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Severe Infra-occlusion and Failed Eruption of Deciduous Molars Associated with Eruptive and Developmental Disturbances in the Permanent Dentition: A Report of 28 Selected Cases

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Abstract. *Retrospective analysis of 28 children suffering from severe infra-occlusion and/or primary failure of eruption of deciduous molars revealed an association with eruptive and developmental disturbances in the permanent dentition, including ectopically placed teeth and aplasia of teeth. Taurodont permanent molars were evident in 19 of the 28 selected cases which suggests a possible developmental relationship between these factors. Problems in relation to treatment of these cases are discussed.*

Refereed Paper

Introduction

Increasing attention has been focused during the past three decades on the hereditary basis for the phenomena of infra-occlusion (submergence) of deciduous molar teeth, and the eruptive failure of both deciduous and permanent teeth (Via, 1964; Bosker *et al.*, 1978; Kurol, 1981; Koyoumdjisky-Kaye and Steigman, 1982a; Helpin and Duncan, 1986; Bjerklin *et al.*, 1992). Furthermore, research has indicated a close relationship between infra-occlusion of deciduous molars, ectopic eruption of permanent teeth and certain types of anomaly such as dental aplasia (Bjerklin *et al.*, 1992). While infra-occluded deciduous molar teeth are a common occurrence in the human community with child prevalence figures from early studies varying from 1·3 to 38·5 per cent (Andlaw, 1974), severe infra-occlusion has been observed relatively infrequently, with the suggestion that it affects only 2·5–8·3 per cent of all infra-occluded deciduous molars (Brearley and McKibben, 1973; Brearley Messer and Cline, 1980, Koyoumdjisky-Kaye and Steigman, 1982b). Comparatively rare are reported cases of primary failure of eruption of deciduous or permanent molar teeth into the mouth, that is teeth for which there is no obvious impediment to eruption e.g. impaction by an adjacent tooth (Kaban *et al.*, 1976; Bosker *et al.*, 1978; Proffit and Vig, 1981; Amir and Duperon, 1982; Brady, 1990; Biandir and Roccuzzo, 1991; Ireland, 1991; Raghoebar *et al.*, 1991).

Ankylosis is a well established and frequent association with infra-occlusion of deciduous molars (Darling and Levers, 1973; Kurol and Magnusson, 1984). The exact mechanism for the initiation of ankylosis is unknown (Kurol and Thilander, 1984), but it is probably due to developmental disturbances in the periodontium (Kurol and Magnusson, 1984). In primary failure of eruption of permanent teeth ankylosis is not always evident *ab initio*, but may follow the application or orthodontic force designed to move the teeth into the arch (Proffit and Vig, 1981). However, histological investigation of secondarily retained (previously erupted, subsequently infra-occluded) permanent molars has shown local areas of root ankylosis in all cases (Raghoebar *et al.*, 1989).

Changes in the distribution of epithelial cell rests of Malassez in the periodontium of ankylosed deciduous molars have been noted, and thought to be aetiologically relevant to subsequent root resorption and ankylosis (Rygh and Reitan, 1963). Studies of permanent teeth with primary or secondary eruptive disturbances have not identified similar changes in the distribution of epithelial cell rests in the periodontium of affected teeth. However, malfunction of the epithelial root sheath (from which the cell rests of Malassez are derived) has been claimed responsible for the anomaly of taurodontism (Bixler, 1976). The apparent association of taurodontism of permanent molars in a number of children with severe infra-occlusion and/or primary eruptive failure of deciduous molar teeth, taken together with problems experienced in their treatment, suggested the need for a retrospective assessment of selected cases and it is this which forms the basis of the present study.

Case Reports

This retrospective study is based on the clinical and radiographic records obtained from 28 children of 26 families attending the Eastman Dental Hospital over the past 25

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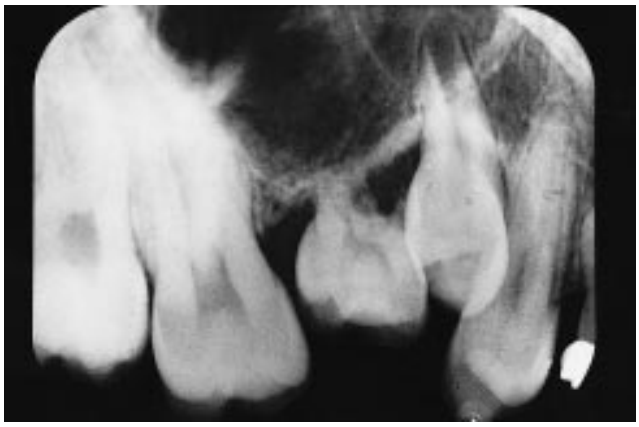


FIG. 1 Severe infra-occlusion of maxillary right second deciduous molar seen in the periapical radiograph of Case 14. Note ectopic eruption of succedaneous premolar.

FIG. 2 Orthopantomograph of Case 18 showing primary failure of eruption of the right mandibular second deciduous molar, together with varying degrees of infra-occlusion of other deciduous molars.

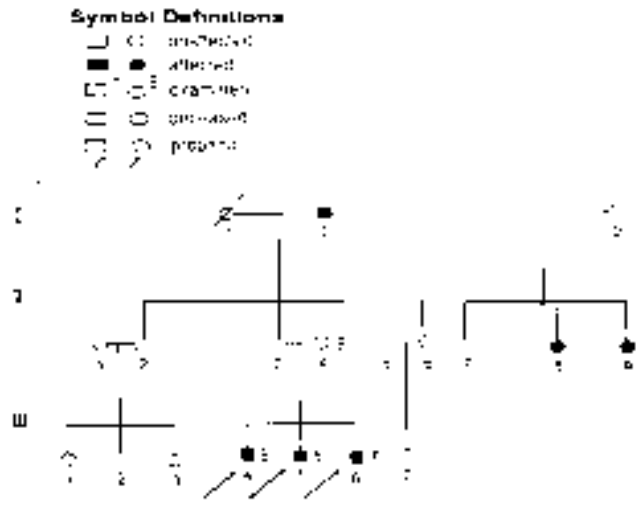


FIG. 3 Pedigree of family for cases 21, 23, and 24 showing an autosomal dominant inheritance pattern with lack of expression in one family member (II_2).

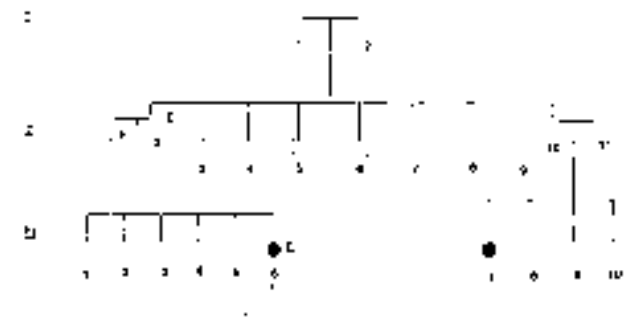


FIG. 4 Pedigree of family for case 27 with first cousin intermarriage for II_1 and II_{10}, showing possible autosomal recessive inheritance pattern.

years. The reason for their inclusion in the study was the observed presence of at least one severely infra-occluded deciduous molar or the evidence of primary failure of eruption of at least one deciduous molar. Severe infra-occlusion (Fig. 1) was judged to be present when the occlusal surface of the deciduous molar was level with or below the interproximal gingival tissue of one or both adjacent tooth surfaces (Brearley and McKibben, 1973). Primary failure of eruption was diagnosed when the unerupted tooth was covered by an intact mucosa and radiographs revealed the tooth deeply buried in the jaw bone (Fig. 2). Details of all clinical and radiological findings, and family histories obtained by parental interview with a senior clinician (mainly the first author) at the initial hospital visit, together with the surgical treatments subsequently undertaken are indicated in Table 1. The cases are listed in sequential order dependent on the date of the first hospital attendance.

The ages of the subjects at the initial visit ranged from 4 years 10 months to 16 years 9 months (mean 9 years 3 months) with a review period for those kept under observation from 1 month to 10 years 9 months (mean 3 years 7 months). The total group consisted of 19 girls and nine boys with three male siblings (cases 21, 23, and 24) from one family. The latter family, together with three other children (cases 19, 20, and 27) had histories of similar problems in other family members. The most extensive pedigrees were present in cases 21, 23, and 24 [Fig. 3], and case 27 (Fig. 4). The former pedigree follows an autosomal dominant pattern of inheritance with variable expressivity, the latter pedigree is most likely explained as an autosomal recessive trait as the parents of both affected girls were first cousins. Two more cases had first degree relatives affected, case 19 had an elder brother and mother affected, and case 20 had an elder brother with the problem. Both these cases could be explained on the basis of autosomal dominant inheritance. Family histories were unobtainable for the remaining 22 cases.

Of considerable interest were two children (cases 18 and 19) with primary failure of eruption of mandibular second deciduous molars as well as other severely infra-occluded deciduous molars. Six children (cases 1, 6, 10, 15, 26, and 27) had primary failure of eruption of deciduous molars unassociated with severe infra-occlusion of the deciduous molars, one child (case 27) had, in addition,

TABLE 1 *All relevant details from case notes and radiographs for the 28 children included in the study*

Case no.	Sex	Age	Review period	Deciduous teeth: Infra-occlusion: Severe	Deciduous teeth: Infra-occlusion: Mod/Min	Deciduous teeth: Failed eruption	Permanent teeth: Infra-occlusion	Permanent teeth: Failed eruption	Imp	Ect	Miss	Taurodont molars	Fam history	Surgical: IP	Surgical: OP	Other features
1	F	6 y 10 m	4 y 10 m	—	—		—	6/	6/	6/	—	6/6	—	✓	—	6/ impact on
						E/			5E/	5?						E/
2	M	16 y 9 m	7 m		—	—	—				—	76/67	—	✓	—	Pyramidal
				E/				5/	5/	5/						roots 7/7
3	F	14 y 5 m	1 y 3 m	E/E	—	—	—	—	/E	—	54/5	7/67	—	✓	—	
											/5	7/67				
4	F	16 y 2 m	1 y 1 m	E/	—	—	—	—	—	5/	—	—	—	—	✓	
5	F	9 y 7 m	—			—	—				—	6/6	—	—	—	
				E/E	D/			/6	E/6	/5						
6	M	5 y 8 m	3 y 8 m	—	—		—	—			—	6/6	—	✓	—	
						E/			5/	5/						
7	F	10 y 7 m	2 m	/E	—	—	—	—	—	/5	—	6/6	—	—	—	
8	F	15 y	2 y 5 m	/E	—	—	65/56	—	/E	/5	—	76/67	—	✓	—	
9	F	7 y 4 m	4 m	E/	—	—	—	—	E/	5/	—	6/6	—	—	—	
10	F	14 y 9 m	?	—	—	E/	76/	—	—	5/	—	Uncertain	—	?	?	
11	F	9 y 2 m	?	/E	E/	—	—		5/5	5/5		—	—	?	?	
					D/			6/6			7/57					
12	F	6 y 2 m	1 m	/E	—	—	—	—	—	/5	—	Uncertain	—	—	✓	
13	M	10 y 1 m	9 y 10 m	ED/	/D	—	6/	—	—	—	2/2	76/67	—	✓	—	
				E /	D/		6/									
14	M	14 y 11 m	—	E/	/E	—	—	—	—	5/	2/5	6/	—	✓	—	Microdont /2
				E/E							5/5					
15	F	9 y 6 m	?	—		/D	—	—	—	—	—	6/6	—	?	?	
					D/											
16	F	7 y 7 m	7 y 3 m	E/	—	—	—	—	E/	5/	—	76/67	—	✓	—	
17	M	7 y 2 m	3 y 9 m	E/E		—	—	—	/E	—	/5	6/6	—	✓	—	
					E/E											
18	F	7 y 11 m	10 y 9 m	E/	/E		—	—	—	—	5/	76/67	—	✓	—	
				/D	D/E	E/					5/					
19	F	6 y 11 m	8 y 4 m	D/DE			6/	—	—		—	7/7	✓	✓	—	Ankylosis
					D/D	E/E	6/			5/5						present in /E
20	F	5 y 9 m	1 y 1 m	E/	D/DE	—	—	—	E/	5/	—	6/6 poss	✓	✓	—	1/1
				E/	D/DE											hypoplastic
21	M	7 y 7 m	6 y 4 m	/E	—	—	6/6	—	—	—	—	6/6	✓	✓	—	Emamel
				/E												opacities
22	F	10 y 3 m	4 y 9 m		—	—	—			/3	—	76/67	—	—	—	
				E/				5/	5/	5/						
23	M	7 y 1 m	4 y 2 m		—	—	—	—	—	—	—	6/6	✓	—	—	Enamel
				/E								/6				opacities
																Severe
																asthmatic
24	M	5 y 10 m	2 y 2 m	D/		—	—	—	—	—	—	6/6 poss	✓	—	—	Enamel
					D/											opacity /C
25	F	5 y 8 m	5 m	/E	—	—	—	—	—	/5	—	—	—	—	✓	
26	F	9 y 7 m	—	—	—	D/	—	—	—	4/	—	6/6	—	—	—	Invaginated 2/
27	F	4 y 10 m	3 y 5 m	—	—	BA/AB	—				—	—	✓	—	✓	
						EA/AE		6/6	6A/A65/5							
28	F	5 y 11 m	1 y 5 m			—	—	/6	6/6	6/6	—	6.6 poss	—	—	—	6/
				D/	/D											spontaneous
																eruption

Key: Mod/Min = moderate/minimum; Imp = impacted; Ect = ectopic; Miss = missing; Fam Hist. = family history; IP = in-patient; OP = out-patient; ? = record unavailable; Poss = possible.

failed to erupt deciduous incisors. Of the deciduous molars affected by severe infra-occlusion in 22 children, 17 were maxillary second molars, 10 mandibular second molars, four maxillary first molars, and two mandibular first molars. Three cases (13, 14, and 19) had severe involvement of three molars, two bilateral and one unilateral. Six cases (3, 5, 17, 18, 20, and 21) had two primary molars severely affected, four bilateral, and two unilateral. Moderate to mild infra-occlusion affected other deciduous molars in 10 of the 23 children exhibiting severe infra-occlusion. Impaction of the severely infra-occluded maxillary second deciduous molar on a mesially tilted first permanent molar was evident in seven cases (3, 5, 8, 9, 16, 17, and 20), and in one case (1) of failed eruption the mandibular second deciduous molar was similarly impacted.

Eruptive disturbances were not limited to the deciduous dentition. Twelve children had problems with the eruption of permanent teeth, in six of whom (cases 1, 2, 5, 22, 27, and 28) impaction against an adjacent tooth could have accounted for the disturbance (Fig. 5). Two of these children (cases 1 and 28) had impaction of maxillary first permanent molars on the distal aspect of the adjacent second deciduous molar. In case 1, extraction of the deciduous molar allowed full eruption of the permanent molar; whereas in the second child (case 28), spontaneous eruption of the permanent molar occurred unilaterally in the right maxilla and extraction was only required for the contralateral deciduous molar. Of the other six children (cases 8, 10, 11, 13, 19, and 21), one child (case 11) failed to erupt mandibular first permanent molars by the age of 9 years 2 months. The remainder suffered from infra-occlusion (secondary retention) of permanent molars and in one case (8) of molar and premolar teeth, subsequent to severe eruptive problems in the deciduous dentition.

Ectopically-placed permanent teeth were evident in the radiographs of 20 cases (71 per cent), most of which were second premolars, In one case (22) a maxillary canine was ectopic in addition to a mandibular second premolar and in another (case 26) a maxillary first premolar was the only ectopically placed tooth. Two cases mentioned above (1 and 28) had ectopically placed and impacted first permanent molars. Of the 18 cases with ectopically placed second premolars, 11 were sited in the maxilla (bilateral in case 11) and seven in the mandible (bilateral in cases 19 and 27). Impaction of ectopically-placed premolars was evident in five children (cases 1, 2, 6, 11, and 22); two of whom (cases 6 and 11) were too young to rule out the possibility for spontaneous eruption of the affected teeth.

Taurodontism of permanent molar teeth was evident from radiographs in 19 of the 28 cases (68 per cent) with three more children potentially affected, but too immature to allow for accurate assessment (cases 20, 24, and 28). Radiographic evidence was inadequate for assessment of this feature in two cases (10 and 12). The radiographic assessments were made from orthopantomographs in 12 children, oblique lateral jaw radiographs in six children (cases 1, 2, 3, 6, 26, and 28) and from periapical radiographs in one child (case 14). Detailed assessment of permanent molar teeth was made by direct tracing of radiographs and applying the landmarks and criteria of Holt and Brook (1979) for the diagnosis of taurodontism, i.e. a ratio of 1:4·5 or less. The use of panoramic radiographs for the assessment of taurodont first permanent molars has been validated by Seow and Lai (1989) employing a different set of landmarks. The latter were not utilized in the present study as these landmarks proved difficult to interpret for all first and second permanent molars from the tracings. Only two children (cases 3 and 23) showed taurodont lower molars and a third child (case 2) exhibited pyramidal (cuneiform) roots in the mandibular second molars (Fig. 6).

Another dental anomaly evident both clinically and radiographically in six children was hypodontia (aplasia) of permanent teeth. Five children (17 per cent) had aplasia of second premolars, two of whom (cases 3 and 11) also had aplasia of a maxillary first premolar or aplasia of both mandibular second molars. A third child (case 14) also had a missing maxillary lateral incisor with an erupted microdont contralateral incisor. Another child (case 13) had bilateral aplasia of maxillary lateral incisors. Also present in the permanent dentition were the coronal invagination of a maxillary lateral incisor (case 26) and

FIG. 5 Oblique lateral jaw radiographs for case 5 showing severe infra-occlusion of both mandibular second deciduous molars with impaction of the right molar on the mesially tilted first permanent molar together with failed eruption and impaction of the mandibular left first permanent molar.

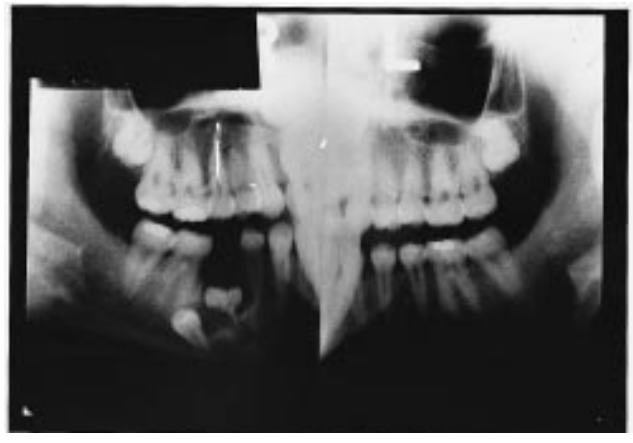
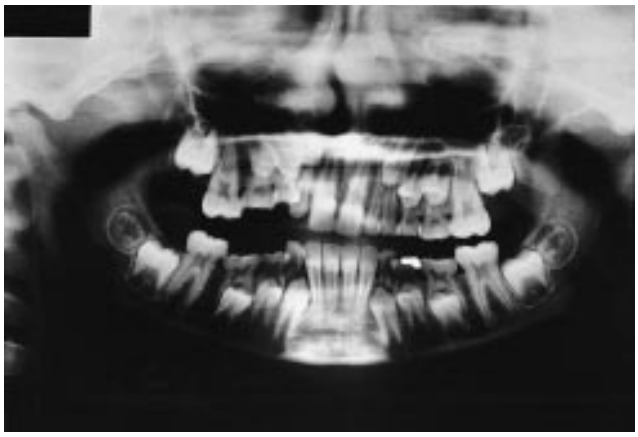


FIG. 6 Oblique lateral jaw radiographs of case 2 showing severely infra-occluded mandibular right second deciduous molar, ectopic and impacted succedaneous premolar, and taurodont maxillary first and second permanent molars together with bilateral pyramidal roots on mandibular second permanent molars.



(a)

(b) Right

(b) Left

FIG. 7(a) Orthopantomograph of case 13 taken at the age of 10 years 1 month. This shows right-sided severe infra-occlusion of both maxillary deciduous molars and the mandibular second deciduous molar. Infra-occlusion of the right first permanent molar was also evident at this stage. Note aplasia of maxillary lateral incisors. (b) Clinical photographs of case 13 taken at a later date showing the problems of infra-occlusion particularly evident on the right side of the jaws.

marked enamel hypoplasia of maxillary central incisors (case 20) which could have been caused by local factors. Discrete whitish enamel opacities affected the incisors and first molars in two brothers (cases 21 and 23) and a mandibular deciduous canine in the third brother (case 24). The latter changes were thought to resemble those seen in the hypomaturation type of amelogenesis imperfecta.

Seventeen children had infra-occluded or unerupted teeth removed surgically or extracted under general anaesthesia, 13 (76 per cent) of whom required admission to hospital for this purpose. The records for three cases (10, 11, and 15) were unavailable on this aspect of their care. The decision on hospital admission was taken after consideration of the child's age and emotional maturity, the complexity of the surgery required, and following discussion with the parents and the maxillofacial surgeon concerned with the operative procedure.

Of the five children with infra-occlusion of permanent teeth (cases 8, 10, 13, 19, and 21) mentioned above, active orthodontic treatment aimed primarily at promoting the eruption of these teeth was undertaken in only one child (case 13). This patient presented at the age of 10 years 1 month with unilateral infra-occlusion of $\frac{6}{6}|$ together with varying degrees of infra-occlusion of his deciduous molars and bilateral aplasia of $\underline{2}|\underline{2}$ (Fig. 7a,b). He was subsequently admitted for the removal of the infra-occluded

FIG. 8 Cephalometric lateral skull radiograph of case 13 taken at the age of 12 years showing evidence of reduced anterior overbite and overjet.

FIG. 9 Orthopantomograph of case 13 aged 15 years showing a marked skeletal open bite which was more pronounced on the right side. Note taurodontism of maxillary first and second molars.

FIG. 10 Cephalometric radiograph of case 13 aged 19 years, which shows persistence of the skeletal open bite.

deciduous teeth under general anaesthesia with the aim of encouraging the eruption of the premolars. At 12 years of age the premolars were seen to be erupting but the infraocclusion of $\frac{6|}{6|}$ persisted. A reduced overbite and overjet were noted at this stage (Fig. 8). Following this visit $\frac{6|}{6|}$ were bonded and buccal elastics fitted to encourage eruption of these teeth. Subsequently, the remaining teeth in the upper arch were bonded, with power chains employed to promote the eruption of the malposed maxillary canines. Active orthodontic treatment continued for 2 years 6 months followed by a maxillary retainer for a further period of 3 months When reviewed at 15 and 19 years he was noted to have developed a skeletal anterior open bite which was more pronounced on the right side, the occlusion on this side being provided by the second permanent molars alone (Figs 9 and 10).

Histological examination was undertaken on both mandibular second deciduous molars which had failed to erupt in case 19. Only one of the molars showed evidence of ankylosis of bone to the inter-radicular root dentine.

Discussion

This study encompasses a larger group of children with severely infra-occluded and/or failed eruption of deciduous molars than any previously published single investigation. Therefore, it has the advantage of observing and analysing associated phenomena which might have escaped notice or have been attributed to a chance finding and not thought worthy of mention. The association in this study of taurodontism of permanent molar teeth with eruptive problems in the deciduous dentition is such an example. This relationship does not appear to have been noted in any previously published reports on the subject and poses the question as to whether the association is only true for severe eruptive problems in the deciduous dentition or whether it applies to infra-occluded deciduous molars in general. At the same time it is necessary to state that the evidence presented in this study is not comparable to that obtained epidemiologically, but was gained from a highly biased sample of referred hospital patients. Further study will be required with much larger groups of children for whom suitable radiographs are available to clarify this point. However, the fact that 19 out of 28 children (68 per cent) in this study of sequentially selected cases had taurodont permanent molars suggests a close developmental association between the anomaly and eruptive disorders in the deciduous dentition. Admittedly most taurodont molars were evident in the maxilla, with only three children (10 per cent) showing concomitant abnormality in the mandible. Three previous studies of population groups (Holt and Brook, 1979, Seow and Lai, 1989; Schalke-Van der Weide *et al.*, 1993) identified taurodontism of mandibular first permanent molars in 6·3–9·9 per cent of individuals. Prevalence figures for taurodontism of maxillary molar teeth in normal population groups are not available at the present time, but it is unlikely that the anomaly would be observed in approximately two-thirds of individuals as is evident in the present study. Of course, care has to be exercised in comparing data from a limited sample of highly selected cases with norms for whole population groups.

It is generally accepted that taurodontism is determined by anomalous activity or malfunction of Hertwig's epithelial root sheath (Bixler, 1976). Such maldevelopment of multirooted teeth is associated more frequently with hypodontia and some types of amelogenesis imperfecta than is the norm for population groups (Seow and Lai,

1989; Winter, 1996). Both these latter conditions are examples of abnormality in ectodermally derived dental tissues. The finding of premolar aplasia in 17 per cent of subjects in this study is similar to that noted in a recent Swedish study which showed a prevalence of 19·4 per cent of premolar aplasia in children with all types of infra-occluded deciduous molar teeth (Bjerklin *et al.*, 1992). The latter study also revealed a relationship between the ectopic eruption of maxillary first permanent molars, ectopic eruption of maxillary permanent canines, and infra-occlusion of deciduous molars. However, detailed statistical analysis in the Swedish study revealed that only the relationship between premolar aplasia and infra-occlusion of deciduous molars reached prevalence figures higher than would be expected for the normal population. These results are reflected in the present study where only one case (22) showed an ectopic maxillary canine and two cases (1 and 28) of ectopically erupting maxillary first permanent molars.

From the assessment of radiographs in this study it was also evident that developing premolars were frequently ectopically placed in relation to other developing teeth in the arch, the problem affected second premolars in 18 or the 28 cases (64 per cent) although only five cases (1, 2, 6, 11, and 22) were judged to show evidence of impaction. Four out of the five cases involved mandibular second premolars, all with severe eruptive problems in the deciduous predecessor. This relationship between more pronounced infra-occlusion and displaced permanent successors has been noted previously (Kurol and Thilander, 1984).

Early studies suggested that infra-occlusion of deciduous molar teeth may in some way be related to structural changes in the periodontal membrane involving the epithelial rests of Malassez (Rygh and Reitan, 1963). Similarly, primary failure of eruption of deciduous and permanent teeth has been attributed to abnormalities in the periodontal ligament structures related to eruption (Proffit and Vig, 1981), although the precise cells involved were not delineated. The latter study also noted an association between eruptive disorders affecting second deciduous molar teeth and first permanent molars comparable to that observed in the present study. Two other aspects found in agreement with this earlier study were the more frequent involvement of posterior teeth and that permanent molars involved in eruptive abnormality either erupted into occlusion and then ceased to erupt further (secondary retention) or failed to erupt at all.

While none of the patients described by Proffit and Vig (1981) had closely affected relatives, an earlier study (Bosker *et al.*, 1978) described nine families in which the condition was clearly inherited by an autosomal dominant gene with complete penetrance. In the present investigation three of the four families with known family histories appear to follow a similar genetic pathway. In one of these families (cases 21, 23, and 24) the three male sibling probands came from a family with a three-generation history (Fig. 3), two members ($II_{8\&9}$) of this family having been described in a previous publication (Ireland, 1991). This family forms a good example of genetic conveyance by an autosomal dominant gene with complete penetrance but variable expressivity. The fourth family (case 27) appears to follow an autosomal recessive pattern (Fig. 4), the proband (III_6) in this family was the offspring of first cousin intermarriage, as was her female cousin (III_7). Case 19 with secondary retention of first permanent molars had a mother and elder brother affected. The brother of case 20 was known to have been affected by severe infra-occlusion of deciduous molars. All other cases were without known family history and are most likely to have been determined by a genetic abnormality with a polygenic mode of inheritance or an environmentally sensitive single gene anomaly (Kurol, 1981).

The fact that these abnormalities were possibly genetically determined was suggested by earlier studies (Via, 1964; Kurol, 1981, Koyoumdjisky-Kaye and Steigman, 1982a,b). These investigations demonstrated a higher prevalence of infra-occlusion of deciduous molars in the siblings of affected children and a varying frequency of the abnormality between different ethnic groups of children. Monozygotic twins have also been reported with similar patterns of infra-occlusion (Helpin and Duncan, 1986). The variety of abnormalities associated with infra-occlusion illustrated by cases in the present study have also been thought to encompass different manifestations of one syndrome, each manifestation having incomplete penetrance and variable expressivity (Bjerklin *et al.*, 1992). Evidence from the present study would suggest that taurodont and pyramidal malformation of permanent molar roots should form part of this syndrome complex. Whether the latter features are governed by the same genetic mechanisms concerned in eruptive failure or whether they are the result of disrupted developmental homeostasis (Witkop, 1985) remains to be determined.

What part ankylosis plays in the primary eruptive disturbances of the deciduous and permanent dentitions remains unclear. Certainly ankylosis affects almost all infra-occluded deciduous molars (Darling and Levers, 1975), although this may be a secondary rather than an initiating factor in the process. With primary failure of eruption of deciduous teeth the evidence remains equivocal as to the part played by ankylosis. The only case investigated in this study (case 21) showed ankylosis in only one of two deciduous molars affected by primary failure of eruption. As far as eruptive disturbances of permanent molars is concerned, ankylosis is not thought to be an initiating factor in the process and the application of orthodontic force in an attempt to bring involved teeth in to the arch may lead to ankylosis rather than normal tooth movement (Proffit and Vig, 1981). However, primarily retained unerupted permanent molars have been treated by surgical exposure of the crowns prior to completion of root formation and spontaneous eruption and continued root development achieved (Raghoebar *et al.*, 1991). The latter investigators admit that secondarily retained (infra-occluded) permanent molars rarely undergo further spontaneous eruption and that orthodontic movement of the affected molars is not successful due to the high incidence of bony ankylosis. It is also possible that some of the cases treated by Raghoebar *et al.* (1991) may have been suffering from retarded rather than failed eruption (Rasmussen *et al.*, 1982).

Finally, what can be learnt from this retrospective study of children treated in a specialist centre over the past 25 years with regard to the problems outlined above. Of prime importance is the reference of the child for specialist

care prior to the eruption of the first permanent molar when it is evident that a deciduous molar has failed to erupt or has become severely infra-occluded. A decision can then be made as to the need for early surgery or a longer term treatment plan can be formulated. Early treatment is indicated when there is aplasia of the successional premolar associated with a severely affected deciduous molar and where there is evidence of possible future crowding in the arch. Such early surgery has indicated in the past the need for admission and for general anaesthesia. More recently, with improved day-care facilities available this treatment has been undertaken on an outpatient basis.

With the eruption of a first permanent molar distal to a severely infra-occluded deciduous molar or one that has failed to erupt into a potentially crowded arch, mesial tilting of the permanent molar is common. This results in impaction of the deciduous molar and complicates the process of surgical removal. In these circumstances, provided the permanent molar does not itself become infra-occluded, where space is required it can be regained later by orthodontic distal movement of the tilted molar. This has the effect of alleviating some of the surgical problems for removing the impacted and infra-occluded deciduous molar and providing space for the successional premolar to erupt. Alternatively, in a markedly crowded arch it may be thought desirable to remove the premolar at the same time as the infra-occluded deciduous molar. Ectopically placed premolars related to infra-occluded deciduous molars generally erupt into the arch without difficulty provided there is sufficient space and they are not deeply impacted.

Orthodontic procedures designed to improve the eruption of secondarily retained (infra-occluded) permanent molars associated with severely infra-occluded deciduous molars are doomed to failure despite any apparent success in the early stages of treatment. While surgical exposure of the crowns of primarily retained (unerupted) permanent molars may encourage their eruption, this cannot be guaranteed even with subsequent orthodontic assistance.

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