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The early signs of malocclusion

B. C. Leighton
London, England
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SUMMARY Although it may appear, when examining the deciduous dentition, that similar malocclusions to those seen in the permanent dentition can be identified, it does not always follow that they will persist. Incipient crowding of the teeth is usually masked by spacing which should normally be present. Small discrepancies of occlusion can arise or be masked as a result of deviation of the mandible away from centric occlusion. Unilateral crossbites, anterior open bites and excessive overjets which are associated with a sucking habit, will usually prove transient and improve spontaneously. It is also possible that crossbites and buccal occlusion of individual premolars may develop as these teeth erupt; these are often caused by displacement due to crowding. If these factors are allowed for then a fairly accurate prediction of arch relationship can be made.

Correlations of tooth size, arch size and spacing of teeth were not strong enough to be used individually for predicting the degree of crowding to be expected in the permanent dentition. However, observation of all these factors, especially if radiographs are available may be used to give a fairly accurate prognosis.

Introduction

It is of considerable importance to the general dental surgeon to recognise the early manifestations of malocclusion. The ability to do this allows him to orient his treatment to avoid jeopardising the prognosis for later orthodontic therapy, and even to foster the development of normal occlusion. Some of the more extreme malocclusions of the deciduous teeth are easy to recognise and leave little doubt of their bad prognosis. For example, crowding of the deciduous incisors is very likely to be followed by crowding of the permanent incisors (Fig. 1). Post-normal occlusion with a very deep incisor overbite is nearly always retained in the permanent dentition, and a severely pre-normal occlusion is unlikely to be resolved spontaneously. The majority of our patients, however, do not fall into these extreme categories and, therefore, render early prediction less certain. For instance, apparently quite severe malocclusions are seen which become corrected spontaneously (Leighton, 1960).

Although previous investigations (Baume, 1950; Bonnar, 1960; Chapman, 1924, 1935) have shown there to be wide individual variation in the development of occlusion even when it becomes normal, so little information was available about these variations that it was felt much would be gained from further longitudinal records collected from birth to adulthood. For this purpose a survey was started 16 years ago. Originally, 530 patients were examined at birth, but only 103 now remain under observation. It is upon the records of these cases that this paper is based. The subjects are all of North West European stock, the majority being English. Forty-six of them were male, 57 female. Attendance at yearly intervals was voluntary although persistent persuasion was used to maintain contact with the patient. Self-selection has undoubtedly played a large part in determining the nature of the sample. This is confirmed by the high proportion of children for whom orthodontic treatment has been sought (39 out of 103). It has been necessary to eliminate these cases for some purposes from the calculations.

The changes that take place in the development of occlusion between birth and 5 years, the age when the deciduous dentition may be considered mature, are very variable. This variety is due to the speed of early growth changes, the susceptibility of the bone, especially the alveolar process, to temporary distortion, and the ready response of the motor system to small premature contacts between opposing cusps.

At birth the overjet between the gum pads varies between 0 and 10 mm with a mean of 5½ mm. By the age of 5 years the average has been reduced to 3 mm (Fig. 2). A gradual forward movement of the lower arch relative to the upper is also reflected in the change of relationship between the upper and lower lateral sulci, which correspond to the interdental septa just distal to the canine crypts. As long ago as 1908, Chapman drew attention to spontaneous changes of molar occlusion between the ages of 3 and 6 years. He described how an apparently post-normal relationship at 3 years might become normal by the age of 6 years (Chapman, 1908, 1935). He felt that this change was necessary to allow the distal aspect of the lower second deciduous molar to assume a mesial relationship to that of its opponent. This in turn would avoid the establishment of a post-normal relationship between the first permanent molars.

Bonnar (1956) reported changes of molar relationship which coincided with eruption of deciduous second molars or of first permanent molars. These also took the form of corrections to post-normal occlusion (Fig. 3). Leighton (1960) described changes which had no directional bias,

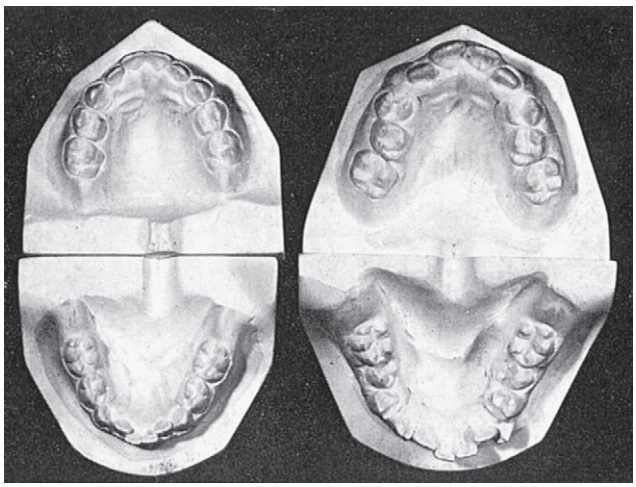

Figure 1 Case in which crowding of the deciduous incisors is followed by marked crowding of the permanent teeth.

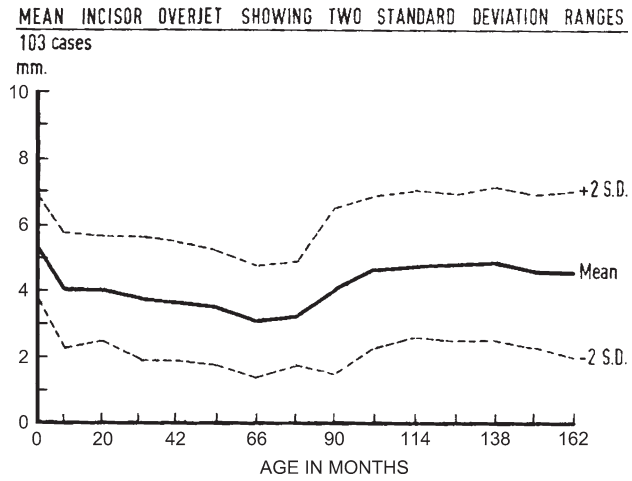

Figure 2 Graph to show changes of mean overjet between birth and 13½ years. The limits of two standard deviations above and below the mean are also plotted.

some cases becoming more post-normal and some less so. These also often occurred as teeth were erupting, and the suggestion was made that they were usually adjustments of mandibular position in response to premature contacts as new teeth erupt (Fig. 4). At this stage the cusps of deciduous teeth are long and sharp. As they become worn down however, a gradual return towards centric occlusion would become possible. Friel (1926) has suggested that by the age of 6 years attrition of deciduous teeth should have eliminated the molar cusps completely, and reduced the incisor overbite to allow forward movement of the lower arch. It should be added that complete freedom of antero-posterior and lateral excursion may be necessary to allow the resumption of centric occlusion. This is perhaps an even more important requirement.

For the purposes of this paper it is necessary to make comparisons between deciduous and permanent dentitions.

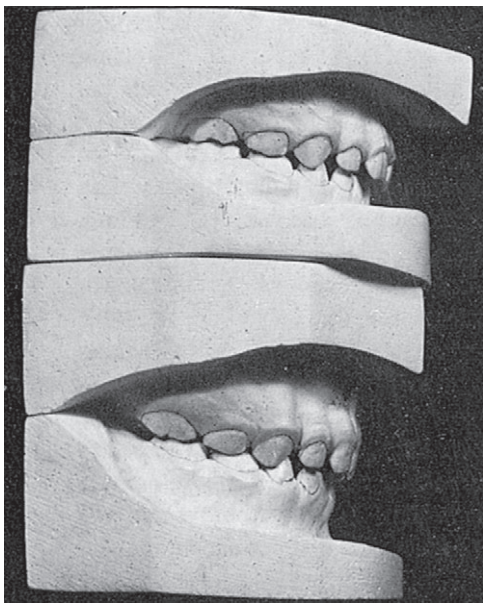

Figure 3 Models of a patient which show spontaneous improvement of a post-normal occlusion between 2½ and 3½ years of age.

This is most valid if observations on the deciduous dentition are made after the above mentioned changes have taken place. The latest age for which complete records of the whole sample were available at the time the analysis was started was 13½ years. For these reasons the deciduous dentition at 5½ years was compared with the permanent dentition at 13½ years. It was found that in a few cases lower permanent central incisors had erupted at 5½ years; where this affected the measurements, as for example spacing, the model taken one year earlier was used.

The following measurements were recorded:

(a) The peripheral length of each arch measured by means of a soft wire just outside the incisal edges and buccal cusps of the teeth from the distal aspect of one second deciduous molar, or premolar, to its homologue (Fig. 5a).
(b) The mesio-distal diameters of all deciduous teeth and their successors were measured with sharp dividers. Each was measured to the nearest 1/10th.
(c) Spaces between deciduous teeth were measured with a feeler gauge made of perspex, and cut to a range of thicknesses between ½ and 3 mm, with ½ mm increments (Fig. 5b).
(d) The incisor overjet, measured as the horizontal distance parallel to the occlusal plane between the labial aspects of the upper and lower incisors (Fig. 5c).
(e) The incisor overbite, measured as the vertical distance, square to the occlusal plane, between the levels of the lower and upper incisal edges.

By the age of 5 years the antero-posterior relationship of the deciduous dental arches indicates fairly accurately the prognosis for the permanent teeth. However, a small change

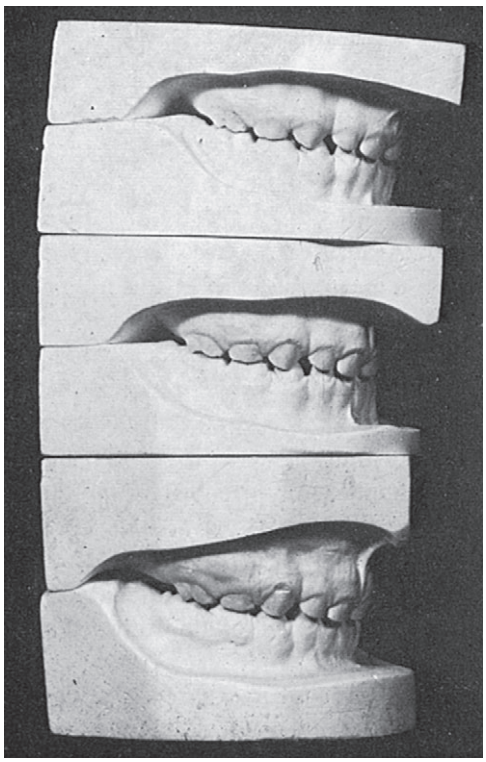

Figure 4 Models of a patient taken at 1½, 2½ and 3½ years to show the development of a post-normal occlusion.

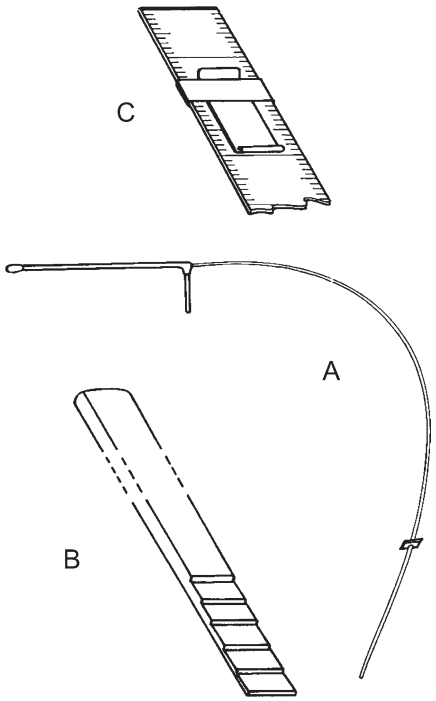

Figure 5 Instrument for use in measuring study models.A. Soft wire gauge for measuring peripheral length of the arch. The rubber disc may be slid along the wire as a marker.B. Feeler gauge for measuring interproximal spaces.C. Ruler and sliding foot used for measuring the incisor overjet.

of antero-posterior occlusion was found in 16 cases out of 103. Four of these were due to orthodontic treatment. Of the remaining 12, five had become mildly post-normal and in seven a mild post-normality was corrected. Four of the former had extractions which might have encouraged the change and one may be explained by the development of a buccal occlusion of the first premolars which caused some distal displacement of the mandible. Four of those with improved occlusion had had crossbites associated with a deviation of the path of closure. In addition to these, two others had had sucking habits. The remaining case developed a lingual occlusion of a permanent upper lateral incisor which appears to have made necessary slight forward displacement of the mandible.

Comparison of incisor overjet showed moderate correlation between the two dentitions (r = 0. 614). Six cases were excluded from this calculation because the incisors had been moved by orthodontic appliances. Of the remainder, only five cases showed an increase of more than 4 mm. These were all skeletally post-normal and in four of them the overjet was large enough to place the erupting upper permanent incisors outside the lower lip, a factor which would be expected to emphasise the overjet.

The presence of a post-normal occlusion of the deciduous dentition with a large incisor overbite always has a poor prognosis (Fig. 6). Where the upper deciduous incisors are inclined lingually and are well covered by the lower lip, it is likely that the case will become Class II division 2 case (Fig. 7). Pre-normal occlusion can usually be identified when the deciduous incisors erupt. The incisor overbite is perhaps the most susceptible of all dimensions to the effects of sucking habits. An anterior open bite of the deciduous teeth is almost invariably due to a sucking habit. The ultimate effect of these habits on the permanent incisors can be dismissed as negligible (Fig. 8; Leighton, 1968). It is, however, necessary to allow for their influence when making assessment of the deciduous dentition.

Like the anterior open bite, crossbites in the deciduous dentition are usually due to a sucking habit. Because the presence of the thumb, finger or comforter in the palate excludes the tongue, an imbalance of force allows some narrowing of the upper arch. At the same time, an increase in the mass of the tongue in the lingual vestibule encourages expansion of the lower arch (Leighton, 1966). Although the discrepancy is not great, it may be sufficient to establish a cusp to cusp occlusion of the deciduous molars and canines. Avoidance of the premature contact thus produced is achieved by moving the mandible to the left or to the right and causes a unilateral crossbite. It is usual for this development to occur between the ages of 2 and 5 years. In the majority of these cases the crossbite is eliminated if the sucking habit has been abandoned by the time the deciduous canines and molars are replaced. A crossbite may also be found where the occlusion is pre-normal.

Here the crossbite is frequently bilateral, and is unlikely to improve spontaneously. Buccal occlusion of the upper

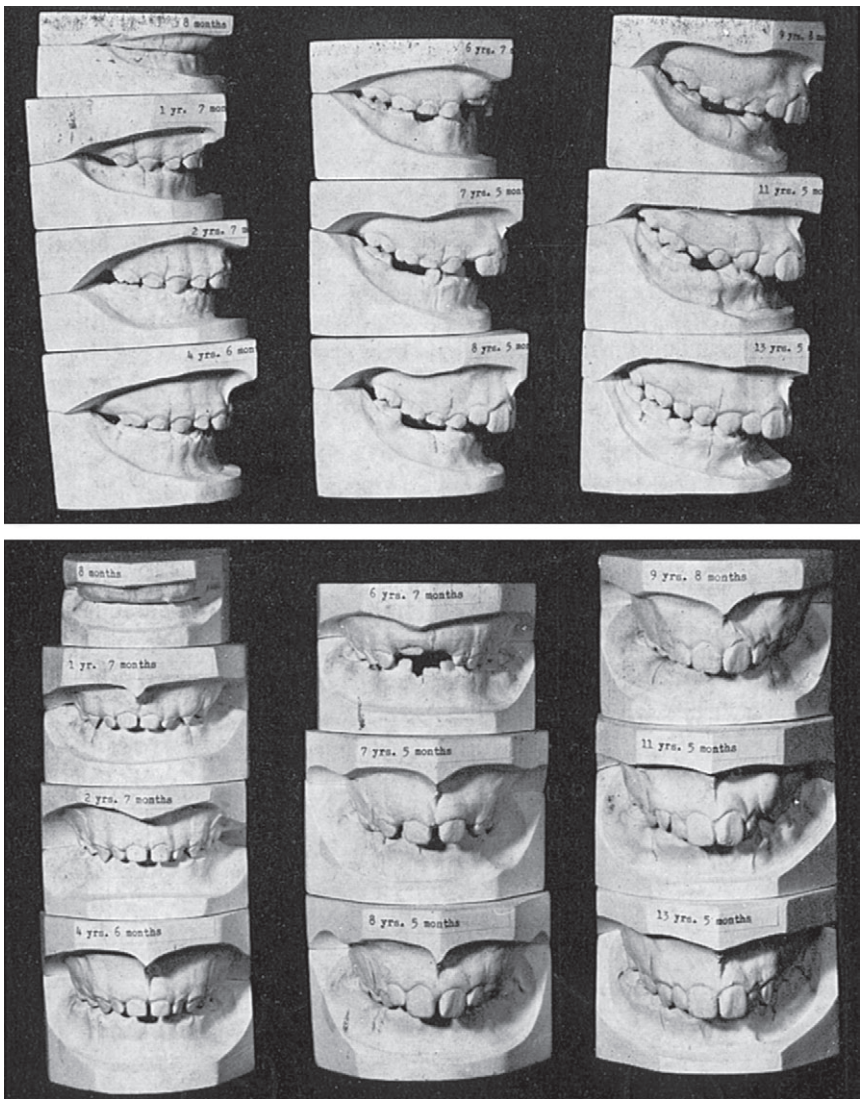

Figure 6 Series of models of a case taken between 7 months and 13½ to show the development of post-normal occlusion and persistence of a deep incisor overbite.

deciduous molars is less common and usually occurs only on one side. Some of these cases have characteristically dome-shaped deciduous molars, with small occlusal surfaces which encourage a cusp to cusp relationship of the upper lingual cusps and lower buccal cusps (Fig. 9). Spontaneous improvement is not uncommon and may be accompanied by some forward movement of the lower arch.

Perhaps one of the most frequent problems to involve the orthodontist is that of crowding. This is particularly true for those who treat the indigenous population of the British Isles. It is usually a manifestation of disproportion between the size of the teeth and that of the dental arches, and is usually treated by extraction of permanent teeth. The fact that extractions may be necessary makes it a matter of great concern to the general dental practitioner to have available the means of making an early prediction of crowding. This will enable him to plan his treatment to avoid conflict with the orthodontic needs of the case, and will indicate to him the stage at which orthodontic treatment should be started. Careful timing of any treatment which is to include extraction of teeth can often be a means of simplifying the mechanical therapy required.

The work of Moorrees (1959) has shown how misleading cross sectional data might be as a basis for the prediction of crowding. After analysing the findings of a longitudinal study he concluded that 'generally speaking, a single physical sign has little meaning unless it can be related to a combination of other factors'. This problem seemed therefore to merit further investigation.

The mean sum of all upper and all lower deciduous tooth diameters was calculated (Table 1). The mean sums of the tooth diameters are all a little larger than those given by Clinch (1963) and Moorrees (1959), but the difference is not great enough to have statistical significance. The correlation

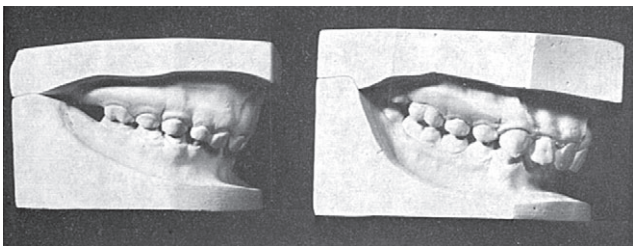

Figure 7 Case in which post-normal occlusion with lingual inclination of the upper deciduous incisors and a deep overbite is followed by a Class II division 2 malocclusion

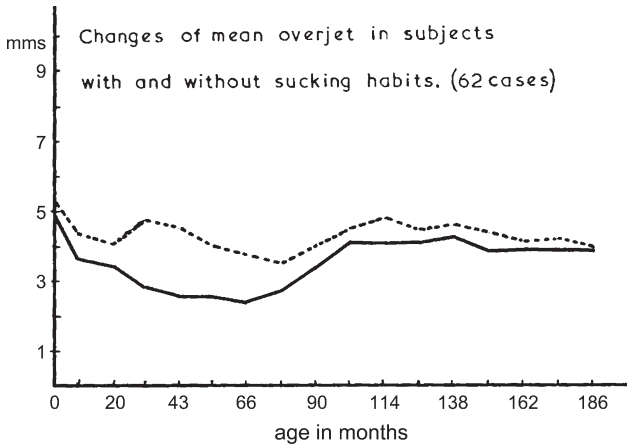

Figure 8 Graph to compare changes of the mean incisor overjet between children with and without persistent sucking habits. The difference is almost eliminated at the age of 13½ years.

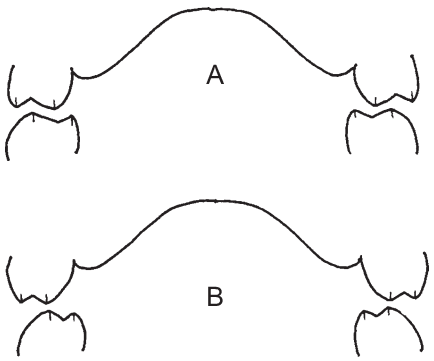

Figure 9 Diagrammatic coronal section of molars to compare the effect on occlusion of a normal bucco-lingual molar shape (A) with that of dome-shaped molars (B).

coefficients for maxillary and mandibular teeth were found to be 0.70 and 0.65, respectively. Although this is fairly strong it is still inadequate as a basis for making a firm prediction of permanent tooth size. The relationship between deciduous and permanent incisors was less strong (Table 2), the correlation coefficients being 0.59 for the maxillary teeth and 0.47 for the mandibular. This was disappointing because it is these teeth which are particularly involved in the subsequent crowding. These figures are similar to those of Moorrees (1959) and

Table 1 Correlation between deciduous and permanent tooth sizes (103 cases).

	Mean	S.D.	r
Upper arch			
Permanent teeth	76.81	±4.16	0.70
Deciduous teeth	70.12	±3.05	
Difference	6.69		
Lower arch			
Permanent teeth	67.50	±3.47	0.65
Deciduous teeth	65.60	3.02	
Difference	1.90		

Table 2 Correlation between deciduous and permanent incisor diameters (103 cases).

	Mean	S.D.	r
Upper arch			
Permanent teeth	31.95	±2.20	0.59
Deciduous teeth	24.00	±1.33	
Lower arch			
Permanent teeth	24.26	±1.52	0.47
Deciduous teeth	17.90	±1.22	

Table 3 Correlation between arch perimeters at 5½ and 13½ years respectively (103 cases).

	Mean	S.D.	r
Upper arch			
13½ years	79.39	6.47	0.55
5½ years	79.07	3.61	0.55
Difference	0.32		
Lower arch			
13½ years	69.14	5.14	
5½ years	72.21	3.66	0.60
Difference	3.07		

confirm the existence of some correlation between deciduous and permanent teeth. A rather weaker correlation was found between the peripheral length of each arch at the ages of 5½ and 13½ years (Table 3). It was felt however, that the extraction of teeth, either deciduous or permanent, had masked some degree of correlation by allowing loss of space and consequent shortening of the arches. To overcome this, all cases from whom any teeth had been extracted were omitted. There remained only 50 cases for whom the correlation coefficients were 0.75 and 0.77 for the maxillary and mandibular arches, respectively (Table 4). This is rather more than a moderate association. It should be added however, that omission of extraction cases eliminated a large proportion of cases which later showed the more severe crowding. It is clear therefore, that neither the size of the deciduous teeth nor the length of the deciduous arch alone is reliable as an indication of what is to follow in the permanent dentition.

Table 4 Correlation between arch perimeters at 5½ and 13½ years respectively in cases from whom no teeth had been extracted (50 cases).

	Mean	S.D.	r
Upper arch			
13½ years	81.28	±5.00	0.75
5½ years	79.46	±3.71	
Difference	1.82		
Lower arch			
13½ years	70.48	±4.14	0.17
5½ years	72.72	±3.32	
Difference	−2.24		

Table 5 Correlation of two dimensions with interdental spacing at 5½ years (103 cases).

	Upper r	*Lower r*
Arch perimeter	0.41	0.39
Sum of tooth diameters	−0.35	−0.37

Table 6 Correlation of three dimensions at 5½ years with the degree of space deficiency at 13½ years (103 cases).

Dimension at 5½ years	*Upper r*	*Lower r*
Sum of tooth diameters	−0.19	−0.30
Sum of interdental spaces	0.52	0.47
Arch perimeter	0.22	0.20

Spacing between deciduous teeth has for many years been accepted as a desirable phenomenon in providing for a discrepancy of size between deciduous and permanent incisor teeth. It has already been shown how the discrepancy amounts to an average of nearly 6 mm in the upper arch and 2 mm in the lower (Table 1), and would suggest that a similar amount of spacing is necessary in the deciduous dentition to provide against crowding of permanent teeth. The ratio of deciduous to permanent tooth sizes is very variable however and the averages of 6 and 2 mm represent ranges of 1.2 to 13.8 mm in the upper arch and −4.0 to 8.3 mm in the lower arch. There is likely therefore to be some difficulty in predicting the amount of space which will be needed. The sum of the spaces within each arch was found to bear a modest relationship to the length of each arch (Table 5). A very similar, but inverse correlation was found with the sum of the deciduous tooth diameters. It would seem therefore, that spacing is equally a function of tooth size and of arch size.

The amount of crowding in the permanent dentition was established as the difference between the peripheral length of each arch and the sum of the diameters of the successional teeth in that arch. Correlation coefficients between this crowding and the peripheral length, tooth diameters and spacing of each arch at the age of 5½ years were calculated. These are given in Table 6. The coefficients for peripheral length and tooth size show very modest relationships which are unlikely to have been chance occurrences. The correlation with spacing of deciduous teeth is greater and is of some importance. The presence of a large overjet with proclination of upper incisors and lingual inclination of lower incisors is likely to cause a greater amount of spacing in the upper arch and less in the lower. It is necessary therefore to make assessments for both arches. Since it is the condition of the lower arch which will usually determine subsequent treatment this is perhaps the more important.

In no case examined was crowding of the deciduous incisors followed by sufficient space for the permanent teeth. Where there was neither spacing nor crowding of the deciduous teeth the chances appear to be more than 2 in 3 that crowding will follow. Where the sum of the spaces was less than 3 mm there seemed a rather better than 1 in 2 chance of crowding. With spacing between 3 and 6 mm this improved to 1 in 5. With a total of more than 6 mm spacing there seemed to be little likelihood of crowding at all.

The good correlation between the arch sizes at 5½ and 13½, where no extractions were performed, might be used in making a prediction if a more accurate assessment of tooth size could be made. It was suggested by Moorrees (1959) that the latter might be achieved more accurately by means of radiographs than by calculating from deciduous tooth diameters. There is no doubt that in order to give a useful prognosis for the degree of crowding all factors should be considered; no single observation is by itself sufficiently reliable. These should include an estimate of arch size, especially the circumference of the arch, tooth size and spacing. Allowance must be made if deciduous teeth are to be extracted, for this appears to be a strong factor precipitating crowding if there is not already generous spacing.

The inference to be drawn from this survey is that the data available at present is insufficient to lay down a formula which gives a precise estimate of the degree of crowding that may be expected in the permanent dentition. A certain amount of experience and judgment is still required in making a forecast. Further investigations embracing other factors and more subjects are likely to yield more accurate information.

Discussion

Professor Baume asked Professor Leighton whether he could define a normal pattern of the deciduous dentition; could he describe a pattern that has a good prognosis for development into a normal occlusion in the permanent dentition. He asked this because he was trying to establish standardised methods of assessing dento-facial anomalies but one must first be able to define a normal deciduous dentition.

Professor Leighton replied that he did not find that a normal occlusion could be identified easily in the deciduous

dentition. He felt sure that a child with very generous spacing and a normal antero-posterior relationship of the arches without a deep incisor overbite was very likely to become normal, but in Britain this was a rare individual. He had managed to collect among his sample about 10 individuals whose permanent occlusion he would consider to be within the definition of normal. These individuals however were all very different in their appearance at an early age. One, whose pictures he had shown in his paper, had an anterior open bite and a crossbite in the deciduous dentition and yet developed normally in the permanent dentition. His answer to the question would therefore be somewhat reserved and he would say that it was easier to identify incipient malocclusion than to identify normality.

Dr Dahan congratulated Professor Leighton on his paper. He and his colleagues had presented in Milan an attempt at a similar work but they had not been as patient as Professor Leighton and had not waited for 10 years before presenting their paper. He had used auto-pantomograms and tried to find correlations between the deciduous dentition, the permanent dentition, the alveolar arch and the basal arch for upper and lower jaws. He asked whether Professor Leighton had found any correlation between the size of groups of teeth and the size of the whole of the dental arch, deciduous or permanent. He had found differences between different Classes of malocclusion. He also asked whether Professor Leighton had tried to find other factors which correlated with the form of the alveolar arch, in his own investigation he had found a correlation between arch form and anomalies of the lingual fraenum.

Professor Leighton said that he had not correlated individual teeth with the whole dentition. He thought however that it was likely that certain teeth are better indicators of the size of the successional dentition than other teeth are. For example, he felt that the incisors were probably not a good indicator; the second deciduous molars and certainly the second premolars are more variable in size than other teeth. He did attempt to make a correlation when dealing with eruption ages and found that it was possible by assessing the eruption ages of the four incisors to predict the age of eruption of the remaining deciduous dentition.

Profesosr van der Linden asked Professor Leighton whether he had considered the possibilities of differences existing between the material that he used in his survey and the material used in other studies in other countries. He felt that Professor Leighton's material was from a typical English population and he wondered whether it was valid to compare results from samples taken in different countries.

Professor Leighton thanked Professor van der Linden for raising a very important point. He agreed that the source of the population was most important. London has a very mixed population and he felt that this produces characteristics which may not be shared by other populations. It was really for this reason that he had found it very important to undertake a British survey and not to transfer the findings from other countries to his own population.

Professor Selmer Olsen congratulated Professor Leighton. He thought that Professor Leighton, more than most of us, was thinking about the children. Too often we deal with grown-up children and we forget that we should do as the blacksmith does and treat the iron when it is red, that is when it is weak. He thought it was important to take the opportunities that are presented for treatment as the child is growing and especially at the time when the deciduous teeth are being shed and the new permanent teeth are erupting, otherwise you miss the best time to carry out the orthodontic treatment.

Professor Leighton said that Professor Selmer Olsen had raised an important point. The purpose of his survey in the first place had been to prevent cruelty to children from orthodontists. He felt sure that many children were overtreated and if he had saved some children from treatment he felt that he would have accomplished something useful.

The Chairman, Dr Logan, congratulated Professor Leighton on an excellent paper and thanked all the members who had taken part in the discussion.

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