Symmetry of Lip Activity in Repaired Unilateral Clefts of the Lip

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One of the first contributions of the plastic surgeon in the habilitation of a child with a cleft of the lip and palate involves the surgical correction of the cleft lip. In repairing the cleft of the lip, the plastic surgeon strives to produce a lip that is close to normal in appearance and function. To date, the major emphasis seems to have been placed on the appearance of the repaired cleft lip rather than on the functional aspects of the repaired lip. This is understandable but results in an interest in a static relationship rather than a moving dynamic relationship during function. Further, it may even be assumed that a good or normal appearance will coincidentally result in good or normal lip function.

It is important, however, to evaluate the potential function of the repaired lip. Not only is near normal function of the lip desirable in itself, but it may be critically important to appearance as well. The plastic surgeon strives to hide the existence of a congenital cleft of the lip by attempting to normalize its appearance. If the repaired lip is grossly abnormal during the performance of such functions as speaking, smiling, and swallowing, then attention may actually be directed to the lip and, of course, to the earlier existence of a cleft of the lip.

In light of this, it was deemed advisable to study surgically repaired clefts of the lip, both during function and in repose. An attempt was made to determine the degree and the direction of lip asymmetry which could be observed in subjects with surgically repaired clefts of the lip when compared with noncleft subjects. For this purpose, surgically repaired unilateral clefts of the lip were studied since the normal or noncleft side of the lip could be compared to the side with the surgically repaired cleft. One of the aims was to determine which side of the mouth (the operated or the noncleft) had the greater movement. Second, if deviations existed, were they evident while the lips were at rest as well as during functional movements?

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Procedure

Data were secured for 24 patients with surgically repaired clefts of the lip and for 22 control noncleft subjects. These subjects ranged in age from seven to 15 years and had no history of previous orthodontic treatment or speech training. The subjects were accompanied by a parent so that an accurate history could be obtained.

In order to analyze the activity of the circumoral musculature and any asymmetry relative to the midline of the face, it was decided that a motion picture analysis would afford the best possible means for this assessment. Certain landmarks were inked on the face of each subject, which appeared in each frame of the motion pictures. These markings allowed baselines to be constructed from which measurements could be made. These landmarks included the outer canthi of the eyes and the outermost corners of the vermilion border of the lips. Figure 1 shows a photograph of an actual frame taken from the context of a film strip; the landmarks previously mentioned are clearly visible. Subsequent to the demarcation of the landmarks, the subjects were oriented in a physiographic cinematography set-up similar to that employed by Rosenblum (*2*) and Sassouni (*3*) and depicted diagrammatically in Figure 2. The subject was seated in a dental chair and the headrest was adjusted. Projectors, which were placed laterally, were then turned on for the purpose of projecting an orienting gridline on the subject. The subject was raised or lowered until the projected horizontal gridline passed through the external auditory meatus of the subject and a point on the lower border of the orbit, known

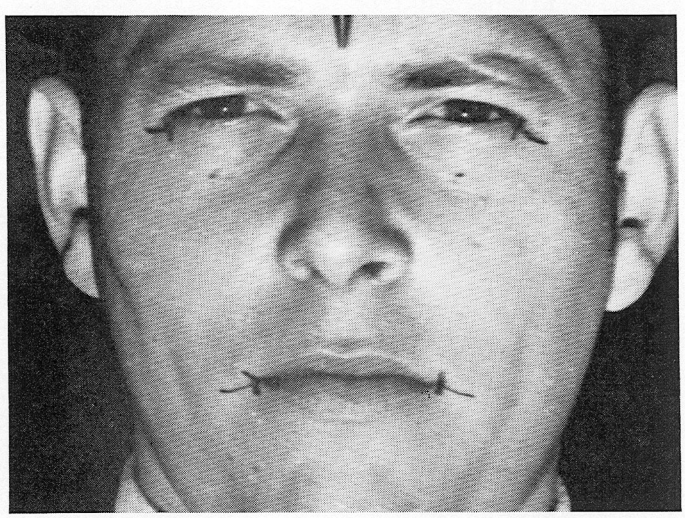

FIGURE 1. A photograph of an actual frame taken from the context of a film strip; the landmarks mentioned are clearly visible. The canthi of the eyes are marked as well as the corners of the lips. These marks are readily visible on each frame of the motion pictures.

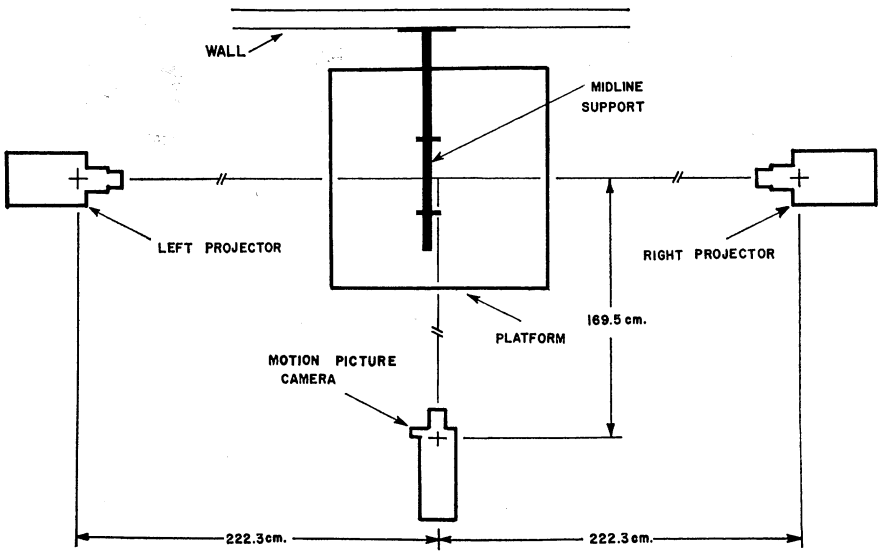

FIGURE 2. A diagrammatic sketch of the physiographic cinematography set-up employed in the study.

as orbitale (a landmark used in roentgenographic cephalometry). The orientation procedure is fully described in previous work done by Haring (*1*) and Rosenblum (*2*). This orientation simply allows the patient to be seated comfortably with the Frankford horizontal plane (external auditory meatus to orbitale) parallel to the floor and with the head in a reproducible posture and at a prescribed distance from the camera lens. The grid projectors were then switched off and the patient was photographed with an Arriflex 16 mm camera at 24 frames per second.

The motion pictures were taken with the subjects at rest and while performing certain functional movements as follows: a) with the subject assuming a maximum smiling position, b) during plosive production while reciting '*Bobby is a big boy*,' and c) during sibilant articulation while reciting '*Sister Susie saw Sam.*' Each film was viewed frame by frame, using an analytical projector. The individual frames were traced reproducing pertinent structures including the inked landmarks on transparent acetate tracing paper. The tracings were then used for measurements using an analysis devised for this study.

A typical tracing with the various landmarks and baselines is shown in Figure 3. The outer canthi of the eyes were used to form a baseline from which a midline could be constructed. A line was drawn connecting the outer canthus of each eye. These particular points were chosen to form the baseline, because they are easily visualized on a frontal photograph and are relatively immobile. The baseline formed by connecting the canthi served as the major baseline for the construction of other baselines. (On Figure 3 it is designated by b.l.) A line, drawn to serve as

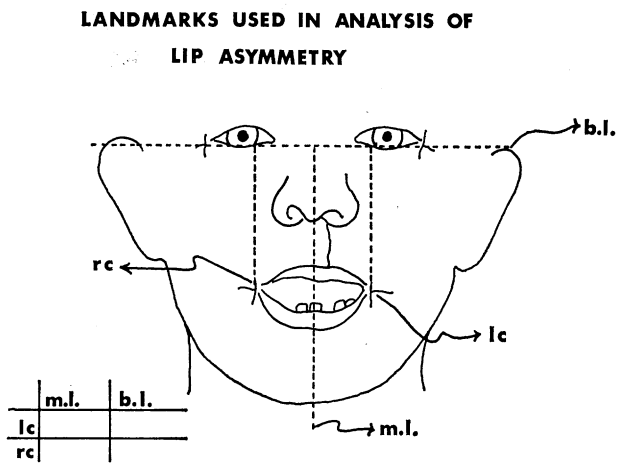

FIGURE 3. The various landmarks of a typical tracing: b.l., baseline formed by connecting the outer canthi of the eyes; m.l., facial midline formed by bisecting the distance between the outer canthi of the eyes and drawing a perpendicular to the baseline; r.c., right corner of the lips and the perpendicular drawn from this landmark to the baseline; l.c., left corner of the lips and the perpendicular drawn from this landmark to the baseline.

the facial midline, was then constructed by bisecting the baseline connecting the outer canthi of the eyes and by dropping a perpendicular from the point of bisection. The facial midline is designated by m.l. As the corners of the mouth move, they may deviate in two directions. They may move horizontally, toward or away from the midline and they may move vertically, toward or away from the baseline. Perpendiculars were then constructed to the baseline from the right and left corners of the mouth, designated by r.c. and l.c. The length of these perpendiculars from the baseline was used to measure the amount of deviation, vertically, during repose, and during function.

The amount of horizontal displacement (deviation in the horizontal direction) was assessed by measuring the distances of the right and left corners of the mouth from the facial midline.

Figures 4, 5, 6, 7, 8, and 9 illustrate the method of determining the degree of symmetry or asymmetry in any of the individual subjects studied. These figures cover the full series of resting and functional tracings. In Figure 4, the vertical measurements (or the distance of the right and left corners of the lips from the baseline) during rest position were both 44.3 mm. Therefore, there is no deviation in the vertical direction and the subject is considered to be 100% symmetrical. There is, however, a discrepancy in the horizontal direction in that the left corner of the lip measures 22.2 mm from the midline of the face and the right corner of the lip measures 18.6 mm from the midline. By dividing the largest dimension into the smallest, it can be concluded that the patient is only 83.78% symmetrical and the deviation is to the left side or the side of the

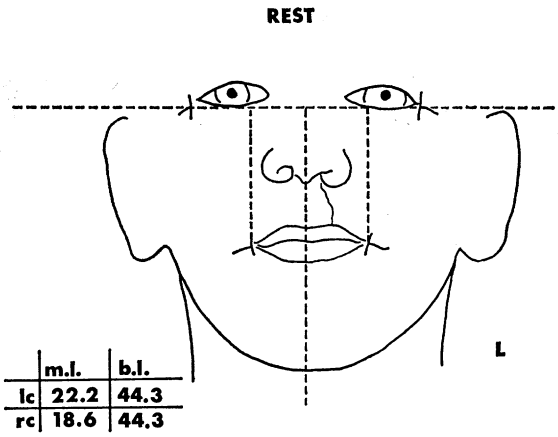

FIGURE 4. The rest position, showing a mild horizontal discrepancy in a patient with a left unilateral cleft lip. The vertical distance of the corner of the lips to the baseline is equal or symmetrical in this case (44.3 mm). The left corner of the lips is further away from the facial midline (22.2 mm) than the right corner of the lip (18.6 mm).

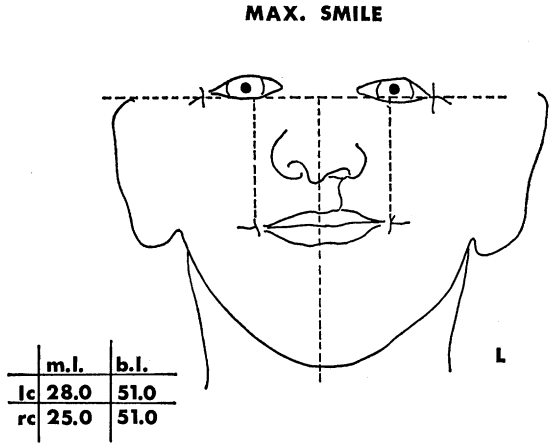

FIGURE 5. The maximum smile position, again mildly asymmetrical in the horizontal direction.

largest dimension, which in this case happens to be the side of the cleft. The same type of analysis was applied during all of the functional positions as well as during rest.

Results

All data from both groups were analyzed statistically to investigate the presence of trends. The results revealed that there was more lip asymmetry in the unilateral cleft lip subjects than in the noncleft individuals. This was especially true in the deviation from the midline both during rest and during function. The mean percentages of asymmetry of

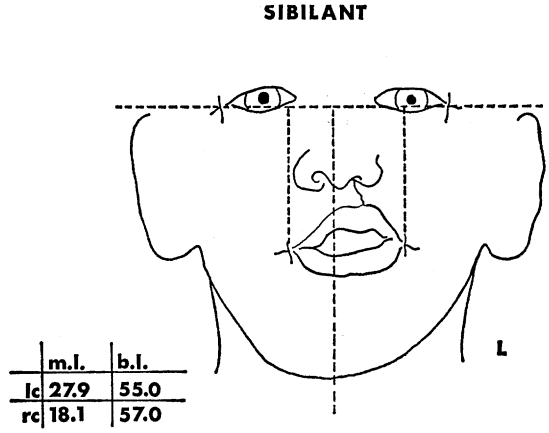

FIGURE 6. The same subject during sibilant production reveals a mild vertical displacement and a large horizontal deviation.

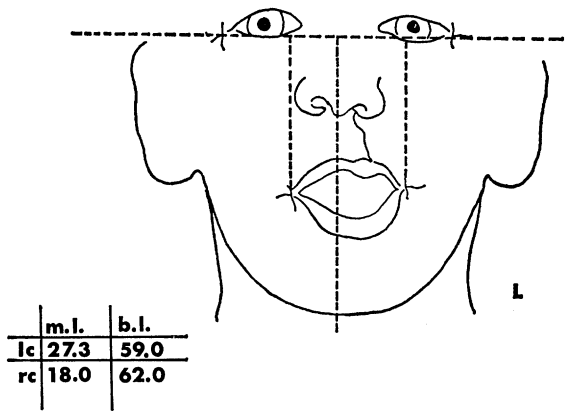

FIGURE 7. During plosive articulation the tracing of the same subject reveals a similar pattern as that depicted in Figure 6.

both groups in the areas studied (100% being perfectly symmetrical) can be observed in Figure 8. As noted during rest and while performing the aforementioned functional movements, the cleft lip group revealed lower mean values in all cases than did the control group, indicating greater asymmetry in the cleft lip group. The control group, however, proved to be more asymmetrical than had been anticipated. This resulted in only two mean differences being found to be significant. The amount of asymmetry in deviation from the midline of the face was surprising in the control group. Perhaps this substantiates the claim that a completely symmetrical face is the exception rather than the rule.

The least amount of deviation from true symmetry was noted during

LIP ASYMMETRY DATA

	REST		MAX. SMILE		PLOSIVE		SIBILANT	
	mean	s.d.	mean	s.d.	mean	s.d.	mean	s.d.
CONTROLS	91.2	5.76	94.3#	4.39	92.0	6.41	91.8#	6.21
CLEFTS	89.7	9.58	90.0#	7.94	88.9	11.80	85.9#	10.79

(#) significant at 5% level of confidence

FIGURE 8. The mean percentages of asymmetry of both groups (100% being perfectly symmetrical). These indicate mean symmetry or asymmetry relative to the facial midline.

% of symmetry from B.L. - Controls

Rest —	98.6
Max. Smile —	97.8
Plosive —	97.9
Sibilant —	98.4

% of symmetry from B.L.- Clefts

Rest —	98.0
Max. Smile —	97.4
Plosive —	97.7
Sibilant —	97.2

FIGURE 9. The mean percentages of asymmetry from the baseline. This measured the distances of the corners of the lips, vertically, from the baseline drawn between the outer canthi of the eyes.

the function of maximum smiling. This was true for both the cleft lip and the noncleft groups. Although, once again, more asymmetry was evident during smiling in the cleft group than in the noncleft group, this was significant at the 5% level of confidence. The greatest degree of deviation from true symmetry was observed in the cleft group during the functional production of speech sounds. Therefore, in the cleft palate individuals, there appeared to be a greater trend for increased asymmetry with increased muscular function. Surprisingly, the side of the cleft was found to be the side of the largest absolute measurement. That is, the corner of the mouth on the side of the cleft moved further away from the midline during function and possibly drew the corner of the

mouth on the noncleft side toward the midline in most of the cleft lip subjects (about 70%). One might suppose that due to the possibility of diminished tissue and contracting scar tissue on the side of the cleft repair, this side would probably be shorter and less mobile as well as more limited in the extent of movement. This does not seem to be the case. The greatest degree of lip movement was on the side of the cleft and it moved away from the facial midline during function.

The asymmetry of function noted relative to the facial midline was not evident in the vertical direction either toward or away from the level of the eyes. There was very little asymmetry exhibited in this direction when the cleft side was compared with the noncleft side during function. At the same time, there was very little difference in this direction when the cleft subjects were compared with the subjects in the control groups. None of the differences noted in the vertical direction were found to be significant.

Differences were looked for within the cleft lip group. Utilizing the information attained from the histories as given by the parents, the number of surgical procedures and evaluations of the adequacy of speech were compared with the asymmetrical activity of the surgically repaired cleft lip. There appeared to be no significant correlation between the degree of asymmetry of lip activity and the age of subject, the degree of speech inadequacy, and the number of surgical procedures. In fact, the greater the number of surgical procedures, which in some cases was as many as three operations on the lip, the more symmetrical was the function of the repaired cleft lip. Of course, this may be a misleading observation since there was no way of correlating this observation with the type of surgery, with the severity of the cleft at birth, or with the surgeon's skill.

Discussion

None of the subjects analyzed in this study were found to be perfectly symmetrical in the region of the lips. This was true of both the cleft and the noncleft subjects. In fact, the degree of asymmetry of the lips of the noncleft subjects was quite definite and sometimes pronounced. This would, of course, indicate that perfect symmetry is extremely difficult to achieve in any one subject. It may even be questioned whether perfect symmetry is a realistic goal. However, it must also be pointed out that the average human, as indicated by the subjects in this study, closely approaches symmetry (approximately 90%). Therefore, in lip surgery, although it may not be possible to achieve true symmetry, it would seem that one should strive to do so.

It can be stated that the surgeon is usually quite successful in his attempt to attain normal symmetry in the repair of a unilateral cleft of the lip. When examined and studied at rest, the symmetry of the lips of the cleft lip subjects very closely approximated the symmetry of the

noncleft subjects. The primary objective of the plastic surgeon seems to have been achieved.

It is during functional movements that the asymmetrical activity of the lip becomes more evident in the repaired cleft lip subjects. This was most pronounced during speech production. The noncleft subjects revealed a fairly constant degree of symmetry during function as well as during rest. In fact, if anything, they were slightly more symmetrical in the postural relationships of the corners of the mouth during function than while at rest. This was true of the repaired cleft lip subjects while performing a maximum smile, but the asymmetry became even more evident during speech production. This too seemed to be minimized in individual cases as the surgeon attempted to improve the lip with secondary lip procedures. This interpretation is derived from the observation that greater symmetry of the lip was noted in the cases which had secondary lip surgery. It should be pointed out, however, that this is hypothetical reasoning since these youngsters were not studied and analyzed prior to the last surgical procedure. It is conceivable that they were just as symmetrical subsequent to the primary closure of the lip.

It is difficult to pinpoint the cause of the asymmetrical lip activity that was observed in the repaired cleft lip subjects during speech production. It is possible that, either as a result of a congenital defect or as a result of the surgical procedure, some of the circumoral muscles are shortened on the side of the cleft.

It is also possible that the asymmetry of the lip activity during function may be a compensatory mechanism on the part of the noncleft side of the lip. Despite the presence of a cleft of the lip and its subsequent surgical repair, the lip must fulfill the same functional demands as a normal lip. Perhaps the deviations in activity must be performed to achieve the desired result, whether it be a speech sound, a smile, or a swallow. The normal side may be compensating for the original congenital cleft in order to produce that desired result. This, of course, is highly speculative. Perhaps with the opportunity of studying subjects with bilateral clefts of the lip that have been surgically repaired, more information would be forthcoming.

Summary

It has been shown that subjects with surgically repaired unilateral clefts of the lip exhibit a greater degree of asymmetry of the lip during function than do normal children. The amount of asymmetry seems to increase with lip function. The greatest degree of lip displacement generally occurs on the same side as the cleft with a horizontal deviation away from the midline of the face. The position of the corners of the lips, vertically, did not differ greatly between the cleft subjects and controls during rest or function. No correlation could be found between the number of surgical procedures on the lip and the amount of asymmetry dur-

ing function. Inequality of lip movement can and should be an important factor in determining surgical and orthodontic procedures.

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References

1. HARING, F. M., A physiometric study of lip muscle function of cleft and noncleft subjects. M.S. thesis, Univ. of Rochester, 1962.
2. ROSENBLUM, R. E., A cinematographic study of orofacial muscle activity during deglutition. M.S. thesis, Univ. of Rochester, 1961.
3. SASSOUNI, V., and KROGMAN, W. M., The physiograph-cephalostat. *Amer. J. Orthod.*, *44*, 307, 1958.