

## Orofacial indices: a study in 240 Nigerian children.

O.M. Oluwatosin and O.A. Oluwatosin\*

Department of Surgery, University College Hospital, Ibadan, Nigeria and

\*Department of Nursing, University of Ibadan, Nigeria.

### Summary

This paper seeks to establish normal orofacial indices in Nigerian children under the age of 12. The children were grouped according to age and sex. The indices studied were: mouth width/upper vermilion arc with lip relaxed; coefficient of upper lip curvature; upper lip height/mouth width; height of cutaneous upper lip/upper lip height; height of upper vermilion/upper lip height; upper lip elasticity; and size of oral aperture. The indices varied with age. Except for upper lip elasticity in 10-11-year-old children, there were no significant differences in orofacial indices in males and females. The coefficient of upper lip curvature which is an index that measure the curve or protrusion of the upper lip, was maximum in two or three-year-olds in both sexes. The orofacial indices calculated from lip dimensions could provide important baseline information for surgical repair or reconstruction of the orofacial region in black children.

**Keywords:** Bite, Burn, Cheilon, Cleft, Coefficient, Indices, Lip, Stomion, Subnasale, Vermilion.

### Résumé

Cette publication veut établir les indices orofaciaux normal aux chez les enfants Nigeriens en dessous de l'âge de 12 ans. Les enfants ont été groupés en fonction de leur ages et sexes. Les indices étudiés ont été: La largeur de la bouche/l'arc du vermillion superieure avec la levre relache; le coefficient de courbure de la levre superieure; la taille de la levre superieure/largeur de la bouche; la taille de la levre superieure cutanee/la taille de la levre superieure; la taille du vermillion superieure/la taille de la levre superieure; l'elasticite de la levre superieure; et la taille de l'apperture orale. Les indices ont varies avec l'age - à l'exception de l'elasticite de la levre superieure chez les enfants agés de 10 a 11 ans, il n'ya pas eu de difference significative dans les indices orofaciaux entre les garçons et les filles. Le coefficient de corbure de la levre superieure qui est un indexes qui mesure la courbe ou le ressortissement de la levre superieurs, a été maximal chez les 2 à 3 ans des deux sexes. Les indices orofaciaux calculés à partir des dimensions de levres pourraient donner des donnés de bases importantes pour la reparation chirurgique ou la reconstruction de la region orofaciale chez les enfants noire.

### Introduction

Congenital clefts, deformities which complicate deep facial burns, road traffic accidents, sport injuries, circumoral bits [1] and defects from excision of facial tumours, as well as

Correspondence: Dr. O.M. Oluwatosin, Department of Surgery, University College Hospital, Ibadan, Oyo State, Nigeria.

those seen after cancrum oris which occurs mainly in the developing world [2], constitute a high proportion of cases presenting to maxillofacial and plastic surgeons. In reconstructing these, several types of procedures and tissue transfers have been described [3,4,5]. The aim is to achieve satisfactory oral function and orofacial cosmesis.

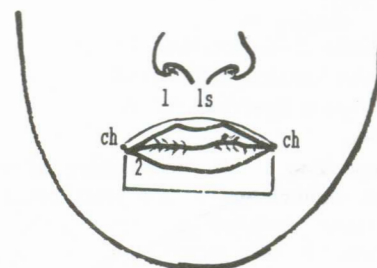
The consideration of lip indices [6] in assessing various types of orofacial pathology and reconstruction in this part of the body necessitates establishment of normals. The aim of this communication therefore, is to determine these in children, within a black population.

### Subjects and method

Two hundred and forty children under the age of 12 years, with normal lips, and divided equally into six groups, had their lip measurements taken. Each group represented a two-year age span and had an equal number of males and females. They were selected randomly from a population of patients attending surgical and children outpatient departments of University College Hospital, Ibadan, Nigeria; children in paediatric wards of the same hospital; and children from three nursery/primary schools within Ibadan. Children with noticeable lip anomalies or who had previous lip operations were excluded from the study.

The following measurements were carried out on each child:

1. mouth width, as the projectile horizontal distance between the two oral commissures, cheilon-cheilon: ch-ch (Fig. 1)

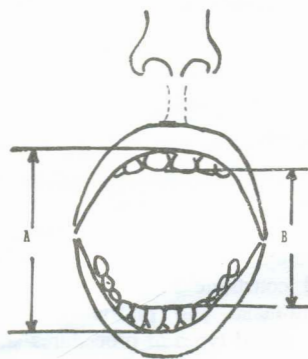


1. Upper Vermilion Arc; ch-ls-ch.

Fig. 1

2. Mouth Width; ch-ch.

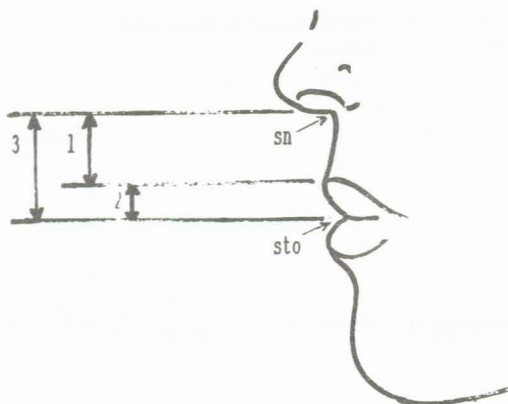
2. upper vermilion arc measurements
  - (a) with the lips at rest, cheilon-labiale superius-cheilon: ch-ls-ch,
  - (b) pursed, i.e., maximally contracted, ch-ls-ch<sub>c</sub>, and
  - (c) in the maximum grinning position, ch-ls-ch<sub>m</sub>.
3. height of the cutaneous upper lip, subnasale-labiale superius: sn-ls, (Fig. II)



A: Soft tissue gape sto-sto.  
B: Interdental gape inc-inc.

Fig. 2

4. height of upper vermillion, labiale superius-stomion: ls-sto
5. midline vertical distances of the oral aperture-
  - (a) with mouth opened wide, in form of soft tissue gape, stomion-stomion: sto-sto, (Fig. III), and
  - (b) interdental gape, incisura-incisura: inc-inc.



1. Height of Cutaneous Upper Lip sn-ls.  
2. Upper Vermilion Height ls-sto.  
3. Height of Upper Lip sn-sto.

Fig. 3

As cooperation in the performance of voluntary movements in children under four years could not be guaranteed, upper vermillion arc measurements during voluntary action, i.e., with mouth pursed and in grinning positions, as well as soft tissue and interdental gapes were not obtained from them.

Mouth width, upper lip heights and soft tissue and interdental gapes were measured with vernier caliper. Upper vermillion arc measurements were obtained by draping a tape measure gently along the upper lips.

Indices were calculated as follows:

- Index I* Mouth width/upper vermillion arc, lip relaxed,  $ch-ch/ch-ls-ch \times 100$ :  
*Index II* Coefficient of upper lip curvature,  $(ch-ls-ch)-(ch-ch)/ch-ch$ :  
*Index III* Upper lip height/mouth width,  $sn-sto/ch-ch \times 100$ :  
*Index IV* Ht. Cutaneous upper lip/upper lip height,  $sn-ls/sn-sto \times 100$ :  
*Index V* Ht. Upper vermillion/upper lip height,

$ls-sto/sn-sto \times 100$ :

*Index VI* Upper lip elasticity,  $(ch-ls-ch_m)-(ch-ls-ch_c)/ch-ch \times 100$ :

*Index VII* Size of oral aperture,  $Sto-sto/2 \times ch-ls-ch_m/2 \times n$  ( $n = 3.142$ ).

Mean values and standard deviations were calculated for each index. These values were compared between sexes, using student's "t" test and among age groups, using analysis of variance. Level of significance was taken to be  $<0.05$ .

## Results

All indices varied with age in both sexes except for the size of oral aperture in males in whom actual increases with age were noted (Tables 1 and 2).

Table 1: Orofacial indices of 240 children in Ibadan

Index	Age (years)	Male n = 20		Female N = 20		t	p
		mean $\pm$ s.d		mean $\pm$ s.d			
Index I	<2	76.6	9.7	81.1	10.0	1.24	>0.1
	2-3	76.6	6.2	80.2	5.0	1.91	>0.05
	4-5	81.7	5.9	79.9	7.0	0.74	>0.1
	6-7	80.0	7.8	80.3	6.0	0.90	>0.1
	8-9	78.7	4.4	80.1	4.8	0.80	>0.1
Index II	10-11	78.1	5.4	79.9	4.2	1.12	>0.1
	<2	0.33	0.17	0.28	0.12	1.17	>0.1
	2-	0.31	0.10	0.24	0.10	2.02	>0.05
	4-5	0.23	0.19	0.21	0.08	0.83	>0.1
	6-7	0.26	0.13	0.25	0.10	0.78	>0.1
Index III	8-9	0.27	0.10	0.26	0.10	0.75	>0.1
	10-11	0.29	0.09	0.25	0.07	1.21	>0.1
	<2	61.0	9.8	56.0	12.6	1.35	>0.1
	2-3	54.8	6.2	56.7	5.7	0.90	>0.1
	4-5	55.0	7.2	53.3	5.4	0.77	>0.1
Index IV	6-7	53.4	5.2	52.9	7.0	0.81	>0.1
	8-9	51.4	7.3	52.6	5.2	0.63	>0.5
	10-11	51.4	5.9	49.5	5.6	1.35	>0.1
	<2	59.5	4.9	59.3	7.1	0.96	>0.1
	2-3	58.8	5.3	59.2	3.9	0.77	>0.1
Index V	4-5	57.8	4.8	59.3	4.6	1.21	>0.1
	6-7	58.5	5.9	58.1	6.2	0.88	>0.1
	8-9	57.2	7.3	59.4	4.4	1.19	>0.1
	10-11	59.6	5.5	56.6	5.2	1.50	>0.1
	<2	40.6	5.0	41.5	6.1	0.56	>0.5
Index VI	2-3	41.2	5.3	42.1	8.3	0.68	>0.1
	4-5	43.0	5.9	40.7	4.6	1.70	>0.1
	6-7	41.5	5.9	41.9	6.3	0.88	>0.1
	8-9	42.8	6.2	40.6	4.4	1.18	>0.1
	10-11	41.0	4.7	43.4	5.2	1.39	>0.1

Table 2: Orofacial indices (upper lip elasticity and size of oral aperture) of 160 children in Ibadan

Index	Age (years)	Male n = 20		Female N = 20		t	p
		mean $\pm$ s.d		mean $\pm$ s.d			
Index VI	4-5	69.5	12.8	66.1	9.9	1.04	>0.1
Upper lip Elast.	6-7	71.2	11.9	68.9	13.9	0.58	>0.1
	8-9	70.7	10.7	72.0	12.0	0.72	>0.1
	10-11	72.8	9.8	62.2	14.1	3.22	>0.005*
	Index VII	4-5	1357	207	1364	294	0.88
size of oral aperture	6-7	1412	165	1433	210	0.70	>0.1
	8-9	1588	281	1494	295	1.20	>0.1
	10-11	1780	332	1582	271	1.90	>0.05

\* significant value

For all the indices, a significant difference between male and female values was noted only in the 10-11 year group, when considering upper lip elasticity (index VI, Table 2).

The width of the mouth was  $76.6 \pm 9.7\%$  to  $81.7 \pm 5.9\%$  of the length of upper vermilion arc (index I, Table 1). The coefficient of upper lip curvature ranged between  $0.23 \pm 0.19$  and  $0.33 \pm 0.17$  in males and  $0.21 \pm 0.08$  to  $0.27 \pm 0.12$  in females (index II, Table 1).

Upper height was a little over half the width of the mouth (index III, Table 1) in most cases. The upper vermilion, Is-sto, occupied  $40.6 \pm 4.4\%$  to  $43.4 \pm 5.2\%$  of upper lip in females compared to males where the vermilion occupied  $40.6 \pm 5.0\%$  to  $43.0 \pm 5.9\%$  of the upper lip height (Index V, Table 1).

The index indicating the relationship of difference in upper vermilion arc length during voluntary facial movement to relaxed vermilion length, i.e., upper lip elasticity index varied with age between  $69.5 \pm 12.8$  and  $72.8 \pm 9.8$  in males, and between  $62.2 \pm 14.1$  and  $72.0 \pm 12.0$  in females (Index VI, Table 2). Mean values obtained for size of oral aperture ranged from  $1357 \pm 207 \text{ mm}^2$  to  $1780 \pm 332 \text{ mm}^2$  (Index VII, Table 2).

Mean values of indices among males were significantly different for indices III and VII (Table 3) while among females, difference was noted only for index III.

**Table 3:** Analysis of variance for among age group comparison

Measurement	Male df N=5 df D=114				Female df N=5 df D=114			
	SST	SSE	F	P	SST	SSE	F	P
I	387	5271	1.7	>0.1	356	4774	1.7	>0.1
II	0.1	1.5	1.8	>0.1	0.04	0.87	1.1	>0.1
III	1267	5692	5.1	<0.05*	689	6241	2.5	<0.05*
IV	87	3383	0.6	>0.5	125	3260	0.87	=0.5
V	101	3480	0.7	>0.5	108	4034	0.6	>0.5
VI	111	9789	0.3	>0.5	1037	11992	2.2	>0.05
VII	$2 \times 10^6$	$5 \times 10^6$	10.2	>0.005*	$5 \times 10^5$	$5 \times 10^6$	2.4	>0.05

### Discussion

Differences in linear measurements have been reported previously [7] and are not unexpected when one considers the age range studied. Despite these differences, the ratio of various linear measurements as measured by the indices are the same in both sexes under the age of 10.

The indices, mouth width/upper vermilion arc, and coefficient of upper lip curvature, give an indication of upper lip curvature or protrusion. The values are affected by the anatomical architecture of the maxilla and the dentition posterior of the upper lip. However, because the coefficient of upper lip curvature is in reference to unit of mouth width, it is more indicative when comparing the curvature of the upper lip in different individuals. It assesses both the relationship of upper lip to structures posterior to it, and the adequacy of reconstructive procedures in restoring normal lip curvature.

A higher mouth width/upper vermilion arc (index I, Table 1) value indicates greater lip convexity, that is, greater lip protrusion. Thus, in this study, female lips protruded, though non-significantly, more than male lips in all except four to five-year age group. Although Farkas [8] found a greater lip protrusion in females, the age group studied was different from that of this study.

The curve or protrusion of upper lip in this study, utilizing coefficient of lip curvature (index II), was maximum under the age of two years in both sexes. Methods of repair of cleft lip and palate should aim at

optimal upper lip curvature by producing minimal interference of blood supply, and avoiding anteroposterior flattening of maxilla.

The study suggests that upper lip elasticity varies with age. Elasticity is conferred on the lip by the elastic fibres that are present at the dermal layer of the skin, and also by muscles acting around oral aperture. The lip elasticity index is thus likely to be altered in diseases involving lip skin, orbicularis oris, buccinator, zygomaticus major and depressor anguli oris muscles, or their nerve supply viz the mandibular and buccal branches of facial nerve. Such conditions include circumoral burns, and other conditions where healing of the lip takes place by second intention and scarring.

Feeding problems often exist in the early postburn phase because of pain while, later, endotracheal intubation, and dental treatment may become difficult and at times hazardous due to the loss of elasticity of circumoral tissues caused by extensive scarring.

Factors that determine interdental gape include the state of the temporomandibular joint, mandible, maxilla, and the state of the muscles responsible for the opening of the mouth. The soft tissue gape is only directly affected by these factors as well as by the state of the skin and muscles surrounding the oral opening. Patients with post cancrum oris defects and deformity can present with an oral aperture severely reduced to such an extent as to impair normal oral nutrition.

Finally, reconstructive surgeons must become acquainted with methods of objectively judging facial proportions [8]. A few reports illustrate the importance of lip anthropometry, for example, in comparison of methods of treatment of lip pathology [9]; and in syndrome diagnosis [10]. Objective assessment of deformities and the various types of repair around the mouth based on established standards of lip indices is recommended.

### Acknowledgements

I wish to express my gratitude to Mr Akingbehin FRCS, former head of the Paediatric Surgical unit, UCH, Ibadan, Mrs C.M. Folorunsho and Bola George, headmistresses of Abadina Primary School, and Faith Foundation Nursery School, Ibadan, respectively, for allowing me to obtain measurements from the children under their care. Also to Dr. Sola Sonubi, FMCS (Nig) former Senior Registrar, Paediatric surgery, UCH Ibadan, at present, Consultant Paediatric Surgeon, OSUTH, Shagamu, Nigeria, for reading through the original scripts.

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