Prevalence of malocclusion in 6-year-old Icelandic children

A study using plaster models and orthopantomograms

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The prevalence of different malocclusion features was investigated in 396 6-year-old Icelandic children, using the epidemiologic registration method described by Björk et al. in 1964. Girls were ahead of boys with regard to dental stage ($P < 0.01$). One or more permanent teeth were congenitally missing in 5% of the children. Postnormal occlusion was found in 27% of the boys and in 31% of the girls, and prenormal occlusion was found in 6% and 5%, respectively. Straight terminal plane at the second deciduous molars was found in individuals with either normal or postnormal occlusion. Thus, it can be misleading to use the relation of the terminal planes as a measurement of the sagittal relation between the jaws. The prevalence of hypodontia was much lower than has been reported previously for Icelandic children. □ *Dentition, mixed; epidemiology; orthodontics; prevalence*

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It would be convenient to be able to forecast with good accuracy how different malocclusions diagnosed in the deciduous dentition will develop through the mixed and into the permanent dentition. Leighton (1) concluded that by the age of 5 years the anteroposterior relationship of the deciduous dental arches could indicate fairly accurately the prognosis for the permanent teeth. Foster & Grundy (2), on the other hand, concluded that an individual prediction based on the deciduous dentition is impossible, but general changes can be foretold with reasonable certainty. Development of the occlusion from the deciduous to the permanent dentition has been studied by several investigators, but the results have been dissimilar and confusing. Baume (3), in a longitudinal study of 30 individuals, found no changes in the molar relation throughout the deciduous dentition. In another study (4) he described how spaces present in the dental arches enabled mesial migration of the deciduous molars, functioning as a biologic mechanism that ensures normal occlusal relation during the eruption of the first molars. Infante (5) found a lower prevalence of class-II malocclusion in 5-year-old white children compared to 2-year-olds: 14% and 27%, respectively, and a slightly higher prevalence of the class-III relation. Rasmussen & Helm (6) found a similar frequency of distoclusion among different age groups of Danish children from 2 to 6 years of age. However, there was a tendency towards a higher frequency of a full cusp distal molar relation in children between 5 and 6 years compared with the younger children.

The purpose of this investigation was to investigate the prevalence of different occlusal traits, aberrations in the dentition, and space anomalies in 6-year-old Icelandic children.

Materials and methods

The material was collected at the Faculty of Odontology, University of Iceland, in January 1987 and in January 1988. The subjects were all attending the first class in elementary school. In 1987, 318 children from 5 elementary schools in the capital city of Iceland, Reykjavik (around 95,000 inhabitants), were invited to participate in the study, and 172 children accepted this invitation. The records of these children comprise dental study models, lateral skull radiographs, posteroanterior skull radiographs, and orthopantomograms (OPGs). In 1988, 398 children from 8 schools in Reykjavik received an invitation to participate. This time 230 children were willing to participate, and the same records were made as previously except for the posteroanterior skull radiographs. No attempt was made to increase the number of participants by sending another invitation to the non-respondents.

Of the total number of 402 children who agreed to participate in the study, 1 subject was excluded because of a cleft lip and palate, one because of bad records, and four individuals were barred from participation because they were of foreign origin. The final sample consisted therefore of 396 Icelandic individuals, 204 boys and 192 girls, with a mean age of 6 years and 7 months (s, 3.6 months). These children represented 55% of all the children attending the 6-year class in Reykjavik at the time the material was collected. In this study only the dental study models and the OPGs were examined. Study models with waxbites recording the intercuspal position were available for all the 396 subjects, and OPGs were available for 191 boys and 179 girls. The intercuspal position was checked by examining the intercuspation on the models. If the waxbite

appeared to be obviously mistaken, the intercuspation was relied on. All the models and OPGs were examined by one of the authors (B. Johannsdottir), and the epidemiologic registration method described by Björk et al. (7) was applied. According to this method, well-defined, single traits of malocclusion are registered within the categories a) anomalies of the dentition, b) occlusal anomalies, and c) deviations in space conditions. The following are considered anomalies of the dentition: premature loss of deciduous teeth, supernumerary teeth, hypodontia, malformed teeth, ectopic or disturbed eruption, infraposition, and transposition. In our study hypodontia, supernumerary teeth, and transposition of teeth are examined on the available OPGs. Occlusal anomalies in the sagittal plane are evaluated for each side separately, and deviations equal to or greater than a half cusp from full class-I relation are recorded. The sagittal occlusion is registered on the first permanent molars or, if not erupted, on the second deciduous molars. The form of the terminal plane of the second deciduous molars was registered as well. Frequent shedding of incisors made systematic registration of overjet and overbite impossible in our study. Physiologic infraocclusion of deciduous molars is recorded as a lateral open bite if it exceeds 2.0 mm. Crossbites and scissors bites (buccal crossbite) are recorded for the molar and the deciduous molar/canine sections of each side only when the cusps have passed one another. The appropriate section is registered if one or more teeth are displaced. Space deviations greater than 2.0 mm are recorded in three segments in each jaw. Dental stages are recorded in accordance with the emergence status of the teeth, but permanent molars are recorded separately:

DS 01 Deciduous teeth erupting
DS 02 Deciduous teeth fully erupted
DS 1 Incisors erupting, early mixed dentition
DS 2 Incisors fully erupted, intermediate mixed dentition
M_0 First molars not fully erupted
M_1 First molars fully erupted

Chi-square tests were used to examine differences in distribution of the findings. Differences were considered statistically significant if they exceeded the 95% probability level. To evaluate the reproducibility of the registration method, registrations of 18 variables were repeated 3 months later on 30 randomly chosen plaster models. For the variables 'right terminal plane' and 'space condition in the lower right segment', discordance was found in three subjects. For the other variables, at most two disagreements were registered, and eight variables had full concordance. The reproducibility was considered acceptable for all 18 variables.

Results

Dental stage

Table 1 shows the distribution of the children in accordance with dental stage (DS). Most of the children, 76%, were in dental stage DS 1. More girls than boys were in DS 1, 84% and 68%, respectively, the difference being statistically significant ($P < 0.01$). The rest of the children still had an intact deciduous dentition (DS 02). Most of the children, 90% of the girls and 71% of the boys, had at least one first molar erupted (M_0 or M_1). The difference between the sexes was statistically significant ($P < 0.05$). Of those children who had at least one first molar erupted, 37% already had all four fully erupted (M_1).

Anomalies of the dentition

Deciduous teeth. Twenty-two children (6%) had prematurely lost deciduous teeth. The most commonly lost teeth were the first and second lower deciduous molars.

Malformed deciduous teeth were restricted to the anterior regions of the jaws. One girl (0.3%) had a supernumerary tooth, a maxillary lateral incisor. Two girls (0.5%) had fused teeth; in both instances there was a fusion between a lower lateral incisor and a lower canine, with a corresponding 'missing tooth' in the region. None of the children had a congenitally missing deciduous tooth. Four children (1%) had peg-shaped teeth in the anterior segments. The only subject with a supernumerary tooth had, in addition, a peg-shaped lateral incisor on the contralateral side.

Inversion of deciduous incisors was found in 27 subjects (7%), with the lateral incisor as the most common tooth in an inverted position.

Permanent teeth. Table 2 shows the prevalence of congenitally missing teeth. One or more congenitally missing permanent teeth were found in 5% of the children: 6% and 4% in girls and boys, respectively. The most

Table 1. Dental stage and eruption stage of first molars (percentage of boys and girls in parentheses)

Dental stage*			Molar eruption stage†		
	Boys	Girls		Boys	Girls
DS 02	65 (32)	31 (16)	M_0	101 (50)	100 (52)
DS 1	139 (68)	161 (84)	M_1	44 (22)	73 (38)

* Difference between sexes: Chi-square = 13.3; $P < 0.01$.
† Difference between sexes: Chi-square = 4.8; $P < 0.05$.

Table 2. Congenitally missing permanent teeth (boys and girls affected, percentage in parentheses)

	Boys	Girls
Upper lateral incisors	4 (2)	1 (0.6)
Upper second premolars	2 (1)	3 (2)
Lower central incisors	2 (1)	1 (0.6)
Lower second premolars	8 (4)	8 (5)
Upper canines	—	2 (1)
Lower canines	—	2 (1)

Table 3. Sagittal molar relation, percentage of all sides (left and right) in boys and girls

	Boys	Girls
Class I	67	64
Class II, ½ to 1 cusp distal	21	25
Class II, more than 1 cusp distal	6	7
Class III, ½ to 1 cusp mesial	6	4
Class III, more than 1 cusp mesial	0.2	0.8

commonly missing teeth were the mandibular second premolars. 50% of all missing teeth, and the maxillary lateral incisors, 16%. One child had 7 permanent teeth missing, 2 children had 4 teeth missing, 4 had 2 teeth missing, and 10 children had 1 tooth missing. Two boys (0.5%) had supernumerary teeth, and in both instances these were mesiodentes. Ectopic eruption of the first permanent maxillary molar was found in 11 children (3%), 6 of them having bilateral occurrence. One child had an ectopic eruption of a central incisor. Transposition of one central incisor was found in one child.

Occlusal anomalies

Table 3 shows the sagittal relation of the molars based on observations for each side separately. Postnormal occlusion (Angle class II), a half cusp or greater deviation from a full class-I relation, was found in 27% of the boys and in 31% of the girls. Prenormal occlusion (Angle class III), a half cusp or greater deviation from a full class-I relation, was found in 6% of the boys and 5% of the girls. When the sagittal relation was evaluated by means of the terminal plane, the commonest relation was a mesial step, 59%. Straight terminal plane and distal step of the terminal plane had prevalences of 19% and 22%, respectively. On those sides (80% of the sides) where the first permanent molar had erupted the relationship between the molar and terminal plane classification was evaluated. A flush terminal plane on the second deciduous molars was found in association with either a class-I or a class-II molar relation, almost equally distributed. Where the terminal plane ended in a distal step, the molar relationship was almost always class II. A mesial step was found in association with a class-I (91%), a class-II (1%), or a class-III (8%) relation. On those sides where no first permanent molar had erupted, a flush terminal plane was found solely in combination with a class-I relation.

If only a bilateral class-I relation was considered a class-I relationship, there was a decrease in the frequency of the class-I relation with a corresponding increase of class-II and class-III relation. According to these criteria, a bilateral class-I relation was found in 54% of the children. A uni- or bi-lateral class-II relation was found in 38% of the children, and a uni- or bi-lateral class-III relation was found in 7%. One per cent of the children had class II on one side and class III on the other side.

Infraocclusion of deciduous molars (lateral open bite >2.0 mm) was found in 2% of the boys and in 4% of the girls. It occurred bilaterally in 90% of them.

Uni- or bi-lateral crossbite in the deciduous molar/canine region was found in 13% of the children. In the permanent molar area the frequency was 7%. The frequency of unilateral crossbite occurring in both regions simultaneously was 4%. Bilateral crossbite occurring in both regions simultaneously was only found in two children. Scissors bite was uncommon and was found only in two children, in the deciduous molar/canine region.

Space anomalies

The space condition was recorded in three segments in each jaw, and the deviation had to be at least 2.0 mm in any of the segments to be registered. Excess of space was more common than lack of space (Table 4). For both sexes, excess of space was most frequent in the anterior segment. More spacing was found in the maxillary lateral segments than in the mandibular lateral segments. This difference was statistically significant both for boys ($P < 0.01$) and for girls ($P < 0.05$). In the maxilla 38% of the boys and 42% of the girls showed no space problems in any of the segments. In the mandible the respective figures were 45% and 63%. A median diastema of more than 2.0 mm was found in 28 children (7%).

Table 4. Space conditions in the upper and lower jaw, percentage of boys and girls

	Spacing		Crowding		No space problems	
Segment	Boys	Girls	Boys	Girls	Boys	Girls
Upper jaw						
Right	19	12	0.5	0.5	81	88
Front	48	47	6	6	46	47
Left	21	15	0	0	79	85
Lower jaw						
Right	8	4	3	1	90	95
Front	48	37	3	0	48	63
Left	8	3	2	0.5	91	97

Other findings

A mandibular midline deviation greater than 2.0 mm to the right of the maxillary midline was found in 4% of the children and to the left in 3%.

Discussion

The material in this study consists of 6-year-old Icelandic children living in the capital city, Reykjavik. The composition of the sample depended on the availability and the willingness of the children and their parents to join the study.

When volunteers are used in studies it is possible that the sample is biased. It can be speculated that parents with malocclusion were more motivated to allow their children to participate in the study, making the proportion of children with malocclusion predictably higher in the sample than in the target population. On the other hand, very concerned parents could have already sought consultation or treatment for their children and, as a consequence, decided not to permit participation. This could have made the proportion of children with malocclusion lower in the sample. Furthermore, socioeconomic conditions and educational level of parents—factors associated with several measures of oral health status—could also have affected their decision. In this manner, although self-selection undoubtedly played a role in determining how representative the sample was, it is difficult to assess the direction and the magnitude of its influence (8). However, given the notable homogeneity of the Icelandic population and the close monitoring of all children within the social health system, such an influence may have been relatively low.

The distinct sex difference in eruptional status of permanent teeth is in agreement with earlier findings of Magnusson (9), who found that girls were generally ahead of boys in dental development and that the difference had a tendency to increase from the earlier to the later dental stages.

Congenital dental anomalies in the deciduous dentition are rather uncommon. Grahnén & Granath (10) found the prevalence of supernumerary teeth to be 0.3%, and Ravn (11) reported the prevalence to be 0.5%. The results in this study are in agreement with those studies. The prevalence of hypodontia in the deciduous dentition has been reported to be from 0.0% to 0.9% by different investigators (10–13). In this sample no one had a congenitally missing primary tooth, which can partly be explained by the size of the material and the dental stage of the individuals in the study.

Agenesis of permanent teeth has been studied in 8- to 16-year-old Icelandic children by Magnusson (14), who found the prevalence of hypodontia to be 8% for both sexes combined. The frequency of hypodontia was 6% in Danish and Swedish children (1, 16). In the present study 5% of the children had one or more permanent teeth missing. The prevalence is somewhat lower than reported earlier, especially when compared with Magnusson's (14) findings in a group of 1116 older Icelandic children. Apart from chance differences in the two samples, it might also be possible that some extracted teeth were recorded as congenitally absent in children of the higher age groups in Magnusson's material.

Studies on prevalence of occlusal anomalies in the age group studied here are rare, and the reported results vary greatly. Comparison is also difficult, as researchers use different methods and criteria for registration of malocclusion. Telle (17) studied 7- to 8-year-old Norwegian children and found a prevalence of 21% for class-II malocclusion and of 7% for class III. Carlsen & Meredith (18), in a study of white children just after the eruption of the first molars, found a prevalence of distoclusion of 40% and of mesioclusion of 1%. Emrich et al. (19) found 11% with class-II, 1% with class-III, and 18% with class-I malocclusion and 69% with normal occlusion in 6- to 8-year-old white children. In the present study a class-II molar relationship was recorded in nearly 30% of the children and class III in around 5%. This is similar to what Telle (17) found but much higher than what Emrich et al. (19) reported.

Some investigators (20, 21) have used the relation of the terminal plane of the second deciduous molars as a measure of the sagittal relationship. This can be misleading, as most researchers consider both a straight and a mesial terminal plane a normal molar relationship (3, 21). The mandibular second deciduous molar very often has a disproportionately large mesiodistal crown dimension as compared with the maxillary one (22), so that a flush terminal plane may exist even though the sagittal relationship is normal. In individuals in whom the crown dimensions of the upper and lower second deciduous molars are proportional, a straight terminal plane indicates a postnormal jaw relation. In this study a straight terminal plane on the second deciduous molars was associated with either a class-I or class-II molar relation, almost equally distributed. Where a class-II molar relation exists in association with a flush terminal plane, the true sagittal relation cannot be established unless the crown ratio of the second deciduous upper and the lower molars and the available spaces in both jaws are taken into consideration. When the lower deciduous molar is wider, most likely a class-I relation will develop at the time the premolars erupt, but when the dimensions of the deciduous molars are similar, a class-II relationship can develop.

The high frequency of the mesial step of the terminal plane in this study, almost 60%, is in agreement with the findings of Carlsen & Meredith (18) in a period just before the eruption of the first permanent molars, and with the findings of Nanda et al. (21) in 5- to 6-year-old children. However, the results are in disagreement with the findings of Baume (3), who found only 14% with a mesial step at the age 5½ years.

Spaces between deciduous teeth is a common finding (1, 23). Our findings that crowding in the dental arches

was uncommon both in the upper and lower jaw and that spaces between the primary teeth in the lower jaw were not as frequent as in the upper one are in agreement with the findings of Rasmussen & Helm (6).

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References

1. Leighton BC. The early signs of malocclusion. Trans Eur Orthod Soc 1969:353–68.
2. Foster TD, Grundy MC. Occlusal changes from primary to permanent dentitions. Br J Orthod 1986;13:187–93.
3. Baume LJ. Physiological tooth migration and its significance for the development of occlusion. I. The biogenetic course of the deciduous dentition. J Dent Res 1950;29:123–32.
4. Baume LJ. Physiological tooth migration and its significance for the development of occlusion. II. The biogenesis of the accessional dentition. J Dent Res 1950;29:331–7.
5. Infante PF. An epidemiologic study of deciduous molar relations in preschool children. J Dent Res 1975;54:723–7.
6. Rasmussen I, Helm S. Forekomsten af tandstillingsfejl i det primære tandsæt. Tandlaegebladet 1975;79:383–8.
7. Björk A, Krebs A, Solow B. A method for epidemiological registration of malocclusion. Acta Odontol Scand 1964;22:27–41.
8. Hennekens CH, Buring JE Epidemiology in medicine. Boston: Little, Brown; 1987. p. 339–41.
9. Magnusson TE. Emergence of permanent teeth and onset of dental stages in the population of Iceland. Community Dent Oral Epidemiol 1976;4:30–7.
10. Grahnén H, Granath L. Numerical variations in primary dentition and their correlation with the permanent dentition. Odontol Rev 1961;12:348–57.
11. Ravn JJ. Aplasia, supernumerary teeth and fused teeth in the primary dentition. An epidemiologic study. Scand J Dent Res 1971;79:1–6.
12. Järvinen S, Lehtinen L. Supernumerary and congenitally missing primary teeth in Finnish children. Acta Odontol Scand 1981; 39:83–6.
13. McKibben DR, Brearley LJ. Radiographic determination of the prevalence of selected dental anomalies in children. J Dent Child 1971;38:390–8.
14. Magnusson TE. Prevalence of hypodontia and malformations of permanent teeth in Iceland. Community Dent Oral Epidemiol 1977;5:173–8.
15. Helm S. Malocclusion in Danish children with adolescent dentition: an epidemiologic study. Am J Orthod 1968;54:352–65.
16. Thilander B, Myrberg N. The prevalence of malocclusion in Swedish schoolchildren. Scand J Dent Res 1973;81:12–21.
17. Telle ES. A study of the frequency of malocclusion in the county of Hedmark, Norway. Trans Eur Orthod Soc 1951;25:192–8.
18. Carlsen DB, Meredith HV. Biologic variation in selected relationships of opposing posterior teeth. Angle Orthod 1960;30: 162–73.
19. Emrich RE, Brodie AG, Blayney JR. Prevalence of class I, class II and class III malocclusions (Angle) in an urban population—an epidemiological study. J Dent Res 1965;44:947–53.
20. Foster TD, Hamilton MC. Occlusion in the primary dentition. Br Dent J 1969;126:76–9.
21. Nanda RS, Khan I, Anand R. Age changes in the occlusal pattern of deciduous dentition. J Dent Res 1973;52:221–4.
22. Van der Linden FPGM The development of the dentition. Chicago: Quintessence; 1983. p. 33–4.
23. Moorrees CFA The dentition of the growing child. Cambridge: Harvard University Press; 1959.

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