The aim of this study was to analyze the relationships among three key anthropometric parameters in the unilateral cleft lip to determine the correlations, if any, among these indices of severity. Using a standardized anthropometric documentation protocol, preoperative measurements of 125 unilateral cleft lips (103 complete and 22 incomplete) were performed under general anesthesia by a single surgeon at the time of primary lip repair at the age of 3 months. The following key measurements were analyzed statistically: (1) the philtral height difference (PHD) between the cleft and noncleft sides, (2) the nasal floor width difference (NFWD) between the cleft and noncleft sides, and (3) the cleft width (CW). The mean values of all three indices were greater in the complete group versus the incomplete group. These differences were statistically significant. Linear relationships were obtained between NFWD and GAP, between PHD and GAP, and between PHD and NFWD in the complete group. In contrast, the relationships between PHD and GAP, and between PHD and NFWD were nonlinear in the incomplete group. These findings suggest that there was a strong correlation between the transverse and vertical tissue deficiencies in the complete cleft lip. In incomplete clefts, however, this correlation did not exist. In other words, the incomplete cleft lip can be associated with a severely short philtrum even in the presence of a relatively mild transverse tissue deficit. Therefore, it is not necessarily easier to repair an incomplete cleft lip in terms of the correction of the vertical tissue deficiency.

INTRODUCTION

The aim of surgical repair of the unilateral cleft lip is to approximate the cleft edges without loss of natural landmarks, to restore the continuity of the orbicularis oris muscle, and to achieve a symmetric appearance of both the lip and the nose. Apparently simple in concept, these goals demand the utmost in flair and finesse from the surgeon, and are notoriously difficult to attain with consistency. Thus, the ultimate target of consistently producing a lip repair that allows the cleft side to be indistinguishable from the noncleft side remains elusive.

In evaluating the severity of a unilateral cleft lip, the surgeon qualitatively assesses the width of the cleft, the shortness of the philtrum on the cleft side, and the severity of the associated nasal deformity. This qualitative evaluation essentially considers tissue deficiencies in three axes: transverse (width), vertical (height), and anteroposterior (depth). These subjective observations can be supplemented by anthropometric measurements that allow the quantification of the various indices of severity. The value of anthropometric data lies in its allowing objective assessments to be made that facilitate the confirmation or rejection of subjective impressions, and in enhancing the accuracy and validity of both preoperative evaluations and postoperative analyses.

Although anthropometric data on the unilateral cleft lip and nonanthropometric analyses of this deformity exist in the literature, the critical indices of severity remain vaguely defined, and the relationships between these indices are largely unexplored. Because of this lack of objective data, cer-
tained clinical observations relating to the unilateral cleft lip deformity remain anecdotal and unsubstantiated by hard data. For example, is a wider cleft associated with a shorter lip and a more severe nasal deformity? The common answer to this question, based on clinical observation, is in the affirmative, suggesting that a complete unilateral cleft lip is usually more difficult to repair than an incomplete cleft.

In the absence of published data that supports this observation, it is hypothesized that the shortness of the philtrum on the cleft side is not directly proportional to the width of the cleft, i.e., that there is no correlation between the tissue deficiencies in the transverse and vertical axes.

The aim of this investigation, therefore, is to define the key anthropometric indices of severity in the transverse and vertical axes in the complete and incomplete unilateral cleft lip and to analyze the relationships among these parameters to validate or refute the stated hypothesis.

**Patients and Methods**

Between 1988 and 1996, 125 patients with unilateral cleft lip with or without cleft palate were evaluated. The patients were stratified into two diagnostic groups: complete (n = 103) and incomplete (n = 22) clefts. In accordance with conventional practice, a cleft was defined as incomplete if a tissue bridge more substantial than a Simonart’s Band was present.

Preoperative anthropometric measurements were performed at the time of primary lip repair at the age of 3 months, under general anesthesia, and by a single surgeon (Lee). The measurements were made under ×2.5 loupe magnification using a plastic millimeter rule that had been shortened so that the end of the rule was flush with the zero mark. The anthropometric landmarks were selected according to a standardized protocol (Fig 1),6–8 which is based on landmarks established by Farkas.9

For the purpose of this study, three measurements were selected as key features which help to define the severity of the unilateral cleft lip deformity: (1) the philtral height difference (PHD) between the cleft and noncleft sides, (2) the nasal floor width difference (NFWD) between the cleft and noncleft sides, and (3) the cleft width (CW).

Based on these measurements, therefore, the three working indices of severity were defined and computed as follows:

1. the philtral height difference (PHD) between the cleft and noncleft sides,
2. the nasal floor width difference (NFWD) between the cleft and noncleft sides,
3. the cleft width (CW).

**Fig 1** Anthropometric documentation protocol for the unilateral cleft lip.

**Fig 2** The three key anthropometric measurements in the unilateral cleft lip: (1) philtral height discrepancy (PHD); (2) nasal floor width (NFW); and (3) cleft width (GAP).
The PHD reflected the magnitude of the vertical tissue deficiency, while the NFWD and the CW were indicators of the tissue shortage in the transverse plane. Measurements in the anteroposterior axis (depth) were not addressed in this investigation.

Statistical Analysis

Statistical analysis was completed using the SPSS® statistical software platform. The anthropometric data were divided into two groups according to whether the cleft was complete or incomplete. The mean, standard deviation and range of values for the three indices (PHD, NFWD, and CW) were determined. The mean values between the two study groups were compared using the Mann-Whitney U-Wilcoxon Rank sum W test. The data for each index were then separately charted to allow visual comparisons to be made between the two groups with respect to the range of values and the maximal values. Finally, the relationships among the three indices were analyzed graphically by group (complete and incomplete) and correlations, if any, determined by computation of the Pearson correlation coefficient.

RESULTS

Mean Values (Complete Versus Incomplete)

The mean values of all three indices were greater in the complete cleft lip group compared with the incomplete group (Table 1). These differences were statistically significant (PHD: \( P = 0.0044 \); NFWD: \( P = 0.0000 \); CW: \( P = 0.0000 \)).

Maximal Values and Range of Values (Complete Versus Incomplete)

The maximal values and range of values for the NFWD and CW indices were clearly greater in the complete versus the incomplete clefts. However, the maximal value and range of values for the PHD index were similar for the two groups. (Fig 3)

Interindex Relationships (NFWD Versus CW, PHD Versus CW, PHD Versus NFWD) by Group

In the complete unilateral cleft lip group, a strong linear relationship was obtained between NFWD and
Fig 4 Interindex relationships in the complete clefts. (A) Nasal floor width difference (NFWD) versus cleft width (CW). Correlation coefficient $R = 0.7523$, $P = 0.000$. (B) Philtral height difference (PHD) versus cleft width (CW). $R = 0.3922$, $P = 0.015$. (C) Philtral height difference (PHD) versus nasal floor width difference (NFWD). $R = 0.2156$, $P = 0.029$. Observe that all three graphs demonstrate linear relationships.
Fig 5 Interindex relationships in the incomplete clefts. (A) Nasal floor width difference (NFWD) versus cleft width (CW). Correlation coefficient $R = 0.5111$, $P = 0.015$, indicating linear relationship. (B) Philtral height difference (PHD) versus cleft width (CW). $R = 0.2302$, $P = 0.303$, indicating nonlinear relationship. (C) Philtral height difference (PHD) versus nasal floor width difference (NFWD). $R = 0.0149$, $P = 0.947$, indicating nonlinear relationship.
CW (Pearson correlation coefficient $R = 0.7523$, $P = 0.000$, Fig 4). The relationships between PHD and CW and between PHD and CW were also linear but to a lesser degree ($R = 0.3922$, $P = 0.000$ for PHD versus CW; $R = 0.2156$, $P = 0.029$ for PHD versus NFWD) (Fig 4).

In the group with incomplete unilateral cleft lip, the only linear relationship obtained was between NFWD and CW ($R = 0.5111; P = 0.015$) (Fig 5). The relationships between PHD and CW and between PHD and NFWD were nonlinear ($R = 0.2302$, $P = 0.303$ for PHD versus CW; $R = 0.0149$, $P = 0.947$ for PHD versus NFWD) (Fig 5).

Discussion

Mean and Maximal Values

The mean and maximal values for CW and NFWD were significantly greater in the complete versus the incomplete clefts. These data support clinical observations that the transverse tissue deficit in the complete deformity is generally more severe. This observation is also consistent with the pathogenesis of clefting, since in the incomplete cleft, the presence of an intervening bridge of tissue would logically be expected to limit the magnitude of separation of the medial and lateral segments in the transverse axis.

The findings concerning the PHD, however, are noteworthy. Although the mean value of the PHD was significantly greater in the complete clefts, the standard deviation was in fact greater in the incomplete group, and the maximal values were similar between the two groups. For example, a PHD of as much as 5 mm was observed in the incomplete group (Table 1). These findings suggest that the spectrum of vertical tissue deficiency in the incomplete cleft is wider than that of its transverse deficit, and similar to that of the complete unilateral cleft. Thus, it appears that the presence of the tissue bridge in the incomplete cleft, which could be a factor in limiting the magnitude of the transverse tissue deficit, fails to exert the same restraining influence on the tissue derangement in the vertical axis.

In summary, although the incomplete clefts on the whole were narrower than the complete clefts, the degree of shortness of the philtrum in the incomplete clefts was unpredictable, and could be as severe as in the complete deformity.

Interindex Correlations

The linear relationships established between NFWD and CW, PHD and CW, and PHD and NFWD in the complete clefts support the view that when the clefting is complete, the indices of transverse and vertical tissue deficiency are directly proportional to one another. In other words, the wider the cleft is, the shorter the philtrum and the more severe (in terms of nostril floor width) the nasal deformity.

In the incomplete group, however, the interindex relationships were less straightforward. The linear relationship that was observed between NFWD and CW seems logical since both are indices of tissue shortage in the transverse axis. However, the nonlinear relationships between PHD and CW and between PHD and NFWD suggest that there is no correlation between the transverse and vertical tissue deficits. In other words, within the range of cleft widths observed in incomplete clefts, a narrow cleft was not necessarily associated with a less severe shortage of philtral height. On the contrary, the shortness of the lip in an incomplete cleft could be as severe as that in a wide complete cleft.

Clinical Implications

The findings of this study suggest that in the preoperative evaluation of a complete unilateral cleft lip, the width of the cleft is a reliable guide to the severity of the other parameters. In other words, “what you

Fig 6  An incomplete cleft lip with a narrow cleft width but a severe philtral height deficiency.
see is what you get,” and a wider cleft is associated with a shorter lip and a more severe nasal deformity. However, the converse is not true in the incomplete cleft where the presence of a narrow cleft does not preclude a severely short philtrum (Fig 6). It is therefore important to recognize that the relatively mild transverse tissue deficiency in the incomplete cleft can be misleading, and that the surgeon has to guard against underestimating the magnitude of the vertical tissue deficit before undertaking the repair. In other words, the incomplete unilateral cleft lip demands the same attention to restoring the philtral height as does the wide complete unilateral cleft, and is therefore not necessarily easier to repair in terms of correcting the vertical tissue shortage.

CONCLUSIONS

Based on the data of this investigation, the hypothesis that there is no correlation between the transverse and vertical tissue deficiencies should be rejected in the case of the complete unilateral cleft lip, as such a correlation was determined to exist. Conversely, in the incomplete cleft, the nonlinear relationships between the indices of transverse and vertical tissue shortage support the hypothesis, underscoring the clinical importance of recognizing that a significant deficit of philtral height may exist even in the presence of a narrow cleft.

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Announcement

Prof. H. G. Luhr Lecture:
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