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Association of ABO Blood Groups with Craniofacial Morphology among Orthodontic Patients in Selected Private Clinics of Kathmandu

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ABSTRACT

Introduction

The craniofacial morphology and blood groups both are related to genetic components, hence it can be hypothesized that blood groups have an association with craniofacial morphology. Some studies showed the relationship whereas others could not find any relationship in different population. The aim of this study was to find out the relationship between ABO blood groups and craniofacial morphology among orthodontic patients of Kathmandu district.

Methods

In this cross sectional analytical study, 385 participants (age range from 13-45 years) were selected among the orthodontic patients who came for orthodontic treatment in private orthodontic clinics. After obtaining written consent, all the patient's demographic information were recorded and lateral cephalograms were obtained from the patient's record. Blood group of all the participants was recorded.

Results

Among 385 participants, 162 (42.07%) were male while 223 (57.93%) were female and the mean age was 16.31±4.38 years. Twenty cephalometric parameters depicting craniofacial morphology were digitally analyzed using lateral cephalograms. The prevalence of blood group O patients was highest (32.20%) followed by blood group B (30.64%), blood group A (29.88%) and blood group AB (7.28%). Statistical analysis with ANOVA revealed nine out of twenty cephalometric parameters were statistically significant among different blood groups ($p<0.05$). Tukey post hoc test was done to find out the difference among the groups.

Conclusion

The evaluation of relationship between blood group and craniofacial morphology revealed that blood groups have association with some craniofacial parameters. This suggests, there may be some genetic influence of ABO blood group on craniofacial morphology.

Keywords: *ABO blood groups, association, craniofacial morphology, orthodontic patients*

INTRODUCTION

Blood groups are inherited through genes on chromosome number nine and ABO blood types do not change as a result of environmental influences during life. Malocclusion has been shown to affect oral health, increased prevalence of dental caries and can cause temporomandibular joint disorders. The etiology of malocclusions is multi-factorial and is not attributed to a single specific cause. Among various etiologies, genetics plays a significant role in causing malocclusions. The relative role of genetic and environmental factors in the etiology has been a matter of discussion and controversy

in orthodontics.[1]

Studies can reveal relationships between malocclusions and some genetic characteristics or accompanied diseases, that help to recognize and treat them. Relationship between the ABO blood group system and some oral diseases such as malocclusions is one of the important genetic characteristics. With the discovery of ABO blood groups and some enzyme polymorphs, it could be possible to determine the zygosity of twins, which are especially helpful in twin studies concerning the role of heritability of malocclusion.[2]

Landsteiner first described the existence of serologic differences between individuals and classify people into four groups depending on whether their red cells contained agglutinogen or not. The presence or absence of these antigens results in the four blood groups: A, B, AB, and O.[3]

Various studies showed that some diseases like dental caries, salivary gland tumors, chicken pox, malaria, oral cancer, hematological malignancies, ischemic heart disease, cholera, periodontal disease etc. were found to have significant association with blood groups.[4-7]

Although genetic factors appear to govern the basic skeletal form and size, environmental factors have much influence on the bony elements,[8,9] Cephlaometric radiograph is used both as a research and a clinical tool for the study of malocclusion and skeletal structure. A cephlaometric radiograph and cephalometric norms plays a significant role in assessing the anterioposterior jaw relation, class of occlusion, to formulate a treatment plan, and is a substantive tool in Orthodontics to aid orthodontic clinicians and research workers.[10,11]

Limited studies have been conducted to find the relationship between oral and dental diseases and ABO blood group that showed contradictory findings that may be due to geographic diversity. This study was conducted to find out relationship of blood groups with craniofacial morphology of Nepalese orthodontic patients which was lacking and hoped that these findings will be helpful for further research.

The aim of this study was to determine the association between ABO blood groups and craniofacial morphology among orthodontic patients of Kathmandu district.

METHODS

Three hundred eighty five participants (age range from 13-45 years) were selected among the orthodontic patients who came for orthodontic treatment treated by same orthodontist (author) in three private orthodontics clinics that were located

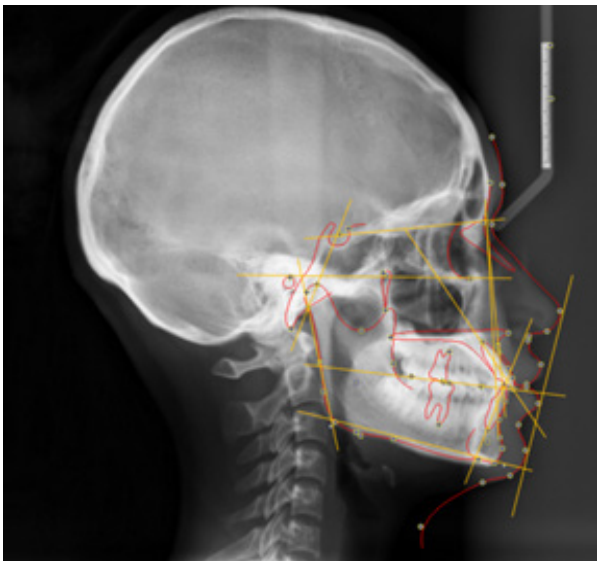

Fig. 1 Digital measurements of craniofacial morphology on lateral cephalogram

in different regions of Kathmandu District. Sample size for this study was determined by using $n=Z^2pq/d^2$, where Z = 1.96, value of p is taken as 0. 5, q=1-p=0.5, allowable error (d) = 0.05 and n is required sample size. Based on these parameters, the required sample size was 384.16 hence, total 385 patients were selected.

Inclusion criteria of this study were patients who came for orthodontic treatment in Orthodontics clinic, Kathmandu, Nepal with identified blood group and who gave consent to this study. Patients were excluded who had previous orthodontic treatment and had systemic disease or Craniofacial anomalies/Congenital syndrome. Also participants who were unaware of their blood group and those who were not willing to share the information were excluded from the study.

Informed written consent was taken from patients or their parents. Blood group of the patient was noted in the data sheet from registered laboratory report or driving license provided by Government of Nepal.

Ethical approval were obtained from institutional review committee of Institute of Medicine, Tribhuvan university, Kathmandu, Nepal (Ref. no. 15 (6-11-E) 2/075/076) before conducting this study.

After obtaining the written consent, lateral cephalograms were obtained from the patient's record and digitally analyzed using Vistadent OC 1.1 software program (GAC International Inc, Bohemia, New York, USA) to obtain craniofacial morphology details of 20 cephalometric parameters sella-nasion to point A (SNA), sella-nasion to point B (SNB), SNA minus SNB (ANB), Wits appraisal (Wits), condylion to point A (Cond-A), condylion to gnathion (Cond-

Table 1. The association of skeletal parameters between blood group A, B, AB and O

Skeletal parameters	Blood group								p-value
	A		B		AB		O		
	Mean (SD)	95% CI for Mean	Mean (SD)	95% CI for Mean	Mean (SD)	95% CI for Mean	Mean (SD)	95% CI for Mean	
SNA	84.33 (2.08)	79.16 89.50	81.66 (2.51)	75.41 87.91	83.66 (2.08)	78.49 88.83	85.00 (4.00)	75.06 94.93	0.526
SNB	80.53 (2.92)	77.46 83.60	79.96 (2.19)	77.66 82.26	77.96 (2.04)	75.82 80.10	81.20 (6.15)	74.74 87.65	0.486
ANB	3.80 (2.77)	1.66 5.93	1.70 (1.91)	0.23 3.16	5.7 (0.85)	5.04 6.35	3.80 (2.58)	1.81 5.78	0.372
Wits	-0.33 (3.55)	-2.58 1.92	-1.33 (1.96)	-2.58 -0.08	-0.66 (1.77)	-1.79 0.46	-1.00 (2.95)	-1.58 -0.77	0.816
Cond-A	83.00 (8.32)	78.39 87.60	76.66 (2.71)	75.16 78.17	75.66 (5.43)	72.65 78.67	78.00 (3.68)	75.95 80.04	0.003*
Cond-Gn	107.33 (6.36)	104.16 110.91	103.00 (3.85)	101.08 104.91	98.66 (3.78)	96.78 100.55	102.55 (2.95)	101.19 104.13	0.000*
Max-Mand	24.00 (3.64)	22.33 25.66	26.33 (6.27)	23.47 29.19	23.00 (2.50)	21.85 24.14	27.33 (3.86)	25.57 29.09	0.05*
NSAr	123.33 (4.28)	121.52 125.14	124.66 (3.76)	123.07 126.25	121.66 (3.37)	120.24 123.09	120.00 (3.00)	118.73 121.26	0.000*
SArGo	142.66 (8.41)	139.33 145.99	145.00 (4.16)	143.35 146.64	150.66 (3.36)	151.99 147.00	146.66 (0.48)	146.47 146.85	0.000*
ArGoMe	123.00 (10.10)	119.22 126.77	118.00 (5.18)	116.06 119.93	114.33 (0.958)	113.97 114.69	121.33 (1.91)	120.61 122.04	0.000*
SN-GoGn	30.83 (9.43)	27.48 34.17	29.70 (6.96)	27.22 32.17	29.33 (2.46)	28.46 30.20	31.66 (2.08)	30.92 32.40	0.388
FMA	23.33 (5.99)	21.30 25.36	22.66 (5.32)	20.86 24.46	21.33 (4.24)	19.89 22.77	23.33 (5.63)	21.42 25.24	0.342
ANS-Me	61.00 (2.48)	60.19 61.80	59.00 (6.56)	56.87 61.12	58.66 (7.22)	56.32 61.00	60.33 (4.98)	58.71 61.94	0.218

Gn), difference of maxillary and mandibular length (Max-Mand), nasion-sella to articulare (NSAr), sella-articulare to gonion (SArGo), articulare-gonion to menton (ArGoMe), sella-nasion to gonion-gnathion (SN-GoGn), Frankfort mandibular angle (FMA), anterior nasal spine to menton (ANS-Me), maxillary incisor to nasion-point A (Max1-NA), maxillary incisor to sella-nasion (Max1-SN), mandibular incisor to nasion-point B (Mand1-NB), incisor mandibular plane angle (IMPA), long axis of maxillary incisor to long axis of mandibular incisor (Mx1-Mn1), upper lip to esthetic line (UL-E), lower lip to esthetic line (LL-E) (Figure 1).

Data obtained were transferred to MS-excel sheet. The data were double entered and analyzed in SPSS software version 21.0. (Armonk, NY: IBM Corp.) with confidence level set at 95% ($P < 0.05$) to test for significance. All procedures such as landmark identification, and measurements were repeated 4 weeks after the first examination by the same investigator. Eighty patients were selected randomly to find the errors associated with measurement and digitizing for intraobserver reliablility. To assess the reliability of the measurement, the intraclass correlation coefficients were performed and value lies between 0.87 and 0.95.

To determine method-error of cephalometric measurements, Dahlberg's formula was used and value was less than 0.68 degrees for angular and 0.39 mm for linear variables that considered to be within acceptable limit.[12]

RESULTS

This cross sectional study found that among the total of 385 participants, 162 (42.07%) were male

Table 2. The association of dental and soft tissue parameters between blood group A, B, AB and O

Parameters	Blood group								p-value
	A		B		AB		O		
	Mean (SD)	95% CI for Mean	Mean (SD)	95% CI for Mean	Mean (SD)	95% CI for Mean	Mean (SD)	95% CI for Mean	
Max1-NA	23.40 (2.84)	22.51 24.28	23.53 (6.02)	21.65 25.41	22.93 (3.39)	21.87 23.99	24.56 (1.58)	24.07 25.05	0.256
Max1-SN	109.00 (5.02)	107.49 110.50	107.33 (4.54)	105.96 108.69	109.33 (6.67)	107.32 111.33	111.00 (2.47)	110.25 111.74	0.007*
Mand1-NB	26.76 (4.08)	25.58 27.95	26.06 (1.65)	25.58 26.54	25.00 (2.18)	24.36 25.63	27.70 (7.42)	25.54 29.85	0.027*
IMPA	87.33 (4.06)	86.18 88.47	88.00 (2.97)	85.87 90.12	88.00 (2.97)	87.16 88.83	90.33 (5.61)	88.75 91.91	0.028*
Mx1-Mn1	125.30 (5.01)	123.93 126.66	125.80 (2.72)	125.05 126.54	125.70 (1.92)	125.17 126.22	125.36 (2.93)	124.56 126.16	0.833
UL-E	-1.00 (1.64)	-1.43 -0.56	-0.66 (2.37)	-1.29 -0.03	-1.00 (0.82)	-1.21 -0.78	-1.00 (2.17)	-1.57 -0.42	0.711
LL-E	-0.33 (1.71)	-0.77 0.10	-0.33 (2.37)	-0.94 0.28	-0.33 (0.95)	-0.57 -0.08	0.00 (-0.25)	-0.36 0.36	0.630

while 223 (57.93%) were female and the mean age was 16.31±4.38 years.

Out of 385 respondents, most of them were of the age group 13-18 years i.e. 45.72%, from the age group 19-25 years there were 33.25% respondents and from the age group of more than 25 years there were only 21.03%.

In the present study, the prevalence of blood group O patients was highest (32.20%) followed by blood group B (30.64%) then blood group A (29.88%) while the prevalence of blood group AB patients was least (7.28%). (Fig. 2)

Almost 95.85% of the populations were Rhesus group positive and 4.15 % were Rhesus group negative.

Craniofacial morphology (SNA, SNB, ANB, Wits, Cond-A, Cond-Gn, Max-Mand, NSAr, SArGo, ArGoMe, SN-GoGn, FMA, ANS-Me, Max1-NA, Max1-SN, Mand1-NB, IMPA, Mx1-Mn1, UL-E and LL-E) were digitally analyzed using lateral cephalogram. The angular parameters like SNA, SNB, ANB, NSAr, SArGo, ArGoMe, SN-GoGn, FMA, Max1-NA, Max1-SN, Mand1-NB, IMPA and Mx1-Mn1 were measured in degrees whereas linear parameters like Wits, Cond-A, Cond-Gn, Max-Mand, ANS-Me, UL-E and LL-E were measured in millimeters. Table 1 and 2 showed the results obtained by digital analysis of lateral cephalogram using Vistadent OC 1.1 software program. Statistical analysis with one way ANOVA was used for association of numerical data and blood groups that revealed nine out of twenty cephalometric parameters like Cond-A, Cond-Gn, Max-Mand, NSAr, SArGo, ArGoMe, Max1-SN, Mand1-NB and IMPA were statistically significant among different blood groups ($p<0.05$). It shows that above parameters value in patients having different blood group were different and there might be chances of some genetic influence of blood group on these dento-skeletal parameters.

Tukey post hoc test was done to find out where the significant difference occurred among the groups. Tukey post hoc test showed the parameters that were statistically significant between different groups is shown in Table 3.

DISCUSSION

This cross sectional study provides information about craniofacial morphology among various blood groups. As the craniofacial morphology and blood groups both are related to genetic components, it can be hypothesized that blood groups have an association with craniofacial morphology. The purpose of this study was to identify such a possibility and to correlate ABO blood group and craniofacial morphology in orthodontic patients of Kathmandu district, Nepal.

Many studies revealed positive correlation of non O blood group with developing risk of ischemic heart disease, severe manifestations of atherosclerosis,

Table 3. Tukey post hoc test for intergroup comparison of dento-skeletal parameter between different blood groups

Parameter	Groups	Mean diff.	Std. Error	p-value
Cond-A	A - B	6.33	1.99	0.013*
	A - AB	7.33	1.99	0.003*
Cond-Gn	A - B	4.33	1.47	0.023*
	A - AB	8.66	1.47	0.000*
	A - O	4.66	1.47	0.012*
	B - B	4.33	1.47	0.023*
	O - AB	4.00	1.47	0.041*
Max-Mand	O - AB	4.33	1.32	0.009*
NSAr	A - O	3.33	1.04	0.011*
	B - AB	3.00	1.04	0.027*
	B - O	4.66	1.04	0.000*
SArGo	A - AB	-8.00	1.35	0.000*
	A - O	-4.00	1.35	0.021*
	B - AB	-5.66	1.35	0.000*
	O - AB	-4.00	1.35	0.021*
ArGoMe	A - B	5.00	1.49	0.006*
	A - AB	8.66	1.49	0.000*
	O - AB	7.00	1.49	0.000*
Max1-SN	O - B	3.66	1.03	0.003*
Mand1-NB	O - AB	2.70	0.90	0.018*
IMPA	A - O	-3.00	1.05	0.026*

and increased risk of infection with cholera.[13] While O blood group individuals have a 4% reduced risk of basal cell carcinoma, 14% reduced risk of squamous cell carcinoma and reduced risk of pancreatic cancer.[14] Along with this, increased risk of ovarian cancer in blood group B while Gastric cancer is more common in blood group A and least in group O.

Despite of several researches done so far in the medical field, only limited researches that relates ABO blood groups with incidence of the oral diseases. The findings of previous studies were contradictory as some showed relationship while others did not. The reasons for this variation may be due to geographical diversity.[7]

Findings of Demir et al. showed the significant association of different ABO blood groups in the rates of colonization of periodontal pathogens in periodontal diseases.[15] Other report showed that oral pathologies like dermatophytosis are common in blood group A.[16] Study by Vivek et al.[17] showed blood group O had a greater chances for periodontitis while Gheisari et al.[18] showed blood group B have a greater likelihood of association with maxillofacial deformities and least with blood group A.

The distribution of ABO blood group varies regionally, ethnically and from one population to another. In the present study, the ABO blood group typing showed the same trend of prevalence as in the general Nepali population (O > B > A > AB) [40, 41].[19,20] This study shows the highest frequency of blood group O (32.20%), followed by B (30.64%), A (29.88%) and least with AB (7.28%).

In Rhesus system, this study shows frequency of Rh-positive was 95.85%, while only 4.15% was Rh-negative. These figures are similar to the other studies[20,21,22] While this finding is little higher than the findings of Pramanik et al.,[23], Chapagain et al.,[24] and Shrestha et al.,[19] who found only 0.8%, 0.14 % and 2.7% of rhesus negative groups.

The etiology of malocclusions is multi-factorial and is not attributed to a single specific cause. Among various etiologies of malocclusions, genetics plays a significant role in causing malocclusions. Along with this, blood groups are inherited through genes that means it is genetically predetermined. In this study, statistical analysis with one way ANOVA revealed nine out of twenty cephalometric parameters like Cond-A, Cond-Gn, Max-Mand, NSAr, SArGo, ArGoMe, Max1-SN, Mand1-NB and IMPA were statistically significant among different blood groups ($p<0.05$). This means, there might be some common genetic characteristics between certain blood groups and dento-skeletal parameters. This indicates that there might be some genetic influence on craniofacial morphology.

The results of this study is contradictory with the study of Shokor et al.,[25] that there was no genetic influence of ABO blood group in relation to variation in craniofacial morphology so the prediction of malocclusion cannot be made in the respective blood group.

Genetic factors responsible for the basic skeletal form and size while environmental factors have much role on the bony elements.[7] Other study stated that environmental factors also played an important role in genetically-influenced facial types and growth patterns.[26] It has been found by several investigators that different ethnic groups have different dentofacial patterns.[11]

Long-term multicenter collaborative studies with diverse population groups with greater sample size and inclusion of healthy control are suggested to make more comprehensive assessment for definitive establishment of their association between blood group and craniofacial morphology.

CONCLUSION

In this study, the results obtained showed a higher fraction of blood group O (32.20%) followed by B

(30.64%) then A (29.88%) and least with blood group AB (7.28%) among orthodontic patients. Statistical analysis with one way ANOVA revealed that blood groups have association with some craniofacial parameters. This suggests that there is some genetic influence of ABO blood group on craniofacial morphology. The derived results can be used as a stepping stone in order to focus the research on correlation between the blood group antigens and development of malocclusion targeting highly susceptible individuals and developing customized treatment strategies.

CONFLICT OF INTEREST

None declared.

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