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RESEARCH ARTICLE

Assessment of Some Anthropometric Parameters of Repaired Unilateral Cleft Lips in Children at Ahmadu Bello University Teaching Hospital, Shika-Zaria, Nigeria

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Abstract

Cleft lip and palate are common congenital anomalies, and surgical outcome of cleft repair is difficult to evaluate due to the complex shape of the nose. In this study, some anthropometric parameters of repaired unilateral cleft lip were compared with those of non-cleft lip children by direct assessment with a view to establish the significance of these parameters in evaluating extent of cleft lip repairs. This was a prospective analytical study. Pre-operative and post-operative measurements (immediately post-operative, and weeks 1 and 4 post-operative) of the anthropometric parameters (nasal aperture width, vertical and horizontal lip lengths) of the cleft and non-cleft sides were taken from the participants and recorded. The values were compared with those of patients without cleft lip within the same age range. Results revealed statistically significant differences ($p < 0.05$) in pre-operative nasal height, nasal aperture width, horizontal and vertical lip lengths between cleft and non-cleft children. At immediate post-operative, there was significant ($P < 0.05$) difference in nasal aperture width, vertical and horizontal lip lengths between cleft, non-cleft sides and non-cleft children. No statistically significant ($P > 0.05$) differences existed at 1- and 4-weeks post-operative for nasal aperture width, vertical and horizontal lip lengths between the repaired cleft and non-cleft sides. In conclusion, vertical and horizontal lip lengths of repaired unilateral cleft showed no significant difference between cleft, non-cleft side and non-cleft children at 4 weeks post-operative period. These anthropometric parameters can therefore be used as quantitative assessment tools to evaluate the extent of cleft repairs in children.

Keywords

Cleft, Repair, Anthropometric, Direct assessment, Lip length

Introduction

Orofacial clefts involving cleft lip, alveolus and palate constitute the most common congenital malformations affecting the craniofacial region among newborns [1-3]. Clefts are described in terms of width and other characteristics. Factors reported to be responsible for these deformities include interaction effects of genetic and environmental factors during early development [4-6]. The occurrence of orofacial clefts shows variation with respect to geographic origin, ethnicity,

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and socio-economic conditions [7,8]. Due to the marked asymmetry that may impact on attractiveness, psychosocial aspects, and various functions by orofacial clefting, surgical correction becomes paramount [2]. The few reported incidences of cleft lip and palate in Nigeria have necessitated the management and care of cleft patients [9]. The treatment of these craniofacial anomalies differs depending on the timing of surgery and technique of reconstruction [10]. Irrespective of the techniques of repair, the re-establishment of symmetry to the lip and nose at the time of repair by ensuring normative measurements between anatomic landmarks has been the main goal of maxillofacial surgeons [11].

The goal of cleft lip surgery is to recreate normal lip architecture, which is aesthetically pleasing and symmetrical to the normal side. In the management of cleft lip, several techniques have been employed [12,13]. In assessing the success of cleft lip repair, several markers have been used including anthropometry measurement and these are targeted towards achievement of symmetry and/or functional restoration [2,3,14]. The various methods of cleft assessment following repair include direct surface assessment [15,16], two-dimensional photography [17,18], three-dimensional imaging [19,20] and anthropometric [21] methods. Anthropometry and clinical examination are considered best to evaluate the morphology of the repaired cleft lip and nose by considering the landmarks related to the nose and lip, the body of the lip, vermillion and the nasal aperture, and vertical and horizontal lip length [20]. The objective assessment of cleft lip repair can be difficult due to the fact that opinions on esthetic appearance are largely subjective. The aim of this study was to compare some anthropometric parameters of repaired unilateral cleft lip with those of non-cleft lip by direct assessment with a view to establish the significance of these parameters in evaluating extent of cleft lip repairs in children of the same age group. The study was conducted at the Ahmadu Bello University Teaching Hospital, a tertiary referral centre in Northern Nigeria.

Materials and Methods

Ethical considerations

The Scientific and Ethics Committee of Ahmadu Bello University Teaching Hospital, Shika-Zaria granted ethical approval, and an informed consent form was used to obtain consent of parents/guardians for this study.

Study population

The study population comprised all patients (2-10 months-old) presented to the hospital and diagnosed with unilateral cleft lip with or without cleft palate during the period (March to December 2020) of the study. The subjects were grouped into children with cleft (cleft children) and children without cleft (non-cleft children); and were sought for within the time frame.

Sample size determination

The sample size for this study was determined based on convenience i.e., based on availability and accessibility of children with cleft during the study period. Hence, a total of 80 patients comprising 40 with cleft (cleft children) and 40 without cleft (non-cleft children) all within the same age group were considered in this study.

Selection criteria

The inclusion criteria were: All patients diagnosed with non-syndromic unilateral cleft lip (with or without cleft palate) within the age range 2 to 10 months, whose parents signed informed consent form.

The exclusion criteria were: Patients presented for revision surgery, patients whose parents declined consent, or who were not fit for surgery.

The normal children (2-10 months) used as controls were recruited at the Pediatric Department of the Hospital where full consent was obtained from their parents/guardian, measurement was taken and compared with values of cleft children.

Preoperative evaluation

Blood samples were taken for full blood count, electrolyte, and urea levels, and for clotting profile. Also, pre-operative photographs were taken, and pre-operative weights and markings recorded in the proforma.

Pre-operative measurements

A magnifying glass, methylene blue and a fine pointed surgical caliper were used for precise markings. All the measurements were taken with the subject in supine position under general anaesthesia, pre-operatively and immediately after surgery. Measurements were also recorded at one week and four weeks post-operatively at each review session.

The landmarks used were:

- Nasion: The point on the roof of the nose where the nasal bone intersects with the frontal bone.
- Subnasale: The point where the nasal septum merges with the skin of the upper lip.
- Alare: The point at the most prominent side wall of the nose.
- Pronasale: The point at the tip of the nose.
- Nasal aperture was measured and recorded on both cleft and non-cleft sides preoperatively and postoperatively. The nasal aperture was from the nasal septum to the medial surface of the ala of the nose.
- The anthropometric measurements recorded were;

- Nasal height (NH): Distance between the nasion and the subnasale.
- Nasal width (NW): Distance between the ala of the nose on both side.
- Horizontal lip length (HLL): Distance from labial commissures to the lateral high point of Cupid's bow on the non-cleft side and the high point of the cleft side.
- Vertical lip length (VLL): distance from the Cupid's bow on the non-cleft side and high point on the cleft side to the point most lateral in the curved line of each ala of the nose.

All the measurements were taken twice by the researcher and the average values were recorded.

Surgical procedure

All the patients were operated on using the straight-line advancement technique under general anaesthesia with the endotracheal tube fixed centrally over the lower lip. The preoperative design of the surgical method was marked on the vermillion and the intraoral mucosa. Key landmarks were tattoed using gentian violet dye and a 26-gauge needle while 2 ml xylocaine with 1:100,000 adrenaline was used for infiltration along the incision line.

Number 15 blade and number 11 blade were used to make the incisions and the orbicularis oris muscle was dissected from abnormally inserted bone and the skin mucosal flap on both sides of the cleft. The freed orbicularis muscle was repaired in full width from the columellar base to the red vermillion using 4.0 vicryl suture and the skin over it sutured with 5.0 vicryl. All the patients were operated on at the modular theatre of the Ahmadu Bello University Teaching Hospital, Shika-Zaria, Kaduna State, Nigeria.

Post-operative evaluation and measurement

The nasal aperture width, horizontal and vertical lip lengths were measured, and the sutured incision line was covered with penicillin ointment and dressed.

Data collection

Data from the patient in this study was collected by the researcher using a structured proforma and these included measurement values of nasal aperture width, horizontal and vertical lip lengths on both cleft and non-cleft sides.

Data analyses

The data collected were entered into Statistical Package for the Social Sciences (SPSS IBM 23) and analyzed using both descriptive and inferential statistics. Anthropometric data were tested using One-way analysis of variance for comparison between pre-operative measurements of cleft side, non-cleft side, and non-cleft children. Paired sample Student's t-test was used for comparison between post-operative measurements of cleft side and non-cleft side. Values of $p \leq 0.05$ were considered significant.

Results

Biodata

The 40 cleft lip patients comprised of 24(60.0%) males and 16(40.0%) females, and the cleft was more common on the left side; 28(70.0%) of them were 2-6 months-old while 12(30.0%) were 6-10 months of age. All the 40 (100.0%) patients had haemoglobin concentrations between 9.0-13.0 g/dL (mean: 11.21 ± 0.20 g/dL), normal electrolyte and urea, and weights between 3.0-8.0 kg (mean: 4.98 ± 0.23 kg).

Anthropometric parameters

Nasal height: The mean nasal height showed not statistically significant (P = 0.756) difference between the cleft side (19.64 ± 2.03 mm) and non-cleft side (19.58 ± 2.28 mm) but it was significantly lower than that for non-cleft children (21.19 ± 1.29 mm) (p = 0.0001).

Nasal aperture width: The pre-operative nasal aperture width was significantly higher in the cleft side (13.70 ± 3.47 mm) compared to the non-cleft side (9.00 ± 2.63 mm) (p = 0.0000) and that of non-cleft children (10.59 ± 1.53 mm) (p = 0.0000). Immediate post-operative nasal aperture width was not significantly different between the cleft side (8.13 ± 1.98 mm) and non-cleft side (8.16 ± 2.55 mm) (p = 0.870) but these were significantly lower than that of non-cleft children (10.58 ± 1.53 mm) (p = 0.0000) (Table 1).

One-week post-operation, nasal aperture width was not significantly different between the repaired cleft side (8.25 ± 2.00 mm) and non-cleft side (8.21 ± 1.94 mm) (p = 0.474). Similarly at 4 weeks post-operation, there was no statistically significant difference in nasal aperture width between repaired cleft side (8.58 ± 1.97 mm) and non-cleft side (8.63 ± 1.96 mm) (p = 0.160) (Table 2).

Vertical lip length: The pre-operative measurement of vertical lip length of the cleft side (9.23 ± 1.85 mm) and non-cleft side (10.05 ± 2.43 mm) was significantly lower when compared with that of non-cleft children

Table 1: Pre-operative nasal height of children with unilateral cleft lip and non-cleft children at the department of maxillofacial surgery of Ahmadu Bello university teaching hospital, Shika-Zaria Nigeria.

Pre-operative	Mean ± SD
Cleft side	19.64 ± 2.03[a]
Non-cleft side	19.58 ± 2.28[a]
Non-cleft children	21.19 ± 1.29[b]

Mean ± SD with the different superscript letters in the same period differ significantly at $p < 0.05$.

Table 2: Nasal aperture width of children with unilateral cleft lip and non-cleft children at the department of maxillofacial surgery of Ahmadu Bello University teaching hospital, Shika-Zaria Nigeria.

	Mean ± SD
Pre-operative	
Cleft side	13.70 ± 3.47[a]
Non-cleft side	9.00 ± 2.63[b]
Non-cleft children	10.59 ± 1.53[c]
Immediate post-operative	
Cleft side	8.13 ± 1.98[a]
Non-cleft side	8.16 ± 2.55[a]
Non-cleft children	10.58 ± 1.53[b]
1 week post-operative	
Cleft side	8.25±2.00[a]
Non-cleft side	8.21±1.94[a]
4 weeks post-operative	
Cleft side	8.58±1.97[a]
Non-cleft side	8.63±1.96[a]

Mean ± SD with the different superscript letters in the same period differ significantly at $p < 0.05$.

Table 3: Vertical lip length of children with unilateral cleft lip and non-cleft children at the department of maxillofacial surgery of Ahmadu Bello University teaching hospital, Shika-Zaria Nigeria.

	Mean ± SD
Pre-operative	
Cleft side	9.23 ± 1.85[a]
Non-cleft side	10.05 ± 2.43[b]
Non-cleft children	12.68 ± 2.20[c]
Immediate post-operative	
Cleft side	11.18 ± 1.96[a]
Non-cleft side	11.20 ± 2.10[a]
Non-cleft children	12.80 ± 2.09[b]
1 week post-operative	
Cleft side	11.53 ± 2.17[a]
Non-cleft side	11.58 ± 2.10[a]
4 weeks post-operative	
Cleft side	11.81 ± 1.95[a]
Non-cleft side	11.85 ± 2.07[a]

Mean ± SD with the different superscript letters in the same period differ significantly at $p < 0.05$.

(12.68 ± 2.20 mm) (p = 0.0000). The immediate post-operative measurement showed no statistically significant difference in vertical lip lengths between the cleft side (11.18 ± 1.96 mm) and non-cleft side (11.20 ± 2.10 mm) (p = 0.889) but this was significantly lower than that of non-cleft children (12.80 ± 2.09 mm) (p = 0.0002) (Table 3).

At one-week post-operation, there was no statistically significant difference in the vertical lip lengths of the cleft side (11.53 ± 2.17 mm) and non-cleft side (11.58 ± 2.10 mm) (p = 0.06) at one-week post-treatment. At 4 weeks post-operative, no statistically significant difference existed for vertical lip lengths between the repaired cleft side (11.81 ± 1.95 mm) and non-cleft side (11.85 ± 2.07 mm) (p = 0.412) (Table 3).

Table 4: Horizontal lip length of children with unilateral cleft lip and non-cleft children at the department of maxillofacial surgery of Ahmadu Bello University teaching hospital, Shika-Zaria Nigeria.

	Mean ± SD
Pre-operative	
Cleft side	14.90 ± 3.22[a]
Non-cleft side	19.05 ± 4.50[b]
Non-cleft children	19.21 ± 3.57[b]
Immediate post-operative	
Cleft side	15.93 ± 2.37[a]
Non-cleft side	17.33 ± 2.07[b]
Non-cleft children	19.30 ± 3.38[c]
1 week post-operative	
Cleft side	17.08±1.97[a]
Non-cleft side	17.21 ± 2.03[a]
4 weeks post-operative	
Cleft side	17.35 ± 2.18[a]
Non-cleft side	17.39 ± 2.18[a]

Mean ± SD with the different superscript letters in the same period differ significantly at $p < 0.05$.

Horizontal lip length

Pre-operatively, the mean horizontal lip length was significantly lower on the cleft side (14.90 ± 3.22 mm) compared to the non-cleft side (19.05 ± 4.50 mm) (p = 0.0000) but showed no statistical difference between non-cleft side and that of non-cleft children (19.21 ± 3.57 mm) (p = 0.851). In the immediate post-operative period, horizontal lip length was significantly lower on the repaired cleft side (15.93 ± 2.37 mm) when compared to the non-cleft side (17.33 ± 2.07 mm) (p = 0.0000) and non-cleft children (19.30 ± 3.38 mm) (p = 0.0000) (Table 4).

At one-week post-operative, the horizontal lip length was not significantly different between the cleft side (17.08 ± 1.97 mm) and non-cleft side (17.21 ± 2.03 mm) (p = 0.352). At 4 weeks post-operative, there was no significant difference in horizontal lip length of repaired cleft side (17.35 ± 2.18 mm) and non-cleft side (17.39 ± 2.18 mm) (p = 0.474) (Table 4).

Discussion

Pre-operative nasal aperture width, vertical and horizontal lip lengths showed statistical ($p < 0.05$) difference between the cleft side and those of non-cleft side and non-cleft children indicating asymmetry in the cleft lip children. This is consistent with the

report of other studies which reported asymmetry between the cleft and non-cleft sides in cleft patients when compared to non-cleft patients using different assessment methods [2,3,22]. The asymmetry observed in cleft lip patients might be associated with hypoplasia of the lip tissue leading to increased nasal aperture width, decreased vertical and horizontal lip lengths as observed in this study. Nasal deformities have been reported to be associated with cleft lip and result from nasal septum deviation, significant distortion of the alar cartilages caused by separation of the bone structures and soft tissues, and unleveling of the maxillary and alveolar bone resulting from spreading of the palatal shelves [13,23,24]. These might be responsible for the differences observed between the cleft side, non-cleft side, and non-cleft children.

At immediate post-operative, the horizontal lip length immediately post-op was significantly higher on the non-cleft side indicating nasal asymmetry. This is consistent with the finding of Mulliken and Martinezperez [25] who reported post-operative nasal asymmetry in unilateral cleft patients despite modifying the management technique to minimize this deformity. Another study has shown that about 30-40% of cleft lip patients require secondary nose surgery to achieve symmetry [26]. Lee's report on the growth ratios of the anthropometric parameters by comparing the cleft and non-cleft side of the same patient found that repaired unilateral cleft retained its vertical and horizontal dimensions determined at the time of the initial repair [16]. He, however, observed changes only in the ratio of the nostril sill width between the cleft and non-cleft side.

At 1- and 4-weeks post-operative, nasal aperture width vertical and horizontal lip lengths showed no statistical difference between the repaired cleft side and non-cleft side. The absence of differences in the nasal aperture width, vertical and horizontal lip lengths between the cleft and non-cleft sides in this study indicated symmetry. This agrees with the finding of Zaleckas, et al. [12] who reported the improvement of lip symmetry with time after surgical repair of unilateral cleft lip. Sabitha, et al. [22] recorded no significant difference between the horizontal and vertical lip lengths following unilateral cleft repair using image analysis of patients with a minimum of one-year follow up. This is consistent with the results of Somensi, et al. [13] who showed improved symmetry of horizontal and vertical lip lengths following unilateral cleft lip repair. The changes in the shape of the nasal aperture have been reported to be a frequent and sometimes unrecognized consequence of surgical repair of cleft [2], the use of nasal aperture width in assessing extent is faced with more challenges and so unreliable.

Since the face and neck are three-dimensional structures which require manipulations in three-planes within the constraints of esthetics, stability and function, advances in technology have made three-dimensional imaging and analysis possible. This ability to capture images in three-dimension has paved way for observation and increase the ability to analyze changes after surgery. Despite this advancement made, analysis made is subjective as it involves different opinions on image analysis [27].

The anthropometric measurement in this study relied on direct patient assessment by the use of caliper. Caliper was used as it is handy and quickly adaptable to varying distances between points, allowing for exact and precise distance measurements of all the landmarks in unilateral cleft lip patients and controls. The outcome of this study is consistent with those of other studies involving the use of image analysis such as 2- and 3-dimensional analyses. However, the consistency of observations in this study with others despite differences in the assessment methods suggests the strength of these anthropometric parameters in assessment the extent of unilateral cleft repair. The measurement in this study is simple, safe, and easily reproducible.

Conclusion

This similarity in anthropometric parameters between the repaired cleft and non-cleft sides after repair therefore suggests that vertical and horizontal lip lengths could be used in assessing the extent of cleft repairs. However, this study is limited by absence of anthropometric data of the same non-cleft children at 1- and 4-weeks post-operative, as these children were not presented due to the COVID-19 pandemic.

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