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Research Article

Bimaxillary Protrusion: Prevalence and Associated Factors in the Trinidad and Tobago Population

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Abstract

Introduction: Bimaxillary protrusion is a malocclusion characterized by proclined upper and lower incisors and prognathic jaws which has been identified in different ethnic groups and populations. Trinidad and Tobago have a mixed ethnicity population suitable to assess the prevalence of bimaxillary protrusion and associated factors in different ethnicities.

Method: An epidemiological survey of 972 children, 566 females (58.2%) and 406 males (41.8%) was conducted. The sample population was 11 - 12 year old (mean age 11.84 years) in high schools across the country. None of the subjects were undergoing or had previous orthodontic treatment. Occlusal and anterior posterior relationships were assessed based on BSI 1983 definitions. The two conditions that made up bimaxillary protrusion, bimaxillary prognathism and bimaxillary proclamation, were assessed using extra-oral and intraoral parameters respectively.

Results: Bimaxillary prognathism and proclination were found with 64.4% and 68.8% prevalence respectively. Both conditions were found across all ethnic groups but with significantly different prevalence rates. There was an association between oral habits and ethnicity. Class 1 incisor relationship, class 1 canines and average overbite were the most common occlusal relationships found.

Conclusion: Bimaxillary protrusion is prevalent in the population of Trinidad and Tobago. Prevalence of bimaxillary protrusion is related to ethnicity. There is an association between ethnicity and oral habits.

Keywords: Bimaxillary Protrusion; Prevalence; Ethnicity; Oral Habits; Trinidad and Tobago

Introduction

In bimaxillary protrusion the characteristic facial profile may be a result of the prognathic maxilla and mandible (bimaxillary prognathism) and/or proclined upper and lower incisors (bimaxillary proclination) [1]. The face is convex and lips procumbent.1-3. Bimaxillary protrusion has long been reported to be prevalent in Afro-Caribbean, African-American, Asian and other populations [1-7]. It is not known how prevalent this condition is in ethnically diverse populations, such as that found in Trinidad and Tobago. The central statistical office reports that three major ethnic groups can be recognized in Trinidad and Tobago, namely Afro-Trinidadian, Indo- Trinidadian and Mixed. Studies have shown that there is an increase in mixing of ethnicities across the Caribbean and worldwide. It is therefore important to identify if there is an increased proportion of bimaxillary protrusion in such populations and any associated factors.

This epidemiologic survey was conducted to obtain this prevalence data and so provide data on the need for orthodontic treatment due to bimaxillary protrusion in ethnically diverse populations. The demand for orthodontic treatment is increasing not just in Trinidad and Tobago but in most countries and publicly funded healthcare systems have introduced methods to prioritize treatment based on objective measures of need. One such measure

widely used is the Index of Orthodontic Treatment Need, but this was not developed for populations where bimaxillary protrusion is prevalent and may not be appropriate in these settings. Appropriate provision of orthodontic services for Trinidad and Tobago and other areas where this is increased prevalence of bimaxillary protrusion require such data to allocate and plan access to limited government health service resources and inform manpower planning decisions in the public and private dental sector [7-10].

Therefore, the aim of this study was to identify the prevalence of bimaxillary protrusion and associated factors in the ethnically diverse population found in Trinidad and Tobago.

Methods

Ethical approval from The University ethics committee was obtained for this epidemiological survey. Approval was then obtained from the Ministry of Education in Trinidad and Tobago to conduct this research in high schools across the country. Principals of high schools were contacted for permission to conduct the research. In the schools that gave permission, consent forms were given out to the students in the first year of high school. Only students from whom consent was obtained from both parents and child were examined.

The sample

This epidemiological survey comprised 1000 high school children. The sample size was determined from an estimate of prevalence of 40% and a population of 20,000 to give a confidence level of 0.95 and precision of 2.5 to be 1006 (Epitools epidemiological calculators. Ausvet Pty Ltd. Available at: http://epitools.ausvet.com.au). One orthodontist (TH) examined the students which were selected from forty-one high schools out of 141 public high schools which gave permission to conduct the research, located across the twin island republic representing both rural and urban populations. Inclusion criteria included all ethnicities including the mixed race population, and all males and females aged 11or 12 years at the time of examination. Exclusion criteria included any craniofacial abnormality and current or previous orthodontic treatment.

Recording procedure

Data was collected on individual data collection forms including school attended, age, gender and self-reported ethnicity. The presence of any self-reported habits was also noted (digit sucking, tongue sucking, tongue thrusting, nail biting, lip licking or lip sucking).

The students were then examined at school in a well-lit area. The candidates were seated on a chair and placed in Natural Head Position.

Extra-oral assessment included presence or absence of bimaxillary prognathism, the anterior posterior, vertical (lower face height and maxillo-mandibular planes angle) and transverse skeletal pattern. Intraoral assessment included incisor classification (assessed using British Standards Institute 1983 definitions), overbite, overjet, canine and molar relationship, and incisor inclination.

Standardized extra-oral profile photographs and orthodontic intra-oral photographs were taken.

The intraoral assessment was done with the use of a dental mirror and the incisor inclination was measured using the Tooth Inclination Protractor (TIP) [11], shown in figure 1.

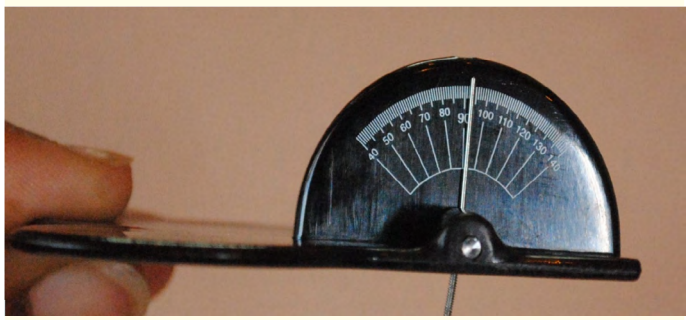

Figure 1: Tooth Inclination Protractor.

The TIP has a plastic platform which was placed intraorally against the occlusal surfaces of the maxillary dentition. The platform has a stainless steel pin whose length can be adjusted and rests on the labial surface of the upper incisor. The upper right central incisor was used to measure the incisor inclination [11,12]. The stainless steel pin was adjusted so that contact was made with the most convex portion of the incisor to record the incisor inclination. The other end of the steel pin rests on a graduated scale of the protractor [12]. In cephalometric analysis the normal value for

the upper incisor to maxillary plane angle is 109º ± 5º. Therefore, any degree above 114º would be considered proclined. The TIP has been shown to underscore the upper incisor to maxillary plane by 10.46 degrees [11]. Therefore, using the TIP an incisor inclination greater than 105 degrees was considered proclined.

The data was coded, entered into a computer and analyzed by a statistical package (IBM SPSS Statistics for Windows, version 22 (IBM Corp., Armonk, N.Y., USA)). The data was then cleaned. It was first checked for any inclusion errors. Candidates outside the age range of 11 - 12 years were removed. In addition, based on ethnicity, there was one Chinese subject and this subject was also removed from the sample as it was not possible to include such a small group in the analysis. The final sample size was therefore 972. Any other missing data entry was completed by manually checking the clinical data recording sheet and checked against the clinical photographs by two investigators (TH and DB).

Recording procedure

1. Bimaxillary Prognathism. An extra oral diagnosis of bimaxillary prognathism was made if all of the following features were present: lower face height and maxilla-mandibular planes angle average or increased, decreased nasolabial angle, lips full and everted and a convex profile [1].
2. Bimaxillary Proclination. An intra oral diagnosis of bimaxillary proclination was made if all the following features were present: proclined upper and lower incisors, overbite reduced or presence of an anterior open bite, incisor inclination of greater than 105º as measured by the TIP [1,11].

Statistical analysis

Descriptive analysis was undertaken. Pearson chi- square and z statistic was used to assess the distribution of bimaxillary prognathism and bimaxillary protrusion in the different ethnicities and p values of less than 0.05 were considered as statistically significant. A binary logistic regression analysis explored other explanatory variables alongside ethnicity to predict the diagnosis of bimaxillary prognathism.

Results

The sample included 58.2% female and 41.8% male subjects. Eleven year olds comprised 15.5% of the sample and twelve year olds 84.5%, with a mean age of 11.84 years. Afro-Trinidadians made up 46.4%, Indo-Trinidadians 35.3% and mixed subjects 18.3% of the sample. Bimaxillary prognathism diagnosis was made in 64.9% of subjects and bimaxillary proclination in 68.8%.

Table 1 shows the distribution of the presence of bimaxillary proclination and bimaxillary prognathism for the three ethnicity groups. Chi squared for bimaxillary prognathism showed a statistically significant difference between ethnicity groups ($p = 0.000$), but a non-significant difference in distribution for bimaxillary proclination ($p = 0.208$). A z test showed that for bimaxillary prognathism there was a statistically significant ($p < 0.05$) difference between each of the three ethnicities.

		Bimaxillary Proclination			Bimaxillary Prognathism		
		Present	Absent	Total	Present	Absent	Total
Ethnicity	Afro-Trinidadian	319	132	451	412	39	451
	Indo-Trinidadian	237	106	343	98	244	342
	Mixed	113	65	178	120	57	177
Total		669	303	972	630	340	970

Table 1: Association between Ethnicity and Bimaxillary Proclination and Prognathism.

In order to explore further the relationship between the presence of bimaxillary prognathism and the other variables recorded a forward stepwise logistic regression was undertaken, with bimaxillary prognathism as the independent variable and the following dependent variables: ethnicity, skeletal pattern, gender, lip sucking, digit sucking, lip licking, tongue sucking and tongue thrusting. The final model included ethnicity, nail biting, tongue thrusting, finger sucking, lip licking and lip sucking and had a R squared value of 0.371. The details of the model are shown in Table 2 with a positive effect of Afro-Caribbean ethnicity (Ethnicity 1) and a negative effect of Indo-Caribbean ethnicity (Ethnicity 2), and a negative effect for the absence of each of the oral habits included in the model. Neither gender nor skeletal pattern were included in the model.

	B	Standard Error	Wald	df	Sig	Exp (B)
Step 1 Ethnicity			260.115	2	.000	
Ethnicity (1)	1.613	.232	48.231	1	.000	5.018
Ethnicity (2)	-1.653	.200	67.938	1	.000	.192
Constant	.744	.161	21.416	1	.000	2.105
Step 2 Ethnicity			219.709	2	.000	
Ethnicity (1)	1.553	.241	41.527	1	.000	4.724
Ethnicity (2)	-1.555	.210	54.667	1	.000	.211
Tonguethrust (1)	-1.670	.224	55.639	1	.000	.188
Constant	1.056	.174	36.688	1	.000	2.876
Step 3 Ethnicity			211.875	2	.000	
Ethnicity (1)	1.551	.243	40.784	1	.000	4.715
Ethnicity (2)	-1.524	.213	51.462	1	.000	.218
Nailbiting (1)	-.635	.180	12.449	1	.000	.530
Tonguethrust (1)	-1.512	.228	44.009	1	.000	.220
Constant	1.377	.201	46.796	1	.000	3.961
Step 4 Ethnicity			201.664	2	.000	
Ethnicity (1)	1.515	.243	38.735	1	.000	4.551
Ethnicity (2)	1.505	.213	49.902	1	.000	.222
Nail biting (1)	-.560	.183	9.364	1	.002	.571
Tongue thrust (1)	-1.418	.231	37.838	1	.000	.242
Liplicking (1)	-.561	.202	7.698	1	.006	.571
Constant	1.716	.239	51.443	1	.000	5.562
Step 5 Ethnicity			202.064	2	.000	
Ethnicity (1)	1.493	.245	37.179	1	.000	4.450
Ethnicity (2)	-1.561	.216	52.368	1	.000	.210
Nail biting (1)	-.540	.184	8.617	1	.003	.583
Tongue thrust (1)	-1.483	.232	40.903	1	.000	.227
Digitsucking (1)	-.481	.196	6.025	1	.014	.618
Liplicking (1)	-.536	.204	6.915	1	.009	.585
Constant	2.065	.283	53.152	1	.000	7.882
Step 6 Ethnicity			203.112	2	.000	
Ethnicity (1)	1.517	2.46	37.998	1	.000	4.558
Ethnicity (2)	-1.567	.217	52.247	1	.000	.209
Nailbiting (1)	-.539	.184	8.548	1	.003	.583
Tonguethrust (1)	-1.544	.235	43.023	1	.000	.214
Digitsucking (1)	-.466	.197	5.619	1	.018	.627
Liplicking (1)	-.520	.205	6.462	1	.011	.594
Lipsucking (1)	-1.588	.742	4.584	1	.032	.204
Constant	3.614	.785	21.191	1	.000	37.121

Table 2: Logistic regression models (forward stepwise) for Bimaxillary Prognathism.

Ethnicity (1) Afro-Caribbean

Ethnicity (2) Indo-Caribbean

Table 3 shows the association between ethnicity and oral habits. Chi squared showed a significant difference between ethnicities for the presence of finger sucking (p = 0.035), tongue sucking (p = 0.00) and tongue thrusting (p = 0.00). Afro-trinidadian subjects were more likely to have these habits and mixed ethnicity least likely to have a finger sucking habit. There was no association between these oral habits and bimaxillary proclination.

Absent		Digit Sucking			Tongue Sucking			Tongue Thrusting		
		Present	Total	Absent	Present	Total	Absent	Present	Total	
Ethnicity	Afro-Trinidadian	286	165	451	347	104	451	38	413	451
	Indo-Caribbean	217	126	343	314	29	343	119	230	343
	Mixed	131	47	178	155	23	178	29	149	178
Total		634	338	972	816	156	972	180	792	972

Table 3: Association between Ethnicity and Oral Habits.

We then looked at occlusal characteristics of the population. Table 4 shows 46.6% of the sample had Class 1 incisor relationship, 16.6% had Class 2 division 1 and 1% had Class 2 division 2 incisor relationship. Class 3 incisor relationship was present in 35.8% of the sample. 45.8% had an average overbite, 17.4% had increased overbite, 29.8% had decreased overbite and 6.7% had an open bite. Class 1 canine relationship was the most common canine relationship (41% right side, 47.1% left side), class 2 was less represented (38.4% right side and 32.8% left side) and class 3 was the least common canine relationship (12.8% right side, 11.6% left side).

	Frequency	Percentage
Class 1	453	46.6
Class2 division 1	161	16.6
Class 2 division 2	10	1.0
Class 3	348	35.8
Total	972	100

Table 4: Incisor Relationship.

Discussion

This study is the first to determine the prevalence of bimaxillary protrusion in a mixed ethnicity population such as found in Trinidad and Tobago. Several studies have shown that bimaxillary protrusion is present in various ethnicities [1-7,13]. This study agrees with the findings of these studies in that bimaxillary protrusion was found in all ethnic groups in Trinidad and Tobago. The prevalence in this study however was much higher than those reported in other countries. The prevalence of bimaxillary protrusion has been reported between 4.09% to 20% [14,15] in other countries. The prevalence of bimaxillary proclination in a Nigerian study was reported to be 3.7% [16].

Associations were looked at because causations cannot be proven in cross-sectional studies. Both chi-squared and linear regression models showed ethnicity to be associated with bimaxillary prognathism, with Afro-Caribbean ethnicity being a predictor for the presence of bimaxillary prognathism and Indo-Caribbean ethnicity being a predictor for the absence of bimaxillary prognathism. A range of oral habits were also predictors of bimaxillary prognathism and were also associated with Afro-Caribbean ethnicity. This study showed no association between bimaxillary proclination and oral habits. This was in contrast to oral habits being reported as an etiologic factor by one author [3].

The prevalence of Class 2 division 1 incisor relationship was lower than that reported in White Caucasian populations [17]. The prevalence of Class 3 incisors was a lot higher than reported by most authors [17-20]. This is possibly a reflection of the high incidence of tongue sucking and tongue thrusting habits leading to proclination of the lower incisors. Class 2 division 2 prevalence was comparable to Isiekwe's findings in a West African population [18], and Class 1 incisor relationship was the most prevalent but less common than reported in most populations [17,18,21]. The decreased overbite in the population reported was higher than previously reported [7]. This increased prevalence of this occlusal feature is however expected in populations where bimaxillary proclination is prevalent [1].

Use of lateral cephalometric radiographs is the most common method used to assess incisor inclination. Use of the TIP is a preferred non-invasive technique [11,12] and was shown to be effective for epidemiological surveys in this study. Lateral cephalometric radiographs have errors associated with landmark identification [27] and measurement of angles [27] and in addition, there is an increase in risk of mitotic changes with the radiation dose [11,28]. The TIP has been shown to be valid, reliable, simple, inexpensive and noninvasive method to ascertain incisor inclination [11,12] and would therefore be the preferred method to use in this type of field research.

These findings have a profound impact on the manner in which care is planned in this and similar populations. The Index of Treatment Need (IOTN), used extensively in the UK and Europe would appear to not be a useful measure of treatment need in this setting. Both the Aesthetic Component and Dental Health Component of IOTN are skewed against scoring class 3 malocclusion, reduced overbite and anterior open bite or bimaxillary proclination as features in need of orthodontic treatment [22-24]. The functional problems and occlusal loading found in Class 3 malocclusion are not considered in the index. In addition, the IOTN does not account for extra-oral features including bimaxillary prognathism, and other related soft tissue features [22,24]. Patients with these features present due to aesthetic concerns related to the bimaxillary protrusion and with functional problems associated with the combination of Class 3 and reduced overbite or open bite. In addition, there are also cultural differences in what is considered attractive. Africans and Caucasians have been shown to differ in their perceptions of dental aesthetics [25]. Ngom reported that Caucasian judges rated the dental aesthetics of African subjects lower than African judges in his study.

Therefore, we propose that IOTN is not a useful tool for planning allocation of resources in Trinidad and Tobago or similar mixed ethnicity populations where bimaxillary protrusion has a high prevalence. Ngom suggested that ICON was marginally better than IOTN for assessing treatment need [25]. Another alternative to IOTN is to conduct a full orthodontic diagnosis to assess treatment need, but this requires greater resources. Some authors have proposed a facial aesthetic index for subjects with bimaxillary protrusion26 and our findings would support this proposal. Further research is required in this field.

Conclusion

- Bimaxillary prognathism has a prevalence of 64.4% and bimaxillary proclination has a prevalence of 68.8% in Trinidad and Tobago.
- The prevalence is much higher in Trinidad and Tobago than reported in other studies
- There is evidence that there is an association between bimaxillary prognathism and ethnicity and a range of oral habits.
- There is no evidence that there is an association between bimaxillary proclination with ethnicity.
- There is an association between ethnicity and digit sucking, tongue sucking and tongue thrusting. Afro-Trinidadians were more likely to have all three habits.
- IOTN may not be the most appropriate tool for assessing treatment need in this and similar populations.

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