Infraocclusion of Primary Molars with Aplasia of the Permanent Successor

A Longitudinal Study

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Infraocclusion of deciduous molars that also lack a permanent successor is found to progress more than where a successor is present, while exfoliation is severely retarded. The aplasia is the most important factor in treatment planning and timing.

KEY WORDS: ANKYLOSIS, APLASIA, INFRAOCCLUSION, MALOCCLUSION, MOLAR, TOOTH DECIDUOUS

Teeth are of great importance for the growth of alveolar bone, and for maintenance of the alveolar bone height. Impaired development of the alveolar bone is frequently observed in regions with permanent teeth absent.

Infraocclusion of deciduous molars also affects alveolar bone development, with lower height of the alveolar bone immediately surrounding deciduous molars in infraocclusion reported by KUROL AND KOCH (1984), and KUROL AND THILANDER (1984) (Fig. 1).

Infraocclusion is frequently associated with ankylosis, which is a direct bony union between tooth and bone. The exact mechanism for initiation of ankylosis is not known. Infraoccluded deciduous molars are believed to remain static while the adjacent teeth move vertically with growth and development of the alveolar process. This leaves the ankylosed tooth in a progressively inferior position in relation to the occlusal plane, giving the visual impression that it is submerging.

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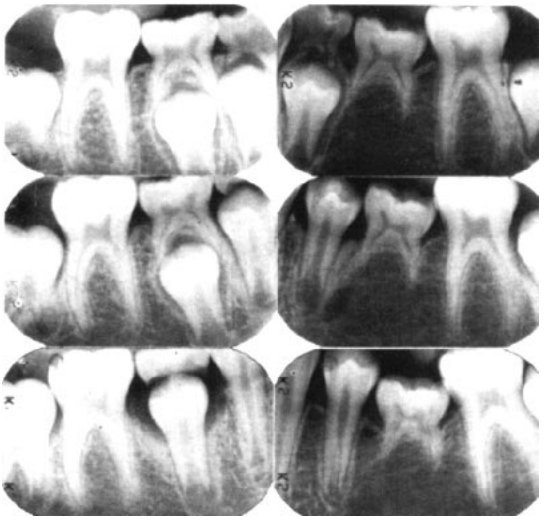

Fig. 1 Periapical radiographs of a girl from 9.0yr to 11.0yr, when the infraoccluded deciduous molar with no successor was extracted and orthodontic treatment started. On the side with no successor, infraocclusion progressed from 4.0mm to 4.8mm, while on the side with a successor the lesser infraocclusion of 2.2mm was static. Note the tipping of the permanent molar, concave marginal alveolar bone contour and deciduous root resorption on the side with no successor.

A combination of the two abnormal conditions, no permanent successor and infraocclusion of deciduous molars, might be expected to affect the alveolar bone growth around these teeth even more seriously, but nothing is yet known about such a combined effect.

In an earlier study on infraoccluded deciduous molars with permanent successors present, it was found that average eruption of permanent successors in the presence of infraoccluded deciduous molars occurred about 6mo later than with deciduous molars at normal levels (KUROL AND THILANDER 1984). The importance of the eruption of the permanent successor was demonstrated with close correlations.

However, it was questioned whether an infraoccluded deciduous molar with no successor would exfoliate spontaneously without the influence of the erupting permanent successor. Aplasia might thus have a further negative influence on the progression and ultimate level of infraocclusion, and thus become important in decisions regarding treatment.

Against this background, a separate detailed analysis of infraoccluded teeth with aplasia of permanent successors was felt necessary.

— Objective —

The objective of this study was to longitudinally follow deciduous molars with both infraocclusion and aplasia of the permanent successor. Effects on occlusal development, marginal alveolar bone, deciduous root resorption and exfoliation of the deciduous molar were studied.

— Subjects —

The 7 boys and 5 girls (12 total) reported here are a subgroup of a larger group of 83 children with infraocclusion of at least one deciduous molar. These 12 were selected because they also had asso-

ciated aplasia of a permanent successor bicuspid. For details, see KUROL AND THILANDER (1984).

The studied children were all found to be healthy representatives of an average Swedish child population. Their history revealed no special findings relevant to this study. Caries was generally low, with 11 of the 20 deciduous molars caries-free and without restorations. Apart from the aplasia, these children did not differ orthodontically from an average population.

Ages at the start of the study ranged from 8.4yr to 15.2yr (mean 10.9yr). The observation period ranged from 2.0yr to 5.0yr (mean 2.7yr), with ages at last observation between 10.8 and 18.7 years. In some cases, the observation was terminated early because of the need for orthodontic intervention.

Altogether, 20 deciduous molars (18 mandibular and 2 maxillary) were studied, all with infraocclusion combined with aplasia of the successor (Table 1).

Bilateral infraocclusion of deciduous molars combined with absence of the permanent successor on both sides was found in 6 of the 12 children. In the other 6, bilateral infraocclusion was present even though a successor was missing on one side only. Unilateral deciduous molar infraocclusion with aplasia of the successor was recorded for only two teeth (Table 2).

Altogether, 85 permanent teeth were found to be missing in the 12 children, with extensive aplasia noted in 5 (Table 3). Missing third molars are included in that number. Symmetrical aplasia was frequent, in agreement with reports by RINGQVIST AND THILANDER (1969).

Table 1

Sample Distribution

Deciduous Molars in Infraocclusion With Aplasia of the Permanent Successor

	First Molar	Second Molar
Maxilla	2	–
Mandible	2	16
Total	4	16

Table 2

Bilateral distribution of Aplasia in longitudinally studied deciduous molars in Infraocclusion

	Pairs	Teeth
Bilateral infraocclusion		
Aplasia both sides	6	12
Aplasia one side	6	6
Unilateral infraocclusion		
Aplasia	–	2

— Methods —

Initial Recordings

At the start of the study, the 12 children were subjected to clinical and radiographic examination, including study casts of the jaws and intraoral color photographs. A complete medical and dental history of child and mother revealed no special findings considered relevant to this study.

Longitudinal Data

The children were examined clinically at 6-month intervals over the observation period, with intraoral radiographs and impressions for study casts taken at each examination. Orthopantomographs were exposed annually.

Clinical examinations

Percussion of infraoccluded molars was used to identify ankylosis, comparing the sound with that of normal teeth. The sharp, clear sound denoting ankylosis was distinguished from the dull sound of a

Table 3

Distribution of Infraocclusion of Deciduous Teeth (≡) and Aplasia of Permanent teeth (Tooth Numbers) in the 12 Subjects

	Maxilla																Mandible															
	8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8	8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8	
1																													≡5			8	M
2																													≡5			8	M
3																													≡5			8	M
4	8				≡4							≡4				8	8				≡4							≡4	≡5			8	M
5	8			6	5	4	3	2	1		2	3		5	6	8	8		≡5			3	2	1		1	2	3		≡5			8	M
6																	8		≡5										≡5			8	M
7																			5										≡5				M
8	8															8													≡5				F
9																													≡5				F
10	8			5			2						5			8	8		≡5										≡5		7	8	F
11	8			5		3	2			2	3		5			8	8		≡5				1	1					≡5			8	F
12	8			5	4	3	2			2	3	4	5			8	8						1	1					≡5		7	8	F

normally-suspended tooth. During percussion, the tip of one finger was held against the tooth and the vibration also noted. According to these criteria, all infraoccluded deciduous molars were ankylosed.

Infraocclusion at the start of the study ranged from 1.3mm to 4.6mm (mean 2.7mm). Maximum infraocclusion during the observation period ranged from 1.6 to 5.3mm (mean 3.7mm) (Table 4). In the 6 pairs with infraocclusion where a successor was present on only one side, the infraocclusion was more pronounced on the side with no successor in all cases (Figs. 1 and 2, Table 5).

Table 4

Infraocclusion (mm) for 20 Deciduous Molars with Aplasia of the Permanent Successor

	Low	Mean	High
Start	1.3	2.7	4.6
Maximum	1.6	3.6	5.3

Radiographic examinations

Lateral cephalometric radiographs, orthopantomographs and intraoral periapical radiographs of the infraoccluded teeth were used.

In order to obtain successive identical orientation for intraoral radiographs, each film was attached to a film holder individually adapted to the occlusal surface of the first permanent molar distal to the deciduous molar under study. This film holder was individually fitted for each child by means of a thermoplastic material, so that it could be positioned identically at each radiographic examination.

Table 5

Infraocclusion (mm) for Six pairs of Mandibular Second Deciduous Molars where aplasia was present on one side only

	Aplasia			No Aplasia		
	Low	Mean	High	Low	Mean	High
At Start	2.2	3.4	4.0	1.3	2.4	3.4
Maximum	3.0	4.5	5.1	2.1	3.3	4.7

A specially-designed lightweight (20gm) aluminum plate was attached to the film holder so that it extended laterally out of the mouth at a right angle to the film as a guide for orienting the x-ray beam for the paralleling technique.

Vertical alveolar bone height in the mandibular first permanent molar region of those with bilateral infraocclusion and unilateral aplasia of the successor was also measured on orthopantomographs. From the most coronal part of the root furcation of the first permanent molar, a line bisecting the mesial and distal roots was drawn to the lower border of the mandible and measured. The orthopantomographs were checked for distortion and enlargement, and if variation in vertical enlargement exceeded 1mm, the radiograph was not used for this measurement.

Lateral cephalometric radiographs were exposed with the mandible in the intercuspal position. The distance from anode to film was 155cm, and from median plane of the skull to the film was 10cm. Correction was not made for magnification because this is a constant that does not affect relative values.

Cephalometric analysis included dental, dentoalveolar and skeletal variables, using conventional orthodontic diagnostic procedures (BJÖRK 1947, HASUND 1973). Airway obstruction was recorded according to LINDER-ARONSON AND HENRIKSON (1973).

Dental Casts

Study casts were used to identify rotation and tipping of teeth, type of malocclusion, and for measurement of infraocclusion and available space in lateral segments. Infraocclusion was measured from a plane established by placing a steel ruler from the mesiobuccal cusp of the first permanent molar to the incisal edge of the central incisor in the same jaw and side. The shortest vertical distance to the occlusal surface of the infraoccluded tooth was measured with sliding calipers to the nearest 0.1mm.

Buccal arch segments were measured from the mesial surface of the first permanent molar to the distal surface of the permanent lateral incisor, representing the arch space for the cuspid and bicuspids. The diagonal distance between the mesial surface of the first permanent mandibular molar and the mesial surface of the lower central incisor, representing the lateral arch length, was also measured on both sides.

— Findings —

Clinical findings

None of the infraoccluded deciduous molars lacking a successor exfoliated spontaneously during the observation period, in contrast to the exfoliation of *all 6* of the infraoccluded deciduous molars with an underlying successor between ages 11.5 and 14.8 (Fig.1).

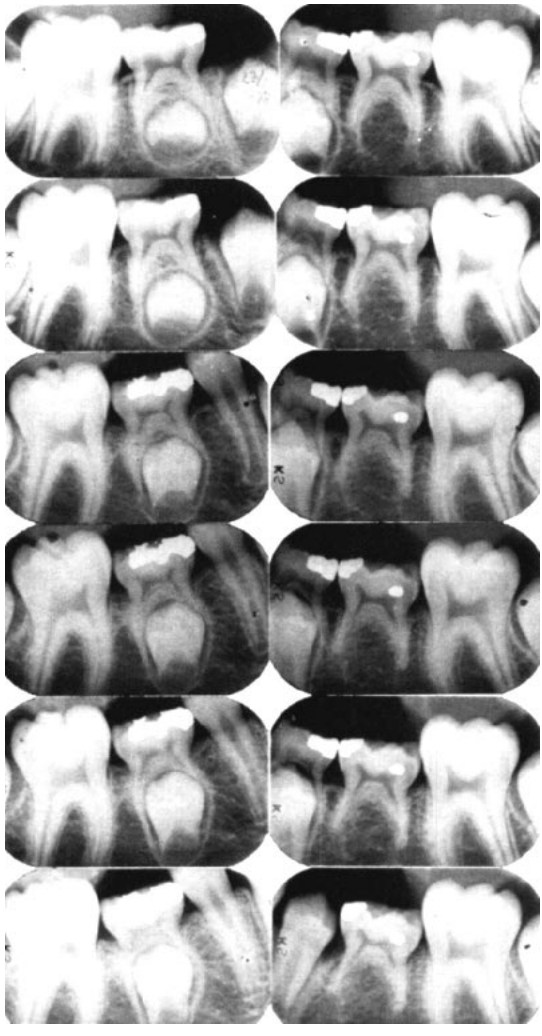

Fig. 2 Periapical radiographs of a boy from 9yr 9mo to 14yr 3 mo of age. Note the infraocclusion on each side, and slow resorption of tooth 75. Percussion sounds indicated ankylosis of all infraoccluded deciduous molars.

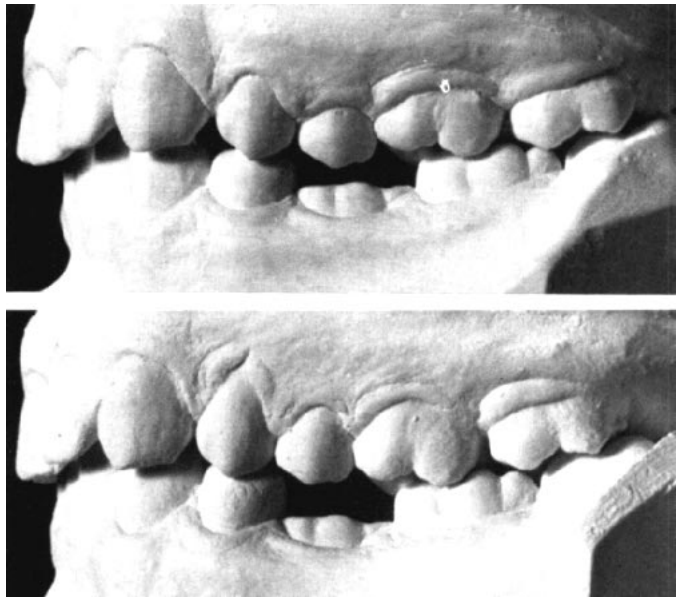

Fig. 3 A boy at 13yr 8mo of age and 18yr 8mo of age. Note the minor increase in infraocclusion (2.8→3.9mm) for tooth 75, which was only 0.4mm during the last 3 years.

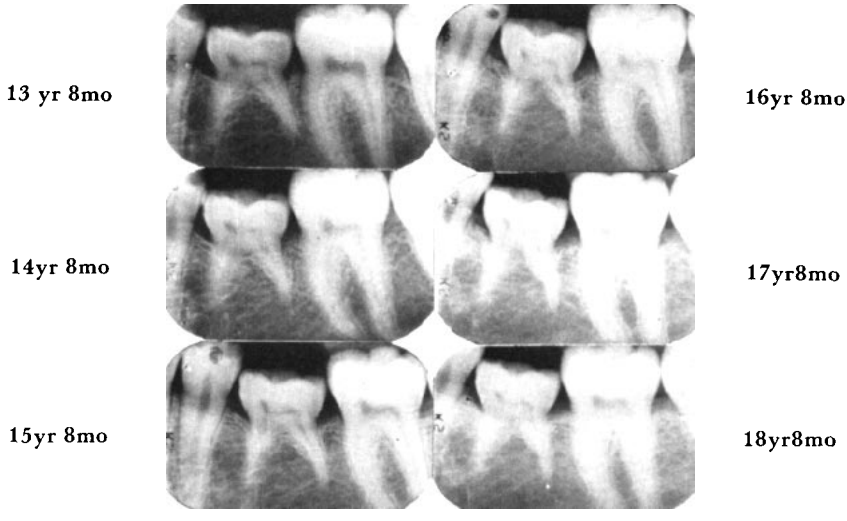

Fig. 4 Annual periapical radiographs of the dentition shown in Fig. 3. Percussion sounds indicated ankylosis at all registrations. Note the slow root resorption of tooth 75.

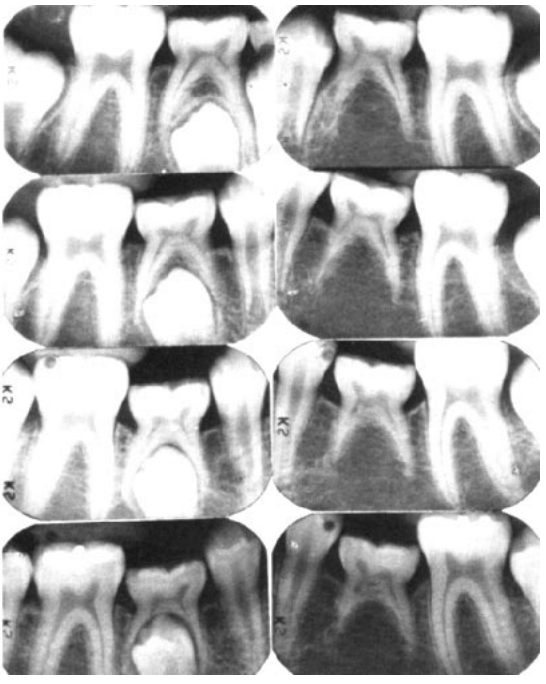

Fig. 5 **Periapical radiographs of a boy from 10yr 5mo to 12yr 11mo of age. Note the root resorption and progressive infraocclusion on both sides. Root resorption for the deciduous molar with no successor was 1.2mm mesially and 0.1mm distally during the 2.5 year observation period. The infraoccluded deciduous molar with a permanent successor exfoliated normally one year after the last radiograph, at 13yr 11mo of age.**

Progression of the infraocclusion was seen at all ages, but it progressed more slowly in the older children (Figs. 2-4). Of the 20 deciduous molars with aplasia of the successor, 18 showed progression of the infraocclusion. The mean annual increase in infraocclusion was 0.5mm ±0.26mm s.d. per year.

Radiographic Findings

In the infraoccluded area, the marginal alveolar bone contour followed the cemento-enamel junction of the infraoccluded deciduous molar.

The vertical alveolar bone height in the first permanent molar region was measured indirectly from the molar bifurcation to the lower border of the mandible. In the 6 children with bilateral infraocclusion of mandibular second deciduous molars where the successor was present on only one side, alveolar bone height showed no systematic difference between the two sides.

The infraoccluded deciduous molars with no successor generally showed very slow root resorption. Identifiable root resorption was registered in 21 of the 36 mandibular roots, while 15 showed only negligible change in root length or none at all. The annual decrease in root length ranged from 0.1 to 1.2mm per year (mean 0.4mm), tending to be less in children older than 13 years (Figs. 3-5).

Cephalometric analysis revealed only small variations from normal mean values.

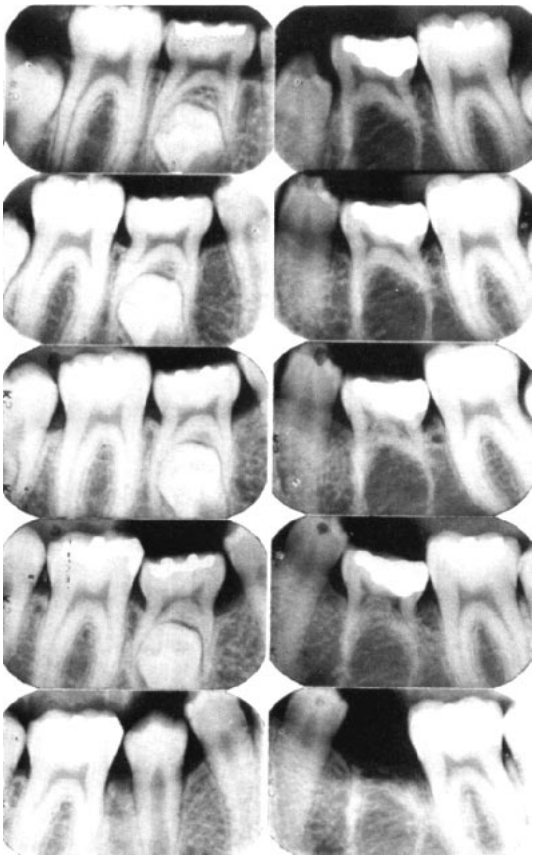

Fig. 6 Periapical radiographs of a boy from 10yr 4mo to 14yr 4mo of age. Both second deciduous molars showed progression of the infraocclusion (left side 3.4mm→4.7mm). The infraoccluded deciduous molar with no successor was extracted at 13yr 4mo of age; note the residual root fragments one year later.

Occlusal Development

No first permanent molar tipping was seen at the start of the observations. At the end of the observation period, tipping of the first permanent molar was noted in 3 of the 9 quadrants where infraocclusion exceeded 4mm (Fig. 1).

Space conditions in mandibular lateral segments showed less than 0.5mm of change in 8 of the 18 quadrants. In the other 10, changes ranging from −1.8mm to +1.3mm were seen, with 5 showing increases and 5 showing decreases.

All 5 quadrants with decrease of space in lateral segments also showed more infraocclusion.

For the rest of the studied variables, no special findings relevant to this study were found.

— Discussion —

The prevalence of aplasia of bicuspids in the Swedish population has been reported to be about 2%-3% (GRAHNÉN 1956, THILANDER AND MYRBERG 1973). The prevalence of infraoccluded deciduous molars has been found to vary between 8% and 14% in the 6–11yr age group

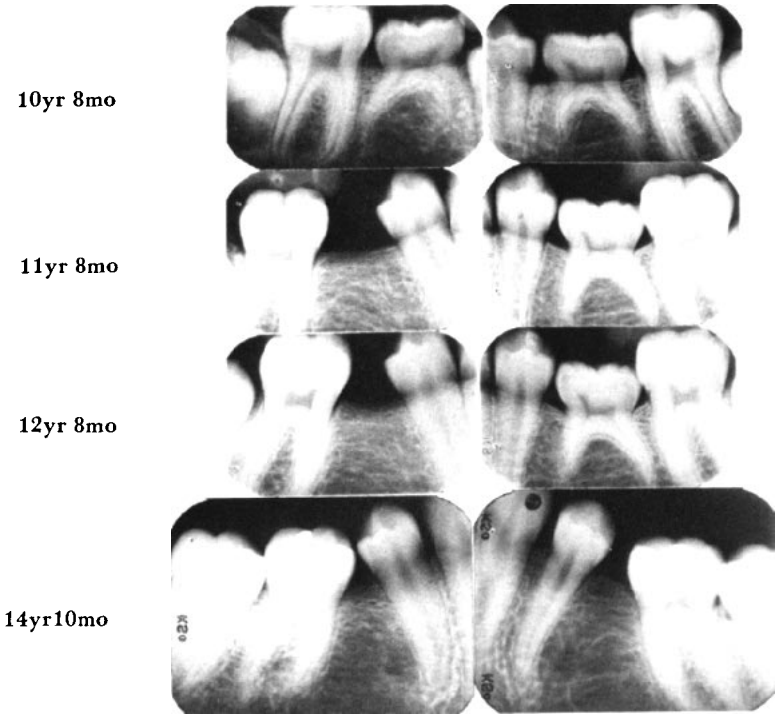

Fig. 7 Periapical radiographs of a boy from 10yr 8mo to 14yr 10mo of age. Bilateral infraocclusion and no successor bicuspids. The infraoccluded second deciduous molar on the right side was extracted at 10yr 8mo of age, and that on the left side at 12yr 8mo of age. Note the gradual closure of extraction gaps and tipping of the first permanent molar. Orthodontic appliances were not used before the last radiograph.

(KUROL 1981). The combination of infraocclusion and no successor must therefore be considered unusual.

The orthodontic treatment plan in cases with aplasia often includes extraction of the affected deciduous molar, so subjects for longitudinal study of such areas are difficult to find. This appears to be the first longitudinal study of the progression and occlusal effects of infraocclusion of deciduous molars combined with aplasia of the permanent successor.

Although the study sample is small, it can nevertheless be considered representative. It includes children of various ages, with spontaneous exfoliation of other deciduous teeth earlier than normal as well as later than normal.

The progression and degree of infraocclusion where permanent successors were present did not differ much from the findings in earlier studies (KUROL AND KOCH 1984, KUROL AND THILANDER 1984). However, the influence of aplasia is clearly reflected in children with bilateral infraocclusion of deciduous molars where a successor is absent on only one side. In these individuals, the side with no successor showed more infraocclusion, which is in agreement with the findings of RYGH AND REITAN (1963).

The presence of a permanent successor

is very important for normal exfoliation of a deciduous molar. No deciduous molars in infraocclusion with aplasia of the successor were found to exfoliate spontaneously, in contrast to exfoliation of all deciduous molars where the successor was present. The spontaneous exfoliation is in agreement with findings in a large sample of infraoccluded deciduous molars (KUROL AND THILANDER 1984). The failure to exfoliate in the absence of a successor bicuspid as found in this sample is therefore of special interest.

Very slow root resorption was nevertheless registered even for most infraoccluded deciduous molars with no successor. This is similar to findings in studies on non-infraoccluded deciduous molars by FANNING (1961), FURSETH (1961), HIDIASI (1976), AND ZADIK ET AL. (1975). It is noteworthy that the root resorption was even slower in children older than 13 years, indicating a slowing of root resorption with age (Fig. 4).

However, even slow root resorption introduces a factor of uncertainty in the long-term prognosis for a deciduous molar remaining in the dental arch. Even though the infraocclusion can be expected to progress only slowly in teenagers, root resorption can still cause later exfoliation. Histological studies seem to support this assumption (KUROL AND MAGNUSSON 1984).

The extent of root resorption and infraocclusion are both important factors to consider in planning treatment in the presence of an infraoccluded deciduous molar lacking a permanent successor.

Clinical Management

In a previous study of the effect of extraction of deciduous molars with successors, a conservative approach to extraction therapy was advocated by KUROL AND KOCH (1984). Careful observation and watchful waiting have been previously recommended by the present Authors for the clinical management of infraoccluded deciduous molars with permanent successors (KUROL AND THILANDER 1984). Different approaches must be considered with aplasia of the permanent successor.

In cases with aplasia of the successor in combination with infraocclusion of a deciduous molar, the patient's age, occlusal status, and the development and condition of the infraoccluded tooth are all important diagnostic considerations.

If progression of the infraocclusion and the root resorption are very slow or imperceptible, and the deciduous molar is considered useful, it may be left in the dental arch (Figs. 3 and 4). Infraoccluded deciduous molars with very slow or no root resorption may remain in the dental arch for many years.

However, the progression of infraocclusion as shown in this study, however slight it may be, will complicate such therapy. Progressive infraocclusion can cause occlusal disturbance, but this can be alleviated by augmenting the coronal height and approximal contacts with bonded materials as described by BONIN (1976) and GORELICK AND GEIGER (1977).

Progressive resorption can also lead to eventual tooth loss.

Where prospects for successful functional retention of an infraoccluded deciduous tooth are not good, extraction must be considered, and therapeutic extraction must not be delayed too long. Early extraction provides more time for spontaneous mesial drift (Fig. 7), and also a more favorable age for the orthodontic treatment that is usually necessary. Delay of extraction also entails the risk of additional losses of alveolar bone.

On the other hand, extraction can necessitate extensive orthodontic treatment, and may involve other complications like root fragments which must be left due to the ankylosis (Fig. 6).

The main conclusion in regard to treatment planning is that infraocclusion is of

minor importance compared to aplasia, which is the determining factor in planning therapy for these patients.

— Summary —

This study demonstrates the importance of a permanent successor for normal exfoliation of infraoccluded teeth.

The most important clinical implication is that infraoccluded deciduous molars combined with aplasia of the successor should be treated with emphasis on the aplasia, especially when the patient is seen at an early age. Other factors to consider are the severity of the infraoccusion, the extent of deciduous root resorption and the age of the patient.

The infraocclusion of these deciduous molars may be expected to progress, with a risk of occlusal disturbances like mesial tipping of permanent first molars. In general, early infraocclusion makes extraction of the deciduous molar a more promising course, and in those cases where extraction is necessary, early extraction is most effective.

If ankylosis occurs late in growth, the infraocclusion may be expected to progress at a diminishing rate. Root resorption of the deciduous molar is also likely to be slow in the absence of a permanent successor, particularly after 13 years. Such an infraoccluded deciduous molar may be left in the dental arch, possibly with augmented occlusal height, and serve as an excellent functional space maintainer for many years — or, it may be removed and the space closed orthodontically or restored. A/O

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