lower incisor retraction would compromise facial aesthetics in these cases³⁴.

There is lack of clear guidance and information to enable GPs to manage cases of infraocclusion of primary molars in practice, taking account of the aforementioned scenarios. The authors propose a treatment tree (Figure 7) that can aid in treatment planning cases of infraoccluded primary molars without permanent successors and without any associated significant malocclusion. The decision tree cannot be fully evidence based given the small volume of research in this area and so is based on the authors' experience. Complex cases of infraocclusion with or without significant malocclusions would benefit from a multidisciplinary specialist input and referral to orthodontics, restorative and paediatric dentistry would be prudent.

Conclusion

Early diagnosis of an infraoccluded molar is essential to avoid common problems associated with this clinical scenario. The treatment modalities depends on a number of factors including age of the patient, presence of a permanent successor, the time of diagnosis in relation to patients growth spurt and the malocclusion present. Complex cases would benefit from multidisciplinary input; however, in majority of simple cases the given decision tree which is based on authors' experience would aid the clinicians in formulating a treatment plan.

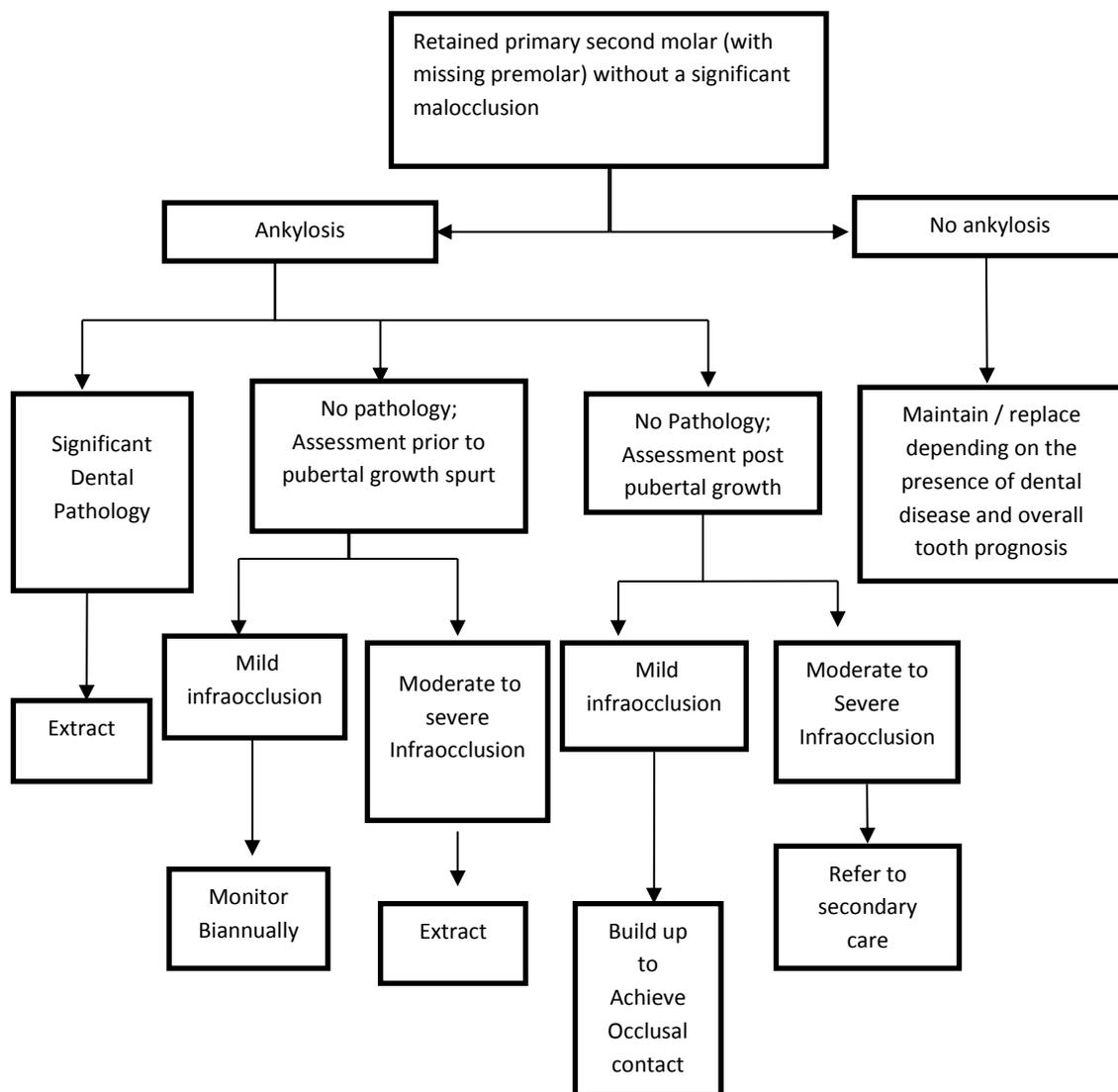


Figure 7 – A treatment algorithm for cases of infraoccluded primary second molars without permanent lower second premolar successors and without significant malocclusion.

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