

Surgical Changes Associated with Le Forte -1 Osteotomy in Cleft Palate Patients: An Anthropometric Study

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ABSTRACT

Background: Face is the most variable part of the body. It permits distinction between races ethnic groups, sexes and even members of the same family. Variability is manifested by the different sizes and shapes of the individual features and even more by the relationships of features to each other. Facial qualities such as harmony, disharmony, or dis-proportion previously only verbally defined can be determined quantitatively by physical anthropometry. In the past few decades, anthropometry, a method of physical anthropology, developed centuries ago, has been re-instated as a clinical method of measurement in new more sophisticated forms. *Beauty lies in the eyes of the beholder*, but objective esthetic evaluation is mandatory to find out the exact problem on a scientific basis.

Keywords: Anthropometric study, Le forte one osteotomy, cleft palate

INTRODUCTION

Face is the most variable part of the body. It permits distinction between races ethnic groups, sexes and even members of the same family. Variability is manifested by the different sizes and shapes of the individual features and even more by the relationships of features to each other. **L.G .ARKAS** et al (1987).¹ Facial qualities such as harmony, disharmony, or dis-proportion previously only verbally defined can be determined quantitatively by physical anthropometry.

Facial evaluation is inevitable for the following:

1. To systematically analyze the face as a whole and also part by part objectively rather than subjectively.
2. To help in deciding on to the surgical procedure, that will benefit the patient most.

Appraisal of patients with middle third facial deformity require special attention in an objective systemic clinical evaluation of the facial

features. A combination of the facial anthropometry in the treatment plan can help in accurately diagnose and develop comprehensive treatment plan for complex facial deformities as they exist in secondary cleft palate population.

MATERIALS AND METHOD

Six patients (3-males, 3- females) with mean age group of 21 years who had undergone primary chelio-palatoplasty (all left side cleft and all was unilateral) Treated in ABSM Institute of Dental Sciences was selected for this study.

Selection was based on the following criteria,

1. All were non-syndromic cleft lip and palate patients
2. 3 females/ 3- males
3. Good quality right and left profile color slides of each patients were available
4. No orthognathic or facial cosmetic surgery had been previously performed

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Variable's	Evaluations	Normal values
	<i>Ratios</i>	
V1	Subnasale-alar groove:subnasale-nasal tip (Sn-Ag:Sn-Pm)	1:2
V2	Nasolabial angle ratio (Sn-CV/FH:Sn-Ls)	1:4
V3	Intraorbitale:Globe (positive, 0, negative)	Positive
V4	Nasal protrusion: Nasal length (Sn-Prn:N-Prn)	1:2:5
V5	Nasal bridge projection: nasal protrusion (Globe-N':Sn-Pm)	1:1.33
V6	Maxillary length ratio (T-Sn:T-N')	1:1
V7	Mandibular length ratio (T-Me':T-N')	1:0.87
V8	<i>Angles</i>	-5
V9	General facial angle (G-Pg'/Vertical)	deg+/- 2
V10	Midface angle (G-SniVertical)	-1
V11	Nasofrontal angle (N' -G tangent N'Prn)	deg+/- 1
V12	Nasolabial angle (Sn-CII:Sn-Ls)	130
V13	Nasomental angle (N'-Prn/Prn-Pg')	deg+-5
V14	<i>Surface contours</i>	100
V15	Paranasal (convex, flat, concave)	deg+/- 5
	Cheek (convex, flat, concave)	125
	Supratip break (present, absent)	deg+/-5
		Convex
		Convex
		Present

For all the patients mid face profile was evaluated anthropometrically by the method proposed by **Nipon .C, Epker** et al in 1995 before undergoing orthognathic surgery. The color slides of the patients profile were projected on to a sketch pad that the distance from the soft tissue nasion (N) to soft tissue pogonion (Pg) was standardized at around 70mm. With the sketch paper used as the screen, the patients profiles were drawn. 15 selected anthropometric norms reported by

Farkas, Koury and Epker were applied and adapted to the study population.

Table 1. Facial anthropometric evaluation adapted for this study

The selected anthropometric norms were as follows:

V1 is the linear ratio between subnasale-alar groove to subnasale-nasal tip (Sn-Ag:Sn-Pm). The normal value is 1:2 or 0.5.

V2 nasolabial angle ratio) is the ratio between the two angles formed by dividing the nasolabial angle by subnasale parallel. The numerator is the angle formed by the subnasal -columella (Sn-CI) and subnasale parallel. and the denominator is the angle formed by subnasale parallel and subnasale-labiale superius (Sn-Ls) (Sn-CI/Frankfort Horizontal (FH):FH/Sn- Ls). The normal value is 1:4 or 0.25.

V3 is the position of orbitale relative to a line drawn from the most anterior projection of globe perpendicular to Frank fort horizontal. The normal position is positive, that is orbitale is anterior to the cornea. For statistic calculation, positive position was coded as 1, zero position as 2 and negative position as 3, respectively.

V4 is the linear ratio between nasal protrusion and nasal length (Sn-Prn: N-Pm). The normal value is 1:2.5 or 0.40.

V5 is the linear ratio between nasal bridge projection and nasal protrusion (Globe- N: Sn-Prn). The normal value is 1: 1.33 or 0.75.

V6 (maxillary length ratio) is the linear ratio between tragon-subnasale to tragon- soft tissue nasion (T-Sn:T-). The normal value is 1:1.

V7 (mandibular length ratio) is the linear measurement between tragon-soft tissue menton to tragon-soft tissue menton to tragon-soft tissue nasion (T-Me:T-N). The normal value is 1:0.87 or 1.15.

V10 (nasofrontal angle) is the angle formed by a line from soft tissue nasion- glabella and aline

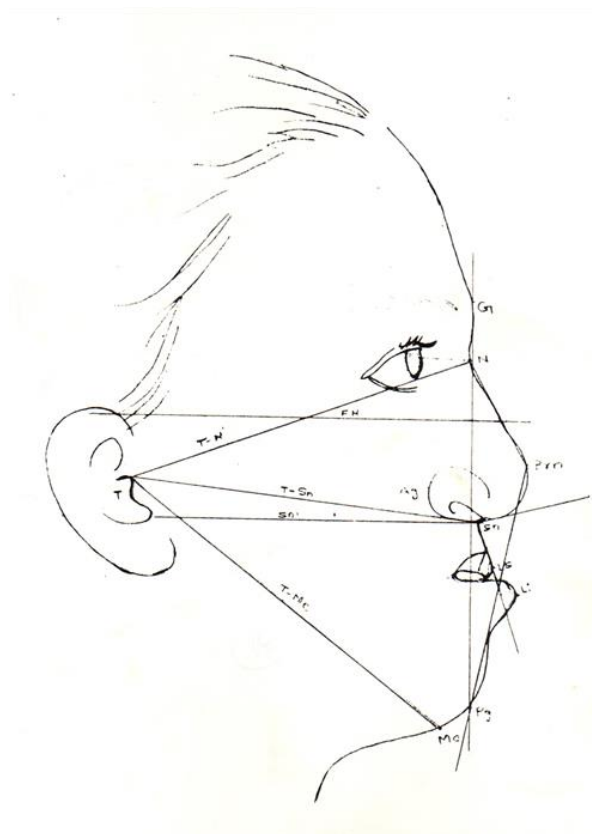


Fig 1: Pre operative anthropometric landmarks.

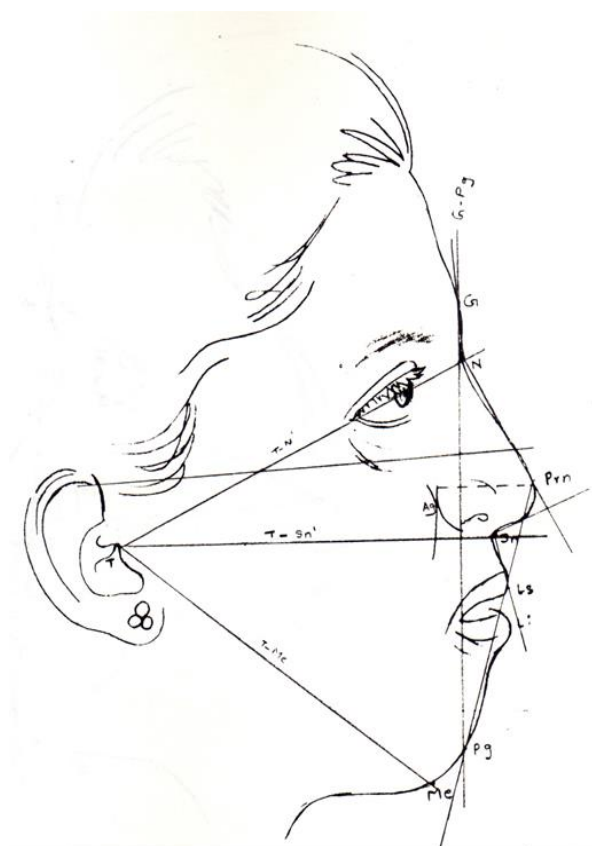


Fig 2: Post operative anthropometric landmarks.

from soft tissue nasion-pronasale (N-G tangent/N-Pm). The normal value is 130 degrees.

V11 (nasolabial angle) is the angle formed by a line from subnasale-columella and a line from subnasale-labiale superius (Sn-CI/Sn-Ls). The normal value is 100 degrees.

V12 (nasomental angle) is the angle formed by a line from soft tissue nasion pronasale and pronasale - soft tissue pogonion (N-Prn/Prn-Pg). The normal value is 125 degrees.

V13 (paranasal) is the surface contour of paranasal area lateral to the alae of the nose. The normal appearance is convex. For statistical calculation, onvex contour was coded as 1, flat contour as 2, and concave contour as 3. respectively.

V14 (cheek) is the surface contours of cheek superior to the paranasal area. The normal appearance is convex. For statistical calculation, convex contour was coded as 1, flat contour as 2, and concave contour as 3, respectively.

V15 (supratip break) is a slight depression in the nasal dorsum just superior to the tip region. The normal appearance is present. For statistic calculation, present was coded as 1, and absent was coded as 2 (However V8 and V9 were not considered in this study because the patients were not in the Frankfort horizontal while taking the photographs.) Difference between the profile of the study group versus norms was evaluated statistically to find out changes in the morphologic valves as proposed for the esthetic face by **Epker** et al. Application of Anthropometry to the treatment plan of patients undergoing orthognathic surgery permits the clinician not only to improve on the facial esthetics 'but also to incorporate other adjunctive esthetic treatment procedures such as, *chelioplasty, rhinoplasty, cheek augmentation* etc.

RESULT

Frequency of each variable that were abnormal in the study group preoperatively was then evaluated and classified as strong, intermediate and weakest characteristics. The result showed that majority of defect in the study group lies in the mid face region. Hence all these patients were scheduled to undergo Le Forte I maxillary advancement based on cephalometric and anthropometric facial

evaluation. Pre and post operative anthropometric variables were then compared to find out any significant changes statistically. Frequency of each anthropometric measurements that was abnormal in the study group was then evaluated post
Table I: Lists the pre-operative Anthropometric values.

operatively and classified as mild moderate and severe characteristics. Frequency of abnormality in each variable in the study population (pre VS post operatively) was then compared accordingly.

Variables	Case I	Case II	Case III	Case IV	Case V	Case VI
VI	15:17 rnm	12:18 rnm	5:15rnm	12:13 rnm	15:15 rnm	14:14
V2	160/110 ⁰	170/110 ⁰	170/60 ⁰	168/130 ⁰	165/98 ⁰	166/90 ⁰
V3	Negative	0 ⁰	0 ⁰	Negative	Negative	Negative
V4	17:23	18:36 rnm	13:35 rnm	13:29 rnm	15:30 rnm	14:34
V5	12:17 rnm	8:12	14:14 rnm	5:13 rnm	10:15 rnm	10:14
V6	80:80	70:74	75:80 rnm	75:75	76:78 rnm	76:80
V7	90:80 rnm	78:74	86:80	94:75	87:78	90:74
V10	150 ⁰	145 ⁰	150 ⁰	135 ⁰	162 ⁰	160 ⁰
V11	85 ⁰	50 ⁰	60 ⁰	60 ⁰	95 ⁰	55 ⁰
VI2	139 ⁰	145 ⁰	150 ⁰	146 ⁰	150 ⁰	155 ⁰
VI3	Concave	Concave	Concave	Concave	Concave	Concave
V14	Flat	Flat	Flat	Flat	Concave	Flat
V15	Absent	Absent	Absent	Absent	Absent	Absent

Table II - Lists the Post-operative Anthropometric values.

Variables	Case I	Case II	Case III	Case IV	Case V	Case VI
VI	14:14 mm	15:14 mm	10:15 nun	11:11mm	11:15nun	12:12 nun
V2	160/108	165/72	74/170 ⁰	165/137	160/95	150/110
V3	Negative	0	0	Negative	Negative	Negative
V4	15:30	12:32	15:30	10:34	15:28	12:32
V5	12:15	8:14	15:18	6:10	8:15	6:12
V6	85/85	68/68	75/75	75/75	78:78	80:80
V7	85/80	82/68	82/72	90/75	90:78	94:80
V10	150 ⁰	138 ⁰	145 ⁰	136 ⁰	155 ⁰	150 ⁰
V11	90 ⁰	85 ⁰	80 ⁰	60 ⁰	100 ⁰	90 ⁰
V12	130	140 ⁰	142 ⁰	140 ⁰	140 ⁰	152 ⁰
V13	Flat	Flat	Flat	Concave	Flat	Concave
V14	Convex	Flat	Flat	Flat	Flat	Concave
V15	Absent	Absent	Absent	Absent	Absent	Absent

Table III: Lists the comparison between the profiles of the study group versus norms - Pre operative.

Variables	't'	Remarks	Statistical Significance
VI Subnasale – Alar groove: Subnasale –nasal tip Sn-Ag : Sn Pm	2.573	P<0.05	S
V2 Nasolabial angle ratio (Sn-CIIFH: FH/Sn-LS)	2.821	P<0.0 1	HS
V3 Infra Orbitale :Globe	2.12	P<0.05	S`

V4 NasalProtrusion Nasal length (SnPrn : -Prn)	0.897	P>0.05	NS
V5 Nasal bridgeprojection : NasalProtrusion (Globe-I -Sn-Pm)	1.254	P>0.05	S
V6 Maxillarylength ratio (T-Sn : T-N)	0.128	P>0.05	NS
V7 Mandibular length ratio- T-Me : T- N)	0.378	P>0.05	NS
V10 Naso frontal angle (N-G Tangent/N-Pm)	6.882	P>0.001	HS
V11 Nasolabial angle (Sn-Cl/Sn-LS)	7.108	P>0.001	HS
V12 Nasomental angle (-Prn/Prn-Pg)	3.075	P>0.001	HS
V13 Paranasal	2.12	P<0.05	S
V14 Cheek	2.12	P<0.05	S
V15 Supra tip break	2.12	P<0.05	S

S= Significant; HS= Highly significant; NS= Non significant

Table IV: Lists the frequency of each variable that was abnormal in the study group pre-operatively.

Frequency	Variables	Indicative of Abnormality
<u>Strongest Characteristics:</u>		
6	V2 Naso labial angle ratio (Sn-Cl.FH:FH/Sn-LS)	< Normal
6	V3 Infra orbitale : Globe	0 or negative "
6	VI2 Nasomental angle (N-Prn/Prn-Pg)	> Normal
6	V 13 Paranasal contour	Concave
6	VI4 Cheek	Flat or
6	Concave	
6	V15 Supratip break	Absent
<u>Intermediate Characteristics:</u>		
5	VI Subnasala Alar groove Subnasale - nasal tip Sn-Ag : Sn-Pm	< Normal
5	V10 Naso frontal angle (N-GIN-Prn)	> Normal
5	V11 Naso labial angle (Sn-Cl/Sn-LS)	< Normal
4	V6 Maxillary length ratio (T-Sn : T-N)	> Normal
<u>Weakest Characteristics:</u>		
2	V4 Nasal protrusion nasal length (Sn-Prn : N-Pm)	< Normal
1	V5 Nasal bridge projection Nasal protrusion (Globe-N : Sn-Pm)	> Normal

Table V: Lists the comparison between the pre/post operative anthropometric profile variables of the study group.

Variabels	Preoperative Mean $\pm$ SD	Postoperative Mean $\pm$ SO	't'	Statistical Significance
VI	0.801 $\pm$ 0.259 1:0.8	0.88 $\pm$ 0.15 1:0.8	0.438 P>0.05	NS
V2	0.599 $\pm$ 0.149	1.0875 $\pm$ 0.764 1: 1.09	0.438 P>0.05	NS
V3	1	1	P = 1	NS
V4	0.495 $\pm$ 0.129	0.430 $\pm$ 0.095 1:0.4	0.3125 P>0.05	NS
V5	0.689 $\pm$ 0.195	0.639 $\pm$ 0.142 1:0.6	0.5625 P>0.05	NS
V6	0.968 $\pm$ 0.027 1.97	I $\pm$ 0 1:1	0.125 P>0.05	NS
V7	1.139 $\pm$ 0.078 1:1.14	1.146 $\pm$ 0.076 1:1.15	1 P>0.05	NS
V10	150.33 $\pm$ 9.933	145.67 $\pm$ 7.448	0.0482 P>0.05	S
V11	66.67 $\pm$ 16.63	84.167 $\pm$ 13.57	0.0422 P<0.05	S
V12	147.5 $\pm$ 5.468	141 $\pm$ 5.648	0.0313 P<0.05	S
V13			P=0.25	NS
V14			P=0.47	NS
V15			P = 1	NS

NS= Non significant; S= Significant

Table VI: Lists the frequency of each variable in the study group post-operatively. n = 6.

Frequency	Variables	Indicative of Abnormality
Strongest Characteristics:		
6	VI Subnasala Alar groove Subnasale - nasal tip Sn-Ag : Sn-Pm	< Normal
6	V2 Naso labial angle ratio (Sn-C1.FH:FH/Sn-LS)	< Normal
6	V3 Infra orbitale : Globe	0 or negative
6	V5 Nasal bridge projection: Nasal protrusion ormal (Globe-N' :Sn-Prn)	Normal
6	VI3 Paranasal Concave	Flat of
6	V15 Supratip break	Absent
Intermediate Characteristics:		
5	V12 Naso mental angle (N'-Prn/Prn-Pg)	> Normal
4	V10 Naso Frontal angle (N' -GIN' -Pm)	> Normal

4	V14 Cheek	Flat
3	VII Nasolabial angle (Sn-Cl : Sn-Ls)	< Normal
Weakest Characteristics:		
I	V4 Nasal protrusion: nasal length (Sn-Prn : N-Pm)	< Normal

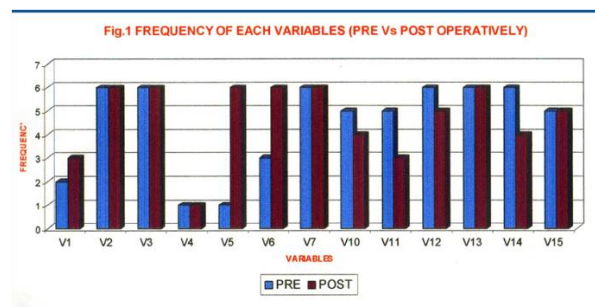


Fig 1: Frequency of eachvariables (Pre vs Post operatively)

DISCUSSION

The quantitative study of cleft was first documented a century ago and uniform assessment of the pre-operative and post operative changes in cleft lip and palate patients were performed 2 decades ago-Farkas et al. Appraisal of the patients with cleft lip and palate require special attention in an objective systemic clinical examination of the facial featAnthropometric facial esthetic evaluation is an objective method that can be used to supplement, objective visual judgement/ Anthroscopy with quantitative measurements. In addition same anthropometric measurements can be used post operatively to analyse treatment results quantitatively.

Four parameters were evaluated statistically in this study. They were designated as

A1-Comparison between anthropometric profile variables of patients presurgically with norms proposed by **Epker** et al.

A2-Frequency of each anthropometric measurements that was abnormal In the study population, pre-surgically.

A3-Comparison between pre and post anthropometric variables.

A4- Frequency of each anthropometric measurements that are abnormal In the study population post operatively.

In A 1,4 statistically highly significant ($p<0.05$) differences existed, the obtuse naso-frontal angle, indicating mid face retrusion, decreased naso labial angle ($\alpha=71$) increased nasomental angle ($\alpha=145$) also grossly altered nasolabial angle ratio, indicating lack of nasal tip projection. Other significant variables noted were, sub nasale - alar groove: sub nasale - nasale tip ratio, which was almost equal (1: 1) in all the patients indicating short collumella in these patients,& a posteriorly placed infra orbitale relative to the globe (negative or 0), a concave para nasal contour & a flat cheek contour ,indicating the degree of retromaxillism in the study groups. According to **ROSSR.B.** and **ENWMARK** - Early palatoplasty predisposes the cleft palate patients to maxillary retrusion, others reported that mid face deficiency is inherent in cleft lip and palate population. Clinically it is commonly stated that cleft lip and palate patients have the appearance of mid face deficiency described in the literature under various terms.

KAPUCU M.R. et al. in 1996 did a study on the effect of cleft lip repair on maxillary morphology in patients with unilateral cleft lip and palate and concluded that the magnitude of maxillary retrusion was not increased by the cleft lip repair and also there is no significant cephalometric differences between patients who had only their palate repaired during their childhood and those who had got only their lip repaired in childhood.¹³ However some of the differences where not statistically significant in the study group because of the unpredictable facial growth pattern, following primary cleft surgery growth was much better in certain morphometric areas as compared to the other areas for eg., Nasal protrusion: Nasal length ratio Nasal bridge projection : Nasal protrusion, Maxillary length ratio and Mandibular length ratio was normal in most of the patients.

According to the 2nd parameter A4, Nasomental angle, infra orbitale relative to the globe, paranasal contour, cheek contour and nasolabial angle ratio was. abnormal in every cleft lip and palate patients studied. Nasofrontal angle and Nasolabial angle, Sub nasal alar groove: sub nasale – nasal tip were abnormal in more than 90% of the CLP patients. 60% of the patients showed abnormality in relation to maxillary length ratio (which was $> 1;1$). Less than 50% showed abnormality nasal protrusion: nasal length ratio, which was less than normal and in nasal bridge projection : nasal protursion ratio, which was greater than normal. Hence this study is in agreement with the idea of **EPKER** et al. in that the majority of the defect in patients with cleft lip and palate is nasal in origin. Specifically the nose as very vertical (flat), the tip was poorly projected, the skeletal, nasal base was deficient and the dorsum and supra tip area were abnormal in the study group.

MCA CANE A.M. did a 3d soft tissue. analysis of 24 adult cleft patients following LeForte 1 maxillary advancement and found that there is a similar pattern of retrusion of the nasal complex - in agreement with the idea of **STEWART** et al. hence stressing the failure in all the cleft group to correct the lack of nasal projection. According to the parameter 3, A3 Statistically significant ($p<0.05$) changes were observed in the following variables Naso frontal angle and naso mental angle reduced post surgically, whereas nasolabial angle increased after Le Forte 1 maxillary advancement. This is evidence that advancement of the maxilla at high Le Forte - level improved the facial profile by improving nasal bridge projection over and above the soft tissue contour of the face.

No statistically significant changes were noticed in the following variables, subnasale alar groove: subnasale nasale tip ratio, nasolabile angle ratio, infra orbitale : globe, nasal protrusion .nasal-length, naso-mental angle, nasal-bridge projection : nasal-protrution, maxillary length ratio, mandibular length ratio. Also changes in paranasal and cheek contour were not statistically significant, which are essentially due to the lack of appreciable changes in the cleft nose deformity. However the concave cheek & the paranasal area improved clinically, but were not statistically significant. According to the

4th parameter, A4, following surgery Nasal bridge projection: Nasal protusion and maxillary length ratio became normal in more than 90% of the study group. 50% of the patients achieved statistically significant improvement in the naso labial angle, 60% in nasofrontal angle. Less than 50% got improvement in the cheek contour (became convex). However there was absolutely no change in, position of the infra orbitale relative to the globe or the flat or concave paranasal contour or absence of supra tip break following the maxillary advancement in any of the patients.

This shows that majority of defect In the nose persisted post operatively, However following Le Forte I maxillary advancement only significant improvement achieved in nasal bride projection: nasal protrusion ratio {I: 1.33 as proposed by **EPKER** et al) and maxillary length ratio (1: 1 as proposed for the attractive face by **EPKER** al). Hence most of the e patients require other adjunctive esthetic procedures such as rhinoplasty, cheek augmentation etc. To bring the abnormal morphologic values to normal mean to produce harmony & thus attractiveness as proposed by **FARKAS**. Hence anthropometry is useful in 1. Specifically diagnosing the soft tissue abnormalities as they exist in the secondarily cleft palate population.2. To decide where exactly the reconstruction should take place to achieve maximum esthetic results.

However, a surgeons eye must take the final decision in treatment planning, if the differences are significant in each individual cases. An attractive feature should not be altered because it deviates from a proportion. As with all the technique of evaluation limitation takes place in measuring anthropometric values also, especially it must be remembered that the values were laid down on the measurements of Caucasian population who are essentially built bigger and ethnically different from the local populace.

SUMMARY AND CONCLUSION

This study was done in 6 patients who underwent high Le Forte osteotomy. Statistically significant changes where noted in the Nasolabial angle, nasomental angle, less significant variables, the cheek and para-nasal area and least significant in the cleft nose deformity. However nasal bridge

projection increased considerably following the osteotomy. Hence anthropometric measurements recommended represents the minimal quantitative data that should be available before surgery, since they provide objective information regarding the soft tissue change, and hence essential for the objective judgment of the post-operative results.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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