

Retrospective Study of the Demographic Characteristics and Distribution of Dental Implant Patients over the Years

Dental İmplant Hastalarının Demografik Özelliklerinin ve Yıllara Göre Dağılımının Retrospektif İncelemesi

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ABSTRACT Objective: This study aimed to retrospectively analyze the distribution of dental implant treatments applied to 9,344 patients according to age, gender, implant site, and year of application. **Material and Methods:** The data of 9,344 patients who underwent dental implant treatment between 2013-2023 at the Faculty of Dentistry, Ondokuz Mayıs University, were included in this study. A total of 34,753 dental implants were evaluated. Criteria such as the patients' age, gender, implant location, and the rates of dental implant applications over the years were assessed. **Results:** Dental implants were applied more frequently to male patients (53.5%) than to female patients (46.5%). The majority of implants (50.4%) were placed in the mandible. The average age at first implant application in male patients (52.08 ± 13.23) was found to be higher than that of female patients (48.87 ± 13.49). In female patients, the number of implants placed in the mandible was observed to be higher than that in the maxilla. In both sexes, the mandibular first molar region was found to be the most frequently treated site. **Conclusion:** This retrospective study offers descriptive information regarding the demographic characteristics of patients who received dental implants, the rate of dental implant procedures performed over the years, and the preferred implant sites within the Turkish population. These findings may contribute to clinical practice by supporting clinicians in treatment planning and decision-making processes.

Keywords: Demography; dental implant; retrospective study

ÖZET Amaç: Bu çalışma, 9,344 hastaya uygulanan dental implant tedavilerinin yaş, cinsiyet, implant bölgesi ve uygulama yılına göre dağılımını retrospektif olarak analiz etmeyi amaçlamıştır. **Gereç ve Yöntemler:** Bu çalışmaya, Ondokuz Mayıs Üniversitesi Diş Hekimliği Fakültesi'nde 2013-2023 yılları arasında dental implant tedavisi gören 9,344 hastanın verileri dâhil edildi. Toplam 34,753 dental implant değerlendirildi. Hastaların yaş, cinsiyet, implant lokasyonu ve yıllara göre dental implant uygulama oranları gibi kriterler değerlendirildi. **Bulgular:** Diş implantlarının erkek hastalara (%53,5) kadın hastalara göre (%46,5) daha fazla uygulandığı bulunmuştur. İmplantların çoğunluğu (%50,4) mandibulaya yerleştirilmiştir. Erkek hastalarda ilk implant uygulama yaşı ortalaması ($52,08 \pm 13,23$), kadın hastalara göre ($48,87 \pm 13,49$) daha ileri bulunmuştur. Kadın hastalarda mandibulaya yerleştirilen implant sayısının maksillara göre daha fazla olduğu gözlemlenmiştir. Her iki cinsiyette de en sık uygulama yapılan bölgenin alt birinci molar diş bölgesi olduğu bulunmuştur. **Sonuç:** Bu retrospektif çalışma, dental implant uygulanan hastaların demografik özellikleri, yıllar içinde gerçekleştirilen dental implant işlemlerinin oranı ve Türk popülasyonunda tercih edilen implant bölgeleri hakkında tanımlayıcı bilgiler sunmaktadır. Bulguların, tedavi planlaması ve karar verme süreçlerinde klinisyenlere katkı sağlayabileceği düşünülmektedir.

Anahtar Kelimeler: Demografi; dental implant; retrospektif çalışma

Since the 1960s, when Branemark and colleagues first defined the concept of osseointegration, the use of dental implants in the treatment of tooth loss has become increasingly widespread.^{1,2} Dental implants provide satisfactory results both aesthetically and functionally.^{3,4} Dental implant treatments

have emerged as a solution for tooth loss due to issues such as stabilization problems experienced with traditional removable dentures, insufficient chewing function, unsatisfactory aesthetics, and the lack of conservative treatment options for tooth-supported fixed restorations.^{5,6}

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Dental implants have a high success rate and survival. However, factors such as the patient's systemic health, age, gender, smoking habits, bone quality, oral hygiene, implant maintenance habits, implant size, implant characteristics, implant location, loading protocol, and clinician experience are considered determinants of implant survival and long-term success.⁵

Various factors play a role in the success of dental implants. Careful patient selection, risk assessment, and the optimization of long-term follow-up outcomes are essential for implant success. Dentists should take demographic risk factors into account and be cautious in applying preventive and therapeutic strategies to enhance the success of dental implants. However, there is limited information regarding the demographic characteristics of patients requiring dental implants, the rate of dental implant procedures over the years, and the preferred implant locations within the Turkish population. Collecting such data would be informative and guiding for practitioners. This study, which analyzes a large data pool, aims to reveal the relationship between dental implant applications and demographic factors, thereby assisting dentists in making more effective treatment plans. Furthermore, by examining the changes in implant application rates over the years, it seeks to contribute to the prevention of tooth loss and the increase of awareness regarding treatment within the community. The findings obtained will provide valuable data for the development of health policies and the improvement of accessibility and effectiveness of implant treatments.

MATERIAL AND METHODS

This study was carried out in accordance with the principles of the Helsinki Declaration. Ethical approval was granted by the Ondokuz Mayıs University Clinical Research Ethics Committee (date: November 8, 2023, no: 2023/354). The study included 9,344 patients who underwent dental implant treatment at the Ondokuz Mayıs University Faculty of Dentistry between 2013-2023, with a total of 34,753 implants assessed. The implants included in our study were from the following brands: ITI (Straumann AG, Waldenburg, Switzerland), Zimmer (Zim-

mer Biomet, Warsaw, Indiana, USA), Implant Direct (Implant Direct Sybron International, Los Angeles, California, USA), Nobel (Nobel Biocare, Zürich, Switzerland), Biohorizons (Biohorizons, Birmingham, AL, USA), Bego (BEGO GmbH&Co. KG, Bremen, Germany), Astratech (Astratech AB, Mölndal, Sweden), Bredent (Bredent medical GmbH&Co. KG, Senden, Germany), NTA (Pilatus Swiss Dental GMBH, Switzerland), Osstem (Osstem Implant Co., Ltd., Seoul, South Korea), Dentium (Dentium Co., Ltd., Seoul, South Korea), Nucleoss (Şanlılar Tıbbi Cihazlar Medical Kimya San Tic Ltd Şti, İzmir, Türkiye), and İmplançe (İmplançe Dental Implants, Trabzon, Türkiye). Patient data was obtained and evaluated after institutional permission was granted, through the hospital's information management system (Turcasoft, Türkiye). The age, gender, implant location, and dental implant application rates over the years of the patients were evaluated retrospectively.

Data were analyzed using IBM SPSS V23. The distribution's normality was evaluated using the Kolmogorov-Smirnov test. To compare categorical variables between 2 groups, the chi-square test was applied, while multiple proportion comparisons were conducted using the Bonferroni-adjusted Z test. The Mann-Whitney U test was employed to compare quantitative data between 2 groups. Spearman's rho correlation coefficient was used to analyze relationships among non-normally distributed variables. The Fisher-Freeman-Halton test was applied to assess group differences, with a significance level set at $p < 0.05$.

RESULTS

A total of 34,753 dental implants were applied to 9,344 patients who underwent dental implant treatment in this study. Of these implants, 17,996 were applied to male patients and 16,757 to female patients. The median number of dental implants differed according to gender ($p < 0.001$), (Table 1). The median number of implants in male patients was 3, while in female patients, it was 2. A statistically significant difference was found in the median age of patients receiving implants based on gender ($p < 0.001$), (Table 2). The median age for implant placement in male patients was 53, while in female patients, it was 50. The

TABLE 1: Distribution of the number of implants by gender

	$\bar{X} \pm SD$	Median (minimum-maximum)	p value
Gender			
Male	4.06 \pm 3.26	3.00 (1.00-20.00)	<0.001
Female	3.41 \pm 2.71	2.00 (1.00-16.00)	
Total	3.72 \pm 3.00	2.00 (1.00-20.00)	

*Mann-Whitney U test. SD: Standard deviation

TABLE 2: Age distribution of patients receiving implants by gender

	$\bar{X} \pm SD$	Median (minimum-maximum)	p value
Gender			
Male	52.08 \pm 13.23	53.00 (15.00-89.00)	<0.001
Female	48.87 \pm 13.49	50.00 (15.00-91.00)	
Total	50.41 \pm 13.46	52.00 (15.00-91.00)	

*Mann-Whitney U test. SD: Standard deviation

average age of patients receiving implants was 50.41 \pm 13.46 years. A statistically significant but weak positive correlation ($r=0.287$, $p<0.001$) was observed between the number of implants and age (Table 3).

The regions of implant placement differ by gender ($p<0.001$), (Table 4). Implants were applied to the maxilla in 50.9% of male patients and to the mandible in 49.1%, while in female patients, 48.1% had implants placed in the maxilla and 51.9% in the mandible. The most commonly implanted dental regions in both males and females were the maxillary and mandibular 1st molars. In males, this was followed by the maxillary and mandibular 1st premolars, while in females, the maxillary 1st premolar and mandibular canine were the most frequently treated.

Regardless of gender, 49.6% of dental implants were inserted in the maxilla, while 50.4% were placed in the mandible. A considerable proportion (74%) of the implants were located in the posterior regions of the jaws. In the maxilla, the most frequently implanted sites were the 1st molar, 1st premolar, and 2nd premolar, whereas in the mandible, the 1st molar, 2nd molar, and 1st premolar were the most commonly treated regions (Figure 1).

The number of implants applied varies according to age groups ($p<0.001$). Of the included dental

implants, 11,948 were applied to patients in the 50-59 age group, making it the most common age range for dental implant application. Following the 50-59 age group, the 60-69 age group with 8,238 dental implants and the 40-49 age group with 7,652 dental implants were the next most common age groups. The youngest age group receiving dental implants was 15-29 years. A total of 1,350 dental implants were placed

TABLE 3: Relationship between number of implants and age

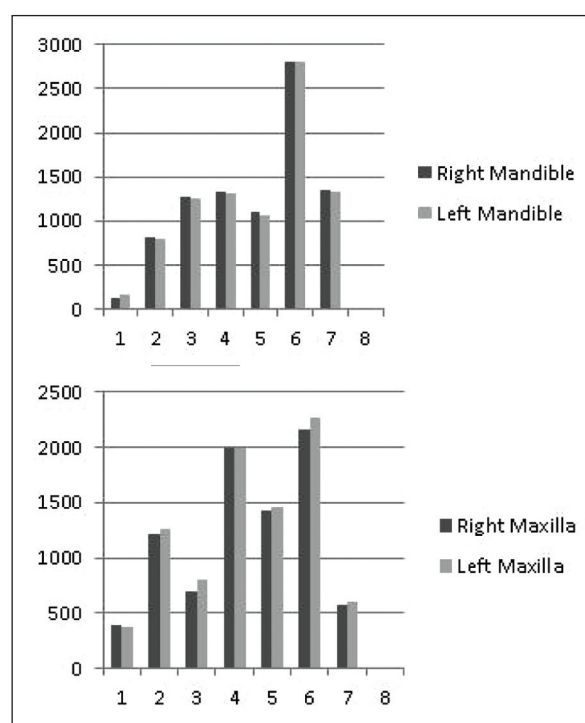
	Age	
	r value	p value
Number of implants	0.287	<0.001

r: Spearman's rho correlation coefficient

TABLE 4: Distribution of implant sites by gender

	Male n (%)	Female n (%)	Total n (%)	p value
Region				
Maxilla	9,166 (50.9)	8,064 (48.1)	17,230 (49.6)	<0.001
Mandible	8,830 (49.1)	8,693 (51.9)	17,523 (50.4)	

*chi-square test; n: frequency

**FIGURE 1:** The distribution of dental implants according to their jaw and tooth numbers

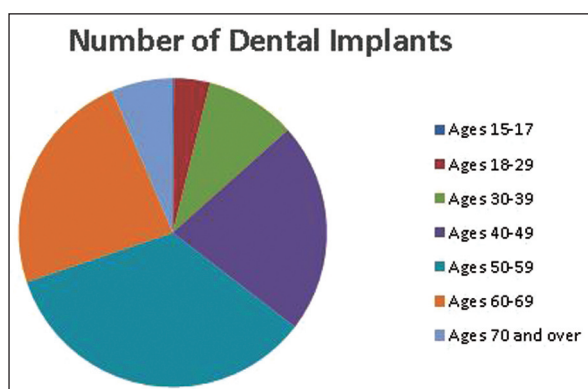


FIGURE 2: The distribution of dental implants according to age groups

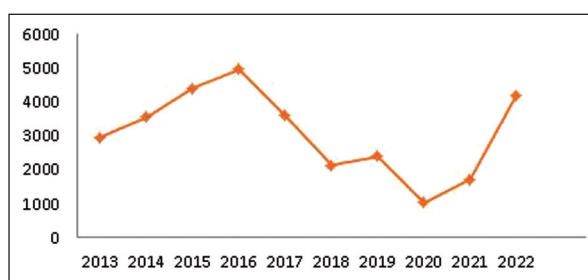


FIGURE 3: The distribution of the number of dental implants by year

in this age group, with the lower 1st molar region being the most frequently implanted site. Among the youngest age group (15-17 years), 54 dental implants were placed, of which 42 were positioned in the maxillary anterior region. Additionally, in patients aged 70 and over, more dental implants were applied to the mandibular canine region compared to other dental regions (Figure 2).

Upon examining the total number of implants placed over the years, the highest number was recorded in 2016, whereas the lowest, totaling 1,024, was observed in 2020. Since the implant data for the last 2 months of 2023 were not included in our study, the year 2023 was excluded from the analysis when evaluating the number of dental implants applied over the years. An increase in the number of implants was observed between 2013-2016, after which a decline in the number of implants began (Figure 3).

DISCUSSION

Dental implants offer a predictable and reliable solution for the restoration of missing teeth, with high long-term success rates reported in the literature.

However, the success and planning of implant therapy are influenced not only by surgical techniques but also by a variety of factors including patient-specific characteristics, systemic health conditions, lifestyle habits, and socioeconomic factors. A comprehensive understanding of these variables is essential to optimize treatment outcomes and ensure long-term stability of implant-supported restorations.^{7,8} This study aimed to analyze demographic and clinical data related to dental implants in a cohort of patients treated at the Ondokuz Mayıs University Faculty of Dentistry between 2013-2023. The majority of implants in our study were placed in the mandible (50.4%), and the maxilla accounted for 49.6%. The highest proportion of implants (34.4%) was placed in patients aged 50-59 years, followed by 23.7% in the 60-69 age group and 22.0% in the 40-49 age group. These findings provide valuable insights into demographic patterns and potential risk factors associated with dental implant treatment.

Although dental implants have been proven to be a long-term predictable treatment for patients, it is important to recognize that not all surviving implants are necessarily successful.⁹ Successful implants remain fully functional and healthy in the oral cavity. Although our study did not assess implant survival rates, it is recognized in the literature that risk factors such as age, gender, and implant location can affect implant survival.^{10,11}

There may be differences in implant survival rates between genders. These differences could be related to changes in bone quality, hormonal factors, and lifestyle behaviors that may affect oral health and implant integration.¹⁰ In this study, which examined a large data pool, it was found that 53.5% of the patients receiving dental implants were male and 46.5% were female. This finding, which does not align with the existing literature, may have been influenced by the sociocultural differences within the studied group.^{5,12}

It was found that the median age of implant application was higher in men compared to women, and this difference was statistically significant.^{13,14} Additionally, women may experience earlier tooth loss due to genetic and hormonal factors.¹⁵ Moreover, so-

cietal perceptions of gender-related health and aesthetic concerns could also influence the choice of implant treatment. Women may opt for implant treatment at a younger age due to aesthetic concerns.¹⁶ Furthermore, the higher median number of implants applied to men compared to women was also statistically significant. The increased age at which men begin treatment and the higher number of implants can be considered a result of age-related tooth loss. Although literature suggests that women tend to be more sensitive to orofacial esthetic concerns and men may prioritize functional rehabilitation in the posterior regions, our study did not provide direct evidence of a statistically significant association between gender and functional or esthetic preferences related to implant site selection. Future research should further investigate these potential associations across diverse populations.^{16,17}

In our study, the average age of patients who received dental implants, regardless of gender, was found to be 50.41 ± 13.46 . In a retrospective study by Bornstein et al. ($n=1,206$), the average age of patients receiving implants was 55.2.¹² In the study published by Vehemente et al. the average age was reported as 53.5 ± 13.9 , while Brennan et al. found the average age to be 53.4.^{18,19} In the study conducted by Mundt et al. ($n=159$), the average age of the patients was reported as 54.1.²⁰ The variation in the average ages across studies is believed to be due to differences in sample sizes. As age increases, the need for dental implants also rises due to the increase in tooth loss.²¹ In our study, a statistically significant but very weak positive correlation ($r=0.287$, $p<0.001$) was observed between the number of implants and age. These findings are consistent with the existing literature.

The position of the dental implant within the oral cavity is another important factor to consider. Implants placed in the posterior regions of the maxilla and mandible have been associated with lower survival rates compared to implants placed in the anterior regions.²² The reason for this could be the decrease in bone quality and the increased functional loads in the posterior regions of the mouth.²² Since implants placed in the mandible are associated with higher survival rates compared to those placed in the maxilla, the anatomical location of implant placement

is another important consideration.⁹ Although our study did not evaluate survival rates, it is noteworthy that 49.6% of the dental implants were placed in the maxilla and 50.4% in the mandible. Furthermore, 73.6% of implants were placed in posterior regions, compared to 26.3% in anterior regions. These anatomical trends are in line with those reported in the literature.^{18,21} These data do not provide information about the most commonly missing teeth, but they allow inferences to be made about the most frequently preferred tooth numbers for implant planning, supporting clinicians in treatment decisions. Moreover, this distribution should also be interpreted in light of prosthetic preferences (e.g., overdenture planning) and functional requirements, and further studies are needed to better elucidate these aspects.¹⁷

The distribution of dental implant applications across different age groups is another parameter examined in our study. According to our results, 11,948 implants (34.4%) were placed in patients aged 50-59, which was significantly higher than in other age groups. This was followed by 8,238 implants (23.7%) in the 60-69 age group and 7,652 implants (22.0%) in the 40-49 age group. These findings confirm that the need for dental implants increases with age.²¹ However, the slightly lower implant application rate in the 60-69 age group compared to the 50-59 age group can be attributed to systemic contraindications for implant surgery, as systemic disorders become more common with advancing age. Such an interpretation aligns with general observations in the literature regarding the role of systemic health conditions in determining implant eligibility among older patients.²³ This interpretation is consistent with the findings of Chrcanovic et al. who reported that systemic medical conditions may influence the decision-making process for implant surgery in elderly patients, potentially leading to lower application rates in this population.²⁴ In addition, socioeconomic challenges and treatment preferences in this age group may also influence patients' access to care.²⁵ In the demographic study by Bural et al. the most frequently implanted age groups were reported as 50-59, 60-65, and 40-49 years. Despite minor differences in age group categorization, the trends observed in our study are consistent with those reported by Bural et al.⁵

Among patients aged 15-29 years, the most frequently treated site was the mandibular 1st molar region, consistent with Lu et al. findings in young adults (18-29 years) that highlight posterior molar predominance in implant placement.²⁶⁻³⁰ This finding aligns with the literature, which suggests that the most commonly lost teeth due to decay in this age group are the mandibular 1st molars.^{30,31} Additionally, the placement of 80% of dental implants in patients under 18 years of age in the maxillary anterior region is thought to be attributed to the higher prevalence of trauma-related tooth loss and congenital maxillary lateral incisor agenesis in this age group. The findings of our study are also consistent with the literature.^{12,30-32} Another notable finding when examining the relationship between the implant placement site and age groups is the concentration of dental implant applications in the mandibular canine region in patients aged 70 and above. These findings can be explained by the higher rates of complete edentulism in this age group and the widespread use of 2-implant overdenture prosthesis treatment in the mandibular canine region for its rehabilitation.⁵ While our study did not evaluate prosthetic design preferences, the implant distribution in middle-aged patients may reflect a greater tendency toward fixed implant-supported restorations, given the functional and esthetic demands typically associated with this age group. In contrast, removable solutions such as 2-implant overdentures may be more prevalent in older patients, as supported by existing literature.¹⁷ These trends merit further exploration in future studies.

Since dental implant treatment is a highly successful method, the use of dental implants is steadily increasing.^{4,5,33} Scientific studies conducted in the field of dental implantology contribute to the widespread use of dental implants.³⁴ When examining the total number of implants applied over the years in our study, the highest number of implants was applied in 2016, while the lowest number was applied in 2020. An increase in the number of implants was observed between 2013-2016, followed by a decline after 2016. This decrease may be related to the hospital's implant procurement protocol. With the coronavirus disease-2019 (COVID-19) pandemic, the

number of implants reached its lowest level in 2020. It should be considered that the COVID-19 pandemic affected not only the number of implant procedures performed but also patient behavior and decisions to seek treatment. During the pandemic, patients' avoidance of elective surgical procedures and the restrictions in access to healthcare services were key factors contributing to the decline in implant application rates.⁸ In addition to procurement protocols and the COVID-19 pandemic, fluctuations in implant numbers over the years may reflect broader economic conditions and healthcare policy changes affecting patient access and treatment planning.⁸ Following this period, a recovery was observed in 2021-2022, likely due to accumulated patient demand and adjustments in the hospital's implant procurement protocols.

Demographic factors, including the patient's age, gender, and the anatomical placement of the dental implant, can have a significant impact on the long-term survival and overall success of dental implant treatments.^{23,24} Comprehensive consideration of these demographic factors during treatment planning and implant placement may help maximize the likelihood of positive patient outcomes. Ultimately, the success of dental implants is multifactorial, and careful patient selection, risk assessment, and long-term care are essential for optimizing results. Dentists should be cautious in monitoring patients with dental implants and apply appropriate preventive and treatment strategies to reduce the impact of demographic risk factors.

Although important factors such as gender, age group, and implant placement site were examined in our study, additional parameters such as the patient's overall health status, systemic diseases, and complications after implant treatment may also need to be analyzed. Additionally, the exclusion of data from the last 2 months of 2023 may not fully reflect the trends in implant treatment. A limitation of this study is the absence of data on implant survival and success rates, as the primary aim was to evaluate the demographic distribution and anatomical placement of dental implants. Future studies should include long-term follow-up data to assess these outcomes.

CONCLUSION

This study provides significant findings by examining the changes in dental implant treatment according to demographic factors, implant placement sites, and annual application rates. These findings demonstrate that demographic factors and annual trends play a crucial role in treatment planning, and clinical decisions should be made more consciously in light of these data. Additionally, the data on the most preferred regions and age groups for implant applications can serve as an important resource in shaping future treatment strategies.

Future research may offer a more in-depth analysis of the long-term outcomes of dental implant treatment and its association with various factors, including the patient's overall health, systemic conditions, and post-treatment complications.

Source of Finance

During this study, no financial or spiritual support was received neither from any pharmaceutical company that has a direct connection with the research subject, nor from a company that provides or produces medical instruments and materials which may negatively affect the evaluation process of this study.

Conflict of Interest

No conflicts of interest between the authors and / or family members of the scientific and medical committee members or members of the potential conflicts of interest, counseling, expertise, working conditions, share holding and similar situations in any firm.

Authorship Contributions

Idea/Concept: Metehan Keskin; **Design:** Yonca Kanat; **Control/Supervision:** Mehmet Cihan Bereket; **Data Collection and/or Processing:** Yonca Kanat; **Analysis and/or Interpretation:** Metehan Keskin; **Literature Review:** Yonca Kanat; **Writing the Article:** Yonca Kanat; **Critical Review:** Mehmet Cihan Bereket.

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