

Association of ABO Blood Groups with Malocclusion in Population of Jaipur, India: A Prospective Study

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Abstract

Background: One of the most important human genetic characteristics is the relationship between the ABO blood group system and diseases and deformities.

Aim: The aim was to find out the relationship between blood groups and malocclusion by comparing blood groups of each individual with one's malocclusion.

Materials and Methods: A total of 300 subjects (age range 15-28 years) were recruited in the study for whom complete information about their malocclusion and blood group type was recorded as per the ABO system. The subjects were equally divided into two groups: Half of the subjects in malocclusion and the remaining half in normal occlusion group who served as control. In normal occlusion group, only those subjects were included, which on clinical evaluation, showed, bilateral Angles Class I molar relationship with acceptable overjet and overbite and well-aligned arches or minimal crowding while the individuals with malocclusion were classified into three groups according to Angles classification.

Results: Statistical analysis with Chi-square test showed that association of blood groups with malocclusion is statistically highly significant ($P < 0.001$) indicating the prevalence of malocclusions is highest in blood group B, followed by A, O and AB with the least prevalence ($B > A > O > AB$). Blood groups B and A had the increased incidence of association with malocclusion while blood groups O and AB had decreased incidence of association with malocclusion.

Conclusions: The evaluation of the relationship between blood and malocclusions revealed that blood groups have an association with malocclusions with prevalence of malocclusions being highest in blood group B, followed by A, O and AB in Jaipur population.

Key words: ABO blood groups, Association, Jaipur population, Malocclusion

INTRODUCTION

The relative influence of genetic and environmental factors in the etiology of malocclusion has been a matter for discussion, debate and controversy in orthodontic literature.¹ Malocclusions have a multi-factorial origin and can hardly

be attributed to a single specific cause. Causes include general factors, such as genetic and hereditary components, nutritional deficiencies and abnormal pressure habits, or local factors, located directly in the dental arch such as supernumerary teeth, tooth decay and premature loss of primary teeth. Indeed, genetics plays a significant role in causing malocclusions. Epidemiological evaluations can reveal relationships between malocclusions and some genetic characteristics or accompanied diseases, which will help to recognize and treat them. One of the most important human genetic characteristics is the relationship between the ABO blood group system and some oral diseases such as malocclusions. With the discovery of ABO

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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.^{1,2}

The ABO blood group system is the first and the most important system defined in 1901 by Karl Landsteiner³ (who received a Nobel Prize in 1930 and together with Weiner; he discovered Rh system in 1940). There are two main antigens, A and B, in the ABO system, present on cell membranes or secreted into the plasma and other fluids of the body. The presence or absence of these antigens results in the four blood groups or blood types: A, B, AB, and O. These antigens are present on the 9th chromosome and are inherited co-dominantly.⁴ Since the malocclusion and blood groups both are related to genetic components, it can be hypothesized that blood groups have an association with malocclusions. In India as well as Western countries, research has been done to find out the relationship between ABO blood group and various systemic diseases, and the results showed that some diseases like dental caries,⁵ salivary gland tumors,⁶ chicken pox,⁷ malaria,⁸ oral cancer,⁹ hematological malignancies,¹⁰ ischemic heart disease,¹¹ cholera¹² etc. were found to have significant association with blood groups.

On evaluating the literature, Weber and Pastern¹³ first studied the association of ABO blood group with periodontal disease. Kaslick *et al.*¹⁴ studied the association of aggressive periodontitis and ABO blood group, they found significantly less patients with blood group O and more patients with blood group B. Roberts,¹⁵ discussed the relationship between ABO blood group and susceptibility to chronic disease as an example of genetic basis for family predisposition. Koregol *et al.*¹⁶ in a study concluded that blood group A formed a significantly higher percentage in the gingivitis group, blood group O formed a higher percentage in the periodontitis group and blood group AB showed the least percentage of periodontal diseases.

In general, a few studies have been conducted to determine the relationship between ABO blood group and the incidence of oral and dental diseases. The reports of some researchers claimed that there was a relationship, whereas some others could not find any relationship, which may be attributed to the geographic diversity of the population. Due to the lack of information on the relationship of blood groups with malocclusion, this study was conducted to fill this lacuna and it is hoped that these findings will be beneficial for future research.

Aims and Objectives

The aim and objective of this study is to find out whether there is a relationship between ABO blood groups and

dental malocclusion by comparing blood groups of each individual with one's malocclusion in population of Jaipur, India.

MATERIALS AND METHODS

This study was conducted on 300 patients (age range 15-28 years) reporting to the Department of Orthodontics and Dentofacial Orthopedics of NIMS Dental College and Hospital, Jaipur and for whom complete information about their malocclusion and blood group type was recorded as per the ABO blood grouping system. Ethical committee clearance was obtained from the institution before starting the study. A separate sheet or proforma was used as a record for each individual including name of the patient, age, sex, blood group, and the malocclusion.

All individuals were assigned for evaluation by a single operator, and occlusal relationships were evaluated at centric occlusion, which was achieved by asking the subject to swallow and then to bite on his/her teeth together. The subjects were equally divided into two groups: Half of the subjects in malocclusion and the remaining half in normal occlusion group who served as control. The cheeks were fully retracted to obtain a direct lateral view of the dentition on each side and dental casts were also used (Figures 1 and 2).

Inclusion Criteria

1. All permanent teeth present in each arch (except third molars), and in a sufficient state of eruption
2. No systemic disease or congenital syndrome.

Exclusion Criteria

1. Dentition with missing molars or carious teeth or any deciduous/primary teeth



Figure 1: Evaluation of occlusal relationships at centric occlusion

2. Dentition with large coronal restoration that might have altered both coronal shape and size
3. End to end cuspal molar relationships or others (not full cusp relationships).

In normal occlusion group, only those subjects were included, which on clinical evaluation, showed, bilateral Angles Class I molar relationship with acceptable overjet and overbite and well-aligned arches or minimal crowding.

Then, in the malocclusion group those individuals were included who fulfilled the criteria according to Angles classification of malocclusion,¹⁷ i.e.. Class I, Class II and Class III malocclusions. The criteria for inclusion were:

Class I Malocclusion

Bilateral Angles Class I molar relationship (mesio-buccal cusp of maxillary first permanent molar occluding in the buccal groove of mandibular first permanent molar) with one or more of these characteristics: Crowded incisors or labial canines, protruded maxillary incisors, anterior end to end occlusion or anterior cross bite, unilateral or bilateral posterior cross bite, mesial drift of molars, anterior or posterior open bite, deep anterior overbite.

Class II Malocclusion

Bilateral Angles Class II molar relationship (disto-buccal cusp of maxillary first permanent molar occluding in the buccal groove of mandibular first permanent molar) with proclined maxillary incisors and increased overjet (Angles Class II div 1 malocclusion) or with retroclined maxillary central incisors and proclined lateral incisors (Angles Class II div 2 malocclusion).

Class III Malocclusion

Bilateral Angles Class III molar relationship (mesio-buccal cusp of maxillary first permanent molar occluding in the inter-dental space between mandibular first and second permanent molars) with end to end incisor relationship or with normal incisor relationship with incisors in cross bite relationship.

Principle for Blood Grouping or Blood Typing

The surface of red cell membrane contains a variety of genetically determined antigens, called isoantigens or agglutinogens while the plasma contains antibodies (agglutinins). To determine the blood group of a person, his/her red cells are made to react with commercially available antisera containing known agglutinins. The slide is then examined by naked eye or under the microscope to detect the presence or absence of clumping and hemolysis (agglutination) of red cells, which occur as a result of antigen-antibody reaction.

Apparatus and Materials

A microscope, glass dropper with a long nozzle, sterile blood lancet or needle, sterile cotton or gauze swabs, alcohol, toothpicks, clean and dry microscope slides, 1% sodium citrate in normal saline were used. Anti-A serum (also called anti-A or alpha agglutinins), anti-B serum (anti-B or beta agglutinins) and anti-D or anti Rh serum were used. For a quick identification, the anti-A serum is tinted blue, anti-B, yellow and anti-D is colorless (Figure 3).

Procedure

Using a glass marking pencil, the slide was divided into three proportions. Lower left corner of the slide was marked anti-A, lower middle portion of the slide was marked anti-B and the lower right corner of the slide was marked anti-D. Another slide was marked S for only red cell suspension in saline. No antiserum will be added to this (Figure 4).

Then by another operator a finger-prick was done under aseptic conditions (Figure 5 and 6), and two drops of blood



Figure 2: Dental study casts used in the study



Figure 3: Anti-A serum, anti-B serum and anti-D or anti Rh serums

were added to the saline on the slide (Figure 7) and mixed with toothpick and thus red cell suspension was prepared for each subject assigned in this study.

1-1 drop of antisera A, B and D was placed on the left, middle and right portions of the slide and 1-1 drop of normal saline was placed on control sides of all proportions

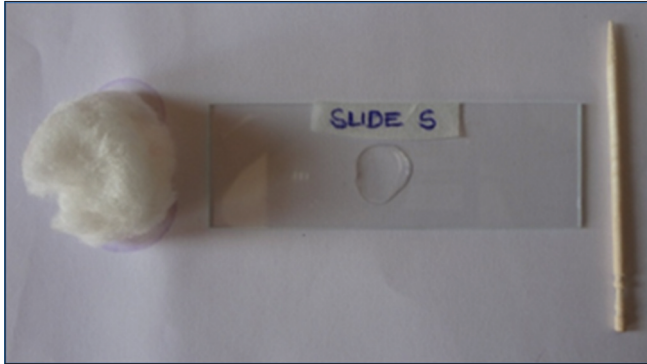


Figure 4: Slide marked with S - for only red cell suspension in saline



Figure 5: Finger-prick under aseptic conditions



Figure 6: Collecting the drops of blood

to confirm agglutination or no agglutination. Antisera and red cell suspension were mixed with the help of three separate toothpicks (for three antisera) and waited for 8-10 min (Figure 8). Then, all the three antisera - red cell mixtures on the slide were inspected, first with the naked eye to see whether agglutination (clumping or hemolysis) had taken place or not. It appeared as a coarse separation of red cells in isolated clumps (red precipitates of cells) and this agglutination was confirmed under low magnification microscope.

Thus, the presence or absence of agglutination indicated individual's blood group (blood type) as shown in Table 1.

Then, the data were collected and statistical analysis of the information obtained was performed using SPSS software (version 20) and the Chi-square test. The differences with $P < 0.05$ were considered statistically significant.

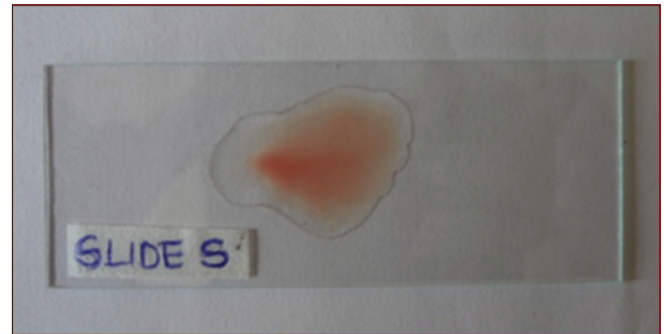


Figure 7: Drops of blood added to the saline on the slide

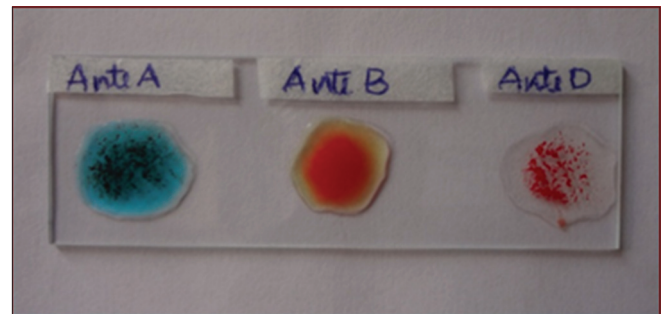


Figure 8: Mixed red cell suspension were mixed for all the three antisera

Table 1: Individual's blood group determination

Antisera A	Antisera B	Antisera D	Blood group
+	-	+/-	A+/A-
-	+	+/-	B+/B-
+	+	+/-	AB+/AB-
-	-	+/-	O+/O-

RESULTS

Among 300 participants, the distribution of all participants with malocclusion and normal occlusion with their respective blood groups is shown in Table 2.

Statistical analysis with Chi square test, showed that association of blood groups with malocclusion is statistically highly significant ($P < 0.001$), indicating the prevalence of malocclusions is highest in blood group B, followed by A, O and AB with the least prevalence ($B > A > O > AB$). Hence, among all blood groups, blood group B has the highest prevalence of malocclusion while blood group AB has the least prevalence of malocclusion. The data from Table 2 shows that blood groups B and A had the increased incidence of association with malocclusion while blood groups O and AB had decreased incidence of association with malocclusion.

DISCUSSION

This study gives us the important information about malocclusion and blood groups. All the subjects were clinically assessed by a single operator to check the occlusal status or relationship to minimize inter-operator bias. Subjects with overall good general health were included to assess the blood groups, so as to have a proper evaluation and classification of blood groups. In a diverse and vast country like India, a large variation in prevalence of malocclusion exists. The distribution of ABO blood groups also varies regionally, ethnically and from one population to another. Malocclusion is a multifactorial disease and the etiology of the disease not been clearly established yet with genetic factors probably playing a role. The purpose of this study was to identify such a possibility and to correlate ABO blood group and malocclusion in population of Jaipur, India.

Blood groups are considered to be important for the purpose of blood transfusion, but some studies have illustrated the statistical relationship of blood groups and some specific diseases. During the last few years, several reports have suggested that ABO blood groups, specifically

non-O blood groups are associated with the risk of ischemic heart disease and of developing severe manifestations of atherosclerosis.^{11,18-20} Compared to non-O group (A, AB, and B) individuals, O group individuals have a 14% reduced risk of squamous cell carcinoma and 4% reduced risk of basal cell carcinoma. It is also associated with a reduced risk of pancreatic cancer.²¹ The B antigen links with increased risk of ovarian cancer. Gastric cancer has reported to be more common in blood group A and least in group O. According to Glass *et al.*,¹² those in the O blood group have an increased risk of infection with cholera, and those O-group individuals who are infected have more severe infections. The mechanisms behind this association with cholera are currently unclear in the literature. Reid and Bird²² and Hadley²³ have shown the relationship between blood group and congenital cataract in the Asian race. Blood group an individuals have been reported to be more susceptible to gall stones, cholangitis²⁴ and tumors of salivary glands,²⁵ pancreas and ovary.²⁶ Cardiovascular diseases are more prevalent in blood groups A, O and non-O.^{5,21,27,28} Diabetes mellitus may be higher in subjects of blood groups A and O.²⁹ Along with these findings, the ABO groups have been suspected of having a role in causation of infertility and fetal loss, but reports were found to be conflicting.³⁰

Thus it is clear that several studies have been carried out to investigate the relation between ABO blood group and incidence of disease in medicine, but limited research has been made to investigate the association between ABO blood groups and occurrence of oral diseases. Few reports claimed that there was a relation of blood groups an increased incidence of oral diseases, whereas some others could not confirm these findings, which may be attributed to geographical diversity in the population.^{14,31-34} Vivek *et al.*³⁵ found that subjects with blood group O and Rh positive had a greater propensity for periodontitis. Gheisari *et al.*³⁶ in their study showed that among different blood groups; those with blood group B were found to have a greater likelihood of association with maxillofacial deformities and the probability of the association of such deformities was found to be the least with blood group A. Demir *et al.* found that different ABO blood groups may show significant differences in the rates of colonization of numbers of periodontal pathogens that are the main etiologic agents of periodontal diseases.³⁷ It has also been reported that blood group A seems to have an association with oral pathologies such as dermatophytosis.³⁸

In our study, the evaluation of the association between blood and malocclusions revealed that blood groups have an association with malocclusions. Statistical analysis with shows that relationship of blood groups with malocclusion is statistically significant ($P < 0.0001$), indicating the prevalence of malocclusions is highest in blood group B,

Table 2: Distribution of malocclusion and normal occlusion with blood group types in the study population

Blood group	Malocclusion (%)	Normal (%)
A	41 (27.33)	18 (12.00)
AB	12 (08.00)	45 (30.00)
B	69 (46.00)	14 (09.33)
O	28 (18.66)	73 (48.66)
Total	150 (100)	150 (100)

Chi-square=66.707 with 3 degrees of freedom; $P=0.000$ statistically highly significant

followed by A, O and AB having the least prevalence. So, among all blood groups, blood group B has the highest prevalence of malocclusion while blood group AB has the least prevalence of malocclusion. No, previous studies have been reported in this regard. In further studies, by increasing the sample size, it can be established whether there is an association between blood groups and types of malocclusions.

As we discuss the reason behind the differences arisen due to blood groups in prevalences of pathologies, deformities or malocclusion, the ABO gene is autosomal and because of this, every person carries two copies of genes coding for their ABO blood group. The A and B blood groups are dominant over the O blood group, and their genes are codominant.^{4,39} Furthermore, if a person inherited one A group gene and one B group gene, his or her red blood cells would possess both A and B antigens. The alleles were termed A (production of A antigen), B (production of B antigen), and O (no antigen production).⁴⁰ The antigens of the ABO system are an integral part of the red cell membrane, which are also found in plasma and other body fluids. The presence or absence of certain antigens has been associated with various diseases and deformities, with antigens also acting as receptors for infectious agents.⁴¹ Immunohistochemical studies have demonstrated the presence of A or B antigens on spinous cells in the non-keratinized oral epithelium of blood group A and B persons where basal cells express precursor structures and the more differentiated spinous cells express the A or B antigens. Blood group O persons who do not have the A and B gene-coded glycosyltransferase express a fucosylated variant (Ley) of the precursor structure.⁴²

Thus, it has always been hypothesised that the presence of a certain kind of pathology may be associated with a specific type of blood group. According to our findings, further differentiations and other reasons should also be considered. The statement of Bakare *et al.*⁴³ seems true that varieties of ABO may play an important role in immunology and in the prevention of diseases. For definitive establishment of their etiogenic role, multicenter collaborative studies, which include diverse population groups, are required to further explore this relation globally.

CONCLUSION

The evaluation of the relationship between blood and malocclusions revealed that blood groups have association with malocclusions. Statistical analysis with Chi-square test revealed that the prevalence of malocclusions is highest in blood group B, followed by A, O and AB with the least prevalence. Hence, among all blood groups, blood group B

has the highest prevalence of malocclusion while blood group AB has the least prevalence of malocclusion.

Further differentiations and other reasons should also be considered, warranting a more comprehensive study. More precise research tools and methods are required to improve knowledge and understanding, which in turn is a prerequisite to the appreciation of the potential for genetic and/or environmental manipulation in orthodontic therapy.

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