Occlusal Changes from the Deciduous to the Early Mixed Dentition in Unilateral Complete Clefts

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The physical habilitation of cleft subjects has for many years been recognized as a multidisciplinary task. It is also increasingly acknowledged that if the dental part of the therapy should represent a permanent benefit to the cleft individual, the treatment procedures cannot be finished until growth has mainly ceased at an age of 18–20 years. The total therapy amounts to a considerable magnitude and might represent a heavy burden on both the patient and his family.

Quantified in time, the orthodontic share of the entire treatment occupies by far the greater part. Consequently, in order to relieve the strain exerted on the cleft patient by the time-consuming treatment, the first discipline to be reconsidered should be the orthodontic procedure.

The orthopaedic and orthodontic treatment planning of the maxillary deformity in clefts seems, up to now, to have been aimed more at a normalization of the upper arch at early developmental stages than at the long-term goal of optimal adult facial morphology including good occlusion of natural teeth. However, due to aberrant growth pattern of various facial structures in cleft individuals, infant normality of maxillary size and position does not warrant favorable facial relationship in adulthood.

As pointed out by Dahl (*3*) progress in rational long-term treatment planning of the cleft malocclusion has been severely impeded due to lack of reliable knowledge about the stage of appearance, localization and extent of the morphological as well as the occlusal aberrations. Such developmental abnormalities may occur throughout the entire period of growth of the craniofacial skeleton in cleft subjects.

Though our knowledge about the variability in facial growth and development in cleft cases still remains on a rather fragmentary level, we now begin to learn the main features in the aberrant developmental pattern sufficiently to exchange the stepwise treatment planning by a long-term therapeutic schedule covering the complete growth period.

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An important aim of a long-term integrated treatment planning for cleft cases should be to reduce the overall treatment time without compromising the final result. A basic principle, therefore, in setting up a rational treatment schedule should be to point out developmental stages or periods at which therapy could be employed most effectively.

Appropriate application of orthodontic therapy depends on the developmental pattern of the cleft malocclusion. Concerning the occlusal development in cleft subjects, we now have sufficient knowledge to distinguish between periods marked by stability and stages where deterioration may be anticipated.

On the basis of more than twenty years of clinical experience in cleft palate teamwork in Oslo, we have learned to recognize the early mixed dentition as a crucial stage in the development of the cleft malocclusion. From a clinical point of view, the remarkable stability of the relatively favorable conditions in the deciduous occlusion is in most cases followed by a considerable occlusal impairment. However, these clinical well known occlusal changes appearing at this stage have to our knowledge never been recorded quantitatively. The aims of the present investigation were: 1) to record longitudinally the changes in frequency of various types of crossbite occurring at the transition from the deciduous to the early mixed dentition in a group of unilateral complete clefts, 2) to relate the findings to the accomplishment of a long term treatment planning of the cleft malocclusion.

Material and Methods

The material employed consisted of 50 cases of unilateral complete cleft of which 31 have been previously described (*1*). Cases possessing soft tissue bridges have been omitted. All cases had their primary surgery in the University Hospital of Oslo (Rikshospitalet) where the lip and hard palate were closed at an age of 3–6 months, employing Millard lip procedure and vomer flap, respectively. The soft palate was closed at an age from 2 to 3 years, using a modification of Langenbeck technique. Presurgical orthopaedics were never employed in Oslo, mainly because the beneficial postoperative development of the maxilla following the introduction of conservative primary surgery was recognized as early as in the middle fifties (*1*).

Sex and cleft side distribution is shown in Table 1. The occlusal develop-

TABLE 1. Sex and cleft side distribution. No. = 50.

sex	*right*		*left*		*total*	
	No.	%	*No.*	%	*No.*	%
boys	11	22	28	56	39	78
girls	2	4	9	18	11	22
total	13	26	37	74	50	100

TABLE 2. Changes in frequency of crossbites in unilateral complete clefts from deciduous to early mixed dentition. No. = 50.

dentition	*no crossbite*		*canine*		*buccal*		*anterior + buccal*		*anterior + canine*		*anterior*		*total*	
	No.	*%*	*No.*	*%*	*No.*	*%*	*No.*	*%*	*No.*	*%*	*No.*	*%*	*No.*	*%*
deciduous	17	34	7	14	6	12	11	22	9	18	—	—	50	100
early mixed	5	10	3	6	3	6	23	46	9	18	7	14	50	100
diff.	÷12	÷24	÷4	÷8	÷3	÷6	+12	+24	0	0	+7	+14		

ment was studied by recording the relationship of the teeth at two stages in each case, 1) in the deciduous dentition and 2) after the complete eruption of the permanent upper central incisors. The crossbite terminology employed is adopted from Pruzansky and Aduss (*13*).

Findings

The frequency of various types of crossbite in the two stages of the cleft occlusion is tabulated in Table 2. The recorded occurrence of crossbite in the temporary dentition is in good accordance with previous findings in materials of unilateral complete clefts treated with primary surgery alone (*8, 13*). To our knowledge, no corresponding registration of the incidence of crossbite in the early mixed dentition is available in the literature for comparison of the data obtained in the present investigation.

Judged from the considerable increase in the frequency of various types of crossbite Table 2 gives the general impression of a severe impairment of the teeth relationship from the deciduous to the early mixed dentition. The radical changes occurring at this developmental stage are illustrated by the excessive diminution of the "no crossbite" group. From constituting about one third of the cases in the deciduous occlusion, this group is reduced to one tenth in the early mixed dentition stage, a difference statistically significant at 1 per cent level of confidence.

If the two columns to the left in Table 2 representing the most favorable occlusal conditions, "no crossbite" and "canine" respectively, are considered together, they are reduced from nearly 50 to 16 per cent, a reduction significant at 5 per cent level of confidence.

If the recorded impairment in crossbite condition is related to possible changes in the shape and size of the maxillary arch, the changes in crossbite pattern can be simplified down to only two independent main groups of crossbites, namely "anterior" and "buccal", where the "canine" group from Table 2 is incorporated in the latter. "Anterior" or frontal inversion would represent possible antero-posterior and "buccal" transverse deficiency in the dimensions of the upper arch.

The changes thus appearing in Table 3 demonstrate that the changes in anterior crossbite are nearly doubled from about 40 to 78 per cent, mainly

at the expense of the "no crossbite" group (Table 2). This change in frequency is statistically highly significant at 0.1 per cent level of confidence

In contrast to this excessive change in anterior teeth relationship, the increase in frequency of buccal crossbite is relatively slight and does not reach the 5 per cent level of statistical significance.

Due to the fact that the term crossbite in principle is a qualitative variable, any impairment of slightly abnormal teeth relationship already registered as crossbite in the deciduous dentition will not be substantiated in the subsequent recording. Consequently, the occlusal deterioration occurring at this stage in the development of the cleft malocclusion is, from a clinical point of view, even more comprehensive than can be read from Tables 2 and 3.

Discussion

Occlusal Changes and Maxillary Deformity. The postnatal development and growth pattern of a cleft maxilla depend on a variety of factors (*12, 13*), some of which are not yet understood. However, a thorough discussion of these problems is considered beyond the scope of this article. Nevertheless, an ever-increasing number of recordings of completely untreated cleft subjects observed at various ages illustrate a nearly uniform picture of a favourable maxillary and occlusal development (*4, 11*). This fact strongly indicates that the main reasons for the maxillary underdevelopment so frequently seen in treated cleft cases have to be sought in the treatment procedure employed. Further, the type and severity of these post-treatment aberrations in the occlusion may vary considerably according to differences in the therapy applied (*1*). The validity of the findings in the present study, therefore, is limited to cases treated with the previously described standardized primary surgery, employed in Oslo for more than twenty years (*1*).

The closure of the lip and hard palate by the vomer flap initiates an approximation of the maxillary segments, a process which seems to be completed relatively soon after the surgery, probably before the end of the first year of life. In the deciduous occlusion, there is a relatively close association between the position of the maxillary segments and the crossbite relationship (*13*).

Preliminary recordings indicate that with the surgical procedure employed in Oslo the subsequent closure of the soft palate about two years later seems to have very little, if any, narrowing effect on the shape of the maxillary arch. This is illustrated by the fact that the segment relationship "approximation without contact of alveolar processes" persists in some cases at the age of 4–5 years, two to three years after the closure of the soft palate (Figure 1A and B). In the Illinois material of Pruzansky and Aduss (*13*), this relationship disappeared completely after palatal repair. The remaining gap between the alveolar processes is usually successively

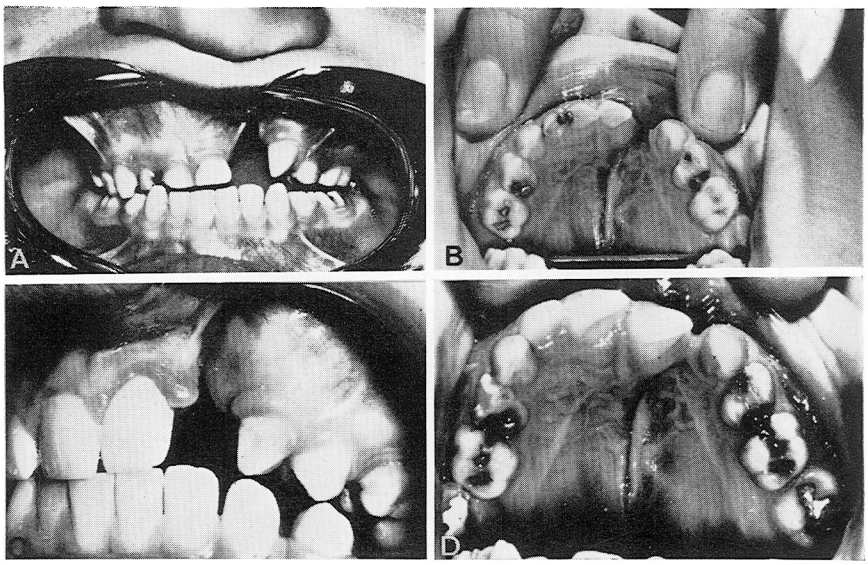

FIGURE 1. One of the cases displaying persistence of the segment relationship "approximation without contact of alveolar processes" two years after the lip repair (A and B). At the age of 8 years the gap is almost filled up by growth of the cleft margins, probably caused by the descendence of the permanent teeth adjacent to the cleft (C and D).

filled up by tissue formation probably induced by the descendence of the anlages of permanent teeth adjacent to the cleft (Figure 1C and D). This means that the maxillary segments reach a stable position relatively early in infancy, and consequently no severe occlusal impairment is to be expected in the temporary cleft dentition.

Even if the mucoperiosteal flap from vomer covering the cleft area in some cases seemingly may exert some resistance to medial displacement of the smaller maxillary segment in the first years after surgery, the tissue maintains its soft character in that no bony junctions form across the cleft. Because the maxillary segments are not overbridged by hard tissue connections, the skeletally open cleft can serve as a passive suture, allowing the maxillary segments to separate during the general growth in width of the facial skeleton. Moreover, orthodontic repositioning of dislocated segments is not prevented.

The findings in the present study corroborate the general clinical opinion that the eruption of the upper permanent incisors in most cases represents the cessation of the occlusal unchangeability, which has been the prevailing feature in the pattern of temporary cleft dentition. The excessive increase in anterior crossbite frequency further confirms the clinical experience that when the deciduous incisors are replaced by the permanent ones the premaxillary area is highly susceptible to changes in teeth relationship, while the moderate increase in buccal crossbite frequency may indicate a con-

siderably higher degree of stability in the lateral regions of the maxillary arch in unilateral complete clefts at this stage.

In contrast to the deciduous dentition where the occlusal abberrations mainly correspond to the position of the maxillary segments, the severe impairment of the relationship of the anterior teeth does not necessarily reflect a further drifting of the anterior segment which stopped moving medially in early infancy. Besides an increasing retrusive position of the maxillary complex occurring in cleft subjects (*5, 7, 10, 14*), the main reason for the inpairment in the anterior teeth relationship is a considerably steeper than normal path of eruption of the upper incisors (*6, 10*). This may be a late result of the moulding effect of the protruding premaxillary region following the surgical reconstruction of the disrupted lip muscles. An inhibitive influence on the forward growth of the premaxillary part of maxilla by the vomer flap operation cannot be disregarded either.

Considered as an alteration of the maxillary arch, the increase in anterior crossbite means an antero-posterior shortening of the upper dental arch due to a lingually inclined eruption of the upper incisors. Even if the increase in buccal crossbite did not reach a statistically significant level, it might represent some real changes in the lateral region of the maxillary segments. A reduction in the transverse dimension of the upper arch would be recorded in the occlusion as an increased frequency of buccal crossbite. Since no eruption of buccal teeth occurs at this stage, a decreased width dimension would mean a further movement of the smaller segment medially. However, a resumed movability of maxillary segments is rather inconceivable at this developmental stage. The increase in buccal crossbite frequency may most probably reflect changes elsewhere in the face. The increasing retrusive position of maxilla in the face means a relative forward shift of the lower jaw. In addition, by the frontal inversion so frequently following the eruption of the upper permanent incisors, the front teeth are in many cases brought into an anteriorly forced bite relationship which brings the mandible to slide further forward, often resulting in an impairment of the border line buccal teeth relationship.

The considerable impairment of the occlusion in unilateral complete clefts by the transition from deciduous to early mixed dentition, as observed in the present study, may be completely explained without implying resumed drifting of maxillary segments. Besides possible changes in the basal sagittal relationship between the maxilla and the mandible, the apparent deterioration of the maxillary deformity occurring at this stage seems to be confined to the incisors and their adjacent tissue, that is the alveolar processes.

Occlusal Changes Related to Long Term Treatment Planning. The findings derived from this study may be of considerable significance by accomplishing a rational long term treatment planning of unilateral clefts. The early stabilization of the maxillary segments removes almost entirely the danger of further occlusal impairment in the completed deciduous

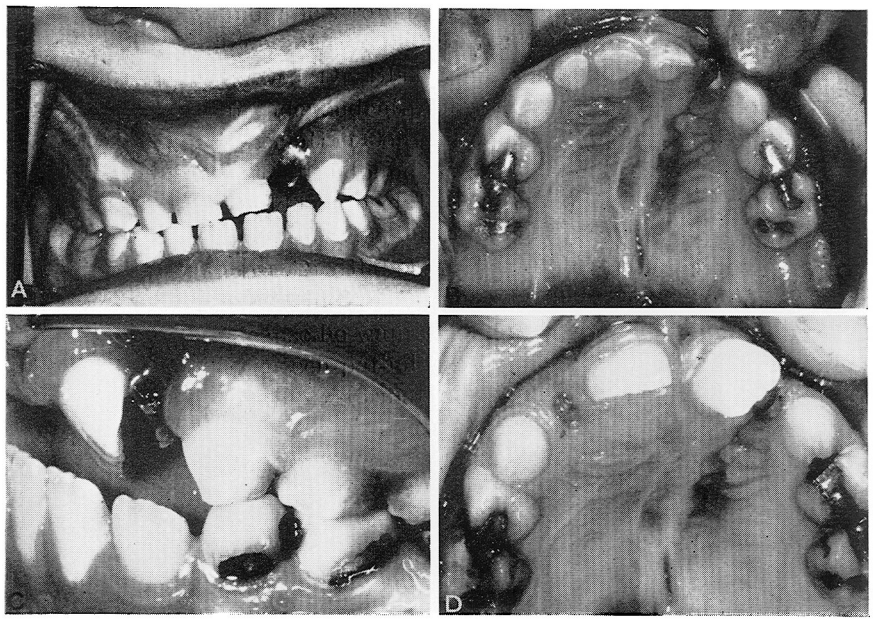

FIGURE 2. A case demonstrating the occlusal impairment from "no crossbite" in the deciduous dentition (A and B) to frontal inversion ("anterior crossbite") (C and D) by the eruption of the permanent upper incisors.

dentition, and the need for preventive orthodontic measures is correspondingly reduced. The moderate crossbite malocclusion occurring in the plural of unilateral clefts in the temporary dentition seems not to impede maxillary growth to any discernible degree and can usually be left untreated. Hence, without making compromise with the final result (*2, 9*), the cleft child can be relieved of wearing any orthodontic device during the important developmental period when speech habits are established.

By the eruption of the upper permanent incisors, a manifest frontal inversion should be corrected as soon as possible (Figure 2). Aesthetically, bad tooth alignment means an additional handicap to the cleft child. Moreover, the growth direction of the alveolar process follows the eruptive path of the front teeth. If the upper permanent incisors are allowed to erupt backwards and downwards, the forward growth of the frontal part of the alveolar process, which constitutes the greater part of the hard tissue support of the upper lip and consequently exerts a deciding influence upon the lip relationship, may suffer. If a medial dislocation of the lesser maxillary segment has been present causing buccal crossbite in the deciduous occlusion, the segment is easily repositioned in close connection to the correction of the anterior teeth. Segment reposition can also be achieved considerably later, even in the early permanent dentition.

The figures in the present study show evidently that in the early mixed dentition, orthodontic treatment has to be initiated in nearly all cases of

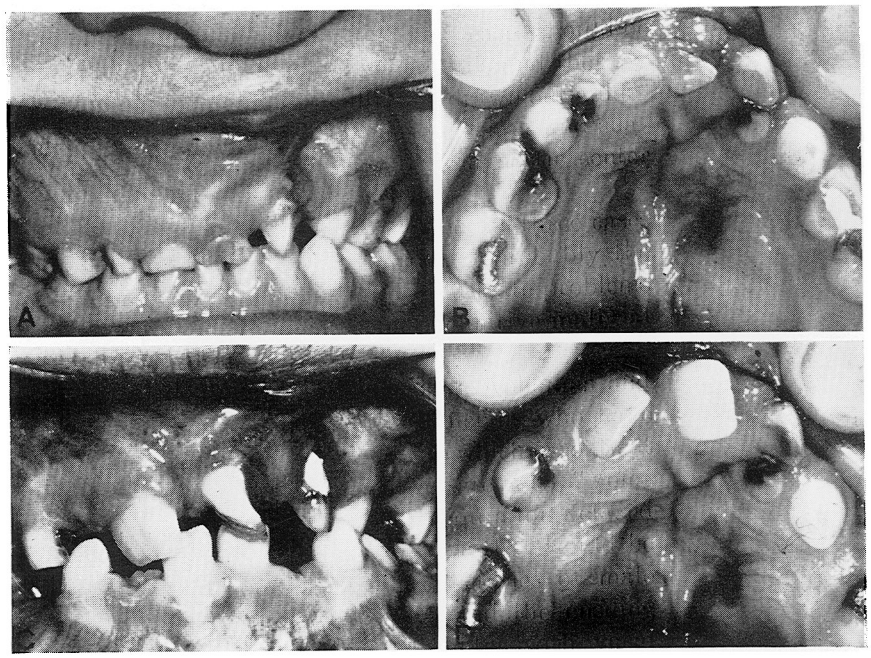

FIGURE 3. A case displaying the persistence of the "no crossbite" condition after the eruption of the upper front teeth. The extensive rotation of the upper central incisors requires immediate orthodontic correction because the malalignment of these teeth may represent a severe additional handicap to a cleft child.

TABLE 3. Changes in total frequency of anterior and buccal crossbit from deciduous to early mixed dentition. No. = 50.

dentition	*no crossbite*		*total frequency of anterior crossbite*		*total frequency of buccal crossbite*	
	No.	%	*No.*	%	*No.*	%
deciduous	17	34	20	40	33	66
early mixed	5	10	39	78	38	76
diff.	÷12	÷24*	+19	+38†	+5	+10

* Significant at 1% level of confidence.
† Significant at 0.1% level of confidence.

unilateral cleft almost independent of the occlusal relationship in the deciduous occlusion. In the "no crossbite" group (Tables 2 and 3) only five out of seventeen cases maintained an overjet relationship after the eruption of the permanent incisors. In three of these five cases one or both central incisors were so badly rotated that immediate orthodontic correction was required for aesthetic reasons (Figure 3). Consequently, only two of the original seventeen cases in this group displaying optimal

deciduous occlusion could temporarily be left untreated after the shedding of the front teeth.

Frontal inversion and severe rotation of permanent upper incisors are orthodontic problems arising at this developmental stage and consequently can not be prevented by any type of treatment in the deciduous dentition.

Summary and Conclusions

By the transition from the deciduous to the early mixed dentition, a severe occlusal impairment occurs almost irrespectively of the conditions in the temporary occlusion. The maxillary segments seem to stabilize relatively early after lip repair. Consequently, further segment dislocation may not be involved in any of the occlusal changes occurring at this stage.

The severe impairment of the front teeth relationship can be explained mainly by the backward inclined path of eruption of the upper permanent incisors resulting in a deficient antero-posterior dimension of the upper arch. A more retrusive position of maxilla counts for the remaining part of this impairment.

The frequently occurring frontal inversion following the aberrant pattern of eruption of the upper incisors may easily lead to a sagittally forced bite condition between the front teeth. This relationship will in turn bring the lower jaw into a more anterior position. Together with an increasingly retrusive position of maxilla, which also contributes to a relative forward shift of the mandible, these changes in intermaxillary relationship can explain the impairment of buccal crossbite conditions without any alteration of the transverse diameter of the upper arch at this occlusal stage.

Related to a long term treatment planning, these findings may provide a basis for the set up of a rational orthodontic scheme aiming at the ultimate goal of optimal adult morphology of the face including acceptable occlusion with a highest possible number of natural teeth.

The contractive forces tending to deform the cleft maxilla immediately after the first operation cease in the course of some months. Due to the relatively close association between segment position and deciduous teeth relationship, a balanced condition of the maxillary segments contributes decisively to a stable temporary occlusion. Consequently, no preventive or therapeutic orthodontic measures will usually be needed during this developmental period.

By the eruption of the upper incisors either an inversion and/or severe rotation of one or both upper central incisors is anticipated to occur almost independent of the relationship in the deciduous occlusion. These conditions of the front teeth require orthodontic correction either for aesthetic or developmental reasons, or both.

Any degree of medially dislocated smaller segment present at this stage is easily repositioned in connection with the correction of the frontal teeth or even considerably later.

From a rational point of view it is important to state that without

making compromise with the final result it is possible to spare the cleft child of wearing any orthopaedic or orthodontic device during this period of occlusal development when speech habits are acquired and cooperation generally is poor.

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