

# Frequency of Dental Implants Placed in the Esthetic Zone in Dental Clinic of Tehran University: A Descriptive Study

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## Abstract

**Objectives:** Anterior maxilla, known as the esthetic zone, plays an important role in facial and smile esthetics. This study assessed the frequency of implant treatments in the esthetic zone of patients presenting to Dental Implant Department of Tehran University during 2002-2012.

**Materials and Methods:** This descriptive study was conducted on dental records of patients receiving implant treatment during 2002-2012. Patient records were retrieved from the archives and patient demographics, implant characteristics, failure rate, prevalence of complications and implant systems were collected. The data were reported as frequency and percentage.

**Results:** Of a total of 2,381 implants placed in the mentioned time period, 492 (20.8%) had been placed in the anterior maxilla and 531 (22.3%) had been placed in the anterior mandible from canine to canine. Timing of implant placement was immediate in 12.0%, early in 0.5% and late in 87.4%. Survival rate was 99.1%. Rate of failure was 0.8%. Failure rate was 0.4% in the maxillary and 1.1% in the mandibular canine to canine region. Complications were reported in 10.1% of patients. Rate of complications was 18.3% in the maxillary canine to canine, 8.9% in the mandibular canine to canine, 18.1% in the maxillary first premolar to first premolar and 9.5% in the mandibular first premolar to first premolar. The frequency of bone grafts placed in these areas was 17.6%, 33.9%, 13.6%, 32.1% and 14.3%, respectively.

**Conclusion:** Of implants placed in our center, around 20% were in the anterior maxilla, and delayed implant placement was the most commonly adopted technique.

**Keywords:** Frequency; Esthetic Zone; Dental Implant

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## INTRODUCTION

At present, dental implants are increasingly used for the reconstruction of edentulous areas [1]. More than one million dental implants are placed annually for patients [2]. The high success rate of osseointegrated implants has been well documented. Clinical literature

reports the five-year success rate of dental implants to be 95-99% [3-5]. Due to high demand, improved designs and high-quality products are produced by the dental implant manufacturers, and as the result, dental implants of various designs and brands are available in the dental market. Despite the high

success rate, implant treatment requires precise case selection and adequate care must be taken when choosing the implant site, framework design, attachment type, proper length and diameter of implants, prosthetic material and type of prosthesis [2]. Achieving primary stability, osseointegration during the healing process and functional loading of implants are the three main requirements for the success of dental implant treatment [1]. In a human mouth, esthetic zone is considered from canine to canine in both the maxilla and mandible. However, based on the smile width, this area may be extended to the first or even second premolars. This zone is particularly important in smile esthetics. Thus, implant placement in the esthetic zone is often more complex and challenging than in other areas of the dental arch. Considering the higher patient demands and expectations from treatments performed in the esthetic zone, it would be beneficial to assess the frequency of implant treatments in the esthetic zone [4-6]. The effects of patient demands and socioeconomic status on selection of this treatment need to be evaluated as well. This study aimed to assess the frequency of dental implants placed in the esthetic zone (first premolar to first premolar) of the maxilla and mandible in patients treated in the Dental Implant Department of Tehran University of Medical Sciences during 2002-2012.

**MATERIALS AND METHODS**

This descriptive study evaluated the frequency of dental implants placed in the esthetic zone (first premolar to first premolar) of the maxilla and mandible of patients presenting to the

Dental Implant Department of Tehran University of Medical Sciences during 2002-2012. Dental records of patients who received dental implants in the esthetic zone during the mentioned time period were retrieved from the archives of the Dental Implant Department and evaluated. The data regarding the patients' sex, smoking status, systemic diseases (and type of disease), overdenture treatment, implant position in the dental arch, implant system used, bone grafting, implant failure (and the reason), implant type, connection type, implant shape (parallel or tapered), implant diameter, implant platform, implant length, sinus lifting, conduction of guided bone regeneration (GBR), use of platelet rich growth factor (PRGF), conduction of nerve transposition, surgical complications (i.e. sinus perforation and dehiscence), use of biomaterials (and type of it), timing of implant placement (immediate or late) and time of loading (immediate, early, late) were all collected from the patient records. The above-mentioned data were retrieved from the dental records of patients who received implants in the esthetic zone of their maxillary or mandibular arches. The data were reported as frequency (number) and percentage.

**RESULTS**

***Anterior region (first premolar to first premolar) of the maxilla:***

Of 2,381 implants placed for patients during 2002-2012 in the Dental Implant Department, 657 (27.8%) had been placed in the maxillary esthetic zone (first premolar to first premolar). Of the 657 implants, 372 (56.6%) had been placed in females and 283 (43.1%) in males.

**Table 1.** Patients' demographic information

	Sex N(%)			Smoking status N(%)			Health status N(%)	
	Female	Male	No data	Non-smoker	Smoker	No data	Healthy	Systemic disease
<b>Maxilla</b>	372(56.6)	283(43.1)	2(0.3)	633(96.3)	22(3.4)	2(0.3)	608(92.5)	47(7.2)
<b>Mandible</b>	374(57.5)	277(42.5)	0	626(96.2)	25(3.8)	0	589(90.5)	62(9.5)

No information was available about the sex of two patients (0.3%). Table 1 summarizes the results regarding the smoking status and systemic health status of patients. Table 2 presents the position of implants (n=657).

With regard to the implant system of 657 implants, the most commonly used implant system was ITI (solid screw, standard, standard plus, taper effect, bone level) placed in 300 patients (45.6%). Table 3 demonstrates the type of connection and shape of implants. In terms of surface type, SLA was the most common surface type observed in 471 cases (71.7%).

The most frequently used implants (n=167, 25.4%) had 4.1mm diameter and RN platform had the highest frequency (n=238, 36.2%). The most commonly used implants had 12mm length (n=266, 40.4%). Data regarding implant placement (immediate/early/late) and implant loading (immediate/delayed) are presented in Table 4.

Sinus lift surgery was performed by open-technique in seven patients (1.1%) and by closed technique in nine patients (1.3%). No information was available in this respect for one patient (0.2%). Also, GBR was performed in 239 patients (36.3%) and biomaterials had been used in 248 (37.8%) out of 657 cases. The most commonly used biomaterials were Bio-Oss+ BioGide membrane (n=66) and Bio-Oss (n=49). No information was available in this respect for one case (0.2%). Implant failure rate was 0.4% (three implants) in the maxilla. No complications were reported in 537 (81.7%) patients while complications occurred in 119 cases (18.1%).

Dehiscence was the most common complication and was reported in 93 cases.

#### **Anterior region (first premolar to first premolar) of the mandible:**

Of 2,381 implants placed for patients during 2002-2012 in the Dental Implant Department, 651 (27.3%) had been placed in the anterior mandible (first premolar to first premolar). Of 651 implants, 374 (57.5%) had been placed in females and 277 (42.5%) in males. Table 1 summarizes the results regarding the smoking status and systemic health status of patients. Table 2 presents the position of implants (n=651).

With regard to the implant system of 651 implants, the most commonly used implant system was Straumann-ITI (solid screw, standard, standard plus, taper effect, bone level) placed in 389 patients (59.7%). In terms of surface type, SLA was the most common surface type observed in 534 cases (82.0%). Table 3 demonstrates the type of connection and shape of implants.

The most frequently used implants (n=278, 42.7%) had 4.1mm diameter. In terms of platform, RN platform had the highest frequency (n=360, 55.3%). The most commonly used implants had 12mm length (n=313, 48.0%).

Data regarding implant placement (immediate/early/late) and implant loading (immediate/delayed) are presented in Table 4. Also, GBR was performed in 112 cases (17.2%). No patient received PRGF. Nerve transposition had been done in only one case (0.2%).

**Table 2.** Position of implants placed in the maxilla and mandible\*

	Right first premolar	Right canine	Right lateral incisor	Right central incisor	Left central incisor	Left lateral incisor	Left canine	Left first premolar	Total
<b>Mandible</b>	97(14.8)	64(9.7)	99(15.1)	96(14.6)	85(12.9)	92(14.0)	56(8.5)	68(10.4)	657(100)
<b>Maxilla</b>	65(10)	174(26.7)	66(10.1)	18(2.8)	27(4.2)	53(8.2)	176(27.0)	72(11.0)	651(100)

\*Numbers indicate the quantity and values in parentheses are the percentage

Biomaterials had been used in 120 (18.4%) out of 651 cases. The most commonly used biomaterials were Bio-Oss (n=29) and autogenous bone (n=18). Implant failure rate was 0.9% (six implants) in the mandible. No complications were reported in 589 (90.5%) cases while complications occurred in 62 cases (9.5%). Dehiscence was the most common complication reported in 55 cases.

**DISCUSSION**

Of 2,381 implants, 657 (27.8%) had been placed in the anterior maxilla and 651 (27.3%) in the anterior mandible (first premolar to first premolar). The high prevalence of implant placement in this area indicates the high incidence of anterior tooth loss probably due to poor oral hygiene or trauma. Tooth loss in the aesthetic zone has significant adverse effects on the speech and facial esthetics of patients. Patients mostly look for the best available option for replacement of the lost tooth in the esthetic zone. An interesting finding of this study was higher number of female patients receiving dental implants in the esthetic zone. This finding indicates the higher esthetic demands of female patients. Due to the excellent properties of dental implants in terms of esthetics and function, they are increasingly used for the replacement of the lost teeth particularly in the anterior region.

Bragger et al, in 2005 also reported the higher frequency of female patients requiring dental implants (55 females versus 34 males) [6]. However, Ko et al, in 2006 evaluated the clinical function of two-stage dental implants placed in patients presenting to two dental

centers in South Korea and reported that the frequency of male patients receiving implants was higher than females [7]. In our study, 7.2% of patients receiving implants in the anterior maxilla and 9.5% of those receiving implants in the anterior mandible (first premolar to first premolar) had systemic diseases. Ko et al, in 2006 demonstrated that 9% of patients receiving dental implants were suffering from systemic conditions [7]. Underlying systemic diseases are among the major risk factors related to implant failure. Thus, systemic conditions must be evaluated and properly treated or managed prior to implant placement in order to decrease the risk of failure. In our study, 3.4% of those receiving implants in the maxillary esthetic zone and 3.8% of those receiving implants in the anterior mandible were smokers. Such insignificant prevalence of smoking may be among the factors contributing to the high success rate of implant treatments in our study. However, it may also indicate inaccurate history taking or dishonesty of patients. Failure of dental implants can be divided into two groups of early and late failures. Early failures occur during the time period following the surgical procedure until prosthetic loading due to impaired healing and lack of osseointegration. Late failures occur as the result of development of peri-implantitis. The effect of smoking is usually late [8].

Immediate implant placement may restore soft tissue support and increase treatment success due to the favorable contour of soft and hard tissues. If tissue regeneration is not required and the area is free from acute infection, immediate implant placement may be the

**Table 3.** Type of connection and shape of implants placed in the maxilla and mandible

	Type of connection N(%)			Implant shape N(%)		
	Internal	External	No data	Parallel	Tapered	No data
<b>Maxilla</b>	603(91.8)	53(8.0)	1(0.2)	451(68.6)	205(31.2)	0
<b>Mandible</b>	613(94.2)	38(5.8)	0	508(78.0)	143(22.0)	1(0.2)

treatment of choice. The main criteria for immediate implant placement include: ideal contour of the hard and soft tissues, esthetic needs of the area, adequate bone health and volume (in terms of quantity and quality) at the site, absence of acute infection and ideal root position and angulation (significant change in the direction/orientation of implant in the socket is an important issue). Immediate implant placement is not the choice of treatment when the adjacent bone is traumatized during the process of root extraction or when the buccal plate is removed [9].

Based on the current study results, of 2,381 implants placed in the maxillary esthetic zone, 23.0% had immediate, 0.7% had early and 76.1% had late placement. In the mandible, 8.3% had immediate, 0.2% had early and 91.5% had late placement. Some studies are in favor of immediate implant placement in the mandibular anterior region due to adequate primary stability and advantages of one-stage surgery as well as shorter duration of treatment. However, this is feasible only if the patient has perfect general health status and the mandibular bone is adequate for receiving four to six fixtures with a minimum length of 10mm and diameter of 3.75 to 4mm [10]. Based on our results, 32.1% of cases receiving implants in the maxillary esthetic zone and 14.3% of those receiving implants in the anterior mandible had bone grafts, which indicates that the bone deficiency could be more prevalent in the anterior maxilla than in the mandible. In this study, the failure rate of implants was 0.4% in the anterior maxilla and 0.9% in the

anterior mandible and the prevalence of complications was 18.1% in the anterior maxilla and 9.5% in the anterior mandible. The authors believe that such a high survival rate of implants could be related to the high compliance of clinicians in dental implant department to the scientific aspects of implant dentistry. However, this high survival rate in the anterior region may also indicate lack of regular follow-ups and lack of information regarding the survival or failure of implants that could make the patient files incomplete for data analysis. Despite the diversity in types of implants, the reported success rates in most studies have been over 90%. In a study by Becker et al, in 2005 the two to three-year survival rate of implants has reported to be 97.2% [11]. In a study by Raghoobar et al, in 2003 the survival rate of implants and prosthesis was 93% [12]. This rate has reported to be 94.3% and 96% in other studies [13,14]. Ko et al, in 2006 reported a success rate of 97.9% after 4.5 years [7]. Carr et al, in 2003 evaluated the clinical function of one-stage implants and reported their survival rate to be 97% [15]. Strauman-ITI was the most commonly used implant system (solid screw, standard, standard plus, taper effect, bone level) followed by Nobel Replace Select, Dentsply-Xive and Implantium; and all demonstrated good treatment outcomes. Several manufacturers produce dental implants of optimal quality. In the maxillary and mandibular anterior region, the frequency of internal and external connections used was 91.8% and 8.0%, and 94.2% and 5.8%, respectively; these values indicate that the

**Table 4.** Timing of implant placement and loading in the maxilla and mandible

	Implant placement N(%)				Implant loading N(%)		
	Immediate	Early	Late	No information	Immediate	Delayed	No information
<b>Maxilla</b>	151(23.0)	5(0.7)	500(76.1)	1(0.2)	3(0.4)	653(99.4)	1(0.2)
<b>Mandible</b>	54(8.3)	1(0.2)	596(91.5)	0	1(0.2)	650(99.8)	0

internal connection was more popular among the clinicians. However, there is no any adverse effect with regard to the use of external connection based on the obtained data from this study. The prevalence of sinus lifting was 2.4% in the anterior maxilla and in the first premolar sites. Presence of the maxillary sinus over the posterior maxilla usually decreases the available bone height for implant placement [16]. Such anatomical limitations can compromise successful osseointegration of implants [17]. Sinus augmentation surgery is performed to enhance implant placement in resorbed posterior maxilla. It is now a well-accepted technique prior to implant surgery [17] allowing the insertion of implants of proper length. In cases with severely atrophic maxillary ridge, local augmentation technique must be necessarily performed in order to prevent complications such as inadequate crown/root ratio [18]; since in this study most implants placed in the anterior zone were in 12mm range, the authors believe this could be one of the influential factors in high survival rate of implants. Although the prevalence of biomaterials used was low in our study, many researchers use tissue regeneration techniques in order to enhance ridge volume and induce new bone formation before implant placement. Other researchers recommend sinus augmentation techniques and ridge reconstruction by using short implants to increase vertical bone height. The authors believe that assessment of the prevalence of complications and success of implants at different areas can help clinicians select the most appropriate implant type available in the market and find factors responsible for implant failure. Such studies can also help clinicians assess the accuracy of the reported success rates. However, it should be noted that these studies must be of optimal quality and have adequate sample size, and long enough follow up periods in order for the results to be generalizable. Although clinical trials are methodologically the strongest studies in

medical sciences, it should be noted that they are conducted under controlled, ideal clinical settings that may limit their generalizability. Moreover, although financial support helps dissemination of knowledge, getting financial support from implant companies may cause a bias in the results.

## CONCLUSION

Although the distribution of dental implants placed in the anterior maxilla and mandible was fairly the same, the failure rate in the anterior mandible was higher while the complications in the anterior maxilla were more pronounced.

## REFERENCES

- 1- Rokn A, Rasouli-Ghahroudi AA, Daneshmonfared M, Menasheof R, Shamshiri AR. Tactile sense of the surgeon in determining bone density when placing dental implant. *Implant Dent.* 2014 Dec;23(6):697-703.
- 2- Le GL, Soueidan A, Layrolle P, Amouriqu Y. Surface treatments of titanium dental implants for rapid osseointegration. *Dent Mater.* 2007 Jul;23(7):844-54.
- 3- Davarpanah M, Martinez H, Etienne D, Zabalegui I, Mattout P, Chiche F, et al. A prospective multicenter evaluation of 1,583 3i implants: 1- to 5-year data. *Int J Oral Maxillofac Implants.* 2002 Nov-Dec;17(6): 820-8.
- 4- Astrand P1, Engquist B, Dahlgren S, Gröndahl K, Engquist E, Feldmann H. Astra Tech and Branemark system implants: A 5-year prospective study of marginal bone reactions. *Clin Oral Implants Res.* 2004 Aug;15(4):413-20.
- 5- Nelson K, Semper W, Hildebrand D, Ozyuvaci H. A retrospective analysis of sandblasted, acid-etched implants with reduced healing times with an observation period of up to 5 years. *Int J Oral Maxillofac Implants* 2008 Aug;23:726–32.
- 6- Bragger U, Karoussis I, Persson R, Pjetursson B, Salvi G, Lang N. Technical and biological complications/failures with single

- crowns and fixed partial dentures on implants: a 10-year prospective cohort study. *Clin Oral Implants Res.* 2005 Jun;16(3):326-34.
- 7- Ko SM, Lee JK, Eckert SE, Choi YG. Retrospective multicenter cohort study of the clinical performance of 2-stage implants in South Korean populations. *Int J Oral Maxillofac Implants.* 2006 Sep-Oct;21(5):785-8.
- 8- Lambert PM, Morris HF, Ochi S. The influence of smoking on 3-year clinical success of osseointegrated dental implants. *Ann Periodontol* 2000;5(1):79-89.
- 9- Wheeler SP. Implant complications in the esthetic zone. *Ann Periodontol.* 2000 Dec; 5(1): 79-89.
- 10- Shahroodi MH, Jan-Nesar S. Implant Success Rate in the Faculty of Dentistry, Tehran University of Medical Sciences. *J Dent Med.* 2000 Oct;13(3):45-52.
- 11- Becker W, Sennerby L, Bedrossian E, Becker BE, Lucchini JP. Implants stability measurements for implants placed at the time of extraction: A cohort, prospective clinical trial. *J Periodontol.* 2005 Mar;76(3):391-7.
- 12- Raghoobar GM, Friberg B, Grunert I, Hobkirk JA, Tepper G, Wendelhag I. Three year prospective multicenter study on one stage implant surgery and early loading in the edentulous mandible. *Clin Implant Dent Relat Res.* 2003;5(1):39-46.
- 13-Teixeira ER, Wadamoto M, Akagawa Y, Kimoto T. Clinical application of short hydroxylapatite-coated dental implants to the posterior mandible: a five-year survival study. *J Prosthet Dent.* 1997 Aug;78(2):166-71.
- 14- Johansson LA, Ekfeldt A. Implant-supported fixed partial prostheses: a retrospective study. *Int J Prosthodont.* 2003 Mar-Apr;16(2):172-6.
- 15- Carr AB, Choi YG, Eckert SE, Desjardins RP. Retrospective cohort study of clinical performance of 1-stage dental implants. *Int J Oral Maxillofac Implants.* 2003 May-Jun;18(3):399-405.
- 16- Nedir R, Bischof M, Vazquez L, Szmukler-Moncler S, Bernard JP. Osteotome sinus floor elevation without grafting material: a 1-year prospective pilot study with ITI implants. *Clin Oral Implants Res.* 2006 Dec;17(6):679-86.
- 17- van den Bergh JP1, ten Bruggenkate CM, Disch FJ, Tuinzing DB. Anatomical aspects of sinus floor elevations. *Clin Oral Implants Res.* 2000 Jun;11(3):256-65.
- 18- Ferrigno N, Laureti M, Fanali S. Dental implants placement in conjunction with osteotome sinus floor elevation: a 12-year life-table analysis from a prospective study on 588 ITI implants. *Clin Oral Implants Res.* 2006 Apr;17(2):194-205.