



## Dental Implant Procedures Performed in Gazi University Faculty of Dentistry, Department of Oral and Maxillofacial Surgery for the last six years: Prevalence and Demographic Distribution

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### Research Article

#### History

Received: 02/08/2024  
Accepted: 05/12/2024

### ABSTRACT

**Objectives:** The primary goal of dental implant treatment is to restore functional integrity, which is vital for oral health in patients with tooth loss, as well as to address aesthetic and psychological concerns. Demographic data from retrospective studies conducted in clinical settings with a high patient volume can be used as additional parameters when evaluating the success of dental implants.

**Material-Methods:** In this study, the distribution of data by treatment years, patient gender and age, tooth regions and number of teeth (FDI system) were reviewed retrospectively for a total of 1892 patients among 7345 patients who underwent dental implant procedures at Gazi University Faculty of Dentistry, Department of Oral and Maxillofacial Surgery between January 2017 and June 2022.

**Results:** It was found that female patients (51.7%) showed a higher prevalence than male patients for dental implant treatments, the mandible and maxilla posterior regions were the most common sites used for dental implants, and the age range of 50-59 years (5<sup>th</sup> decade) had the highest number of dental implants (31.1%). Moreover monthly figures showed that the majority of the dental implant procedures were performed in 2019, prior to the COVID-19 pandemic.

**Conclusion:** Based on these results, it was concluded that patient demographics are an important factor in planning dental implant treatment.

**Keywords:** Dental Implant, Demographic Distribution.

## Gazi Üniversitesi Diş Hekimliği Fakültesi Ağız Diş ve Çene Cerrahisi Anabilim Dalı'nda Son Altı Yılda Gerçekleştirilen Dental İmplant Operasyonları; Sıklık ve Demografik Dağılım

### Research Article

#### Süreç

Geliş: 02/08/2024  
Kabul: 05/12/2024

### Öz

**Amaç:** Dental implant tedavilerinin temel amacı, diş kaybı yaşamış hastaların ağız sağlığında önemli olan fonksiyonel bütünlüğün sağlanmasının yanı sıra estetik ve psikolojik sorunların da ortadan kaldırılmasına yöneliktir. Hasta yoğunluğunun fazla olduğu kliniklerde yapılan retrospektif çalışmalarla birlikte sağlanacak demografik bilgiler dental implantların başarı kriterlerinin değerlendirilmesinde kullanılacak diğer parametreler için bir temel oluşturmaktadır.

**Gereç-Yöntemler:** Bu çalışmada Ocak 2017-Haziran 2022 yılları arasında Gazi Üniversitesi Diş Hekimliği Fakültesi Ağız Diş ve Çene Cerrahisi Anabilim Dalı'nda implant tedavisi gören 7345 vaka arasından 1892 vakanın yıllara, cinsiyete, yaşa, diş bölgeleri ve numaralarına göre dağılımı retrospektif olarak incelenmiştir.

**Bulgular ve Sonuçlar:** İmplant uygulaması yapılan 1892 hastadan kadın hastaların %51,7 ile erkek hastalardan daha fazla implant tedavisi gördükleri saptanmıştır. Bununla beraber, alt çene ve üst çene posterior bölgelerin en fazla implant uygulanan bölgeler olduğu saptanmıştır. En çok implant yapılan yaş aralığının ise %31.1 ile 50 ila 59 yaş aralığında (5. dekatta) olduğu gözlemlenmiştir. Aylık ortalamaya bakıldığında ise en fazla implantın 2019 yılında pandemi öncesinde yapılmış olduğu da bulgular arasındadır. Bu sonuçlara dayanarak, hasta demografisinin dental implant tedavisinin planlanmasında önemli bir faktör olduğu sonucuna varılmıştır.

**Anahtar Kelimeler:** Anksiyete, Depresyon, Temporomandibular Bozukluk.

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**How to Cite:** Hurmuzlu M, Mollaoglu N. (2024) Dental Implant Procedures Performed in Gazi University Faculty of Dentistry, Department of Oral and Maxillofacial Surgery for the last six years: Prevalence and Demographic Distribution, 27(4):240-244.

## Introduction

Tooth loss is an irreversible condition that is associated with adverse outcomes. Complete tooth loss or edentulism is defined as “the ultimate indicator of the disease burden for oral health”.<sup>1</sup> Although the prevalence of tooth loss has decreased over the last decade, it is still a major concern worldwide, particularly among adults and the elderly population.<sup>2</sup>

Tooth loss, either partial or complete, has numerous effects on oral functions and, consequently, on oral health. From a physiological perspective, bone loss is an ongoing process that continues following tooth loss. Bone loss resulting from teeth loss is four times greater in the mandible than in the maxilla. Additionally, edentulism has been found significantly influence the alveolar bone resorption, which can lead to a reduction in alveolar crest height. This reduction affects facial height following tooth loss, thereby altering the facial appearance. Alveolar resorption can also cause significant changes in the soft tissue profile of both the lower lip and mandible.<sup>3-5</sup>

The number of teeth is regarded as the key determinant of oral functions and overall oral health status. A systematic review examining the relationship between oral function and the number of teeth has shown that having fewer than 20 teeth is associated with impaired chewing ability and performance.<sup>6</sup> Furthermore, it is also known that the thickness of the masseter muscle is reduced in edentulous patients, which in turn decreases bite force and directly affects chewing efficiency.<sup>7</sup>

In some cases, edentulism may be associated with functional and sensory deficiencies of the oral mucosa and musculature, and salivary glands. Edentulous population also shows reduced tissue regeneration, which can impair the function of the oral mucosa. A positive correlation between edentulism and oral mucosal disorders; aging; denture use; denture stomatitis; oral candidiasis and traumatic ulcers, has been previously reported.<sup>8,9</sup> Although most oral mucosal disorders affecting adults and older individuals are benign, some may become malignant.<sup>10</sup> Edentulism can also induce oral dyskinesia, which is characterized by abnormal, involuntary, stereotypic orofacial movements.<sup>11</sup>

The concept of osseointegration was first introduced by Brånemark nearly 50 years ago. Since then, dental implantology has evolved from experimental efforts to a successful and predictable treatment modality for replacing missing teeth.<sup>1</sup> Dental implants are of significant importance as they can restore natural function, protect the alveolar bone, provide additional support, preserve surrounding tissues, and enhance aesthetics. Consequently, dental implant treatment has become a routine clinical practice in modern dentistry. Several studies have reported that dental implants improve chewing function and enhance the quality of life in patients

with complete or partial edentulism.<sup>2-5</sup> As a result, dental implants have become an excellent treatment option for the restoration of missing teeth. Despite their long-term survival, the rate of failure in dental implants increases over time. Patient-related factors such as overall health, age, gender, socioeconomic status, smoking habit, bone quality, oral hygiene, and untreated infections, along with implant-related factors including implant size, surface characteristics, location, and loading protocol, as well as clinician experience, have been reported to influence the success or failure of implants.<sup>5,6</sup>

While the implant design, surface characteristics, framework materials, and surgical protocols have been well-documented in the literature, there is still a need for detailed demographic data and further information on the sites of implant placement. Therefore, the aim of this study was to retrospectively analyze patient demographic data and dental implant localizations to provide information on the location and number of dental implants by age and gender. For this purpose, demographic and implant-specific data of patients who underwent dental implant treatment at Gazi University Faculty of Dentistry, Department of Oral and Maxillofacial Surgery between January 2017 and June 2022 were analyzed.

## Materials and Methods

Approval for the study was obtained from the Ethics Committee for Non-Interventional Clinical Trials of Gazi University Faculty of Dentistry (Date: 06/10/2022, No. E-21071282-050.99-519934). In this study, archived data of a total of 7345 patients who referred to Department of Oral and Maxillofacial Surgery at Gazi University Faculty of Dentistry between January 2017 and June 2022 were reviewed retrospectively, and 1892 patients were included in this study with total of 6486 dental implants placed over a 6-year period. Only patients age of 18 years or older having dental implant treatment were included to study. Demographic data (age and gender) and location of implants were reviewed.

All the patients included in this study were classified according to age and gender and statistical analysis was performed according to the position of the dental implants placed. To determine the statistical significance of the study, a 95% confidence interval was established using the single proportion confidence interval approach. Demographic parameters were statistically analyzed by comparing the mean values.

Analysis by age was done both by decades and by specific age ranges (Table 1):

1. 18-29 age group
2. 30-39 age group
3. 40-49 age group
4. 50-59 age group
5. 60-69 age group
6. 70-79 age group
7. 80-89 age group

**Table 1. Distribution of dental implants by age group.**

Variable (n=6486)	n	%
<b>Age group</b>		
18-29	310	4.8
30-39	594	9.2
40-49	1358	20.9
50-59	2019	31.1
60-69	1719	26.5
≥70	486	7.5

Implant location were divided into four regions as follows (Table 2):

1. Anterior maxillary region, including the teeth number 13 to 23.
2. Anterior mandibular region, including the teeth number 33 to 43.
3. Posterior maxillary region, including the teeth number 14 to 17 and 24 to 27.
4. Posterior mandibular region, including the teeth number 34 to 37 and 44 to 47.

**Table 2. Distribution of all dental implants by location.**

Variable (n=6486)	n	%
<b>Implant Location</b>		
Anterior maxilla	942	14.5
Posterior maxilla	<b>2388</b>	<b>36.9</b>
Anterior mandible	774	11.9
Posterior mandible	2382	36.7

Initially, an analysis was performed based on the total number of dental implant procedures carried out over the 6-year period, including patient age, gender, tooth number, and dental region. Data analyses were then carried out for the following years:

1. Year 2017
2. Year 2018
3. Year 2019
4. Year 2020
5. Year 2021
6. Year 2022 (first 6 months).

### Statistical Analysis

Considering the error rate and standard deviation, the mean value of each parameter was evaluated quantitatively. Statistical comparative analyses for each parameter were conducted using the R software (Version 4.0.4 (2021-02-15) -- "Lost Library Book" Copyright (C) 2021-The R Foundation for Statistical Computing). Data visualization was performed using MS Excel and R software packages. The normality of the data distribution was checked using the Shapiro-Wilk test. For variables that followed a normal distribution, a paired samples t-test was used to compare two groups. Two-way ANOVA was used to compare the means of two independent variables or factors from two or more populations. Unless stated otherwise,  $p < 0.05$  was considered statistically significant.

### Results

This study included 1892 patients with mean age of 53.  $21 \pm 12.51$  years (18 to 87 years). Total of 51.7% of the

patients ( $n = 978$ ) were female, and 48.3% ( $n = 914$ ) were male.

A total of 310 implants (4.8%) were placed in patients in the 18-29 age group, 594 implants (9.2%) in the 30-39 age group, 1358 implants (20.9%) in the 40-49 age group, 2019 implants (31.1%) in the 50-59 age group, 1719 implants (26.5%) in the 60-69 age group, and 486 implants (7.5%) in the  $\geq 70$  age group (Table 1). Among a total of 6486 implants, 3282 implants (50.6%) were placed in female patients and 3204 implants (49.4%) in male patients.

It was found that 942 implants (14.5%) were placed in the anterior maxillary region, 2388 implants (36.9%) in the posterior maxillary region, 774 implants (11.9%) in the anterior mandibular region, and 2382 implants (36.7%) in the posterior mandibular region (Table 2).

When the distribution of implants according to tooth numbers was analyzed, it was found that the highest number of implants were placed in teeth numbered 26,16,24,14 in the maxilla, and in the mandible, in teeth numbered 36,46,33,43, respectively (Table 3).

There was no statistically significant relationship between gender and dental implant placement ( $p > 0.05$ ). In both genders, dental implants were most frequently placed in the region of teeth numbered 36, 46, 16 and 26, respectively. However, there was a significant association between gender and the year of implant placement ( $\chi^2 = 107,166$ ;  $p = 0.000$ ) (Table 4). Moreover, statistically significant relationship was also observed between gender and age group ( $\chi^2 = 25,785$ ;  $p = 0.000$ ) (Table 5).

Table 3. Distribution of dental implants according to FDI tooth numbering system.

	n	%		n	%
<b>Tooth Number (#)</b>			<b>Tooth Number</b>		
11	126	1.9	31	39	0.6
12	157	2.4	32	99	1.5
13	186	2.9	33	<b>256</b>	3.9
14	<b>333</b>	5.1	34	220	3.4
15	265	4.2	35	234	3.6
16	<b>398</b>	6.1	36	<b>469</b>	7.2
17	175	2.7	37	270	4.2
21	131	2.0	41	37	0.6
22	153	2.4	42	94	1.4
23	198	3.1	43	<b>256</b>	3.9
24	<b>345</b>	5.3	44	231	3.6
25	252	3.9	45	219	3.4
26	<b>414</b>	6.4	46	<b>469</b>	7.2
27	202	3.1	47	258	4.0

Table 4. Distribution of patients by gender between 2017 and 2022.

Sex (Variable)	Female (n=3282)		Male (n=3204)		Statistical analysis* Probability
	n	%	n	%	
<b>Year</b>					
2017	609	18.6	652	20.3	$\chi^2=107,166$ <b>p=0.000</b>
2018	<b>931</b>	28.4	720	22.5	
2019	<b>993</b>	30.3	<b>829</b>	25.9	
2020	215	6.6	307	9.6	
2021	157	4.8	307	9.6	
2022	377	11.5	389	12.1	

\* Pearson's Chi-Square cross-tabulations were used to examine the relationships between two categorical variables.

Table 5. Distribution of gender by age group.

Sex (Variable)	Female (n=3282)		Male (n=3204)		Statistical analysis* Probability
	n	%	n	%	
<b>Age groups (years)</b>					
18-29	160	4.9	150	4.7	$\chi^2=25,785$ <b>p=0.000</b>
30-39	301	9.1	293	9.1	
40-49	767	23.4	591	18.4	
50-59	<b>973</b>	29.6	<b>1046</b>	32.6	
60-69	843	25.7	876	27.3	
≥70	236	7.3	248	7.7	

\* Pearson's Chi-Square cross-tabulations were used to examine the relationships between two categorical variables.

## Discussion

Osseointegrated dental implants represent a highly effective and predictable treatment method for tooth loss. Following the introduction of the "osseointegration" concept in the 1950s, which revolutionized the field of dentistry, dental implants have become a routine procedure. Since then, numerous scientific studies have been conducted on the use and effectiveness of dental implants.<sup>12-16</sup> Dental implants are a successful, highly effective, and predictable treatment modality used to address problems caused by tooth loss and to restore the function of missing teeth.<sup>17</sup> Despite the increase in dental implant procedures in Türkiye over the past decade, studies failed to provide quantitative data.<sup>18</sup> The challenges in collecting quantitative data may be attributed to the newly developing automation and hospital systems, as well as difficulties in tracking surgical procedures within the existing system in Türkiye. The need for implant treatment has been correlated with tooth loss and advancing age.<sup>19</sup> Our study included 1892

patients with a mean age of 53.21 years (range, 18 to 87 years). More than half of the patients (51.7%) were female. The mean age of the male patients was significantly greater than that of female patients (Table 1). Similarly, in a retrospective study by Noack et al., which examined approximately 2000 dental implants placed between 1981 and 1997, the 50-59 age group received the greatest number of implants, in both males and females.<sup>20</sup> According to the results of this study, implant procedures were most frequently performed in the 5<sup>th</sup> decade (31%), followed by the 6<sup>th</sup> decade (26%) in both sexes (Table 3). Also, a significant association was observed between sex and age group (Table 5) ( $p < 0,05$ ). It was observed that 23.4% of the female patients were in the 40-49 age group, while 32.6% of the male patients were in the 50-59 age group. Furthermore, the patients in the 18-29, 30-39, and 40-49 age groups were predominantly female, whereas those in the 50-59, 60-69, and ≥70 age groups were predominantly male. Previous studies from Türkiye also reported quite variable mean ages.<sup>21</sup> In our study, the age

range of patients who received implants was 18-87, with the most common age for receiving implant treatment being 57 years for women and 60 years for men. The slight age variations observed might be explained by differences in sample size, methods used for age categorization, or socioeconomic status of the populations examined. A study at Yonsei University involving 1814 implants and 640 patients found that 49% of the patients who received implants were in their 40s and 50s<sup>22</sup> much younger than our study population. In agreement with our findings, published studies also show that dental implant treatment is more common among female patients compared to male patients (Table 4).<sup>23-25</sup> It was found that 993 (30.3%) females received dental implants in 2019, while 652 (20.3%) males received implants in 2017. Males mostly received dental implants in the years 2017, 2020, 2021, and 2022, while females mostly underwent implant treatment in the years 2018 and 2019 (Table 5) ( $p < 0.05$ ). The distribution of implants by year shows that the most implant procedures were performed in 2019, just before the COVID-19 pandemic started in Türkiye.

The distribution of implants by dental region was also evaluated in detail. In our patients, dental implants were most commonly placed in the posterior maxillary region, followed by the posterior mandibular region (Table 5). The lowest number of implants were placed in the anterior mandibular region. When examining the posterior maxillary region by individual dental regions, the tooth number 26 was the most frequent implant location (Table 3). There was no significant association between sex and implant regions ( $p > 0.05$ ). The distribution of implant regions was homogeneous irrespective of gender. Likewise, in a retrospective study, it was reported that the majority of dental implants were placed in the maxillary molar region and that the mandibular molar region was the second most common implant site (Table 2).<sup>26-29</sup> In contrast, Drago et al. reported in a retrospective study that dental implants were predominantly placed in the mandible (87.3%) and that a significant portion of implants (75.4%) were placed in the anterior region.<sup>28</sup>

A significant relationship was found between sex and the year of implant placement, with female patients receiving a higher number of dental implants than male patients ( $p < 0.05$ ). Our study revealed that 71 (31.6%) female patients underwent dental implant procedures in 2019, while in 2017, 2020, and 2021, the majority of patients receiving implants were male, and in 2018, 2019, and 2022, the majority were female (Table 4).

In this study, implant treatments were more commonly applied to the molar teeth compared to other teeth. Regarding the tooth numbers of the teeth undergoing implant treatment, the maxillary and mandibular first molars (teeth #16, 26, 36 and 46) were the most commonly treated teeth. The least frequently treated teeth were the teeth #31, 32, 41, and 42 (Table 3). Similar findings were reported in a 2018 study from Türkiye involving 1000 patients.<sup>30</sup> Another retrospective study by Bornstein et al. reported that implants were most frequently placed in the posterior mandible region, with

the most common implant site being the tooth #36, and the least common implant site being the anterior mandibular region.<sup>31</sup> The distribution of dental implants by implant location observed in our study is consistent with Bornstein et al.'s findings.<sup>31</sup> In addition, this study emphasizes that the prevalence of dental implant surgery is higher in the 50-59 age group in both genders.

## Conclusions

This study revealed that the demand for dental implants increased significantly in certain age groups for both genders, as well as the number of dental implant placements being higher in the posterior mandibular region. Based on these results, it was concluded that patient demographics are an important factor in planning dental implant treatment. However, further research is needed in different geographic and demographic settings to confirm these results.

## Conflicts of Interest Statement

In this study, there is no conflict of interest.

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