Presurgical Changes in Unilateral Cleft Palate Subjects

A. G. HUDDART, B.D.S., F.D.S., D. Orth. R.C.S.
West Midlands, England

This investigation utilizes *computerized measuring* and statistical techniques, *stereophotogrammetry*, and a newly developed method of measuring palatal surface areas to study changes in the *maxillary arch dimensions* at birth and at 4 months in 3 groups of subjects: (1) 30 complete unilateral cleft lip and palate cases who were treated by *presurgical maxillary orthopaedics*; (2) 15 similar cases who had no such treatment and served as controls; and (3) 30 normal children.

The changes occurring in the 3 groups over the 4-month period were compared. In particular, it was noted that presurgical treatment had a constrictive effect on general arch growth and that it also retarded the growth of palatal tissue. The significance of this in relation to other findings and to presurgical treatment in general is discussed.

The fact that presurgical maxillary orthopaedic treatment can significantly reduce the width of the alveolar and palatal defects in cleft lip and palate cases has long been accepted by some. Exactly how this is brought about, however, has been a subject of some controversy. McNeil (1954) and Fish (1972) considered that palatal tissue growth was stimulated by the appliances. Huddart and Crabb (1977), however, showed that, in unilateral cases, during the first four months of life, the treatment actually reduced the rate at which palatal mucosa increased in size.

There was also evidence (Huddart, 1967; Robertson, 1970) that the treatment influenced the spatial position of the segments. Burston (1958) claimed that it made the lesser segment in unilateral cases move or grow forward more than it otherwise would have done, thus reducing the width of the alveolar defect. He also stated (1958) that the external strapping used in such treatment corrected any displacement of the centreline which might exist in this type of case.

Many of the claims made regarding presurgical treatment, however, have been based on subjective rather than objective judgments.

The present investigation, therefore, set out to analyze the changes resulting from presurgical maxillary orthopaedic treatment during the first 4 months of life using 3 groups of subjects: (1) 30 unilateral cleft lip and palate cases who were treated presurgically; (2) 15 similar cases who were not so treated and who served as controls; and (3) 30 normal children.

The type of presurgical treatment carried out has already been described (Huddart, 1961; Huddart and Zilberman, 1977) and is undertaken routinely at the West Midlands Regional Plastic Unit. It differs somewhat from the classic method involving sectioning the model, the provision of multiple appliances, and the use of stimulator pads as described by McNeil (1954) and Burston (1958) in that the model was not sectioned and usually only one appliance was used. In order to produce segmental movement, expansion screws were incorporated in the appliances, but there were no stimulator pads as these studies had been found in preliminary studies to be unnecessary. Clinically, the West Midlands treatment was just as effective as the McNeil method in reducing the width of alveolar and palatal clefts, and the improvement gained warranted the demand on the limited resources available to carry it out.

Method

Plaster models were made of the maxillary arches of each subject at birth (0–14 days)

Dr. Huddart is Consultant Orthodontist, West Midlands Regional Plastic & Jaw Surgery Unit, Wordsley Hospital, Wordsley, Near Stourbridge, West Midlands, England.

A portion of this material was presented as a short paper to the British Society for the Study of Orthodontics in London on the 13th February 1978.

The investigation was undertaken under the auspices of the Research Committee, West Midlands Regional Health Authority.

and again at 4 months (110–130 days). Certain landmarks were identified and marked on the models. These included postgingivale, the crest of the alveolar ridge, the anterior dental papilla, and the margins of the cleft.

The models were then photocopied in the horizontal plane; and, after sectioning, the cut surface was photocopied again to give a transverse view of the arch (Huddart 1967). The plane of section was 20 mm. posterior to the anterior dental papilla because, in the newborn infant, it would run through or only slightly anterior to postgingivale. The same distance was chosen when sectioning the 4-month models so that changes occurring during the period of the investigation at one specific transverse site in the mouth could be examined.

The photocopies were next measured using a computerized technique in which the lines of the diagram were converted into coordinate data using a D-Mac Pencil Follower Trace Analyzer (Huddart, Clarke, and Thacker 1971).

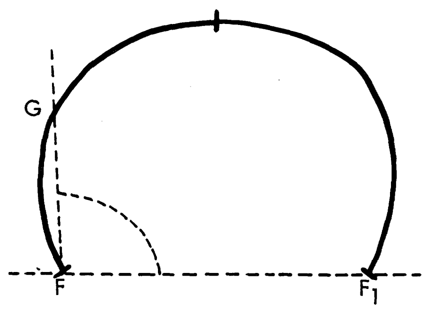

FIGURE 1A. Normal Subjects.

F	= postgingivale (right side)
F_1	= postgingivale (left side)
G	= where the arc of a circle radius 15 mm. centred on postgingivale (F) cuts the crest of the alveolar ridge on the right side
G_1	= where the arc of a circle radius 15 mm. centred on postgingivale (F_1) cuts the crest of the alveolar ridge on the left side
$F - F_1$	= mean postgingivale baseline. (A line joining postgingivale on each side and at 90° to the median palatal raphe. If the arch is asymmetrical, the line is at 90° to the median palatal raphe and equidistant from F and F_1).
Angle GFF_1	= angle of alveolar convergence. The mean value was found to be 94.77° at birth and 96.17° at 4 months.

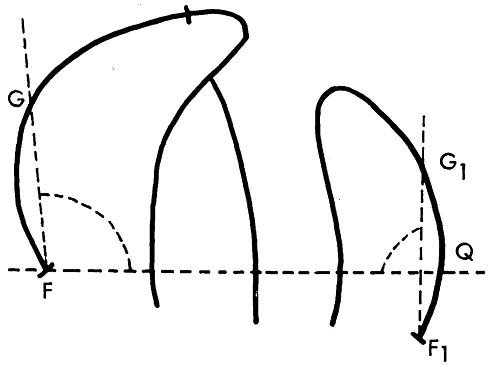

FIGURE 1B. Unilateral Cleft Subjects.

F	= postgingivale (greater segment)
F_1	= postgingivale (lesser segment)
G	= where the arc of a circle radius 15 mm. centred on postgingivale (F) cuts the crest of the alveolar ridge on the greater segment
G_1	= where the arc of a circle radius 15 mm. centred on postgingivale (F) cuts the crest of the alveolar ridge on the lesser segment.
F − Q	= Baseline. The computer locates point G, 15 mm. from F using the co-ordinate data provided and then constructs the line FQ such that the angle GFQ is 94.77° in the newborn subjects and 96.17° if they are aged 4 months.

These coordinate data were then fed on punched paper tape into a computer to be measured and statistically analyzed.

A computer used for measuring purposes can also locate its own baseline. In the normal subjects, this was the "mean postgingivale baseline" situated equidistant from postgingivale on each side and at 90° to the sagittal plane ($F - F_1$, Figure 1A). In the cleft cases, however, the baseline used was derived from the "angle of alveolar convergence" found in the normal subjects. This was the angle formed by the "mean postgingivale baseline" and a line joining postgingivale at a point on the crest of the alveolar ridge 15 mm. anterior to it (G, Figure 1A). At birth, this "angle of alveolar convergence" (angle GFF_1, Figure 1A) measured 94.77° and at 4 months 96.17°. To establish a baseline for the cleft subjects, the computer was programmed to locate point G (Figure 1B) on the crest of the alveolar ridge 15 mm. from postgingivale on the greater segment (F, Figure 1B). It then constructed another line through postgingivale (F) at an angle of 94.77° to the line GF

(Figure 1B) when measuring photocopies of the maxillary arch at birth and at 96.17° when the child was 4 months old (angle GFQ, Figure 1B).

In this way, a baseline (FQ, Figure 1B) was established which related only to the greater segment, thereby permitting the measurement of changes in the position of the lesser segment relative to the greater. The choice of 15 mm. for the length of the line FG (Figure 1B) was based on preliminary studies of the length of the lesser segment in the newborn infant. Any rotation of this segment was given by the angle between lines F_1 and G_1 (Figure 1B) and the baseline FQ. For this purpose, F_1G_1 had to be strictly comparable to FG. It was found that, while F_1G_1 had to be as long

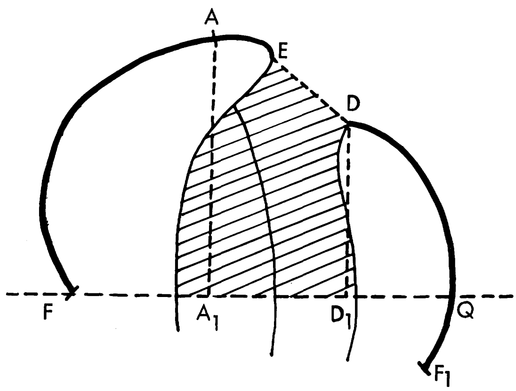

FIGURE 2A. Unilateral Cleft Subject.

A	= incisive point. (Where a line joining the labial frenum to the anterior margin of the anterior dental papilla, crosses the crest of the alveolar ridge).
D	= anterior end of lesser segment and distal margin of alveolar cleft
E	= mesial margin of alveolar cleft
F	= postgingivale (greater segment)
F_1	= postgingivale (lesser segment)
F − Q	= baseline (see Figure 1 and text)
A_1	= where a line from A meets F − Q at 90°
D_1	= where a line from D meets F − Q at 90°

Measurement definitions

A − F	= alveolar arch length (intact side)
(A − E) + (D − F_1)	= alveolar arch length (cleft side)
D − E	= width of alveolar cleft
D − D_1	= antero-posterior position of lesser segment
A − A_1	= height of dental arch
F − A_1	= width of intact side
Shaded area	= palatal cleft area.

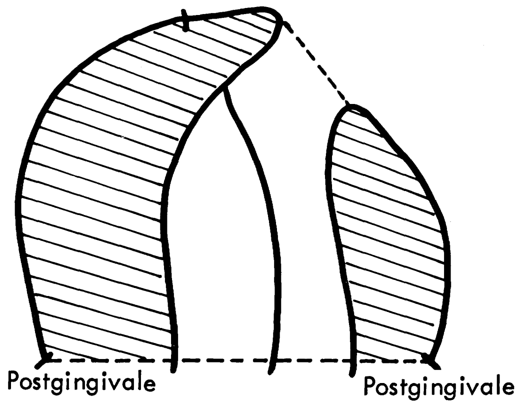

FIGURE 2B. Unilateral Cleft Subject. Overall Area = peripheral outline (2 dimensions). Area of Palatal Tissue = shaded areas (3 dimensions). For these area measurements, the base line used is a line joining postgingivale on the greater and lesser segments. It is, therefore, directly comparable anatomically to the baseline used in the normal subjects (F − F_1 Figure 1A).

as possible to represent the position of the segment accurately, if F_1G_1 was greater than 15 mm., point G_1 would, in some of the cleft cases at birth, be located beyond the segment in the alveolar cleft and would, therefore, be useless for measurement purposes. On the other hand, a lesser distance such as 10 mm. would be ineffective for the measurement of rotational changes.

As part of the investigation, the area of palatal tissue and the overall area of the arches were also measured using stereophotogrammetry and a newly developed vacuum adaptation technique (Huddart, Crabb, and Newton, 1978). The baseline used for this purpose was a line joining postgingivale on each side (FF_1, Figure 1A for normal cases and Figure 2B for cleft subjects).

A preliminary examination of the results showed 16 factors which were particularly important as far as the narrowing of the alveolar and palatal clefts was concerned. These are detailed in Figures 1 and 2. These 16 factors were measured at birth and again at 4 months in the presurgical cases and were compared with the same factors in the controls and equivalent factors in the normal cases. The results of the investigation relating to the effects of presurgical treatment on the overall area of the arch and the area of palatal tissue have already been published (Huddart and Crabb, 1977). This aspect of the investi-

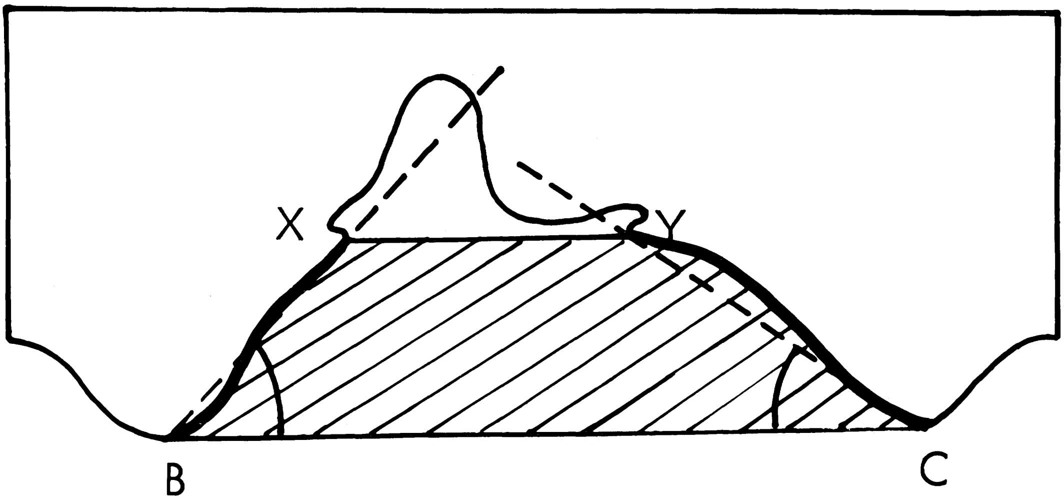

FIGURE 2C. Transverse Section (Unilateral Cleft Subject). The plane of section is 20 mm. distal to point A (Figure 1 and text).

B = alveolar crest (lesser segment)
C = alveolar crest (greater segment)
X = margin of palatal cleft (lesser segment)
Y = margin of palatal cleft (greater segment)

Measurement definitions

(B − X) + (Y − C)	= width of palatal tissue
X − Y	= width of palatal cleft
B − C	= posterior arch width
Angle XBC	= slope of palatal shelf (lesser segment)
Angle YCB	= slope of palatal shelf (greater segment)
Shaded portion	= cross sectional area of the palate (in normal subjects, X and Y are in the midline and correspond to the median palatal raphe).

gation will, therefore, be considered here only in relation to its effect on the other factors.

Results and Discussion

The results of the investigation are summarized in Tables 1 through 13.

These show that a highly significant narrowing of the palatal and alveolar clefts (Tables 1, 2, and 3) occurred in the presurgical cases, and this appeared to be achieved in four ways.

(1) By the effect of the treatment on the width of the arch. Although, at birth, the arches in the cleft cases were significantly wider than normal, the appliances prevented the arches from continuing to widen as craniofacial growth proceeded. The posterior arch width in the normals and the controls increased by approximately similar amounts, but there was minimal increase in the width of the presurgical cases during the 4-month period (Table 4).

(2) By the effect of the treatment on the slope of the palatal shelves. In the cleft cases the slope was significantly steeper than normal at birth (Tables 5A and 5B). In comparison, at the end of 4 months, the shelves in the control cases and in the normals had increased in steepness, while the slope in the presurgical cases had changed much less and was closer to the values found in the normal children at that age. The available tissue in the presurgical cases was, therefore, used more effectively in the transverse plane, and consequently the width of the palatal cleft was reduced.

(3) By preventing the anterior end of the lesser segment from rotating outwards (Table 6). At birth, the lesser segment in the cleft cases was rotated with an "angle of convergence" of only 81°–86° compared to 94.77° in the normal subjects. As the posterior arch width in the clefts was wider than normal at birth (Table 4), this rotation would appear to be due mainly to an outward displacement of the posterior end of the lesser segment. In

the control cases, the anterior end of the segment gradually swung outward as growth proceeded so that, by 4 months, the angle of convergence had increased to 94.20° compared to the normal value of 96.17°. This was probably because the tongue's forcing its way into the cleft and because of the pull of the divided labial musculature (Figure 3B). In the presurgical cases, presumably because of the presence of the appliance and external strapping, this rotation did not occur to the same extent. By 4 months, the lesser segment had an "angle of convergence" of only 89.84° (Figure 3A).

(4) By inhibiting the growth of the anterior end of the *greater* segment as shown by changes in the height of the dental arch (Table 7). Forward growth in this region appeared to be reduced by the pressure of the external elastic strapping across the front of the arch.

The investigation showed that the *width* of palatal tissue at birth in the cleft cases was significantly less than normal, the deficiency being approximately 22% (Table 8). There was also a deficiency in the *area* of palatal mucosa in the newborn which ranged from the equivalent of 2.5% to 32.2% of the area of a normal palate. The mean deficiency was 16.8% (Table 9A).

When the alveolar arch length was measured, it was found that the length of the intact side was significantly *less* than normal at birth (Table 10B) but that the length on the cleft side was approximately *equal* to that found in the normals (Table 10A).

KEY TO ALL TABLES

***	significant at the 0.1% level
**	significant at the 1% level
*	significant at the 5% level
NS	not significant

TABLE 1. Width of palatal cleft (mm) (see figure 2C).

	normal (1)	*presurgical* (2)	*control* (3)	*comparison* 1–2	2–3	1–3
Birth	—	16.01	14.38	—	*	—
4 months	—	10.61	12.98	—	***	—
Change	—	5.40	1.40	—	***	—
Significance	—	***	**			

TABLE 2. Area of palatal cleft (mm^2) (see figure 2A).

	normal (1)	*presurgical* (2)	*control* (3)	*comparison* 1–2	2–3	1–3
Birth	—	302.11	267.67	—	*	—
4 months	—	193.24	246.21	—	**	—
Change	—	108.87	21.46	—	***	—
Significance	—	***	NS			

TABLE 3. Width of alveolar cleft (mm) (see figure 2A).

	normal (1)	*presurgical* (2)	*control* (3)	*comparison* 1–2	2–3	1–3
Birth	—	11.76	10.04	—	NS	—
4 months	—	7.13	8.90	—	NS	—
Change	—	4.64	1.15	—	***	—
Significance	—	***	NS			

TABLE 4. Posterior arch width (mm) (see figure 2C).

	normal (1)	presurgical (2)	control (3)	comparison 1-2	2-3	1-3
Birth	28.52	36.04	34.63	***	NS	***
4 months	33.40	36.78	38.52	***	NS	***
Change	4.88	0.75	3.89	***	***	NS
Significance	***	*	***			

TABLE 5A. Slope of palatal shelves (see figure 2C). Greater segment.

	normal (1)	presurgical (2)	control (3)	comparison 1-2	2-3	1-3
Birth	24.45°	32.79°	34.26°	***	NS	***
4 months	28.30°	32.32°	37.42°	**	**	***
Change	3.86°	−0.47°	3.16°	***	**	NS
Significance	***	NS	*			

TABLE 5B. Slope of palatal shelves (see figure 2C). Lesser segment.

	normal (1)	presurgical (2)	control (3)	comparison 1-2	2-3	1-3
Birth	24.45°	39.30°	39.18°	***	NS	***
4 months	28.30°	36.60°	40.99°	***	**	***
Change	3.86°	−2.70°	1.81°	***	*	NS
Significance	***	*	NS			

TABLE 6. Rotation of lesser segment (see figure 1B).

	normal (1)	presurgical (2)	control (3)	comparison 1-2	2-3	1-3
Birth	94.77°	86.75°	81.63°	***	NS	***
4 months	96.17°	89.84°	94.20°	***	NS	NS
Change	1.40°	3.09°	12.57°	NS	**	***
Significance	*	NS	***			

In the normal subjects, the values relate to the "angle of alveolar convergence." (see Figure 1A and text).

If this finding is related to the deficiencies of tissue width and area (Tables 8 and 9A) and to the reduced height of the dental arch (Table 7) at birth, it suggests that the cleft maxilla is hypoplastic compared to that of a normal child. The fact that the length of the alveolar arch on the *cleft* side is approximately the same as normal, probably indicates that the plane of the alveolar cleft runs transversely (coronally) and not radially (at right angles to the line of the arch). If the cleft runs transversely, the anterior end of the lesser segment would then represent the *palatal* aspect of the alveolus in the region of the alveolar cleft, while the mesial end of the greater segment would represent the labial portion

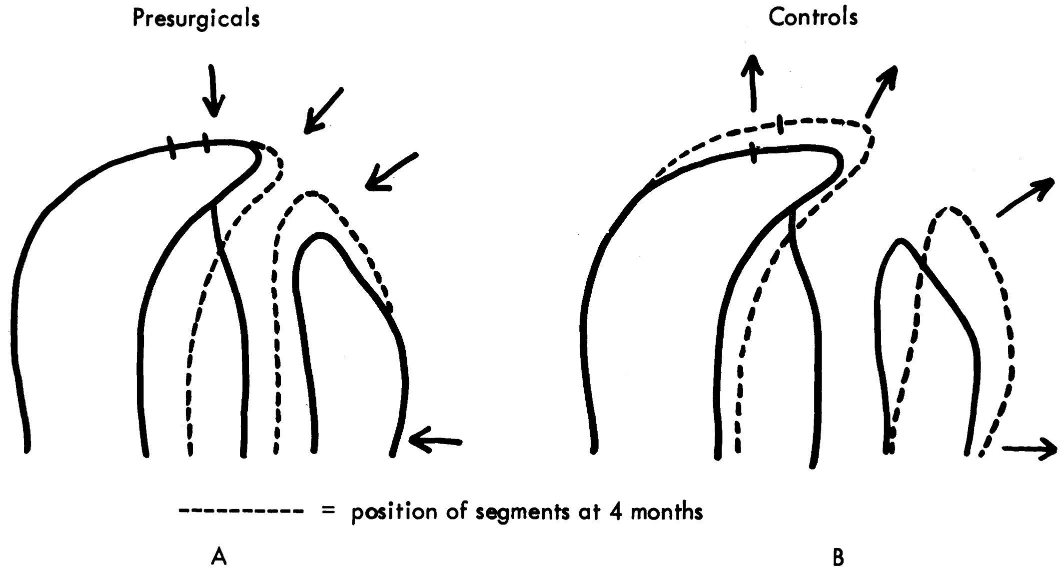

FIGURE 3A and B. Maxillary Arch Changes (birth to 4-months). (A) Presurgical Cases and (B) Controls. In the presurgical cases, the constrictive effect of the treatment enables the growth on the margins of the cleft to narrow the width of the defect.

TABLE 7. Height of dental arch (mm) (see figure 2A).

	normal (1)	*presurgical* (2)	*control* (3)	*comparison* 1–2	2–3	1–3
Birth	25.09	24.27	24.03	NS	NS	NS
4 months	28.75	26.22	27.32	***	NS	*
Change	3.66	1.95	3.30	***	*	NS
Significance	***	***	***			

TABLE 8. Width of palatal tissue (mm) (see figure 2C).

	normal (1)	*presurgical* (2)	*control* (3)	*comparison* 1–2	2–3	1–3
Birth	32.03	26.73	26.87	***	NS	***
4 months	39.00	33.42	35.08	***	NS	***
Change	6.97	6.69	8.21	NS	NS	NS
Significance	***	***	***			

(i.e. an overlap would exist if there were no deficiency of tissue or segmental displacement in the region of the alveolar cleft).

During the investigation, the palatal tissue in the control cases tended to grow more quickly than in the normals so that the tissue area deficiency dropped from 16.8% at birth to 9.5% at 4 months. There was minimal improvement, however, in the presurgical cases where tissue growth was significantly less than in the control subjects with the result that the deficiency was still 15.2% at 4 months (Table 9A).

There was significantly more narrowing of

TABLE 9A. Area of palatal tissue (mm^2) (see figure 2B).

	normal (1)	*presurgical* (2)	*control* (3)	*comparison* 1-2	2-3	1-3
Birth	747.1	621.6	630.1	***	NS	***
4 months	965.7	818.6	873.8	***	NS	**
Change	218.6	197.0	243.7	NS	*	NS
Significance	***	***	***			

TABLE 9B. Overall area (mm^2) (see figure 2B).

	normal (1)	*presurgical* (2)	*control* (3)	*comparison* 1-2	2-3	1-3
Birth	638.0	787.0	725.3	***	NS	***
4 months	814.3	838.7	905.3	NS	*	***
Change	176.3	51.7	180.0	***	***	NS
Significance	***	***	***			

TABLE 10A. Total cleft side arch length (mm) (see figure 2A).

	normal (1)	*presurgical* (2)	*control* (3)	*comparison* 1-2	2-3	1-3
Birth	34.33	34.37	34.23	NS	NS	NS
4 months	38.70	39.67	39.37	NS	NS	NS
Change	4.37	5.29	5.14	NS	NS	NS
Significance	***	***	***			

TABLE 10B. Intact side arch length (mm) (see figure 2A).

	normal (1)	*presurgical* (2)	*control* (3)	*comparison* 1-2	2-3	1-3
Birth	34.33	30.86	30.11	***	NS	***
4 months	38.70	34.78	35.78	***	NS	***
Change	4.37	3.92	5.67	NS	*	NS
Significance	***	***	***			

the palatal cleft in the presurgical cases (Tables 1 and 2) because the appliances also restricted the overall growth of the arches. This more than compensated for the slight reduction in the amount of tissue growth associated with the wearing of the appliances (Table 9B).

The palatal cleft was also reduced, however, by the effect the treatment had on the slope of the palatal shelves (Tables 5A and 5B). At 4 months, the shelves in the presurgical cases were lying more horizontally than in the controls so that the available tissue was being used more effectively to narrow the cleft.

The alveolar cleft was narrowed mainly by the appliances and strapping, which prevented the anterior end of the lesser segment from rotating outward as growth proceeded (Table 6). The strapping restricted the forward growth of the anterior part of the greater segment (Table 7). There was no evidence in the investigation that the anterior end of the lesser segment moved or grew forward significantly more in the presurgical cases than it did in the controls (Table 11), nor did the center line move across to the affected side any more often in the presurgical cases than in the controls (Table 12).

It would appear that, although presurgical treatment tends to retard the growth of the palatal mucosa slightly, it narrows the alveolar and palatal clefts by the constrictive effect of the appliances and strapping, and it also alters the slope of the palatal shelves.

This can be seen if the three factors contributing to the width of the palatal cleft are studied. These are tissue deficiency, lateral segmental displacement, and an increased slope of the palatal shelves. Table 14 gives the percentage which each of these factors contributes to the width of the palatal cleft at

TABLE 11. Antero-posterior position of lesser segment (mm) (see figure 2A).

	normal (1)	*presurgical* (2)	*control* (3)	*comparison*		
				1–2	*2–3*	*1–3*
Birth	—	17.29	17.47	—	NS	—
4 months	—	19.23	19.29	—	NS	—
Change	—	1.93	1.82	—	NS	—
Significance	—	***	*			

TABLE 12. Intact side width (mm) (see figure 2A).

	normal (1)	*presurgical* (2)	*control* (3)	*comparison*		
				1–2	*2–3*	*1–3*
Birth	13.08	9.82	9.12	***	NS	***
4 months	14.75	13.10	13.45	***	NS	*
Change	1.67	3.28	4.34	***	NS	***
Significance	***	***	***			

TABLE 13. Cross sectional area of the palate (mm^2) (see figure 2C).

	normal (1)	*presurgical* (2)	*control* (3)	*comparison*		
				1–2	*2–3*	*1–3*
Birth	105.54	169.32	169.02	***	NS	***
4 months	163.24	188.47	240.72	***	***	***
Change	57.71	19.15	71.70	***	***	NS
Significance	***	*	***			

TABLE 14. Factors contributing to the width of the palatal cleft (%).

	birth		*4 months*	
	presurgicals	*controls*	*presurgicals*	*controls*
Tissue deficiency	33.10	35.88	52.59	30.20
Segmental displacement	46.97	42.49	31.86	39.45
Slope of palatal shelves	19.93	21.63	15.55	30.35

birth and at 4 months. At birth, approximately one-third of the width of the cleft is the result of tissue deficiency. Just less than half results from lateral segmental displacement, and about one-fifth from the increased slope of the palatal shelves. At 4 months, however, in the presurgical cases, tissue deficiency has become responsible for over half the width of the cleft presumably because of interference with tissue growth. In the control cases, where there is no interference with growth, it is responsible for less than one-third of the width. In the control cases, where the slope of the palatal shelves becomes steeper as growth proceeds (Tables 5A and 5B), the slope of the shelves is responsible for nearly one-third of the width of the cleft. In the presurgical cases, where the shelves are lying more horizontally, this factor is only half as important and is responsible for only 15% of the width of the cleft.

Exactly why the slope of the shelves is reduced is difficult to establish. Rotation around the zygomatico-maxillary and associated sutures is unlikely as this would tend to widen the arch, and we know that this does not occur (Table 4). The slope change may be due to the appliances' excluding the tongue from the cleft or, possibly, because they restrict the vertical growth of the segments since they cover the alveolar ridges.

These inhibiting and constricting actions do not appear to have any adverse effect on the extent of cross bite malocclusion in the older child. It has been shown that there is no increase in crossbite malocclusion in presurgically treated cases compared to an equivalent control group at 5 years of age (Huddart, 1972).

Because it narrows the width of the alveolar and palatal clefts (Tables 1, 2 and 3), presurgical treatment facilitates the eventual surgical closure of the defect, and evidence is also being accumulated that it is beneficial to the patient in other ways.

For example, the cross-sectional area of the palate (Table 13) is significantly larger in newborn cleft palate infants than in normal children so that the tongue functions in a more spacious environment. The dimensions of the oral cavity, however, are substantially reduced when the lip and palate have been repaired and the maxillary segments have become stabilized to the new balance of muscle forces created by the surgery. Because of this, behavior patterns learned in early infancy may have to be modified to enable the tongue to continue to function satisfactorily as the child grows.

Fitting a presurgical appliance immediately reduces the intra-oral and the cross-sectional dimensions of the palate to a more normal value, and the tongue can learn to function within the confines of the normalized space from birth onward. The treatment also produces cross-sectional areas at 4 months that are much closer than are the controls to the values found in normal children (Table 13).

Presurgical cases, therefore, have a relatively more normal and constant intra-oral dimension than the controls during the early months of life, and their tongue behavior patterns may possibly reflect this fact. For example, a preliminary study of the speech of our cleft palate patients between 4 and 5 years of age has shown that 47% of the presurgical cases have normal tongue tip movement compared to 36% in the controls. On the other hand, interdental characteristics were found in 40% of the control cases while only 14% of the presurgicals had this type of tongue behavior.

Conclusion

It must be stressed that the investigation just described examined only the changes in the maxillary arch and the area of palatal tissue in cases receiving presurgical treatment as carried out at the West Midlands Regional Plastic Unit. In assessing whether or not presurgical treatment should be undertaken, however, it must be remembered that these are only two of the factors to be considered. No account was taken in this investigation of the important social and pediatric aspects of the treatment and its effects on speech, and occlusion was only briefly considered.

Providing a balanced judgment on whether or not presurgical treatment should be undertaken will require an objective assessment of all aspects both in the short-term and the long. Until such investigations come to fruition, it is necessary to rely on subjective opinion. In the opinion of the surgeons at the West Midlands Regional Plastic Unit, presurgical treatment facilitates lip and palate repair and does not appear to have any long-term adverse effects on occlusion despite its mildly inhibiting effect on tissue growth. Because of this and also because of its important social and pediatric effects, it is recommended that the treatment should be carried out wherever possible for children with complete unilateral and bilateral clefts of the lip and palate provided it can be started within two or three days of birth.

Acknowledgements: This investigation was undertaken under the auspices of the Research Committee of the West Midlands Regional Health Authority in collaboration with the Computer Department, Keele University, and the Department of Surveying, University of Newcastle-upon-Tyne. In particular I would like to thank Dr. H. Greenwood, Head of the Computer Department at Keele University, and Mr. Ian Newton of the Department of Surveying at the University of Newcastle-upon-Tyne for their generous help and assistance in the course of the project.

I would also like to thank Mrs. S. Wall and Mrs. S. Cooper of the Department of Statistics, West Midlands Regional Health Authority, for help with the analysis of the findings: Mr. R. Paton and his staff at the Photographic Department, The Royal Hospital, Wolverhampton, for the illustrations; and Mrs. K. Randle for secretarial assistance.

References

BURSTON, W. R., The Early Orthodontic Treatment of Cleft Palate Conditions, *Dent. Proc.*, *9*, 41, 1958.

FISH, J., Growth of the Palatal Shelves of Post-Alveolar Cleft Palate Infants, *Brit. Dent. J.*, *132*, 492, 1972.

HUDDART, A. G., Presurgical Dental Orthopaedics, *Trans. Brit. Soc. Study Orthod.*, *107*, 1961.

HUDDART, A. G., An Analysis of the Maxillary Changes following Presurgical Dental Orthopaedic Treatment in Unilateral Cleft Lip & Palate Cases, *Trans. Europ. Orthod. Soc.*, *299*, 1967.

HUDDART, A. G., CLARKE, J., AND THACKER, T., The Application of Computers to the Study of Maxillary Arch Dimensions, *Brit. Dent. J.*, *130*, 397, 1971.

HUDDART, A. G., AND ZILBERMAN, Y., Presurgical Treatment in the Newborn Cleft Palate Infant, *Israeli J. Dent. Med.*, *26*, 15, 1977.

HUDDART, A. G., CRABB, J. J., AND NEWTON, I., A Rapid Method of Measuring the Palatal Surface Area of Cleft Palate Infants, *Cleft Palate J.*, *15*, 44–48, 1978.

MCNEIL, C. K., *Oral and Facial Deformity*, London: Pitman, 1954.

ROBERTSON, N. R. E., Recent Trends in the Early Treatment of Cleft Lip & Palate, *Trans. Brit. Soc. Study Orthod.*, *56*, 184–197, 1970.