ORIGINAL ARTICLE

Retrospective Descriptive Analysis of Dental Records Related to Dental Implant Applications

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Abstract

Background: The aim of this study was to evaluate the most frequent sites of dental implants and demographic characteristics of patients referred to the Gazi University School of Dentistry Departmant of Oral and Maxillofacial Surgery over the last two years.

Methods: In this retrospective study, the records of 1259 patients who received dental implant treatment at the Department of Oral and Maxillofacial Surgery, Gazi University School of Dentistry, between January 2021 and December 2023 were reviewed. A total of 4370 dental implants from 28 different brands were analyzed. Demographic variables (age and gender) and implant-related variables (implant localization and implant brands) were recorded. Implant localization was determined according to the FDI World Dental Federation tooth numbering system. Descriptive statistics were calculated, and chi-square tests were performed to evaluate associations between categorical variables with a significance threshold of p<0.05.

Results: Of the 1259 patients, 49.2% were male and 50.8% were female and the mean age was 51.5 years. The most common site for dental implants was the lower left posterior region, and the most frequently implanted site was tooth number 46 followed by 36.

Conclusions: In conclusion, despite the increasing prevalence and high success rates of dental implants, the preservation of natural teeth remains a global priority due to both economic and health-related considerations. In this retrospective study, we analyzed the distribution of dental implants with respect to gender, age, and anatomical localization, with the aim of providing insights that may assist both clinicians and patients in making informed decisions focused on the preservation of permanent dentition.

Keywords: Demography; Dental Implants; Edentulous Jaw; Retrospective Studies; Treatment Outcome.

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INTRODUCTION

The concept of osteointegration was first introduced by Branemark nearly 50 years ago. Since then, implant application has been a successful and predictable form of treatment in dentistry (1,2). Also, dental implant surgery is associated with high success rates of over 95% (3,4). In recent years, dental implant treatment in dentistry has become a routine clinical practice (5). Intraosseous implant-supported prostheses are recognized as successful, effective replacements for missing teeth as they are a treatment method with predictable outcomes (6).

Dental implants can improve masticatory function and improve quality of life in patients with complete or partial edentulism (2,5-7). Therefore, dental implants have become an important treatment option in the treatment of lost teeth. Despite their long-term success, the failure rate of dental implants increases over time. In addition to factors related to the patient's health, other factors such as age, gender, socioeconomic status, smoking habit, bone quality, oral hygiene, as well as implant-related factors such as implant size, surface characteristics, localization, loading protocol, and clinician experience have been reported as determinants of implant success or failure (7,8).

Retrospective evaluation of the characteristics of clinical applications of dental implants has long been a valuable method to guide physicians (9). While there is a lot of information on implant design, surface properties and surgical protocols (10), there is insufficient information on implant location and number of implants applied and implant locations by gender

We aimed to fill this gap in knowledge by performing a retrospective medical record-based survey.

MATERIALS AND METHODS

The records of 1259 patients who applied to Gazi University School of Dentistry Department of Oral and Maxillofacial Surgery to have dental implants between January 2021 and December 2023 were retrospectively examined. A total of 4370 dental implants belonging to 28 different brands applied to these patients were evaluated (Table 1).

This study was conducted in accordance with the Principles of the Declaration of Helsinki and ethical approval was received from Health Sciences University Gülhane Scientific Research Ethics Committee (Decision Date: 28.06.2024, Meeting no: 2024/06, Project/Decision No: 2024-367). Inclusion criteria were data availability and having received dental implant treatment. Cases whose panoramic radiographs were not available or whose images were of poor quality were excluded from the study. Only implants that were documented on a satisfactory panoramic radiograph obtained after placement were included. The aim of the study was to describe the distribution of implants according to demographic and anatomical variables; therefore, follow-up data regarding subsequent implant survival or loss were not analyzed, and no distinction was made between implants that later remained in function or were removed.

Demographic information (age and gender) of the patients, as well as the localization of the implants placed on the patients between January 2021 and December 2023 were retrieved. The tooth numbering system used is the international tooth numbering system determined by World Dental Federation (FDI) (5). For the purposes of this study, anterior sites were defined as incisors and canines (FDI teeth 13–23 and 33–43), whereas posterior sites were defined as premolars and molars (FDI teeth 14–18, 24–28, 34–38 and 44–48). Systemic health conditions (e.g. cardiovascular disease, diabetes) were routinely evaluated in all patients as part of the standard preoperative assessment in our clinic. However, systemic diseases were not included as study variables and were not used as independent inclusion or exclusion criteria beyond the usual clinical contraindications for implant surgery. Thus, all patients who had been deemed suitable for implant placement according to institutional protocols and who met the radiographic and data-availability criteria were included in this analysis.

Statistical Analysis

Descriptive statistical methods (number, percentage) were used to evaluate the data. Associations between categorical variables [e.g., age group and jaw (maxilla/mandible), jaw and anterior–posterior localization, and age group and localization according to the midline]

Table 1. Dental Implant Brands, Number of Implants Applied And Percentages		
Dental implant brands	**Total Number of Implants**	**Percentage ~ (%)**
Alphabio	137	3.13
Astratech	152	3.47
Bego	43	0.98
Bilim	126	2.88
Blueskybio	53	1.21
Cteck	48	1.09
Dentegris	111	2.54
Direct	179	4.09
DTI	24	0.54
Euroteknika	26	0.59
IBS	48	1.09
IHDE	113	2.58
Implance	49	1.12
Implantswiss	17	0.38
JD	94	2.15
Medentica	514	11.76
Medikal Instinct	4	0.09
Megagen	156	3.56
MIS	30	0.68
MSI	163	3.72
Nobel	751	17.18
Nucleoss	100	2.28
Omnitech	118	2.70
SGS	59	1.35
Straumann	907	20.73
Tecom	45	1.02
Ziacom	71	1.62
Zinedent	232	5.32
	4370 (Total)	

were evaluated using Pearson's chi-square (χ^2) test, and for each analysis, the test statistic (χ^2) and degrees of freedom (df) are reported. For all analyses, the statistical significance threshold was set as $\alpha = 0.05$. The methodology was reviewed by an independent statistician. SPSS 28.0 (Statistical Package for Social Sciences) was used for these analyses.

RESULTS

A total of 1259 patients, aged between 15 and 81, were included in this study. The average age of the patients was found to be 51.5 years.

Panoramic radiographs revealed that in this sample, 4370 dental implants were applied to all areas except third molars. When distribution of the participants in the study was analyzed by gender, 49.2% were male and 50.8% were female. The age distribution of cases are given in Table 2 which shows that the age group which had the most cases was 50-59yr (30.4%). When distribution according to the jaw location was analyzed, 50.7% were in maxilla, 49.3% were in mandible. In addition, 49% were located at the right side of the midline and 51% were left side of the midline. When analyzed according to the direction, 24.8% were done in the anterior and 75.2% were in the posterior jaw. When analyzed according to anterior posterior (AP), 49.2% were located on the right and 50.8% were on the left part of the jaw. When distribution of dental implants according to tooth numbers was analyzed, it was found that the most common dental implant was placed in the 1st molar region in both jaws (8% tooth number 46, 7.8% tooth number 36, 6.6% tooth number 26, and 6.2% tooth number 16, respectively) and the second most common dental implant was placed in the 1st premolar region of the upper jaw (tooth number 24 and 14, 5.6% and 5.3%, respectively). In contrast, the least frequently implanted sites were the mandibular central incisor regions (tooth numbers 41 and 31, 0.5% and 0.6%, respectively).

Chi-square test was used to test whether there was a statistically significant relationship between age and MM (maxilla - mandible) variables. There was a statistically significant relationship between the two variables. When the implant localizations were examined, 70.6% of those aged 19-29 years were localized in the maxilla and

29.4% in the mandible; 45.9% of those aged 70-79 years were localized in the maxilla and 54.1% in the mandible; and 27% of those aged 80-89 years were localized in the maxilla and 73% in the mandible (Table 2). Thus, there was a trend towards decreasing frequency of maxilla-based implants with age.

Chi-square test was used to test whether there is a statistically significant relationship between gender and MM variables, but no relationship was detectable.

There was a statistically significant relationship between tooth number and gender (p<0.05): 36.5% of those with tooth number 12 were male and 63.5% were female, 58.2% of those with tooth number 15 were male and 41.8% were female, 38.6% of those with tooth number 35 were male and 61.4% were female, and 59.5% of those with tooth number 36 were male and 40.5% were female.

Another statistically significant relationship was detected between MM and AP (anterior posterior) variables: 56.1% of the anterior ones were done in maxilla (43.9% in mandible), while 48.9% of the posterior ones were in maxilla (51.1% in mandible) (Table 3).

There was also a statistically significant relationship between age groups and implant localization with respect to the midline. For example, 39.7% of patients aged 19–29 years had implants placed on the right side, while 60.3% had implants placed on the left side (Table 4).

DISCUSSION

Dental implants have gained widespread acceptance and popularity worldwide as a long-lasting and effective solution for replacing missing teeth. With an aging global population, there is an increased prevalence of tooth loss due to factors such as age-related conditions, tooth decay, periodontal disease and simply wear-and-tear. This has led to increasing demand for tooth replacement solutions, with dental implants being a popular choice. Increased awareness of oral health importance and its impact on overall well-being has encouraged more individuals to seek long-term solutions for missing teeth. Dental implants offer a natural-looking and functional alternative to traditional dentures or bridges. Ongoing research and clinical studies contribute to the refinement of dental implant techniques and materials. Posi-

Table 2. Relationship Between Age and The Number of Implants Placed in The Maxilla and Mandible (MM: Maxilla-Mandible)

			Maxilla	Mandible	Total	χ^2 (p)
Age	15-18	n	2_a	1_a	3	
		% Age	66.70%	33.30%	100.00%	
		% MM	0.10%	0.00%	0.10%	
	19-29	n	$\mathbf{89_a}$	$\mathbf{37_b}$	126	
		% Age	**70.60%**	**29.40%**	100.00%	
		% MM	**4.00%**	**1.70%**	2.90%	
	30-39	n	270_a	224_a	494	
		% Age	54.70%	45.30%	100.00%	
		% MM	12.20%	10.40%	11.30%	
	40-49	n	426_a	448_a	874	
		% Age	48.70%	51.30%	100.00%	
		% MM	19.20%	20.80%	20.00%	
	50-59	n	665_a	662_a	1327	48.165 (<0.001*)
		% Age	50.10%	49.90%	100.00%	
		% MM	30.00%	30.70%	30.40%	
	60-69	n	442_a	381_a	823	
		% Age	53.70%	46.30%	100.00%	
		% MM	20.00%	17.70%	18.80%	
	70-79	n	$\mathbf{303_a}$	$\mathbf{357_b}$	660	
		% Age	**45.90%**	**54.10%**	100.00%	
		% MM	**13.70%**	**16.60%**	15.10%	
	80-89	n	$\mathbf{17_a}$	$\mathbf{46_b}$	63	
		% Age	**27.00%**	**73.00%**	100.00%	
		% MM	**0.80%**	**2.10%**	1.40%	
Total		n	2214	2156	4370	
		% Age	50.70%	49.30%	100.00%	
		% MM	100.00%	100.00%	100.00%	

*χ^2: Chi-square test statistic (df=7), *p<0.05, a,b: Each subscript letter denotes a subset of column categories whose column proportions do not differ significantly from each other at the .05 level.*

Table 3. The relationship Between MM and AP (MM: Maxilla-Mandible, AP: Anterior-Posterior

			AP			
			Anterior	Posterior	Total	χ² (p)
MM	Maxilla	n	609	1605	2214	17.2 (<0.001*)
		% MM	27.5%	72.5%	100.0%	
		% AP	56.1%	48.9%	50.7%	
	Mandible	n	476	1680	2156	
		% MM	22.1%	77.9%	100.0%	
		% AP	43.9%	51.1%	49.3%	
Total		n	1085	3285	4370	
		% MM	24.8%	75.2%	100.0%	
		% AP	100.0%	100.0%	100.0%	

χ²: Chi-square test statistic (df=1), *p<0.05

tive outcomes from these studies help build confidence in the safety and efficacy of dental implants among both patients and practitioners. For these reasons, dental implants have been used successfully for dental treatment for a long time. Retrospective analysis of patients and treatments may provide valuable guidance for dental practice. Despite the large number of dental implant applications in recent years, quantitative data are not yet widely available [7]. This may be attributed to the inadequacy of electronic or manual patient records in hospitals and the subsequent difficulty in quantitative data collection. In this study, quantitative data obtained from the electronic archive of Gazi University School of Dentistry were evaluated.

Although the present study exclusively analyzed conventional intraosseous implants placed in healed edentulous sites, it should be emphasized that dental implant rehabilitation may also involve alternative surgical procedures such as the ridge split technique, the use of platelet-rich fibrin, pterygoid and zygomatic implants, and the all-on-four concept, which have been reported as successful options in specific clinical situations [11–13]. Mentioning these modalities underlines that the implant localizations identified in our sample represent only a part of the broader spectrum of implant-based rehabilitation strategies currently used in clinical practice. The frequency of dental implant treatment is proportional to increasing age and tooth loss [8]. In a study conducted by Vehemente et al. [6] the mean age of patients undergoing dental implant procedures among those indicated for such treatment (age range: 16-92 years) was 53.5 years. Eltaş et al. [14] on the other hand, studied a wider age range (20 to 78 yr) and reported an average age of 45.2. In the present study, the mean age of a total of 1259 patients aged between 15 and 81 years was 51.5 years, indicating that dental implant application is proportional to increasing age (Table 2). Cartelli et al. [15] pointed out that female patients in Brazil receive dental implant treatment approximately twice as often as male patients. Bozkurt et al. [16] reported the percentage of female patients as 55.3%. Another study by Polat et al. [17] also found that the proportion of female patients was higher in dental implant applications. In the present study, female patients accounted for a higher proportion of dental implant treatments (61.7%), consistent with previous reports.

Table 4. Relation Between Age and Localization According to Midline					
			Localization according to midline (L)		
			Right to the midline	Left to the midline	Total	χ^2 (p)
Age	15-18	n	3$_a$	0$_a$	3	
		% Age	100.00%	0.00%	100.00%	
		% L	0.10%	0.00%	0.10%	
	19-29	n	**50$_a$**	**76$_b$**	126	
		% Age	**39.70%**	**60.30%**	100.00%	
		% L	**2.30%**	**3.40%**	2.90%	
	30-39	n	261$_a$	233$_a$	494	
		% Age	52.80%	47.20%	100.00%	
		% L	12.20%	10.50%	11.30%	
	40-49	n	439$_a$	435$_a$	874	
		% Age	50.20%	49.80%	100.00%	
		% L	20.50%	19.50%	20.00%	
	50-59	n	642$_a$	685$_a$	1327	14.1 (0.049*)
		% Age	48.40%	51.60%	100.00%	
		% L	30.00%	30.70%	30.40%	
	60-69	n	412$_a$	411$_a$	823	
		% Age	50.10%	49.90%	100.00%	
		% L	19.20%	18.40%	18.80%	
	70-79	n	303$_a$	357$_b$	660	
		% Age	45.90%	54.10%	100.00%	
		% L	14.10%	16.00%	15.10%	
	80-89	n	32$_a$	31$_b$	63	
		% Age	50.80%	49.20%	100.00%	
		% L	1.50%	1.40%	1.40%	
Total		n	2142	2228	4370	
		% Age	49.00%	51.00%	100.00%	
		% L	100.00%	100.00%	100.00%	

*χ^2: Chi-square test statistic (df=7), *p<0.05, a,b: Each subscript letter denotes a subset of column categories whose column proportions do not differ significantly from each other at the .05 level.*

Urvasızoglu et al. (7), examined the edentulous state of 87 jaws with implants in 67 patients and they observed that the most common edentulous state was partial edentulism (n=32; 37%) that resulted in edentulousness. This was followed by a single missing tooth (n=26; 30%), partial edentulism with a toothed ending (n=21; 24%) and, least frequently, complete edentulism (n=8; 9%). Bural et al. (18) reported that 48.2% of the implants were applied in cases of complete edentulism, and 23.2% in edentulous cases. Buser et al. (19) noted that the total edentulous mandible was the most common (n=392) and the total edentulous maxilla (n=23) was the least common in their study. Similarly, Polat et al. (17) in 2019, it was reported that 56.2% of a total of 315 implants were applied to the maxilla, while 43.8% were applied to the mandible. According to the results of this study, most dental implants were applied to the left mandibular posterior region. This region was followed by right mandibular posterior, left maxillary posterior and right maxillary posterior, respectively (Table 4). In the study conducted by Sarı and Tümer (20), the mandibular canine tooth was the most implanted tooth region, followed by the maxillary first molar tooth region. The area where the fewest implants were applied was the maxillary lateral tooth area. In this study, the maxillary lateral incisor region similarly showed a relatively low frequency of implant placement (1.7% for tooth number 12 and 1.9% for tooth number 22), whereas posterior regions, particularly the first molars, predominated. Akın et al. (21) found that most frequently lost tooth was tooth number 18, followed by the first molars (16, 26, 36, 46). In the present study, it was determined that tooth number 46 was the most lost and most implanted. This was followed by teeth numbers 36, 26 and 16, respectively. This predominance of mandibular first molars as implant sites may be related to the fact that these teeth are the first permanent teeth to erupt, remain in function for many years, and are frequently affected by caries and extensive restorations from an early age, which increases their likelihood of eventual tooth loss and replacement with implants. Therefore, our findings highlight the importance of preventive strategies and early restorative interventions targeting first molars in order to reduce the need for implant-supported rehabilitation in later adulthood.

We observed that 2156 (49.3%) implants were applied to the lower jaw and 2214 (50.7%) were to the upper jaw.

These figures are similar to those reported by others. Adalı et al. (22) reported that 48.3% of dental implants were localized in the lower jaw. The corresponding frequency was 47.6% in the lower jaw in the report by Urvasızoğlu et al. (7)

Urvasızoğlu et al. (7) also reported that 40.0% of dental implants were placed in the anterior region and 60.0% were placed in the posterior region. In a study by Polat et al. (17), 28.2% of dental implants were found to be localized in the anterior region. In the present study, 1085 (24.8%) of the implants were in the anterior position, which is similar with other studies (Table 3). We also emphasize that 1616 (49.2%) of 247 implants were placed on the right side of the patients (1st and 4th regions), and 1669 (50.8%) were placed on the left side (2nd and 3rd regions) (Table 4).

Implants offer stability and functionality comparable to natural teeth. They allow individuals to eat, speak, and engage in daily activities with confidence, without the concerns associated with removable dentures. In addition, dental implants help preserve the jawbone by stimulating bone growth through the process of osseointegration. This prevents bone loss, a common issue that occurs when teeth are missing. However, not everyone is a candidate for dental implants as factors such as overall health, jawbone density, and oral hygiene all play an important role confirmed in determining suitability. It's important for individuals considering dental implants to consult with a qualified dentist or oral surgeon to assess their specific needs and determine the most suitable treatment plan.

Despite the growing use and success of dental implants, the global priority remains to be the preservation of natural teeth, driven by both economic and health concerns. In this retrospective study, we examined the distribution of dental implants according to gender, age, and localization with the view that the results may guide dentists and patients in their efforts toward the preservation of permanent teeth.

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Abbreviations List

FDI: World Dental Federation
χ^2: chi-square
df: degrees of freedom
AP: anterior posterior
MM: maxilla – mandible

Ethics Approval and Consent to Participate

This study was conducted in accordance with the Principles of the Declaration of Helsinki and ethical approval was received from Health Sciences University Gülhane Scientific Research Ethics Committee (Decision Date: 28.06.2024, Meeting no: 2024/06, Project/Decision No: 2024-367).

Consent for Publication

This study was designed as a retrospective review of hospital data; thus, ethics committee approval was obtained, while patient informed consent was not deemed necessary.

Availability of Data and Materials

The data in this article were obtained from the archives of the Gazi University.

Competing Interests

Both of the authors certify that they have no affiliations with or involvement in any organization or entity with any financial interest or non-financial interest in the subject matter or materials discussed in this manuscript.

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