ISSN: 2581-5989
PubMed - National Library of Medicine - ID: 101738774

International Journal of Dental Science and Innovative Research (IJDSIR)

IJDSIR : Dental Publication Service

Available Online at:www.ijdsir.com

Volume – 7, Issue – 6, November – 2024, Page No. : 09 - 17

An Assessment of Correlation Between ABO Blood Groups and Sagittal Skeletal discrepancies - An Observational Study

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Citation of this Article: Dr Hemanth Kumar Chintakunta, Dr Y Muralidhar reddy, Dr G Dharmadeep, Dr Sakshi Tiwari, "An Assessment of Correlation Between ABO Blood Groups and Sagittal Skeletal discrepancies - An Observational Study", IJDSIR- November – 2024, Volume –7, Issue - 6, P. No. 09 – 17.

Type of Publication: Original Research Article

Conflicts of Interest: Nil

Introduction

This study investigates the correlation between ABO blood groups and sagittal skeletal discrepancies, exploring how variations in blood types may relate to differences in jaw positioning and tooth alignment. ABO blood types—O, A, B, and AB—play crucial roles in transfusion compatibility and organ transplantation due to their distinct antigen-antibody profiles.[1] Blood group O, characterized by absence of antigens but presence of both anti-A and anti-B antibodies, serves as the universal donor, while blood group AB, which lacks antibodies but possesses both A and B antigens, is considered the universal recipient.[2] Skeletal malocclusion, involving misalignment or malpositioning of the jaws and teeth, is influenced by genetic and environmental factors impacting craniofacial development.

Despite previous research on regional and racial variations in ABO blood types, the specific relationship between ABO blood groups and sagittal skeletal patterns remains underexplored. This study aims to contribute novel insights by analyzing a cohort of participants with diverse ABO blood groups and assessing their distribution across various sagittal skeletal classifications. By elucidating potential associations

between blood group types and skeletal malocclusions, this research seeks to enhance our understanding of craniofacial biology and inform clinical practices related to orthodontics and maxillofacial surgery.[3]

Materials and Methods

This study includes 200 individuals aged 13-35 years from patients visiting the Department of Orthodontics and Dentofacial Orthopedics at G. Pulla Reddy Dental College and Hospital, Kurnool, as well as from the local population in and around Kurnool city. Participants, who had not undergone previous orthodontic treatment, provided informed consent (in Telugu or English) prior to inclusion. Blood samples and lateral cephalograms were obtained from each subject following standard procedures. Participants were categorized into four groups based on ABO blood typing: Group A (Blood Group A), Group B (Blood Group B), Group C (Blood Group AB), and Group D (Blood Group O). Blood typing involved using three slides marked with anti-A, anti-B, and anti-D monoclonal antibodies, while lateral cephalograms (Fig-1) were taken using an OPG machine with cephalostat, ensuring standardized procedures for image capture and subsequent manual tracing.

Procedure for Blood Typing

Based on standard lab procedure, 3 slides were used. On slide was marked with anti-A, other marked anti-B and the third slide was marked anti-D monoclonal antibodies. Finger was pricked under aseptic conditions for collecting the blood sample of all subjects.One drop of antisera A(Fig-2), B (Fig-3) and D (Fig-4) was placed on the respective slides. Antisera and red cell suspension were mixed with the help of separate toothpicks.[4] After 8-10 min, 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. Agglutination appeared as a coarse separation of red cells in isolated clumps (red precipitates of cells) and this agglutination was confirmed under low magnification microscope.[5](Fig-5)

Procedure for Lateral Cephalogram

Lateral cephalograms were uniformly obtained using an OPG machine equipped with a cephalostat, operated by the same radiographer throughout the study. Each participant stood erect, facing forward with head position adjusted to align the central X-ray beam precisely at the external auditory meatus and perpendicular to both the film plane and midsagittal plane.[6] Careful attention ensured bilateral head support via plastic ear rods inserted into the external auditory meatus, maintaining transverse plane alignment. Additional support was provided by a nose piece positioned at the nasion for vertical plane stability. Following these preparatory steps, X-rays were administered, and subsequently, all lateral cephalograms were manually traced.[7]

Cephalometric Analysis

Lateral cephalogram obtained from all subjects were traced manually for following landmarks and measurements.

Landmarks: Sella(S), Point A, Point B, Nasion (N). Angular measurements:

Sella-Nasion-Point A angle: SNA

Sella-Nasion-Point B angle: SNB Point A-Nasion-Point B angle: ANB

Linear measurement: Point A – Point B: Wits Appraisal

Results

Subjects were divided based on blood groups with minimum of 50 each. Cephalometric analysis done to assess the SNA, SNB, ANB, Wits Appraisal. Then the Malocclusion is classified under following categories:

1. Class I,
2. Class II with Maxillary Excess,
3. Class II with Mandibular Deficiency,
4. Class III with Mandibular Excess,
5. Class III with Maxillary Deficiency.

The mean age of the participants was 25±9.95 years. The distribution of Blood groups and Sagittal skeletal relation among the sample was calculated. Blood Groups 'A', 'B', 'AB' and 'O' with 50 samples each and the distribution of skeletal class I were 26 (52%), 31 (62%), 27 (54%), 29 (58%) respectively. The distribution of skeletal class II with maxillary excess were 5 (10%), 0 (0%), 0 (0%), 3 (6%) respectively. The distribution of skeletal class II with mandibular deficiency were 14 (28%), 18 (36%), 16(32%), 11 (22%) respectively. The distribution of skeletal class III with mandibular excess were 4 (8%), 0 (0%), 6 (12%), 4 (8%) respectively. The distribution of skeletal class III with maxillary deficiency were 1 (2%), 1 (2%), 1 (2%), 3 (6%) respectively (Table-1, Table-2).

Overall distribution of skeletal class II with maxillary excess showed higher percentage in Blood Group 'A' with respect to other Blood groups. (Table-3)

Overall distribution of skeletal class II with mandibular deficiency showed higher percentage in Blood Group 'B' with respect to other Blood groups. (Table-4).

Overall distribution of skeletal class III with mandibular excess showed higher percentage in Blood Group 'AB' with respect to other Blood groups. (Table-5)

Overall distribution of skeletal class III with maxillary deficiency showed higher percentage in Blood Group 'O' with respect to other Blood groups. (Table-6)

Overall distribution of sagittal malocclusion with blood groups were presented graphically. (Table-7).

Discussion

In present study, it was observed that distribution of skeletal class I with Blood group 'A', 'B', 'AB', 'O' were 26 (52%), 31 (62%), 27(54%), 29 (58%) respectively (Table-1, Table-2). Overall distribution of skeletal class I showed higher percentage in Blood Group 'B' with respect to other Blood groups. (Table-4) According to Sharma et al.[8], blood group B had the highest prevalence of dental malocclusion which is statistically significant and is in correlation with the present study.

The study of Akshi Rathi et al.[9] reveals that the Blood group 'B' had the highest prevalence in Class I skeletal pattern and is in correlation with the present study. Sampath et al[18], in their investigation concludes that skeletal sagittal malocclusion and vertical skeletal pattern were related to ABO blood types. Skeletal class I malocclusion with high angle pattern was highly significant associated with O+ blood group which is not in correlation with the present study. According to Gheisari et al.[10] the Blood group 'B' has most prevalence with maxillofacial abnormalities among the various blood groups which has correlation with the present study.

A study conducted by Rathi A et al.,[11] showed a highest prevalence of malocclusion in O group and a significant correlation between certain malocclusion and ABO blood groups. Angle's classI malocclusion was found to be more common in 'O' blood group and is not in correlation with the present study. In present study, it was observed that Skeletal class II with maxillary excess with Blood group 'A', 'B', 'AB', 'O' were 5 (10%), 0 (0%), 0 (0%), 3 (6%) respectively (Table- 1, Table-2).

Overall distribution of skeletal class II with maxillary excess showed higher percentage in Blood Group 'A' with respect to other Blood groups. (Table-3) Adel

Rashid and Hanem El Feky,[12] conducted a study to investigate the relationship between the blood groups and malocclusion among the Egyptian population. It was found that highest prevalence exists between class II malocclusion with blood group 'A' in Egyptian population which is in correlation with the present study.

In present study, it was observed that Skeletal class II with mandibular deficiency with Blood group 'A', 'B', 'AB', 'O' were 14 (28%), 18 (36%), 16 (32%), 11 (22%) respectively (Table-1, Table-2). Overall distribution of skeletal class II with mandibular deficiency showed higher percentage in Blood Group 'B' with respect to other Blood groups. According to Akshi Rathi et al.[11] there is a correlation that showed the occurrence of blood group B has high prevalence in Class II skeletal patterns and is in correlation with the present study.

According to Sampath Aravind et al[8] there was an association between ABO blood groups and skeletal sagittal malocclusion and vertical skeletal pattern. Skeletal class II malocclusion with high angle pattern was associated significantly with 'B' blood group which is in correlation with the present study. A study conducted by Rathi A et al.,[11] showed a highest prevalence of malocclusion in O group and a significant correlation between certain malocclusion and ABO blood groups. Angle's class II malocclusion was found to be more common in A blood group which is in correlation with the present study.

According to Schnibben CL[13] study, relationships between the Rh factor, ABO blood groups, and inherited malocclusions such as skeletal type, Class II division 1 show significantly higher percentage of type A blood group and similar results were noticed in the present study. In present study, it was observed that Skeletal class III with mandibular excess with Blood group 'A', 'B', 'AB', 'O' were 4 (8%), 0 (0%), 6 (12%), 4 (8%) respectively (Table- 1, Table-2). Overall distribution of skeletal class III with mandibular excess showed higher percentage in Blood Group 'AB' with respect to other Blood groups. (Table-5) In present study, it was observed that Skeletal class III with maxillary deficiency with Blood group 'A', 'B', 'AB', 'O' were 1 (2%), 1 (2%), 1(2%), 3 (6%) respectively (Table-1, Table-2). Overall distribution of skeletal class III with maxillary deficiency showed higher percentage in Blood Group 'O' with respect to other Blood groups. (Table-6)

According to Akshi Rathi, Sanjeev Datana, Shiv Shankar Agarwal, S. K. Bhandari[14] there is a correlation that showed the occurrence of blood group 'A' more in Class III skeletal pattern which is not in correlation with the present study. The study of Patrick Michael Flannery[15] to investigate the possible correlation between the ABO human blood groups, the Rh factor and hereditary malocclusions of skeletal Class III relation. This investigation shows that there is no direct genetic link or influence of blood group antigens on the development of skeletal pattern of the jaws of Class III nature which was not statistically significant and is in correlation with the present study.

According to Shokar FF et al[16], showed more relevant comparison of the craniofacial morphology and its association with ABO blood groups. Whereas the current study and other related studies cannot achieve the significant correlation as no such previous studies has been done before.

As the information is very limited, therefore, other institutions should carry out such researches to explore the correlation among them.

Therefore, in order to determine the relationship between sagittal malocclusions and ABO blood group alleles, we should concentrate on molecular analysis in future research. When comparing dental malocclusions to

skeletal malocclusions, evidence from twin and familial studies has strongly suggested that the former have a greater component of heritability, with a stronger genetic component of variability for the vertical skeletal cephalometric measurements than the anteroposterior skeletal cephalometric measurements[17].

Conclusion

Skeletal class I malocclusion was associated with higher percentage in Blood Group 'B' but not statistically significant.

Skeletal class II malocclusion with Maxillary excess was associated with higher percentage in Blood Group 'A' and with Mandibular deficiency was associated with higher percentage in Blood Group 'B'. The data is not statistically significant.

Skeletal class III malocclusion with mandibular excess was associated with higher percentage in Blood Group 'AB' and with maxillary deficiency was associated with higher percentage in Blood Group 'O'. The data is not statistically significant.

Intergroup comparison of these blood groups was statistically not significant between all the groups.

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Legend Figures

Fig 1: Lateral Cephalogram

Fig 2: Anti-A reagent and patient blood in glass slide

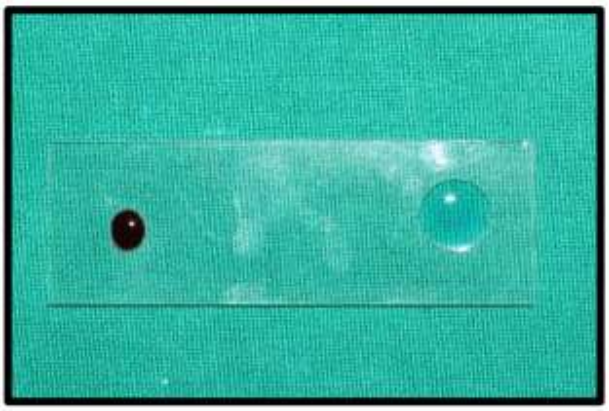

Fig 3: Anti-B reagent and patient blood in glass slide

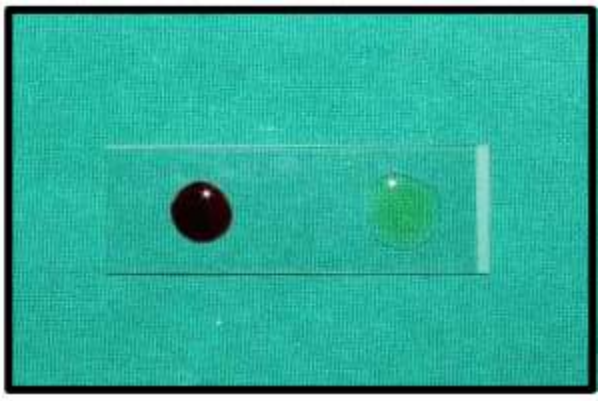

Fig 4: Anti-D reagent and patient blood in glass slide

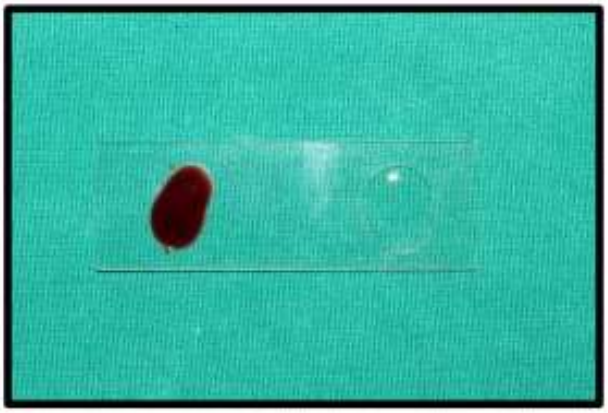

Fig 5: Light Microscope

Table 1: Blood Groups with Inferences

	Inference				
	Class I	Class II with maxillary excess	Class II with mandibular deficiency	Class III with mandibular excess	Class III with maxillary deficiency
BLOOD GROUP - A	26	5	14	4	1
BLOOD GROUP - B	31	0	18	0	1
BLOOD GROUP - AB	27	0	16	6	1
BLOOD GROUP - O	29	3	11	4	3
Chi-square	18.764				
P value	0.094(NS)				

Table 2: Overall comparison of Blood groups and Sagittal skeletal malocclusion

Blood groups		Inference					χ^2 value	p value
		Class 1	Class 2 with maxillary excess	Class 2 with mandibular deficiency	Class 3 with mandibular excess	Class 3 with maxillary deficiency		
Group A	N	26	5	14	4	1	18.76	0.094 (NS)
	%	52.0%	10.0%	28.0%	8.0%	2.0%		
Group B	N	31	0	18	0	1		
	%	62.0%	0.0%	36.0%	0.0%	2.0%		
Group AB	N	27	0	16	6	1		
	%	54.0%	0.0%	32.0%	12.0%	2.0%		
Group O	N	29	3	11	4	3		
	%	58.0%	6.0%	22.0%	8.0%	6.0%		

Table 3: Cephalometric analysis of Blood Group A includes 50 subjects

Table 1 BLOOD GROUP - A					
Sno	SNA(°)	SNB(°)	ANB(°)	Wits Appraisal(mm)	Inference
1	82	80	2	0	1
2	81	71	10	5	3
3	84	82	2	-1	1
4	78	79	1	1	1
5	87	82	5	2	2
6	84	81	3	1	1
7	82	72	10	6	3
8	82	81	1	1	1
9	81	77	4	1	1
10	80	78	2	0	1
11	82	79	3	0	1
12	82	80	2	0	1
13	82	78	4	0	1
14	82	76	6	3	3
15	81	77	4	1	1
16	87	78	9	5	2
17	85	81	4	1	1
18	81	77	4	1	1
19	81	78	3	1	1
20	86	79	7	3	2
21	78	76	2	1	1
22	86	82	4	2	2
23	81	79	2	0	1
24	84	76	8	3	3
25	84	80	4	4	3
26	83	78	-5	1	1
27	82	84	2	3	4
28	83	74	-9	5	3
29	84	79	5	4	2
30	79	77	2	1	1
31	75	70	50	6	3

32	81	79	2	1	1
33	81	79	2	1	1
34	76	80	4	3	5
35	80	83	3	-5	4
36	82	84	2	-2	4
37	80	71	9	10	3
38	82	72	10	7	3
39	81	77	4	0	1
40	81	79	2	0	1
41	82	75	7	2	3
42	82	77	5	2	3
43	82	76	6	4	3
44	80	76	4	1	1
45	79	76	3	0	1
46	94	90	4	1	1
47	80	81	1	1	4
48	81	73	8	4	3
49	80	76	4	1	1
50	82	76	6	3	3

Inference	
1	SKELETAL CLASS 1
2	SKELETAL CLASS 2 WITH MAXILLARY EXCESS
3	SKELETAL CLASS 2 WITH MANDIBULAR DEFICIENCY
4	SKELETAL CLASS 3 WITH MANDIBULAR EXCESS
5	SKELETAL CLASS 3 WITH MAXILLARY DEFICIENCY

Table 4: Cephalometric analysis of Blood Group B includes 50 subjects

32	82	80	2	1	1
33	82	74	8	2	3
34	78	76	2	1	1
35	74	80	6	-6	5
36	80	74	6	2	3
37	77	74	3	1	1
38	82	80	3	1	1
39	81	78	3	1	1
40	83	77	6	3	3
41	84	78	6	3	3
42	88	85	1	0	1
43	79	77	2	1	1
44	81	80	1	1	1
45	83	79	4	0	1
46	82	80	2	1	1
47	78	76	2	1	1
48	82	80	2	0	1
49	83	77	6	4	3
50	76	75	1	1	1

Inference	
1	SKELETAL CLASS 1
2	SKELETAL CLASS 2 WITH MAXILLARY EXCESS
3	SKELETAL CLASS 2 WITH MANDIBULAR DEFICIENCY
4	SKELETAL CLASS 3 WITH MANDIBULAR EXCESS
5	SKELETAL CLASS 3 WITH MAXILLARY DEFICIENCY

Table 5: Cephalometric analysis of Blood Group AB includes 50 subjects

Table 2 BLOOD GROUP - B					
Sno	SNA(°)	SNB(°)	ANB(°)	Wits Appraisal(mm)	Inference
1	80	81	1	1	1
2	80	75	5	3	3
3	80	76	4	4	3
4	81	78	3	0	1
5	78	74	4	5	3
6	82	77	5	1	3
7	77	76	1	0	1
8	79	76	3	0	1
9	80	78	2	0	1
10	82	78	4	1	1
11	89	90	10	0	1
12	82	75	7	3	3
13	78	77	1	1	1
14	79	77	2	0	1
15	84	75	9	5	3
16	84	78	6	3	3
17	85	78	7	0	1
18	83	77	5	2	3
19	79	74	5	2	3
20	82	78	4	1	1
21	83	77	6	4	3
22	80	81	1	1	1
23	82	77	5	2	3
24	78	76	2	0	1
25	81	77	4	0	1
26	80	76	4	1	1
27	81	77	4	0	1
28	82	80	2	1	1
29	82	78	4	0	1
30	82	77	5	3	3
31	85	77	8	5	3

Table 3 BLOOD GROUP - AB					
Sno	SNA(°)	SNB(°)	ANB(°)	Wits Appraisal(mm)	Inference
1	80	79	1	0	1
2	79	77	2	1	1
3	8	80	2	1	1
4	82	81	1	1	1
5	80	79	1	1	1
6	84	76	8	2	3
7	81	75	6	7	3
8	81	77	4	1	1
9	78	77	1	1	1
10	82	79	3	1	1
11	84	80	4	1	1
12	84	82	2	1	1
13	83	82	1	1	1
14	84	82	2	0	1
15	83	83	0	1	1
16	82	78	4	-4	3
17	79	83	4	-3	4
18	81	80	1	1	1
19	82	80	2	1	1
20	83	76	7	6	3
21	79	74	5	3	3
22	76	74	2	1	1
23	81	79	2	1	1
24	84	82	2	1	1
25	81	87	6	-7	4
26	75	79	4	-6	5
27	80	86	6	-3	4
28	83	90	7	-7	4
29	80	75	5	2	3
30	76	71	5	5	3
31	83	77	6	3	3
32	82	75	7	6	3

33	80	73	7	1	3
34	91	87	4	1	1
35	80	75	5	2	3
36	83	79	4	1	1
37	83	86	3	-5	4
38	82	80	2	1	1
39	82	79	2	0	1
40	80	72	8	3	3
41	81	79	2	1	1
42	80	74	6	4	3
43	82	77	5	2	3
44	79	81	2	-2	4
45	80	77	3	0	1
46	82	76	6	2	3
47	82	79	3	1	1
48	81	78	3	1	1
49	82	76	6	3	3
50	81	78	3	0	1

Inference	
1	SKELETAL CLASS 1
2	SKELETAL CLASS 2 WITH MAXILLARY EXCESS
3	SKELETAL CLASS 2 WITH MANDIBULAR DEFICIENCY
4	SKELETAL CLASS 3 WITH MANDIBULAR EXCESS
5	SKELETAL CLASS 3 WITH MAXILLARY DEFICIENCY

Table 6: Cephalometric analysis of Blood Group O includes 50 subjects

33	79	73	6	3	3
34	82	77	5	6	3
35	78	73	5	2	3
36	83	80	3	1	1
37	84	80	4	1	1
38	78	780	0	0	1
39	36	80	6	1	2
40	79	84	7	-5	4
41	81	77	4	0	1
42	83	79	4	0	1
43	82	79	3	1	1
44	82	80	2	1	1
45	82	79	3	1	1
46	78	80	2	-4	5
47	81	83	2	-5	4
48	82	80	2	1	1
49	80	84	4	-4	4
50	78	80	2	-5	5

Inference	
1	SKELETAL CLASS 1
2	SKELETAL CLASS 2 WITH MAXILLARY EXCESS
3	SKELETAL CLASS 2 WITH MANDIBULAR DEFICIENCY
4	SKELETAL CLASS 3 WITH MANDIBULAR EXCESS
5	SKELETAL CLASS 3 WITH MAXILLARY DEFICIENCY

Graph 1: Overall distribution of malocclusion and blood groups

Table 4 BLOOD GROUP - O					
Sno	SNA(°)	SNB(°)	ANB(°)	Wits Appraisal(mm)	Inference
1	78	77	1	1	1
2	71	81	10	-8	5
3	84	79	5	3	2
4	80	75	5	2	3
5	81	79	2	1	1
6	81	77	4	1	1
7	82	78	4	0	1
8	82	83	1	-1	4
9	82	79	3	0	1
10	75	70	5	5	3
11	78	76	2	0	1
12	85	81	4	1	1
13	84	79	5	5	3
14	81	79	2	1	1
15	82	75	7	1	3
16	78	72	6	5	3
17	83	81	2	1	1
18	76	75	10	1	1
19	81	80	1	1	1
20	81	79	2	1	1
21	82	76	6	5	3
22	76	74	2	1	1
23	83	78	5	5	3
24	84	80	4	1	1
25	84	79	5	4	2
26	82	78	4	1	1
27	83	71	2	0	1
28	81	74	7	7	3
29	81	79	2	0	1
30	81	79	2	1	1
31	82	80	2	1	1
32	82	79	3	0	1