

# Evaluation of the Effect of Surgical Repair on Lip–Nose Morphometric Parameters of Patients with Unilateral Cleft Lip using Two-Dimensional Photogrammetry: A Comparative Study between the Cleft and the Non-Cleft Side

## Abstract

**Background:** This prospective, comparative study was carried out to evaluate the effect of cleft lip repair on lip–nose morphometric characteristics of subjects with complete unilateral cleft lip/palate at the University of Maiduguri Teaching Hospital, Borno State, Nigeria. **Materials and Methods:** The study population consisted of a total of 29 subjects. Lip repair was done using Millard's rotation advancement technique by a single consultant. Standardised photographs were taken; preoperatively and during different postoperative periods; immediately, 1 week, 3, and 6 months. Indirect measurements of eight linear distances were carried out using Rulerswift software application. For all statistical analyses of mean difference, a P-value of less than 0.05 was accepted as being statistically significant. **Results:** A total of 52% were women, whereas 44% were men. There are considerable disparities between the cleft and non-cleft sides of complete unilateral cleft patients before surgery; statistically significant differences of 1.4 mm, 6.3 mm, and –17.6 mm in vertical lip height, philtral height, and nasal width respectively. Six months after repair, statistically significant differences in lip height between the cleft and the non-cleft side were observed in vertical lip height, nasal width, and philtral height (mean difference of  $-1.28 \pm 0.78$ ,  $2.02 \pm 2.86$ ,  $1.22 \pm 1.83$  mm;  $P < 0.001$ ,  $P = 0.016$ ,  $P = 0.022$ , respectively). Horizontal lip height was maintained with no statistically significant difference (mean difference of  $-0.12 \pm 2.19$  mm). **Conclusion:** Following cleft repair, using Millard's rotation advancement technique, differences in lip–nose morphometric parameters were found to be reduced, however, not always eliminated by treatment.

**Keywords:** Cleft lip, lip–nose, morphometry

## Introduction

The most prevalent facial congenital anomaly is cleft lip with or without palate (CL/P), which typically affects 1 in 1000 to 1 in 700 live births, depending on the area and racial makeup of the community.<sup>[1]</sup> Butali *et al.* in Nigeria reported a prevalence of 0.5:1000 live births.<sup>[2]</sup> Several operative options are available for the surgeon to correct lip deformity in unilateral CL/P patients.<sup>[3,4]</sup> Millard's rotation advancement technique is a key method in unilateral cleft lip surgery. This technique and various variants are common among surgeons worldwide.<sup>[4]</sup> In unilateral CL/P (UCL/P), the anatomy is asymmetrical between the cleft side and the non-cleft side, with several surface landmark measurements that have

been quantified in the repair as well as to evaluate changes following repair and healing.<sup>[5,6]</sup> Surgeons in developing countries often perform intraoperative and post-operative evaluations of cleft lip deformities with the eye. Such evaluations are subjective and influenced by the observing surgeon's experience and understanding of the functional, aesthetic, and anatomic relations of the perioral region. Several methods have been documented in assessing the surface landmarks of lip before and after cleft repair.<sup>[5]</sup> This study was designed to objectively assess the amount of lip length changes before and after surgery in complete UCL/P patients using 2-dimensional photogrammetry to compare cleft and non-cleft sides.

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## Materials and Methods

A total of 29 subjects with complete unilateral cleft lip, requiring repair participated in the prospective study. The study included complete UCL/P patients without alveolus or palate. Participants with incomplete unilateral CL/P, bilateral CL/P, cleft lip revision after primary cleft lip repair, unsuited for general anaesthesia, syndrome or craniofacial anomaly (other than cleft lip), craniofacial surgery or trauma, or presurgical orthopaedics were excluded.

Surgical repair was carried out under general anaesthesia with endotracheal intubation by a single Consultant Oral and Maxillofacial surgeon using Millard's rotation advancement technique for all subjects. Subjects' two-dimensional complete frontal faces were captured marked and measured by a single senior resident. A Nikon digital camera with fixed focus and a locally made frame of 7 inches in length was used. This keeps the object-lens distance constant for repeated photography,<sup>[7,8]</sup> with the camera fixed to the frame and positioned to touch the subject's chin and forehead for standardization. Photographs taken included preoperative, immediate postoperative, 1 week, 3, and 6 months postoperatively.



Figure 1: Digital camera with a frame providing a fixed object-lens distance

Marking of complete unilateral cleft landmarks was done on the softcopy photographs [Figure 1A]. Eight linear distances on the lip and nose; vertical lip height cleft side, vertical lip height non-cleft side, horizontal lip height cleft side, horizontal lip height non-cleft side, nasal width cleft side, nasal width non-cleft side, philtral height cleft side, philtral height non-cleft side [Figure 1B] were then measured in millimetres using computer software; RulerSwift software version 1.0 (1) 2016 for analysis [Figures 2 and 3].

Data obtained were treated as confidential information and analysed using a statistical software package for social sciences (SPSS, version 20.0) software. Descriptive statistics of respondents' socio-demographic characteristics, type, and side of cleft were performed and presented using frequency distribution tables and charts as appropriate. Preoperative and postoperative mean anthropometric values for each variable in subjects with UCL/P were determined for the cleft side, non-cleft side, and corresponding control sides. A paired *t*-test was used to determine the difference between the means of the anthropometric data of the lips as appropriate. For all statistical analyses of mean difference, a *P*-value of less than 0.05 was accepted as being statistically significant.

## Results

A total of 29 subjects with complete unilateral cleft lip participated in the study. The age distribution ranged from three months to 55 years. There were more females 16/29 (55.2%) than males. The predominant laterality of cleft was found on the left side (72.4%). Eleven subjects had a complete cleft lip, alveolus and palate, while 18 subjects had complete cleft lip and alveolus.

Preoperative anthropometric data of cleft subjects generally showed statistically significant differences between the cleft and non-cleft sides in the vertical lip height, philtral height, and nasal width, with discrepancies in of 1.4 mm, 6.3 mm, and -17.6 mm, respectively. Differences in horizontal lip height were not statistically

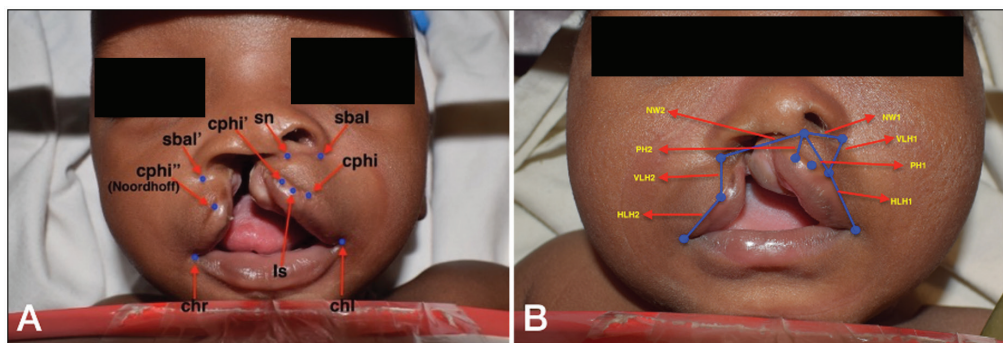


Figure 2: (A) Complete unilateral cleft landmarks.<sup>[12]</sup> (B) Eight UCL/P anthropometric distances. sn: base of the columella, sbal/sbal': right alar base/left alar base, Is: peak of the Cupid's bow, cphi and cphi': right edge of Cupid's bow/left edge of Cupid's bow, chr/chl: right commissure/left commissure, VHL1: vertical lip height on non-cleft side, VHL2: vertical lip height on cleft side, HLH1: horizontal lip height on non-cleft side, HLH2: horizontal lip height on cleft side, NW1: nasal width on non-cleft side, NW2: nasal width on cleft side, PH1: philtral height non-cleft side, PH2: philtral height cleft side

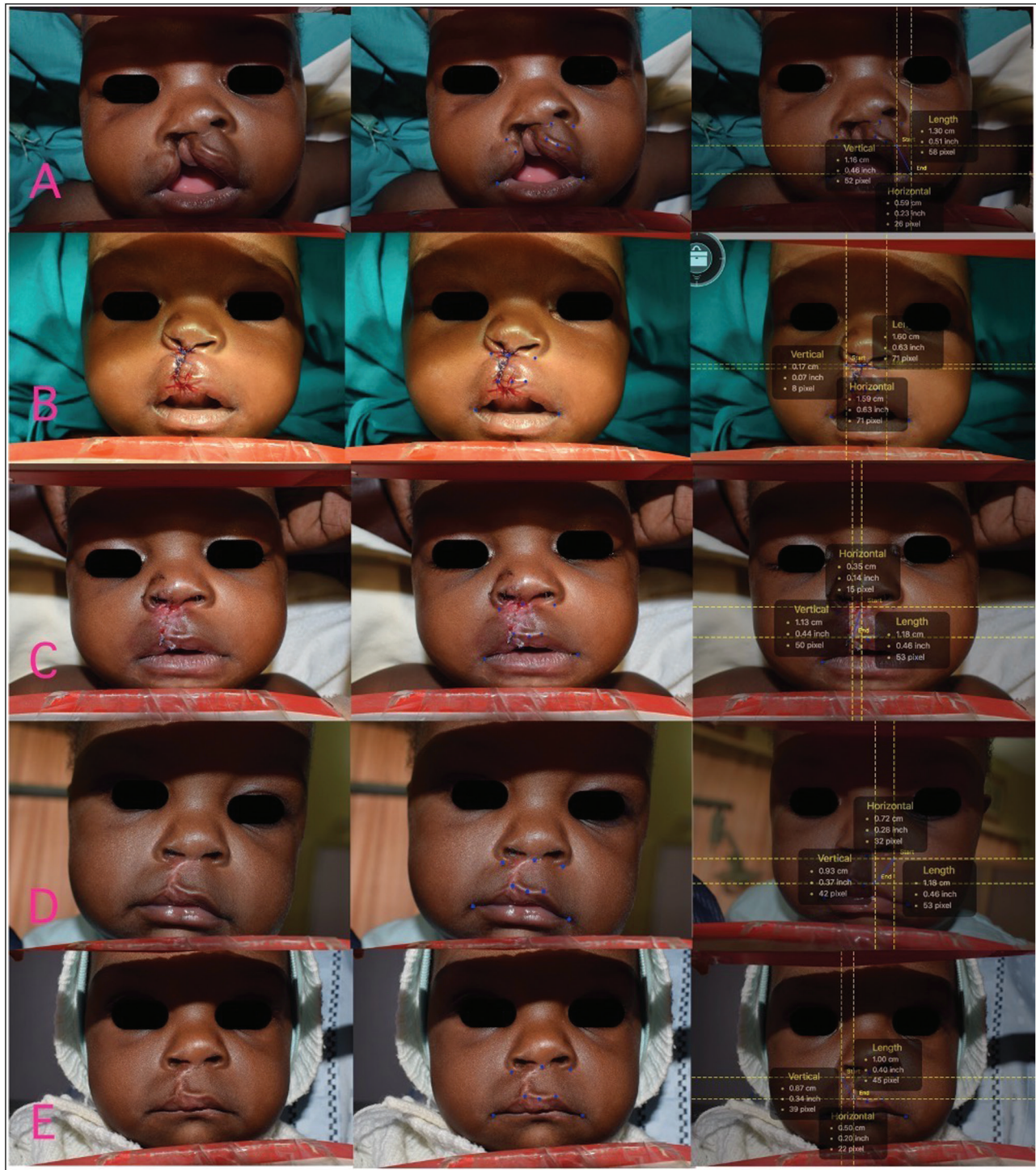


Figure 3: (A) Preoperative photograph with marked points and with landmark measurement. (B) Immediate postoperative photograph with points and with landmark measurement. (C) Week postoperative photograph with points and photograph landmark measurement. (D) Three months postoperative photograph with marked points and with landmark measurement. (E) Six months photograph with marked points and with landmark measurement

significant. The non-cleft sides had longer lengths than the cleft side [Table 1].

The immediate postoperative finding showed statistically significant differences in lip height between the cleft side and the non-cleft side were observed in the vertical lip height, horizontal lip width and nasal width (mean difference of

$-0.62 \pm 1.16$ ,  $-2.96 \pm 2.22$  and  $-0.62 \pm 1.52$  mm;  $P = 0.007$ ,  $P < 0.001$  and  $0.036$ , respectively). No statistically significant difference was observed on cleft side versus non-cleft-side in the immediate postoperative, Philtral height  $0.089 \pm 1.803$  mm;  $P = 0.791$ . A similar pattern of the result was observed a week after surgery [Table 2].

**Table 1: Comparison of preoperative anthropometric measurement of cleft and non-cleft sides of complete UCL/P patients**

Variable	Non-cleft side Mean (mm)	Cleft side Mean (mm)	Mean $\pm$ SD (non- cleft/cleft side) (mm)	T	P
Vertical lip height	8.5448 $\pm$ 2.23568	7.1931 $\pm$ 1.6639	1.3517 $\pm$ 1.9179	3.795	0.001**
Horizontal lip height	12.6966 $\pm$ 3.08562	12.2552 $\pm$ 2.21724	0.4414 $\pm$ 3.0812	0.771	0.447
Nasal width	8.4828 $\pm$ 1.82582	21.4690 $\pm$ 4.29394	-12.9862 $\pm$ 3.9650	-17.64	0.001**
Philtral height	11.5034 $\pm$ 2.9697	5.1966 $\pm$ 1.75387	6.3069 $\pm$ 2.2453	15.13	0.001**

\*\* Significant at  $P < 0.01$

**Table 2: Comparison of postoperative anthropometric data of repaired cleft and non-cleft sides complete UCL/P patients**

Period	Variable	Repaired cleft side (mm)	Non cleft side (mm)	Mean $\pm$ SD (Repaired cleft side/ Non cleft side) (mm)	T	P
Immediate post operation	Vertical lip height	9.5207 $\pm$ 1.9884	10.1445 $\pm$ 2.1823	-0.62414 $\pm$ 1.16056	-2.896	0.007**
	Horizontal lip height	14.8862 $\pm$ 3.735	17.8552 $\pm$ 3.87378	-2.96897 $\pm$ 2.22873	-7.714	<0.001**
	Nasal width	9.1276 $\pm$ 2.39760	9.7517 $\pm$ 2.21805	-0.62414 $\pm$ 1.5247	-2.204	0.036*
	Philtral height	10.3828 $\pm$ 2.54363	10.2931 $\pm$ 2.31639	0.08966 $\pm$ 1.80364	0.281	0.791
One week post operation	Vertical lip height	9.9679 $\pm$ 1.63754	11.2286 $\pm$ 1.80818	-1.26071 $\pm$ 0.92189	-7.236	<0.001**
	Horizontal lip height	14.2751 $\pm$ 2.767	15.4036 $\pm$ 3.7088	-1.14643 $\pm$ 2.36447	-2.566	0.016**
	Nasal width	11.8071 $\pm$ 2.13436	10.4643 $\pm$ 2.1931	1.34286 $\pm$ 0.214363	3.315	0.003**
3 months post operation	Philtral height	11.0714 $\pm$ 2.28422	10.4429 $\pm$ 2.15792	0.62857 $\pm$ 1.84086	1.807	0.082
	Vertical lip height	9.9368 $\pm$ 1.6483	11.500 $\pm$ 1.3379	-1.56316 $\pm$ 1.55142	-4.392	<0.001
	Horizontal lip height	14.5368 $\pm$ 2.5790	15.1684 $\pm$ 2.78369	-0.63158 $\pm$ 1.93335	-1.424	0.172
	Nasal width	12.2895 $\pm$ 2.07897	10.8474 $\pm$ 1.73665	1.44211 $\pm$ 2.32816	2.700	0.015**
6 months post operation	Philtral height	10.6316 $\pm$ 1.94081	10.3789 $\pm$ 1.67815	0.25263 $\pm$ 1.64397	0.670	0.511
	Vertical lip height	9.9000 $\pm$ 1.38719	11.1867 $\pm$ 1.22175	-1.28667 $\pm$ 0.78637	-6.337	<0.001
	Horizontal lip height	14.6467 $\pm$ 2.49023	14.7733 $\pm$ 2.05616	-0.12667 $\pm$ 2.19267	-0.224	0.826
	Nasal width	12.4600 $\pm$ 1.96098	10.4333 $\pm$ 1.60653	2.02667 $\pm$ 2.86792	2.737	0.016**
	Philtral height	11.2000 $\pm$ 2.67368	9.9800 $\pm$ 1.53400	1.2200 $\pm$ 1.83311	2.578	0.022*

\*\* Significant at  $P < 0.01$

Three months postoperatively, no statistically significant difference was observed on cleft side versus non-cleft-side 3 months postoperative; Philtral height and horizontal lip height were  $0.25 \pm 1.64$  and  $-0.63 \pm 1.93$  mm and  $P = 0.511$  and  $P = 0.172$ , respectively. Statistically significant differences in lip height between the cleft side and the non-cleft side were observed in the vertical lip height and nasal width (mean  $-1.56 \pm 1.55$ ,  $1.44 \pm 2.32$ ;  $P < 0.001$ ,  $0.015$  respectively) [Table 2].

The results of the 6 month postoperative period showed no statistically significant difference in cleft side versus non-cleft-side Horizontal lip height only (mean difference  $-0.12 \pm 2.19$ ;  $P = 0.826$ ). Statistically significant differences in lip height between the cleft side and the non-cleft side were observed in all the other heights; vertical lip height, nasal width, and philtral height (mean difference of  $-1.28 \pm 0.78$ ,  $2.02 \pm 2.86$ ,  $1.22 \pm 1.83$  mm;  $P < 0.001$ ,  $P = 0.016$ ,  $P = 0.022$ , respectively) [Table 2].

## Discussion

There is a growing interest in cleft surgery outcomes; most of such studies that have been carried out in the African population are largely subjective assessment studies. While

there are other options for measuring a person's face, the clinical two-dimensional photography utilised in this study serves as the gold standard for most outcome studies since it is simple, inexpensive, and widely accessible, even in low-income communities.<sup>[9]</sup> To ensure that all images are taken at the same distance with the camera of fixed focal length, a locally fabricated frame was utilised [Figure 3]. This method guarantees that images taken at different times will always have the same magnification.<sup>[7,8]</sup>

In this study, preoperative lip lengths of the non-cleft side were significantly longer than that of the cleft side. This same discrepancy has been documented and reported in several.<sup>[10,11]</sup> According to Chou *et al.*<sup>[10]</sup> patients with UCLP had statistically significant differences in horizontal lip height, vermilion width, nostril width, and philtrum height between the cleft and non-cleft sides, with mean values of 2.8, 3.7, 0.4, and 4.4 mm. A direct comparison of the values of these different studies may not be possible because of the different methodologies and variables assessed. Patients with unilateral cleft lip and palate often have prominent lip asymmetry, which is characterised by the separation of the borders surrounding the cleft.<sup>[12]</sup> According to Mooney *et al.*<sup>[13]</sup> patients with cleft lip deformities have less lip muscle

bulk. To address the stated discrepancy in lip heights, surgical techniques that restore the vertical lip height and philtral heights, particularly on the cleft side, should be used in the repair of UCL/P.<sup>[3,10,12]</sup>

The results of this study showed clear improvements following lip repair, with some distinctions in the different postoperative reviews. Immediately postoperatively, muscles having been detached from their abnormal attachments and united with skin re-draped, measurements are expected to change; however, this may be masked because of the effects of local tissue oedema and adrenaline infiltration during surgery. With initial wound healing, suture removal after 5 days, and further wound maturation the anthropometric data change.

In this study, the vertical lip height differences varied postoperatively. The decrease recorded by 3–6 months could be attributed to postoperative scar contracture with Cupid's bow pulling up. Several reports confirmed this occurrence during this postoperative period and it is said to resolve spontaneously with long-term follow-up without the need for secondary repairs.<sup>[4,11]</sup> As such, parents need to be counselled about this, whenever Millard's technique is used for UCL repair.

The horizontal lip height retained its growth dimension achieved postoperatively and may be attributed to choosing the non-cleft side peak of the cupid's bow on the lateral lip element at Noordorf's point. This point as suggested by Noordorf is anatomically determined as described, choosing the point too medially will elongate the horizontal lip height and shorten the vertical lip height and vice versa.<sup>[10,14]</sup>

## Conclusion

Before repair, significant differences existed in lip measurements between the cleft and non-cleft sides of complete UCL/P patients. The impact of surgery was quite clear, following repair, differences were reduced, but not always eliminated by treatment. In comparisons of early versus late postoperative measurements, residual differences in lip heights significantly improved with time.

Millard's rotation advancement technique significantly improved lip lengths and provided a good outcome in UCL/P consistent with norms.

## Declaration of Patient Consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Nil.

## Conflicts of interest

There are no conflicts of interest.

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