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The relationship between ABO blood types and survival of dental implants

Serap Keskin Tunc PhD[1], *Levent Cigerim PhD*[1]

Original Article

Abstract

BACKGROUND AND AIM: Bacteria colonization is the main cause of periodontal diseases and may be effected by ABO blood types. Since implant survival is severely reduced by peri-implant disease, this study aimed to evaluate the marginal bone resorption levels and survival rates of implants which were followed for 1-8 years and analyze these values with respect to demographic data and blood types.

METHODS: Patients who had undergone implant treatment and had prosthetic rehabilitation at the School of Dentistry in Van Yuzuncu Yil University, Van, Turkey, between March 2010 and March 2017 were studied in this cross-sectional retrospective study. In this study, 272 individuals were included, and a total of 963 implants were evaluated. Individuals who had implant treatment were called for control visits and clinical and radiological examinations. The effects of blood types were evaluated in terms of implant survival, failing implant, post-operative complications, and mesial-distal marginal bone resorption. Statistical analysis was performed using NCSS 2007 software. The Kruskal-Wallis test, Pearson's chi-square test, Fisher's exact test, and Fisher-Freeman-Halton exact test were used for statistical analysis. Statistical significance level was considered at $P < 0.05$.

RESULTS: The mean age of the participants was 49.49 ± 11.92 years. The blood types of the participants were O (52.2%), A (30.5%), B (11.1%), and AB (6.3%). The implant survival rate was found to be 98.3%. There was no significant difference between blood types in terms of gender and age ($P > 0.05$). On the other hand, mesial-distal bone resorption was higher in patients with O blood type older than 50 years ($P < 0.05$).

CONCLUSION: The fact that 52.2% of the patients with implants had O blood type, which is higher than the Turkish general population, may suggest that individuals with O blood type are more prone to tooth loss. To the best of our knowledge, this is the first study that assessed the impact of blood type on the success of dental implants.

KEYWORDS: Blood Group Antigens; Dental Implant; Alveolar Bone Loss

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Implants are among treatments routinely used for tooth loss. Recent studies have shown that the clinical success and survival rates of dental implants vary between 73%-100%.[1-4] Optimal soft and hard tissue characteristics such as good bone quality and a healthy adherent keratinized gingiva surrounding the implant neck are required for the success of dental implants.[5] Most researchers are concerned about the short/long-term and mechanical/technical complications of implants, most common of which are peri-implant diseases and marginal bone loss (MBL).[1,2,4,6-8] A long-term complication of microbial dental plaque-induced peri-implant inflammatory disease is MBL around the implant;[8] however, this symptom may also be observed in the absence of such a disease. An MBL of 2 mm in the first 12 months of the implant followed by a loss of 0.1-0.2 mm per year is considered normal. Bone loss usually occurs irreversibly.[9] Improved surface properties and implant designs have increased implant survival rates;[10] however, the factors determining implant success rates are diverse and need to be further investigated. Genetic characteristics such as ABO blood types and the state of the immune system have

1- Assistant Professor, Department of Oral and Maxillofacial Surgery, School of Dentistry, Van Yuzuncu Yil University, Van, Turkey
Address for correspondence: Serap Keskin Tunc PhD; Assistant Professor, Department of Oral and Maxillofacial Surgery, School of Dentistry, Van Yuzuncu Yil University, Van, Turkey; Email: levent139@hotmail.com

important effects on the success of the implants.[2,11,12] Several studies have shown that the ABO blood types are associated with increased susceptibility to infection[13] and various systemic diseases.[14-18] Similar studies also reported that there was a significant association between the blood types and susceptibility to musculoskeletal system injuries, fractures, and cardiovascular disease (CVD).[19-21] The main cause of periodontal diseases, bacteria colonization, has also been shown to be associated with the blood types.[22,23] Because of these data in the literature, ABO blood types have been hypothesized to affect the dental implant success and survival. The present study evaluated the correlation between the implant survival and marginal bone resorption around implant area with ABO blood types.

Methods

This cross-sectional retrospective study utilized the data of patients who were treated with implants and had prosthetic rehabilitation at the School of Dentistry in Van Yuzuncu Yil University, Van, Turkey, between March 2010 and March 2017, and had been observed for at least one year. All procedures performed in studies involving human participants were in accordance with the ethical standards of Van Yuzuncu Yil University Clinical Sciences Ethics Committee (YYU-29112017/05) and with the 1975 Declaration of Helsinki and its later amendments or comparable ethical standards. Before the study, an informed signed consent form was obtained from all participants. The inclusion criteria comprised non-smoker patients who were at least 18 years of age without any systemic disease, whose implants were placed at bone level without any hard and soft tissue augmentation. The included patients were rehabilitated with fixed prosthetic restoration and received flat abutment, having one crown or bridge with cemented implants, and did not miss any follow-up visits after implant surgery evidenced with radiographic recordings. The anamnesis was taken from patients who received implant treatment, and their blood type [A, B, AB, O, and Rhesus (Rh) status], time of implantation, follow-up period, post-operative complications, and tooth brushing habits were recorded. On radiological examination, both periapical and panoramic radiographs were taken. In this study, periapical radiographs were taken with a parallel technique to measure the amount of mesial and distal bone resorption in the neck region of the implants (Figure 1).

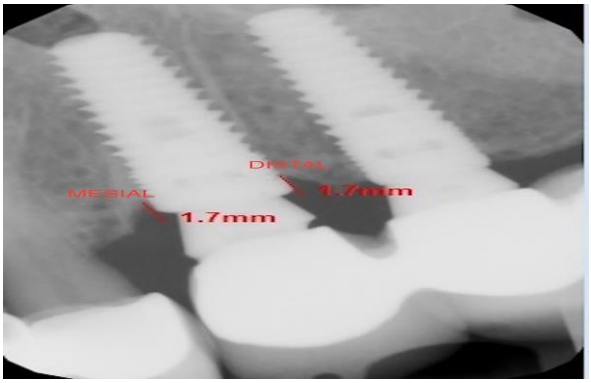

Figure 1. Periapical radiograph (parallel technique) to measure the amount of mesial and distal bone resorption in the neck region of the implant

A film holder (Super-Bite, Kerr Corporation, Orange, CA, USA) was used by the parallel technique, and the intraoral sensor (KaVo, Biberach, Germany) was positioned parallel to the long axis, while the long cone was placed perpendicular to the long axis of the implant. One of the researchers performed all clinical examinations. The other researcher performed radiological evaluations and measurements, and the measurements were examined by a radiologist who was not included in the study.

Statistical analysis was performed using Number Cruncher Statistical System (NCSS) 2007 software (Kaysville, Utah, USA). Descriptive statistics [mean, standard deviation (SD), median, frequency, percentage, minimum, and maximum) were used to evaluate the data. The conformity of quantitative data to normal distribution was tested with the Shapiro-Wilk test and graphical analysis. The Kruskal-Wallis test was used for the comparison of non-normally

distributed quantitative variables between more than two groups. Pearson's chi-square test, Fisher's exact test, and Fisher-Freeman-Halton exact test were used to compare the qualitative data. Statistical significance level was considered at $P < 0.05$.

Results

A total of 272 patients (141 men and 131 women) with an age range of 19 to 77 years (mean age: 49.50 ± 11.88 years) were included in the study. Patients' frequency of tooth brushing and distribution of blood groups are shown in table 1.

Table 1. Distribution of descriptive properties

Variable		Value
Age (year)	Min-Max (median)	19-77 (50)
	Mean ± SD	49.50 ± 11.88
Gender [n (%)]	Men	198 (49)
	Women	207 (51)
Blood group [n (%)]	O Rh (-)	10 (3.7)
	O Rh (+)	132 (48.5)
	AB Rh (-)	1 (0.4)
	AB Rh (+)	16 (5.9)
	A Rh (-)	8 (2.9)
	A Rh (+)	75 (27.6)
	B Rh (-)	4 (1.5)
	B Rh (+)	26 (9.6)
Tooth brushing habit [n (%)]	None	42 (15.4)
	1-2 times per day	210 (77.2)
	1-3 times per week	20 (7.4)

SD: Standard deviation; Rh: Rhesus

The total number of implants placed in 272 patients was 963. The implant survival rate was found to be 98.3%. The duration after the implant surgery ranged between 1 to 8 years, with an average duration of 3.61 ± 1.90 years. The location of the implants, the location of the failed implants, and post-operative complications are shown in table 2.

In addition, of the 16 failed implants, 3 were observed in patients with AB blood type, 3 in patients with A blood type, 3 in patients with B blood type, and 7 in patients with O blood type. There was no statistically significant difference among the blood types in terms of the implant failure rate ($P > 0.050$).

The amount of mesial and distal marginal bone resorption and the incidence rates are shown in table 3.

No statistically significant difference was found among different blood types (A, B, AB, and O) in terms of the incidence of failed implants and mesial and distal bone resorption ($P > 0.05$). Besides, there was no statistically significant difference among blood types in terms of mesial and distal bone resorption of implants with respect to age and gender ($P > 0.050$) (Table 4).

No statistically significant difference was found between the degree of mesial and distal bone resorption of patients with A, B or AB blood type in terms of age ($P > 0.050$).

Table 2. Distribution of implant properties

Variable		Value
Number of implants according to the region*	Maxilla anterior	49
	Maxilla posterior	137
	Mandible anterior	83
	Mandible posterior	163
Number of the failed implants [n (%)]	Yes	16 (1.7)
	No	947 (98.3)
Number of patients with failed implant(s)	Yes	259
	No	13
Region of failed implants [n (%)]	Maxilla anterior	4 (25.0)
	Maxilla posterior	3 (18.7)
	Mandible anterior	2 (12.5)
	Mandible posterior	7 (43.7)
Post-operative complication [n (%)]*	None	240 (88.2)
	Implant fracture	8 (2.9)
	Abutment fracture	7 (2.6)
	Nerve damage	11 (4.0)
	Sinus infection	7 (2.6)

*There are multiple options.
SD: Standard deviation

Table 3. Amount of mesial and distal marginal bone resorption and resorption regions

Variable		Value
Mesial marginal bone resorption (mm) [n (%)]	1	23 (2.4)
	≥ 2	25 (2.6)
	None	915 (95.0)
Distal marginal bone resorption (mm) [n (%)]	1	23 (2.4)
	≥ 2	27 (2.8)
	None	913 (94.8)
Resorption regions (marginal bone resorption ≥ 2 mm) [n (%)]	None	912 (94.7)
	Maxilla anterior	8 (0.8)
	Maxilla posterior	17 (1.8)
	Mandible anterior	11 (1.1)
	Mandible posterior	15 (1.6)

However, there was a statistically significant difference between the degree of mesial bone resorption of patients with O blood type in terms of age (P = 0.011; P < 0.050). The rate of mesial bone resorption that was 2 mm or higher in patients aged 50 years or over was significantly higher than those aged under 50 years (P = 0.036; P < 0.050).

There was a statistically significant difference between patients with O blood type in terms of the amount of distal bone resorption in terms of age (P = 0.002; P < 0.010). The rate of distal bone resorption of 2 mm or more in patients aged 50 years or older was significantly higher than those aged below 50 years (P = 0.015; P < 0.050) (Table 5).

Discussion

The data obtained in this study showed that the incidence of failed implants and the mesial and distal MBL rates around implants were similar among different blood groups. Nevertheless, the patients with O blood type who were older than 50 years exhibited higher mesial and distal bone resorption compared to younger patients. Implant survival rate was found to be 98.3% with the mean follow-up period of 3.61 ± 1.90 years. Doornewaard et al. reported that the implant survival time was 5 years or more, and after placement, the implants had a survival rate of 97.3%. They reported that less than 5% of the implants were affected, noting that a minimum of 3 mm of bone loss was required after at least 5 years to prove the presence of peri-implantitis. They also reported that patients with periodontal disease history and smoking habits exhibited more bone loss.[24]

Table 4. Comparison of mesial and distal bone resorption amounts between blood groups according to age and gender

Amount of marginal bone resorption			Total	Age (year)		Gender	
			Mean (mm)	< 50	≥ 50	Women	Men
Amount of mesial marginal bone resorption	Group A	Min-Max (median)	0-3 (0)	0-3 (0)	0-2 (0)	0-3 (0)	0-2 (0)
		Mean ± SD	0.08 ± 0.37	0.12 ± 0.48	0.03 ± 0.22	0.10 ± 0.48	0.06 ± 0.28
	Group B	Min-Max (median)	0-2 (0)	0-1 (0)	0-2 (0)	0-1 (0)	0-2 (0)
		Mean ± SD	0.06 ± 0.27	0.05 ± 0.22	0.08 ± 0.35	0.06 ± 0.24	0.06 ± 0.31
	Group AB	Min-Max (median)	0-2 (0)	0-0 (0)	0-2 (0)	0-0 (0)	0-2 (0)
		Mean ± SD	0.12 ± 0.48	0	0.13 ± 0.49	0	0.21 ± 0.62
	Group O	Min-Max (median)	0-8 (0)	0-3 (0)	0-8 (0)	0-8 (0)	0-5 (0)
		Mean ± SD	0.12 ± 0.62	0.03 ± 0.26	0.19 ± 0.80	0.09 ± 0.62	0.14 ± 0.62
		Test value*	χ^2: 0.162	χ^2: 6.550	χ^2: 4.553	χ^2: 1.499	χ^2: 2.089
		P	0.984	0.088	0.208	0.682	0.554
Amount of distal marginal bone resorption	Group A	Min-Max (median)	0-2 (0)	0-2 (0)	0-2 (0)	0-2 (0)	0-2 (0)
		Mean ± SD	0.07 ± 0.34	0.11 ± 0.43	0.03 ± 0.20	0.09 ± 0.41	0.05 ± 0.27
	Group B	Min-Max (median)	0-1 (0)	0-1 (0)	0-1 (0)	0-1 (0)	0-1 (0)
		Mean ± SD	0.05 ± 0.22	0.05 ± 0.22	0.05 ± 0.22	0.06 ± 0.24	0.04 ± 0.19
	Group AB	Min-Max (median)	0-4 (0)	0-0 (0)	0-4 (0)	0-0 (0)	0-4 (0)
		Mean ± SD	0.16 ± 0.68	0	0.17 ± 0.69	0	0.28 ± 0.88
	Group O	Min-Max (median)	0-6 (0)	0-2 (0)	0-6 (0)	0-6 (0)	0-4 (0)
		Mean ± SD	0.09 ± 0.46	0.03 ± 0.21	0.18 ± 0.69	0.10 ± 0.54	0.12 ± 0.54
		Test value*	χ^2: 0.662	χ^2: 6.591	χ^2: 7.715	χ^2: 1.279	χ^2: 3.106
		P	0.882	0.086	0.052	0.734	0.376

*Kruskal-Wallis test
SD: Standard deviation

Table 5. Comparison of bone resorption amounts in blood groups according to age, gender, and presence of failed implant

Amount of marginal bone resorption			Age (year)		Gender		Failed implant	
			< 50	≥ 50	Women	Men	No	Yes
Amount of mesial marginal bone resorption (mm)	Group A	None	128 (92.8)	145 (97.3)	106 (94.6)	167 (95.4)	270 (95.1)	3 (100)
		1	5 (3.6)	3 (2.0)	2 (1.8)	6 (3.4)	8 (2.8)	0 (0)
		≥ 2	5 (3.6)	1 (0.7)	4 (3.6)	2 (1.1)	6 (2.1)	0 (0)
	Test value	P	χ^2: 3.638	0.147##	χ^2: 2.454	0.296##	χ^2: 1.947	> 0.999##
	Group B	None	78 (95.1)	37 (94.9)	64 (94.1)	51 (96.2)	112 (94.9)	3 (100)
		1	4 (4.9)	1 (2.6)	4 (5.9)	1 (1.9)	5 (4.2)	0 (0)
		≥ 2	0 (0)	1 (2.6)	0 (0)	1 (1.9)	1 (0.8)	0 (0)
	Test value	P	χ^2: 2.180	0.540##	χ^2: 2.229	0.263##	χ^2: 2.518	> 0.999##
	Group AB	None	8 (100)	45 (93.8)	22 (100)	31 (91.2)	50 (94.3)	3 (100)
		1	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
		≥ 2	0 (0)	3 (6.3)	0 (0)	3 (8.8)	3 (5.7)	0 (0)
	Test value	P	χ^2: 0.528	> 0.999¥	χ^2: 2.051	0.271¥	χ^2: 0.179	> 0.999¥
	Group O	None	221 (98.2)	253 (92.3)	223 (96.1)	251 (94.0)	467 (94.9)	7 (100)
		1	2 (0.9)	8 (2.9)	4 (1.7)	6 (2.2)	10 (2.0)	0 (0)
		≥ 2	2 (0.9)	13 (4.7)	5 (2.2)	10 (3.7)	15 (3.0)	0 (0)
	Test value	P	χ^2: 9.103	0.011*#	χ^2: 1.272	0.529#	χ^2: 0.651	> 0.999##
Amount of distal marginal bone resorption (mm)	Group A	None	128 (92.8)	146 (98.0)	106 (94.6)	168 (96.0)	271 (95.4)	3 (100)
		1	4 (2.9)	2 (1.3)	1 (0.9)	5 (2.9)	6 (2.1)	0 (0)
		≥ 2	6 (4.3)	1 (0.7)	5 (4.5)	2 (1.1)	7 (2.5)	0 (0)
	Test value	P	χ^2: 4.835	0.076##	χ^2: 4.013	0.136##	χ^2: 2.055	> 0.999##
	Group B	None	78 (95.1)	37 (94.9)	64 (94.1)	51 (96.2)	112 (94.9)	3 (100)
		1	4 (4.9)	2 (5.1)	4 (5.9)	2 (3.8)	6 (5.1)	0 (0)
		≥ 2	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
	Test value	P	χ^2: 0.004	> 0.999¥	χ^2: 0.281	0.695¥	χ^2: 0.161	> 0.999¥
	Group AB	None	8 (100)	45 (93.8)	22 (100)	31 (91.2)	50 (94.3)	3 (100)
		1	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
		≥ 2	0 (0)	3 (6.3)	0 (0)	3 (8.8)	3 (5.7)	0 (0)
	Test value	P	χ^2: 0.528	> 0.999¥	χ^2: 2.051	0.271¥	χ^2: 0.179	> 0.999¥
	Group O	None	221 (98.2)	250 (91.2)	222 (95.7)	249 (93.3)	464 (94.3)	7 (100)
		1	2 (0.9)	9 (3.3)	3 (1.3)	8 (3.0)	11 (2.2)	0 (0)
		≥ 2	2 (0.9)	15 (5.5)	7 (3.0)	10 (3.7)	17 (3.5)	0 (0)
	Test value	P	χ^2: 11.480	0.002**#	χ^2: 1.904	0.386#	χ^2: 0.526	> 0.999##

Data are presented as number and percentage

#Pearson's chi-square test; ##Fisher-Freeman-Halton test; ¥Fisher's exact test; *P < 0.050; **P < 0.010

In the present study, individuals who were smokers or had systemic diseases were excluded due to the possible effects of smoking and systemic diseases on bone loss. Albrektsson et al. reported that the clinical survival rates of implants were 95%-99% during a follow-up period of more than 10 years and clinical evaluation showed mucositis or peri-implantitis as serious problems.[12] In contrast, some studies suggested chronic inflammation around an implant to be a natural and required response, and bone loss or pocket formation should not always be considered as a disease.[8,9]

Papaspyridakos et al. reported post-operative complications of failing implants (2%) and implant and abutment fracture (0%) in patients followed up for 5 years.[25] In this study, failing implant rate was 1.7%, implant fracture rate was 2.9%, and abutment fracture rate was 2.6%. The rates in this study are similar to ours.

Lovatto et al. reported that cylindrical implants were more successful than the conical ones in their study, where they reviewed the effects of implant geometry on implant survival and bone resection.[26] In the present study, all implants were cylindrical, which may have a positive effect on implant survival and bone resorption.

Ormianer et al. evaluated bone resorption rates in patients with diabetes using cone-beam computed tomography (CBCT), and reported less bone resorption in implants placed near the anterior regions.[27] In this study, it was observed that bone resorption was the least in the maxillary region.

The most common blood type in Turkey is A.[28] There are several studies which evaluated the relationship between ABO blood types and muscle and bone metabolism.[19-21] Some researchers reported that ABO blood types were associated with Achilles tendon problems and people with O blood type were more prone to tendon injuries.[29] In addition, there are studies reporting that the risk of osteoporosis in patients with O blood type is higher than those with other blood types.[14] It was also reported that people with A blood type were more prone to hip fracture and mortality rate in these people was higher than those with other blood types.[19] Previous studies have reported that periodontal health status may differ according to blood types.[23,30,31] Anup et al. reported that gingivitis was highly seen in subjects with A blood type and periodontitis in subjects with O blood type, and also, healthy periodontium was highly seen in subjects with B blood type. There was higher prevalence of gingivitis in Rh positive group.[32] In the present study, 52% of the participants had O blood type, which is higher than the general population in Turkey, indicating that the rate of O blood type was the most common blood type among patients who were inserted for implant treatment. According to a study by Hakki Ciftci et al., O blood type rate is 30.65%.[28] Although there was no difference between the blood types in terms of implant survival and bone resorption, the mesial and distal bone resorption degree was found to be significantly higher in those with O blood type aged over 50 years. The higher rates of tooth loss may occur in individuals with O blood type. The difference in the number of individuals, the average age, and gender distribution in the blood groups were the limitations of the study.

Conclusion

In this study, the overall implant survival rate was found to be 98.3%. The mean mesial bone resorption was 0.0965 mm, and the mean distal bone resorption was 0.0934 mm. Although there was no statistically significant difference among the blood types in terms of gender, mesial and distal bone resorption was found to be higher in individuals with O blood type and those aged above 50 years. Individuals with O blood type might be more prone to tooth loss. This is the first study in the literature which analyzed the potential effects of ABO blood types on the dental implant success, and further research is

necessary to assess this issue in more detail. In addition, other causes of tooth loss should also be investigated.

Conflict of Interests

Authors have no conflict of interest.

Acknowledgments

All procedures performed in studies involving human participants were in accordance with the ethical standards of Van Yuzuncu Yil University Clinical Sciences Ethics Committee (YYU-29112017/05) and with the 1975 Declaration of Helsinki and its later amendments or comparable ethical standards.

References

1. Becker W, Hujoel P, Becker BE, Wohrle P. Dental implants in an aged population: Evaluation of periodontal health, bone loss, implant survival, and quality of life. Clin Implant Dent Relat Res 2016; 18(3): 473-9.
2. Erdogan O, Ucar Y, Tatli U, Sert M, Benlidayi ME, Evlice B. A clinical prospective study on alveolar bone augmentation and dental implant success in patients with type 2 diabetes. Clin Oral Implants Res 2015; 26(11): 1267-75.
3. Schimmel M, Srinivasan M, McKenna G, Muller F. Effect of advanced age and/or systemic medical conditions on dental implant survival: A systematic review and meta-analysis. Clin Oral Implants Res 2018; 29(Suppl 16): 311-30.
4. Moraschini V, Poubel LA, Ferreira VF, Barboza ES. Evaluation of survival and success rates of dental implants reported in longitudinal studies with a follow-up period of at least 10 years: A systematic review. Int J Oral Maxillofac Surg 2015; 44(3): 377-88.
5. Gellrich NC, Rahlf B, Zimmerer R, Pott PC, Rana M. A new concept for implant-borne dental rehabilitation; how to overcome the biological weak-spot of conventional dental implants? Head Face Med 2017; 13(1): 17.
6. Benlidayi ME, Tatli U, Salimov F, Tukel HC, Yuksel O. Comparison of autogenous and allograft bone rings in surgically created vertical bone defects around implants in a sheep model. Clin Oral Implants Res 2018; 29(11): 1155-62.
7. Manicone PF, Passarelli PC, Bigagnoli S, Pastorino R, Manni A, Pasquantonio G, et al. Clinical and radiographic assessment of implant-supported rehabilitation of partial and complete edentulism: A 2 to 8 years clinical follow-up. Eur Rev Med Pharmacol Sci 2018; 22(13): 4045-52.
8. Ng KT, Fan M, Leung MC, Fokas G, Mattheos N. Peri-implant inflammation and marginal bone level changes around dental implants in relation to proximity with and bone level of adjacent teeth. Aust Dent J 2018; 63(4): 467-77.
9. Alasqah MN, Alrabiah M, Al-Aali KA, Mokeem SA, Binmahfooz AM, ArRejaie AS, et al. Peri-implant soft tissue status and crestal bone levels around adjacent implants placed in patients with and without type-2 diabetes mellitus: 6 years follow-up results. Clin Implant Dent Relat Res 2018; 20(4): 562-8.
10. Borba M, Deluiz D, Lourenco EJV, Oliveira L, Tannure PN. Risk factors for implant failure: a retrospective study in an educational institution using GEE analyses. Braz Oral Res 2017; 31: e69.
11. Hammerle CHF, Tarnow D. The etiology of hard- and soft-tissue deficiencies at dental implants: A narrative review. J Periodontol 2018; 89(Suppl 1): S291-S303.
12. Albrektsson T, Jemt T, Molne J, Tengvall P, Wennerberg A. On inflammation-immunological balance theory-A critical apprehension of disease concepts around implants: Mucositis and marginal bone loss may represent normal conditions and not necessarily a state of disease. Clin Implant Dent Relat Res 2019; 21(1): 183-9.
13. Seymour RM, Allan MJ, Pomiankowski A, Gustafsson K. Evolution of the human ABO polymorphism by two complementary selective pressures. Proc Biol Sci 2004; 271(1543): 1065-72.
14. Choi JW, Pai SH. Associations between ABO blood groups and osteoporosis in postmenopausal women. Ann Clin Lab Sci 2004; 34(2): 150-3.
15. Dosluoglu HH, Nader ND. Commentary on 'ABO blood type does not influence the risk of cardiovascular complications and mortality after vascular surgery'. Eur J Vasc Endovasc Surg 2013; 45(3): 261-2.
16. Iodice S, Maisonneuve P, Botteri E, Sandri MT, Lowenfels AB. ABO blood group and cancer. Eur J Cancer 2010; 46(18): 3345-50.
17. Lu BB, Li KH. Association between ABO blood groups and osteoporosis severity in Chinese adults aged 50 years and over. J Int Med Res 2011; 39(3): 929-33.
18. Wu O, Bayoumi N, Vickers MA, Clark P. ABO(H) blood groups and vascular disease: A systematic review and meta-analysis. J Thromb Haemost 2008; 6(1): 62-9.
19. Uzoigwe CE, Smith RP, Khan A, Aghedo D, Venkatesan M. Association of ABO blood group with fracture pattern and mortality in hip fracture patients. Ann R Coll Surg Engl 2014; 96(6): 442-5.

20. Toro G, Lepore F, Cicala SD, Concilio P, Calabro G, Toro A, et al. ABO system is not associated with proximal femoral fracture pattern in Southern Italy. Hip Int 2018; 28(2_suppl): 84-8.
21. Kujala UM, Jarvinen M, Natri A, Lehto M, Nelimarkka O, Hurme M, et al. ABO blood groups and musculoskeletal injuries. Injury 1992; 23(2): 131-3.
22. Demir T, Uslu H, Orbak R, Altoparlak U, Ayyildiz A. Effects of different blood groups on the reproduction of periodontal pocket bacteria. Int Dent J 2009; 59(2): 83-6.
23. Mostafa D, Elkhatat EI, Koppolu P, Mahgoub M, Dhaifullah E, Hassan AH. Correlation of ABO blood groups and rh factor with the severity of generalized chronic periodontitis: Across sectional study in Riyadh, Saudi Arabia. Open Access Maced J Med Sci 2019; 7(4): 617-22.
24. Doornewaard R, Christiaens V, De Bruyn H, Jacobsson M, Cosyn J, Vervaeke S, et al. Long-term effect of surface roughness and patients' factors on crestal bone loss at dental implants. A systematic review and meta-analysis. Clin Implant Dent Relat Res 2017; 19(2): 372-99.
25. Papaspyridakos P, Bordin TB, Natto ZS, El-Rafie K, Pagni SE, Chochlidakis K, et al. Complications and survival rates of 55 metal-ceramic implant-supported fixed complete-arch prostheses: A cohort study with mean 5-year follow-up. J Prosthet Dent 2019; 122(5): 441-9.
26. Lovatto ST, Bassani R, Sarkis-Onofre R, Dos Santos MBF. Influence of different implant geometry in clinical longevity and maintenance of marginal bone: A systematic review. J Prosthodont 2019; 28(2): e713-e721.
27. Ormianer Z, Block J, Matalon S, Kohen J. The effect of moderately controlled type 2 diabetes on dental implant survival and peri-implant bone loss: A long-term retrospective study. Int J Oral Maxillofac Implants 2018; 33(2): 389-94.
28. Hakkı Ciftci I, Onder E, Bozkurt H, Guducuoglu H, Korkoca H, Guzel Kurtoglu M. The distribution of blood group in van city. Van Med J 2004; 11(1): 22-4.
29. Eken Bf, Sercan C, Kaya D, Ulucan K. Molecular approach to soft tissue injuries not affected by pulse. Eurasian Research in Sport Science 2018; 3(1): 15-25.
30. Vivek S, Jain J, Simon SP, Battur H, Supreetha S, Haridas R. Association of ABO blood group and Rh factor with periodontal disease in a population of Virajpet, Karnataka: A Cross-Sectional Study. J Int Oral Health 2013; 5(4): 30-4.
31. Koregol AC, Raghavendra M, Nainegali S, Kalburgi N, Varma S. ABO blood groups and Rhesus factor: An exploring link to periodontal diseases. Indian J Dent Res 2010; 21(3): 364-8.
32. Anup P, Varma S, Girish S, Keshava A, Zope S, Vishwajeet K. ABO and Rh blood group system and periodontal disease - a prevalence study. Br J Med Med Res 2016; 16(5): 1-6.