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Validation of a Lip Asymmetry Scale and Determination of Lip Asymmetry Associated Factors Among Children Following Primary Unilateral Cleft Lip Repair at Corsu Rehabilitation Hospital, Uganda

Lubega William^{1*}, **Martin Tungotyo^{1,2}** and **Andrew Hodges²**

¹Mbarara University of Science and Technology, P.O.Box 1410, Mbarara, Uganda

²Comprehensive Rehabilitation Services Uganda (CoRSU) hospital, P.O.BOX 46, Kisubi, Uganda

Corresponding Author: Lubega William, Mbarara University of Science and Technology, P.O.Box 1410, Mbarara, Uganda.

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Abstract Summary

This cross-sectional study involving 80 children assessed lip asymmetry after primary unilateral cleft lip (UCL) repair at CoRSU Rehabilitation Hospital in Uganda. The research aimed to determine the prevalence and associated factors of lip asymmetry and validate a visual analog Unilateral Cleft Lip Asymmetry Scale (UCLAS).

Key findings included:

- 100% of participants had some degree of lip asymmetry.
- 17.5% had severe lip asymmetry.
- Factors significantly associated with severe asymmetry included respiratory infection 14 days prior to surgery, surgical technique, surgeon's cadre, early postoperative complications, and assessments within 6 months post-surgery.

UCLAS proved reliable, with good fair to almost perfect intra- and inter-rater agreement and high internal consistency (Cronbach's $\alpha > 0.8$).

Abbreviations : CL – Cleft Lip, CP – Cleft Palate, UCL – Unilateral Cleft Lip, UCLAS- Unilateral Cleft Lip Asymmetry Scale, CoRSU- Comprehensive Rehabilitation Services in Uganda, W.H.O- World Health Organization

Introduction

Cleft lip (CL), often associated with cleft palate (CP), is one of the most common craniofacial anomalies. It presents both physical and psychosocial challenges, with postoperative facial appearance being a central concern. Lip asymmetry, particularly in Unilateral Cleft Lip (UCL) patients, impacts self-esteem and social integration [1,2].

In Uganda, CL/CP incidence ranges between 73–134 per 100,000 live births [3,4]. However, there is a scarcity of African studies focusing on postoperative lip asymmetry. There also lacks a standardized aesthetic assessment tool. Thus, this study fills that gap by evaluating lip asymmetry and validating a novel visual scale.

Methods

A cross sectional study conducted at CoRSU hospital, a cleft centre in Uganda, from July 2019 to April 2020. Children with repaired UCL, minimum 3 months post-surgery and whose caregivers/parents gave written consent were enrolled. Those with secondary lip revisions and incomplete medical records. 80 children underwent assessment and data collected

included demographics, surgical details, pre-operative health status. Lip measurements were done using Castroviejo calipers. Standardized 2D photos were cropped to show only the nasolabial region evaluated.

The visual analog Unilateral Cleft Lip Asymmetry Scale (UCLAS) was based on a 5-point Likert scale (1 = very poor, 5 = very good), the following components were scored:

- Lip height discrepancy
- Vermillion border shape
- Vermillion mucosa volume
- Scar thickness

Total scores:

- 16–20 = Mild asymmetry
- 12–15 = Moderate asymmetry
- 4–11 = Severe asymmetry

Assessments were conducted twice by two cleft surgeons for reliability testing.

Statistical Analysis of the data was done using STATA version 12.0, Chi square, Fischer's exact test and multivariate logistic regression were performed to determine factors associated with severe lip asymmetry. Probability values (p-values) less than 0.05 were considered statistically significant.

Intra- and inter-rater reliabilities of overall scores of assessment tool were assessed using the weighted Kappa scores. The overall reliability of the test was determined using the Cronbach alpha, which is a measure for internal consistency of the test. Cronbach Alpha level of 0.7 is acceptable.

Results

Demographically 80 children were enrolled for this study. Age range was 6- 214 months (medium=13 months). Male to female ratio of 1.1:1. 70% has complete UCL. The ratio of left to right unilateral cleft lip was 1.2: 1. 56% had associated cleft palate.

For the lip asymmetry prevalence, our study revealed that all children had lip asymmetry with mild (16.2%), Moderate (66.3%) and Severe (17.5 %).

For the lip component findings were found that:

- Lip height asymmetry: Present in 54%; long lips more common than short
- Vermillion mucosa discrepancy: 53%; mostly excess mucosa
- Vermillion border mismatch: Severe in 18%
- Scar thickness: Severe in 18%

Analysis of patient factors revealed that history of infection (especially respiratory) within 14 days pre-surgery was significantly associated with severe asymmetry (AOR= 5.03, p=0.033. Other factors (cleft type, haemoglobin level, nutritional status were not statistically significant.

For surgical factors our study found that:

- **Surgical Technique:** Fisher technique associated with long lips and excess vermillion mucosa
- **Cadre of Surgeon:** Trainees (less experienced surgeons) associated with higher severe asymmetry
- **Post-op Complications within 72 Hours:** Associated with increased asymmetry
- **Post-op Assessment <6 Months:** AOR=13.69, significant predictor

Adjusted analysis (from the full study dataset): history of infection 14 days before surgery remained independently associated with severe lip asymmetry (AOR=5.03, 95% CI 1.14–22.21, p=0.033) after adjusting for type of cleft lip, nutritional status, associated cleft palate, and haemoglobin level (none independently significant, $p \geq 0.125$). Post-operative period <6 months also remained independently associated with severe lip asymmetry (AOR=13.69, 95% CI 1.21–155.14, p=0.035) after adjusting for cadre of surgeon, surgical technique, and early complications; notably, cadre of surgeon (AOR=3.02, p=0.159) and surgical technique (AOR=2.60, p=0.424) were no longer statistically significant once adjusted.

On evaluation of the reliability of UCLAS our study found that for the Inter-rater reliability, the overall Kappa was in fair agreement (0.35 – 0.37) with the highest agreement the scar thickness (Kappa = 0.46). For Intra-rater reliability we found excellent for assessor 1 (Kappa = 1.0), (Kappa = 1.0, a ceiling effect warranting cautious interpretation — though the two rating series were conducted two weeks apart, which somewhat mitigates immediate-recall concerns), moderate for assessor 2 (Kappa = 0.51). For internal Consistency; Cronbach's Alpha >0.84 across assessments, indicating strong internal consistency.

Discussion

Perfect symmetry in the human face is non-existent; every child had lip asymmetry post UCL repair aligning with literature [5-8]. Most asymmetries were moderate. Lip height (long lip) and vermillion mucosa excess were the most common deformities, differing from other studies (e.g., Cheema et al.) where scars and mucosa deficiency were more prevalent [9]. The widespread use of Fisher technique in this study may explain the predominance of these specific asymmetries.

Only recent respiratory infections were significantly associated with severe asymmetry, potentially due to wound contamination or impaired healing. In our study center we follow a strict presurgical criteria whereby all cleft lip surgical patients should have body weight $\geq$ 5kgs, haemoglobin levels of $> 10\text{g/dl}$, no malaria parasites, white cell count of $<10,000/\text{ml}$ and no lower respiratory infections. Fillies reported that a body weight of $>4.5\text{ kg}$ at the time of surgery, hemoglobin of $>10\text{ g/dl}$, and white blood cell count of $<10,000/\text{ml}$ was associated with less risk of complications. However, fifteen (15) of our participants suffered from infections and majority of these (60%) suffered from respiratory tract infections 14 days prior to surgery and reported that partial wound dehiscence following cleft lip repair could be due to contamination of the surgical site with mucus [10,11]. This could interfere with healing resulting in lip asymmetry. Adekeye also attributed the wound dehiscence observed in his study to contamination of surgical site by the attending mothers trying to perhaps clean the mucus or hasten wound healing. These observations could perhaps explain our findings. Other anticipated factors like weight-for-age or anemia were not statistically significant.

Cadre of primary surgeon was found to be associated with severe lip asymmetry. Experienced plastic surgeons had better outcomes than trainees—consistent with Narayanan's statement that cleft surgery is more of an art honed by experience [12]. The less experienced surgeons, plastic surgery trainees, had a higher proportion of severe lip asymmetry among the participants they operated (30%) compared to those operated by experienced plastic surgeons (12%).

Postoperative assessments done earlier (<6 months) were more likely to identify severe asymmetry, possibly due to unresolved inflammation and scar remodeling. A meta-analysis study by Al Omari found no consensus on the timing of measurements of cleft lip surgical outcomes [13]. Assessments have been done as early as 4 weeks post-operative by Abdurazaq et al. assessed their participants at 9 years [14]. Early assessment could be associated with more asymmetry due to ongoing post-surgical inflammatory process and vertical lip scar contraction as observed in some studies [15,16]. Further research is needed to follow up cleft lips with severe lip asymmetry to establish whether they improve over time and also guide on the timing of measurement of surgical outcomes.

Findings of our study revealed that the surgical technique used to repair unilateral cleft lips was associated with severe lip asymmetry. Most of the unilateral cleft lips in our study were repaired using the Fisher technique (70%) [17]. Our study also found a significant statistical association between Fisher technique and both lip height asymmetry ($p=0.001$) and vermillion asymmetry ($p= 0.023$) (long lips and vermillion mucosa excess respectively). Grabb and Cheema reported similar findings. Also, majority of patients with severe cleft lip 92.9% were repaired using the fisher technique [9,18]. This could be because it's the commonest procedure used and more especially by junior surgeons.

Postoperative complications like bleeding, wound dehiscence, and infections were also linked to poor symmetry, highlighting the importance of early surgical care.

Visual Analog Unilateral Cleft Lip Asymmetry Scale for Labial Assessment

In our study, the inter-rater reliability and intra rater reliability was found to range from fair to perfect agreement with weighted Cohen's kappa scores ranging from 0.35 - 1 at 95% CIs. The reliability scores in our study are lower than findings by Adeola et al. who reported substantial to almost perfect agreement with kappa values range of 0.80–0.87 [19]. The difference could be due to the fact that the raters in Adeola et al. were familiar with the assessment tool.

Similar to findings by Adeola et al. our study had strong internal consistency with Cronbach's Alpha values > 0.8 . Based on these results our visual analog unilateral Cleft lip asymmetry rating scale is reliable [19]. The strength of this rating scale is its ability to immediately express the individual lip component anatomical deficiency of concern, hence the type and severity of asymmetry and perhaps, the extent of secondary surgery that may be required. The scores are nominal and ranked ordered whereby the Score 1 is the worst outcome and Score 5 is the best outcome. Thus a high score is associated with less lip asymmetry and more aesthetically acceptable.

Limitations Include

- Levelling effect when totaling component scores (i.e., high scores may mask low ones)
- Only labial aesthetics assessed, excluding nasal components Nollet reported that among the numerous advantages of standard rating scales for nasolabial aesthetics in unilateral cleft lip surgery, is the prospect of being able to draw comparisons between protocols, centers, and individuals and to determine the necessity for secondary surgery and type of surgery that may be required. Also a standardized tool aids in patient/caregiver communication about expected treatment outcomes of both primary and secondary unilateral cleft lip repair.

Conclusion

Severe lip asymmetry post-UCL repair at CoRSU is 17.5%. Key associated factors are pre-op respiratory infections, surgical technique, timing of assessment, surgeon's experience, and early complications. UCLAS is a reliable tool for evaluating lip symmetry post-surgery.

Declarations

Ethics Approval and Consent to Participate

Study was approved by the Mbarara University of Science and Technology Research Ethics committee and Uganda National Council of Science and Technology (UNCST). All informed consent was obtained from only the parents of legal guardians of the participants as all participants were under age of 16 years.

Availability of Data and Material

The datasets generated and analysed during this study are not publicly available as the author is still using the data set to carry out more research.

Competing Interests

The authors declare that they have no competing interests

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Authors' Contributions

WL was the principal investigator in the study who designed and conducted the study, analysed and interpreted the data and wrote the manuscript. AH and MT were the research supervisors providing overall guidance in the research and also critically reviewed the manuscript. All authors read and approved the final manuscript.

Author Information

The author is a Plastic and reconstructive surgeon trained at Mbarara University of Science and Technology (CoRSU hospital campus) and currently working at Uganda Cancer Institute as an Onco-plastic and Reconstructive Surgeon. The research study was done as a requirement for the achievement of Masters of Medicine in Plastic and Reconstructive surgery at the University.

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Tables and Captions

Factors	No Severe lip asymmetry n=66 (f,%)	Severe lip asymmetry n=14 (f,%)	COR 95% CI	X2p value
Age of the child ≤ 12 months 13-24months >24 months	31(45.0)/ 15(22.7)/ 20(30.3)	8(57.1) / 3(21.4) / 3(21.4)	1.72(0.410.41, 7.27) / 1.33(0.24, 7.56) / 1.00	0.752
Sex Male Female	36(54.6) 30(45.5)	5(35.7) 9(64.3)	0.49(0.14,1.53) 1.00	0.207
Type of Cleft Lip Complete Unilateral Cleft lip Incomplete Unilateral Cleft lip	45(68.2) 21(31.8)	11(78.6) 3(21.4)	1.77(0.43,6.79) 1.00	0.445
Associated Cleft Palate Yes No	36(54.6) 30(45.5)	9(64.3) 5(35.7)	1.50(0.45,4.96) 1.00	0.505
Nutrition Status (Weight for Age) at time of urgery Surgery): Not Underweight/ Underweight	51(77.3) / 15(22.7)	13(92.9) / 1(7.1)	3.82(0.46,31.66) / 1.00	0.185
History of infection 14 days before surgery Yes No	9(13.6) 57(86.6)	6(42.9) 8(57.1)	4.75(1.33,16.93) 1.00	0.016
Post-operative period <6months 6-12months >12months	22(33.3) 21(31.8) 23(34.9)	8(57.1) 5(35.7) 1(7.1)	8.36(0.97,72.48) 5.48(0.59,50.78) 1.00	0.054 0.135

Cadre of primary surgeon Plastic Surgery trainee Plastic Surgeon	19(28.8) 47(71.2)	8(57.1) 6(42.9)	3.30(1.01,10.79) 1.00	0.048
Surgical technique used to repair cleft lip Fisher Modified Millard	43(65.2) 23(34.9)	13(92.9) 1(7.1)	6.95(0.85,56.56) 1.00	0.039
Early Postoperative complications within 72hrs Yes No	3(4.6) 63(95.5)	3(21.4) 11(78.6)	5.73(1.02,32.10) 1.00	0.047

Table 1: Patient & Surgical Factors Associated with Severe Lip Asymmetry COR: DENOTES CRUDE ODDS RATIO (UNADJUSTED), CI: DENOTES CONFIDENCE INTERVAL, X2: DENOTES PEARSON CHI SQUARE

Rater Reliability Test	Description	Overall score	Lip Height Score	Vermillion border line up score	Vermillion mucosa score	Scar thickness score
Inter-Rater	Series 1	0.3578	0.3574	0.4118	0.3034	0.4650
	Series 2	0.3669	0.3752	0.3350	0.2694	0.4121
Intra-Rater	Assessor 1	1.000	0.6480	0.5013	0.5631	0.5732
	Assessor 2	0.5178	0.4847	0.4625	0.4188	0.4494

Table 2: the Inter-Rater and Intra-Rater Weighted Cohen's Kappa Statistics.

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