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TITLE: Cephalometric norms for Bimaxillary Protrusion in Trinidad and Tobago: A preliminary study

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Abstract: The aim of this study is to establish for the first time cephalometric norms for bimaxillary protrusion in Trinidad and Tobago population and to compare findings to previously published norms for other bimaxillary protrusion groups.

Materials and Methods: 109 standardized lateral cephalometric radiographs were taken by one investigator of bimaxillary protrusion patients prior to receiving orthodontic treatment. The sample consisted of 52 boys and 57 girls aged 10-17 years. The cephalograms were traced using 48 hard and soft tissue and 25 linear and angular cephalometric measurements. Independent sample t-test was used to assess inter-gender differences, norms were calculated. ANOVA was used to assess inter-ethnic differences. The results were then compared to the norms for other bimaxillary protrusion populations.

Results: The mean values and standard deviations obtained were: SNA, 85.9° (± 4.9°);SNB, 78.7°(± 4.5°); ANB, 7.2°(± 2.5°); MMPA, 32.3°(±5.1°);UI-LI,109.7° (±8.2°); UI-Max, 118.7° (±6.1°); LI-Man, 101.4° (±5.9°); LI-Apo, 3.8° (±2.6°); Upper lip to E-plane 2.0mm(±3) and Lower Lip to E-plane 5.6mm(±3.2).The independent t-test showed sexual dimorphism with SNA and upper and lower lip to E-plane being higher in males compared to females. ANOVA showed differences between ethnic groups with LI-Apo, and lower lip to E-plane. The maxilla and mandible were more anteriorly placed in this sample as compared to Caucasian norms. ANB, MMPA, UI-Max, LI-Man, LI-Apo, upper lip and lower lip to E-plane, were all higher in this population compared to other bimaxillary protrusion populations.

Conclusions: There are some fundamental differences in the cephalometric norms for the bimaxillary protrusion population in Trinidad and Tobago and in the context of orthodontic diagnosis and treatment planning these cephalometric norms should be the yardstick.

Keywords: bimaxillary protrusion, cephalometric norms, Trinidad and Tobago

Introduction

Based on craniofacial characteristics the human race can be placed into three major groups the Caucasian, Negroid and Asian (Hewes 1962). Trinidad and Tobago is a cosmopolitan country with three major ethnicities, namely people of East Indian descent (35.43%of population), African descent (34.22% of population) and the mixed population (22.82% of population).

Bimaxillary Protrusion has been reported to be the most common malocclusion in Trinidad and Tobago (Hoyte, Ali, and Bearn 2018). Several ethnic cephalometric standards have been established for relatively homogenous groups(Alexander and Hitchcock 1978, Alcalde et al. 1998, Bacon, Girardin, and Turlot 1983, Carter and Slattery 1988, Behbehani et al. 2006, Cerci, Martins, and de Oliveira 1993). However, many populations are cosmopolitan like Trinidad and Tobago and have produced mixed facial characteristics that have not yet been studied. Cephalometric differences has been shown between racial groups and morphological subgroups within these groups can be seen (Angel 1950). Since racial characteristics have been noted to lead to cephalometric variations, it is important to recognize the difference of a homogenous ethnic group and a blended group to ensure treatment planning is tailored to appropriate outcomes, and improve patient's expectations (Alcalde et al. 1998).

Orthodontic diagnosis and treatment planning require careful evaluation of the patient's cephalometric values and comparison to known population norms. Radiographic cephalometry has also been used to assess treatment progress and craniofacial growth, tasks in research and individual patient growth(Ajayi 2005).

No data exists on cephalometric standards for the Trinidad and Tobago population. These specific analyses would enable clinicians to improve diagnosis and treatment planning.

The purpose of this study was to establish cephalometric standards for the Trinidad and Tobago population.

Materials and Methods

The study was conducted after receiving approval from the University of the West Indies ethics committee. The study was conducted following the guidelines of the Declaration of Helsinki (Helsinki 2004)

The sample size consisted of 109 standardized lateral cephalometric radiographs. These radiographs were obtained from patients receiving orthodontic treatment at the dental hospital who had given consent for their records to be used. This was a fixed appliance study with bimaxillary protrusion various incisor relationships class1, class 2 division 1 and class3. The subjects all had overjet <7mm and aged 10-17.

Obtaining Consent

Patients consent was sought prior to the commencement of orthodontic treatment. The procedure as well as the risks and benefits were explained to the patient.

Cephalometric measurements

One operator (TH) took all lateral cephalograms with a single cephalostat (Gendex)at 70 kv, 9MA. The distance from the X-ray focus to the mid-sagittal plane was 150 cm and between the film and the mid-sagittal plane was 15cm. All subjects were positioned with their Frankfort plane parallel to the floor. Participant's lips were in a relaxed position and teeth in maximum intercuspation. The cephalograms were digitized using Dolphin^{TM} Digital Imaging System version 10.5, Chatsworth, CA. The cephalograms were then digitally traced using 48 hard and soft tissue landmarks and 25 linear and angular cephalometric measurements were recorded (Table 1)

All tracing and analyses were conducted and 39 were reassessed by D.B a supervisor

Any disagreement was resolved by dialogue and if necessary, by reanalysis and retracing.

The means and standard deviation for different genders and the whole sample were obtained. The mean was then compared to Caucasoid, African-American and Chinese norms.

There were 52 boys and 57 girls aged10-17 years mean age 13.42 years. The distribution by age is shown in bar charts. (figure 1). Each patient was positioned in the cephalostat with the head oriented with the Frankfurt plane horizontal to the floor, the teeth in occlusion and the lips closed. The digital lateral cephalograms were digitized. The cephalometric analysis was done by using the Dolphin Imaging software. All radiographs were traced by one author. The tracings were done twice for each radiograph at least three months apart.

The following landmarks were identified on each cephalogram (figure) sella turcica (S), nasion (N), oribitale (O), porion (P), gnathion (GN), pogonion (Pog), gonion (Go), menton(M), anterior nasal spine (ANS), posterior nasal spine(PNS), A point, B point, maxillary incisor apex(MxIA), mandibular incisor apex(MIA), upper incisor tip(UIT),lower incisor tip(LIT).

The definitions of the various landmarks have been previously reported. From the landmarks the following skeletal and dental lengths and angles were measured: sella-nasion-A-point angle (SNA), sella-nasion-B-point angle(SNB), A point-nasion-B point angle (ANB), Saddle/Sella angle (SN-Ar), Convexity angle (NA-Apo), sella –nasion-palatal plane angle(SN-PP), palatal plane-maxillary plane (PP-MP), maxillary plane-sella-nasion angle (MP-SN), Upper incisor axis to palatal plane angle (U1-PP), lower incisor axis to mandibular plane angle(L1-MP), interincisal angle (U1-L1), upper face height (N-ANS), lower anterior face height (LAFH), lower face height ratio (LAFH/TAFH), posterior face height to anterior face height ratio (PFH/AFH), maxillary unit length(Co-ANS), mandible unit length(Co- Pog), lower incisor protrusion (L1-Apo), Overbite, Overjet, upper lip to E- plane, lower lip to E-plane, nasolabial angle (Col-Sn-UL), Mentolabial Angle.

Recording Procedure

Bimaxillary Protrusion is a malocclusion characterized by extra orally bimaxillary prognathism (prognathic jaws, this comprises 64.4% of this population) and intraorally of bimaxillary proclination (proclined incisors) (Hoyte, Ali, and Bearn 2018).

Bimaxillary Proclination is an intraoral diagnosis made if upper and lower incisors are proclined (Hoyte, Ali, and Bearn 2018). This has been shown to be 68.8% of the Trinidad and Tobago population(Hoyte, Ali, and Bearn 2018).

Statistical Analysis

Intra examiner reliability was calculated using a statistical package (IBM SPSS Statistics for Windows, version 22 (IBM Corp., Armok, N.Y., USA). The methodology was checked for quality by looking at bar charts and normality curves. Box plots were produced to aid in checking for outliers. Outliers were then assessed to ascertain if it was a landmark identification

problem, a technical error or a correct value appearing as it was an abnormal measure. Basic descriptive statistics included means, standard deviations, maximum and minimum were computed for each cephalometric variable. An independent t-test was conducted to ascertain any sexual dimorphism. ANOVA was used to analyze differences between the three ethnic groups.

Results

The cephalometric findings by gender is presented in Table 1. Male and female data were compared with an independent t-test. Twenty-five analyses were compared so the criterion p-value was adjusted so that statistical significance was any value <0.002 (0.05/ 25=0.002) are listed in Table 1. Descriptive data was also compared for each ethnic group and ANOVA compared between ethnic group differences and a Bonferroni correction was again applied (Table 2). The combined data was analyzed and the mean, minimum, maximum and standard deviation computed (Table 3). Intra examiner reliability was also calculated (Table 4). The norms were compared to the Caucasian, African -American and Chinese bimaxillary protrusion norms (Table 5).

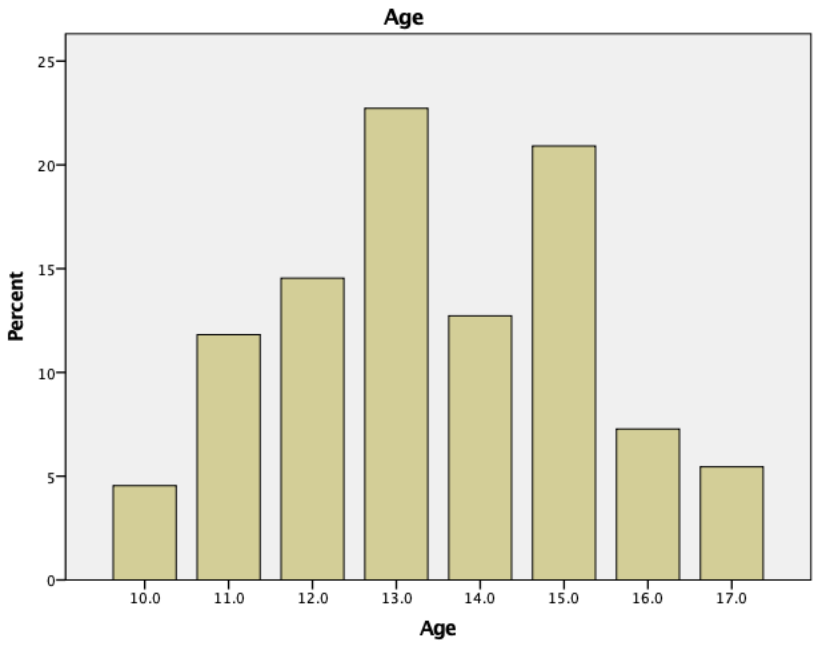

Figure 1 shows percentage distribution by age

Table.1 Comparison of minimum, maximum, mean standard deviation and independent t-test for boys and girls

Linear (mm) and angular (°) measurements	Boys n=52				Girls n=57				Independent sample t-test P value*
	Minimum	Maximum	Mean	SD	Minimum	Maximum	Mean	SD	
SNA	69.9	98.9	86.7	4.6	73.5	105.9	85.2	5.1	0.018
SNB	69.8	92.0	79.7	4.2	68.2	92.3	77.8	4.6	0.001
ANB	-1.8	14.1	7.1	2.4	2.4	15.1	7.3	2.5	0.395
SN-AR	110.0	149.9	124.9	6.7	103.4	148.6	128.4	7.6	0.004
NA-Apo	-3.4	32.4	17.0	6.0	1.3	34.9	17.4	7.0	0.645
SN-PP	-12.9	9.4	-1.0	4.2	-8.5	11.1	0.8	4.2	0.002
PP-MP	20.9	42.2	32.1	4.8	21.0	45.0	32.5	5.3	0.587
MP-SN	22.2	50.4	36.1	5.6	23.7	57.6	38.2	7.0	0.10
U1-Palatal Plane	108.7	138.9	118.4	6.3	105.5	133.2	119.0	6.0	0.450
L1-MP	85.6	115.8	100.9	5.7	87.0	117.9	101.8	6.0	0.246
U1-L1	82.2	129.9	110.7	8.5	91.6	130.6	108.8	7.8	0.77
N-ANS	36.3	64.6	49.7	4.8	36.3	60.2	49.7	4.7	0.983
ANS-Me	53.0	90.3	67.7	7.1	54.8	83.0	66.7	6.3	0.247
LAFH/TAFH	51.7	61.4	56.8	2.2	51.1	62.7	56.4	2.3	0.209
PFH/AFH	57.2	73.4	65	4.1	51.3	74	63.4	5.1	0.100
Co-ANS	72.9	106.8	88.5	7.0	72.6	102.9	87.4	6.1	0.185
Co-Pog	93.5	140.7	112.3	8.9	94.6	136.9	110.8	8.1	0.191
L1-Apo	-3.9	10.5	3.7	2.8	-1.4	9.6	3.9	2.4	0.720
Overbite	-5.9	5.4	1.7	2.4	-4.1	4.9	1.4	1.8	0.260
Overjet	-0.4	10.3	4.2	1.9	-0.2	8.5	4.6	1.7	0.176
Upper Lip to E-Plane	-2.1	8.6	2.9	2.3	-4.6	8.6	1.3	3.3	0.001
Lower Lip to E-Plane	-1.6	14.1	6.4	2.8	-3.3	12.2	4.9	3.6	0.002
Col-Sn-UL	48.7	112.2	84.7	12.1	56.5	116.4	84.6	11.1	0.957
Mentolabial Angle	98.7	164.8	130.6	15.3	96.9	169.5	131.2	15.3	0.782

*Significant difference at P<0.002

Table.2 Comparison of minimum, maximum, mean standard deviation and ANOVA for between ethnic groups

Linear (mm) and Independent	Afro Trinidadian n=62				Indo Trinidadian n=16				Mixed n =31				ANOVA
angular (°) measurements	Min	Max	Mean	SD	Min	Max	Mean	SD	Min	Max	Mean	SD	P value*
SNA	69.9	105.9	85.8	6.04	78.5	91.7	85.3	3.78	78.5	93.7	85.64	3.71	0.926
SNB	68.4	92.3	78.54	5.13	69.8	84.7	78.3	4.07	73.4	88.7	79.18	4.04	0.803
ANB	-1.8	14.1	7.32	2.90	4.5	10.5	6.95	1.52	1.4	10.5	6.94	2.14	0.402
SN-AR	107.3	148.6	128.28	8.56	117.8	134.9	125.76	5.40	117.4	135.4	125.96	4.93	0.240
NA-Apo	-3.4	34.9	17.22	7.45	9.5	21.8	16.05	3.20	1.5	25.7	14.97	5.90	0.351
SN-PP	-12.1	8.9	-.31	4.61	-8.7	4.1	-1.02	3.44	-8.1	6.7	.068	4.26	0.724
PP-MP	23.1	43.2	33.46	4.94.	21.0	38.7	32.73	4.71	20.9	41.2	30.92	5.09	0.085
MP-SN	22.2	56.7	38.09	7.08	24.6	45.7	36.68	6.4	23.7	45.9	36.04	5.58	0.380
U1-Palatal Plane	106.4	136.4	118.25	6.33	110.2	131.2	119.5	6.25	106.4	136.4	118.74	6.49	0.815
L1-MP	87.9	117.1	101.22	5.70	89.3	115.8	100.4	7.63	85.6	109.6	100.11	5.74	0.710
U1-L1	83.7	124.2	109.11	7.99	94.8	129.9	109.5	10.22	130.6	110.0	112.01	8.35	0.283
N-ANS	37.0	61.4	49.67	4.81	9.3	50.6	44.26	9.79	36.3	58.8	49.65	5.18	0.004
ANS-Me	6.2	82.6	67.34	10.07	15.7	74.8	61.27	13.63	54.9	80.0	65.72	6.85	0.102
LAFH/TAFH	53.4	62.0	56.9	2.05	52.9	61.4	57.3	2.87	52.9	62.7	56.2	2.34	0.242
PFH/AFH	53.6	72.7	63.53	5.08	57.8	73.4	64.41	5.52.	55.7	73.9	65.09	4.16	0.409
Co-ANS	72.9	103.4	87.56	6.69	75.5	99.2	84.11	6.68	77.0	101.7	85.97	5.27	0.117
Co-Pog	94.6	136.9	112.41	9.22	95.4	120.6	106.48	7.49	97.2	132.2	110.89	7.60	0.045
L1-Apo	0.2	10.4	4.92	2.26	-0.1	8.0	2.60	2.11	-1.4	9.6	3.41	2.57	0.000
Overbite	-4.6	5.4	1.6	2.31	5.1	1.42	1.61	1.83	-4.5	1.55	1.42	2.24	0.903
Overjet	-0.3	10.3	4.41	1.81	1.2	6.4	4.34	1.76	-0.2	8.2	4.17	1.77	0.834
Upper Lip to E-Plane	-4.6	8.6	2.77	3.06	-3.8	3.7	0.275	2.45	-3.2	6.5	1.31	2.40	0.003
Lower Lip to E-Plane	-2.1	12.2	6.33	3.05	-1.1	9.9	3.28.	2.86	-3.3	12.1	4.78	3.25	0.001
Col-Sn-UL	52.7	106	82.1	10.85	67.6	116.4	88.96	13.53	48.7	101.6	80.75	12.34	0.067
Mentolabial Angle	96.9	159.9	131.8	14.48	112.3	164.8	135.84	14.61	104.3	169.5	131.83	16.9	0.527

*Significant difference at P<0.002

Table 3 Cephalometric norms for the Trinidad and Tobago population

Linear(mm) and Angular (º) Measurement	Minimum	Maximum	Mean	Standard Deviation
SNA	69.9	105.9	85.9	4.9
SNB	68.2	92.3	78.7	4.5
ANB	-1.8	15.1	7.2	2.5
SN-AR	103.4	149.9	126.7	7.4
NA-Apo	-3.4	34.9	17.2	6.5
SN-PP	-12.9	11.1	-0.03	4.3
PP-MP	20.9	45.0	32.3	5.1
MP-SN	22.2	57.6	37.2	6.4
U1-Palatal Plane	105.5	138.9	118.7	6.1
L1-MP	85.6	117.9	101.4	5.9
U1-L1	82.2	130.6	109.7	8.2
N-ANS	36.3	64.6	49.7	4.7
ANS-Me	53.0	90.3	67.2	6.7
LAFH/TAFH	51.1	62.7	56.6	2.3
PFH/AFH	51.3	74.0	64.2	4.8
Co-ANS	72.6	106.8	88.0	6.6
Co-Pog	93.5	140.7	111.5	8.5
L1-Apo	-3.9	10.5	3.8	2.6
Overbite	-5.9	5.4	1.5	2.1
Overjet	-0.4	10.3	4.4	1.8
Upper Lip to E-Plane	-4.6	8.6	2.0	3.0
Lower Lip to E-Plane	-3.3	14.1	5.6	3.2
Col-Sn-UL	48.7	116.4	84.7	11.6
Mentolabial Angle	96.9	169.5	130.9	15.3

Table 4 Intra examiner reliability

Linear (mm) and Angular (º) Measurements	Intraclass Correlation Coefficient	
	Single Measures	Average Measures
SNA	0.825	0.904
SNB	0.874	0.933
ANB	0.761	0.864
SN-AR	0.655	0.792
NA-Apo	0.789	0.882
SN-PP	0.749	0.857
PP-MP	0.872	0.931
MP-SN	0.917	0.957
U1-Palatal Plane	0.803	0.891
L1-MP	0.863	0.926
U1-L1	0.821	0.902
N-ANS	0.616	0.762
ANS-Me	0.760	0.863
LAFH/TAFH	0.738	0.849
PFH/AFH	0.843	0.915
Co-ANS	0.524	0.688
Co-Pog	0.904	0.949
L1-Apo	0.792	0.884
Overbite	0.744	0.853
Overjet	0.855	0.922
Upper Lip to E-Plane	0.877	0.935
Lower Lip to E-Plane	0.904	0.95
Col-Sn-UL	0.739	0.85
Mentolabial Angle	0.796	0.887

Table 5. Cephalometric norms for other ethnicities with bimaxillary protrusion

Angles (degrees) Linear measurements (mm)	Caucasian Standards		African American		Chinese Standards		Trinidad & Tobago	
	Mean	SD	Mean	Standard Error	Mean	SD	Mean	SD
SNA	82.0	3.5	88.2	0.7	83.78	3.49	85.9	4.9
SNB	78.0	3.0	83.9	0.7	79.88	3.84	78.7	4.5
ANB	2.3	2.8	4.3	0.4	3.90	1.96	7.2	2.5
MMPA	27	NR	27.7	NR	28	NR	32.3	5.1
UI-LI	135	6.0	112.8	1.5	121.68	7.78	109.7	8.2
UI- Max	109	5.0	118	NR	113	NR	118.7	6.1
LI-Man	93	NR	101	NR	98.38	7.58	101.4	5.9
LI- Apo	2.7	1.7	NR	NR	3.1	1.8	3.8	2.6
Upper Lip to E-Plane (mm)	-0.6	2.0	NR	NR	0.8	1.9	2.0	3.0
Lower Lip to E-Plane (mm)	-2.0	2.0	NR	NR	2.8	2.2	5.6	3.2

NR- not reported
(Fonseca and Klein 1978)
(Chan 1972)

Discussion

The results of this study showed some unique characteristics of bimaxillary protrusion in Trinidad and Tobago. Trinidad is a cosmopolitan country the cephalometric norms can only be used in this and any other similar cosmopolitan societies. All measurements displayed normality.

The intra examiner reliability in all measurements except Co-ANS was very close to 1. This shows a high degree of reliability and agreement between the repeated tracings. The discrepancy with Co-ANS could be explained with the difficulty in locating ANS. Landmark identification is considered to be the major source of errors with cephalometric tracing(Baumrind and Frantz 1971, Houston et al. 1986). In this study however landmark identification, cephalometric tracing and analysis were carried out by one examiner to minimize error.

The independent t-test showed sexual dimorphism with the measurements of SNB and upper and lower lip to E-plane, $p<0.002$, Table 1. These values were higher in males compared to females. This demonstrates that males in the society had a more prognathic mandible and protrusive profile than females. The ANOVA showed difference between L1-Apo and Lower lip to E-plane showing that between ethnic groups there was a difference in protrusion of the lower incisor and prognathism of the lower jaw Table 2 .

The skeletal, dental and soft tissue characteristics of an individual are affected by variables like race and gender. Proper diagnosis and treatment planning would therefore entail identifying the normal features of a specific race or ethnic group. This study used lateral cephalograms on the bimaxillary protrusion population in Trinidad and Tobago and showed that there are differences in the skeletal, dental and soft tissue profiles not just when compared to Caucasians with bimaxillary protrusion and also to other bimaxillary protrusive populations.

The mean SNA and SNB values show that Trinidad and Tobago children have prognathic maxilla and mandible relative to anterior cranial base and their values were close to the Chinese standards for prognathism(Chan 1972) (Table 4). In both this study and two African -American studies (Fonseca and Klein 1978, Alexander and Hitchcock 1978) the maxilla was significantly anterior to the cranial base. The maxilla and mandible in relation to the cranial base were more anteriorly placed in this sample as compared to Caucasians.

The SNB angle was, however, not large enough to offset the larger SNA angle resulting in a large ANB difference (7.2°± 2.5°). The ANB was significantly higher in this study than African-American(Fonseca and Klein 1978) and Chinese (Chan 1972) bimaxillary protrusion values. The MMPA of Trinidadian children was significantly steeper than Caucasians, Chinese and African American children. The high values for FMPA were reported by Kapila (1989) on Kenyan children and Drummond (1968) on African-American children. This implies that Trinidad and Tobago bimaxillary protrusion population are possibly vertical growers. Ricketts (1960) stated that subjects with a low mandibular plane angle tended to have more prominent chins and are horizontal growers. This was confirmed by Aki et al. (1994) who showed that subjects with a more prominent mental symphysis are horizontal growers. The subjects in this study were characterized by reduced chin prominence. The mandible however was not retrusive because the position of B point as reflected by SNB angle was 78.7° ±4.5°.

Fonseca and Klein (1978) also found lower face height (A-Pog) to be increased in their sample as compared with Caucasians. In this sample lower face height was measured using ANS-Me and it was also found to be increased (value 67.2%) compared with Caucasian bimaxillary protrusion norms.

In bimaxillary protrusion the upper and lower incisors are proclined (bimaxillary proclination). The presence of bimaxillary proclination can be assessed by using an interincisal angle of less than 120° as the definition(Keating 1985, Lamberton, Reichart, and Triratananimit 1980). This study showed protrusive dentoalveolar relationships with bimaxillary proclination being similar to that reported in African-American subjects(Fonseca and Klein 1978). The mean interincisal angle was 109.7° ± 8.2°. Bimaxillary proclination has being described as a feature of the Trinidadian profile (Hoyte, Ali, and Bearn 2018). UI-LI met at a more acute angle because of the increased proclination. The interincisal angle was similar to that reported for Nigerian children (Ajayi 2005) but lower than that for African-American (Fonseca and Klein 1978). Alexander and Hitchcock (1978) reported similar findings of procumbent and protrusive incisors in African Americans. Bimaxillary proclination was also reported as a general feature of Bantu children, (Savage 1963). The lower incisor to APog demonstrated that the lower incisors in this study were protrusive compared to Caucasians norms but the amount of protrusion was closer to the Chinese bimaxillary protrusion norms.

The soft tissue profile differed mainly in the protrusion of the lips. The upper lip to E-plane was much more protrusive in this sample compared to Chinese and Caucasian standards. The lip protrusion in this study would be an unacceptable treatment objective by Ricketts' standards but it reinforces the view that what is unacceptable in one population can be normal in another.
The observed differences suggest that different cephalometric norms are required to treat the Trinidad and Tobago bimaxillary protrusion population. The information in this study can be applied to orthodontic treatment of those with bimaxillary proclination. The use of orthodontic brackets that appear to be designed for Caucasian cephalometric normal values are inappropriate in the treatment of populations such as this one with bimaxillary proclination.
Limitations to this study include the large age variation from 10 to 17 years which included prepubertal and adults. All patients were however in permanent dentition. But participants were at varying areas on the growth scale.

Conclusions

- From the values obtained in this study, Caucasian and other bimaxillary protrusion norms cannot be applied to the Trinidad and Tobago population.
- When the bimaxillary protrusion population for Trinidad and Tobago is to be assessed norms for this population should be the yardstick.
- The standards provided in this study should serve as orthodontic treatment objectives.
- Sexual dimorphism was shown with SNB and upper and lower lip to E-plane.
- Differences between ethnic groups were shown only with L1-Apo and lower lip to E-plane
- The maxilla and mandible were more protrusive (increased SNA and SNB angles respectively) than Caucasian samples but similar to Chinese standards.
- The upper and lower incisors were more proclined than Caucasians in this study and similar to African American standards
- The lower face height was higher in this study compared to other ethnicities
- The upper and lower lip were more protrusive in this study compared to Chinese and Caucasian norms.

- Use of orthodontic brackets that appear to be designed for Caucasian cephalometric normal values are inappropriate in the treatment of populations with bimaxillary proclination

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