



THE DIAMETER AND LENGTH PROPERTIES OF SINGLE POSTERIOR DENTAL IMPLANTS: A RETROSPECTIVE STUDY

ABSTRACT

Objectives: The aim of this study was to evaluate the length and diameter properties of single dental implants that posteriorly placed on the mandible and maxilla.

Materials and Methods: Two hundred ninety three posterior single dental implants were evaluated in this retrospective study by same surgical procedure from 2010 to 2016 years. Demographics of patients, anatomic localizations, implant characteristics (length and diameter), satisfaction of the patient and implant loss were recorded. Implants that placed only single in posterior defect site (premolar or molar) with limited by a natural tooth or a prosthetic restored tooth on the either side of edentulous region were included. Visual analogue scale (VAS) was used for the satisfaction of the patients. The descriptive statistical analysis were done.

Results: A total of 275 patients with 293 dental implants (139 male and 136 female), ranging from 18 to 72 years (42.13 mean years) were analyzed. The majority of the dental implants were inserted mandible (156, 53.3%), 137 in maxilla (137, 46.7%). The first molar region was the most implantation area, inserting with 181 (61.9%) implants, of which 115 (39.3%) were in mandible, 66 (22.6%) in maxilla. The most frequent implant diameter placed was the 4 millimeter (mm) (54, 18.4%) and 12 mm (94, 32%) was the most frequent used implant length. Nine implants were failed and all success rate was found to be 97%.

Conclusions: According to these results, single dental implants in the posterior region can be used safely with high success rates.

Keywords: Mandible, maxilla, dental implant, posterior.

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INTRODUCTION

Dental implants have been used to reconstruct the aesthetic and functional demand of individuals since 1960s. Oral dental implants have been increasingly preferred in replacing single missing teeth according to the traditional fixed dentures.¹ The priority success indicator of implants is osseointegration described as; direct structural and functional connection between living bone and loading implant.² Primer stabilization, quality and quantity of jaw bones, implant design, implant surface texture, surgical procedures, aesthetic and function of prosthesis, radiographic bone loss and patient pleasure must be taken into attention as the success criteria of implants success. Also the success and survey of dental implants are related to the clinical and radiographical examinations with description of risk factors before being implantation and follow up after implantation.³⁻⁵

The survey of dental implants can be evaluated in the two phases as an osseointegration and loading. Failure in the second phase is associated primarily with bone loss around the implant neck. Bone resorption in the neck area is associated with force distribution in that area. There are many factors effecting the distribution of stress including implant position, occlusion, masticatory forces, number of implant, primer stabilization and reasons related to prosthesis.⁶

Implant diameter is the one of the factors effecting the stress distribution because the wider area in the cervical portion of the implant may better distribute the masticatory forces.⁷ Increasing the success of posterior implants is related to increased surface area therefore wide-diameter and longer length implants have been suggested in the posterior region.⁸ On the contrary, several research in the literature have been advocated that short implants between 6-10 mm with appropriate conditions produce well results.^{9,10}

The aim of this study was to evaluate the characteristic features of the implant length/diameter, distribution of the single posterior implants based on anatomic area, implant survival and patient satisfaction.

MATERIAL AND METHODS

Ethical approval was obtained from the Ethics

Committee of Sanko University, Gaziantep, Turkey (June 11, 2018; session: 2018/07, decision no: 03).

This retrospective study were conducted on two hundred seventy five patients who had attended to the Faculty of Dentistry, Gaziantep University and rehabilitated by the single dental implants between the 2010 January and 2016 December. Only single implants those had placed in the posterior regions (premolar or molar) of the mandible or maxilla were included. All patients were assessed by age, gender, characteristic of implants (diameter and length), follow-up, failure of implant and patient satisfaction. All of the examined implants had either a natural tooth or a prosthetic restored tooth on either side of the edentulous site.

A total of 293 dental implants were evaluated. Different 11 brand of implants follow as Straumann (Straumann Institute, Waldenburg, Switzerland), Bredent (Bredent medical GmbH & Co.KG, Senden, Germany), Biotech (Biotech Dental, Salon de Provence, France), Zimmer Dental (Carlsbad, CA, USA), Biohorizons (Maestro Dental Implants, Birmingham, AL, USA), Mis® Seven (MIS®, Medical implants System, Israel), NucleOSS, (Şanlılar Tıbbi Cihazlar Medikal Kimya San Tic Ltd. Sti, İzmir, Turkey), Implantace (AGS Medikal Merkez, Kadıköy, İstanbul), BIOMET 3i, Palm Beach Gardens, FL, USA), Implantium implants (Dentium Co., Seoul, Korea), DIO Implant, Busan, Republic of Korea were performed under local anesthesia with the same surgical procedure.

The patient's satisfaction level were assessed with a 10-point visual analog scale anchored by the verbal descriptors "no satisfaction" (point 0) and "very severe satisfaction" (point 10).

RESULTS

Present study was consisted of 275 patients who had 293 posterior single dental implants placed, of whom 136 (49.4%) were female and 139 (50.6%) were male. The mean age of the patients was 42.13±12.53, ranging from 18 to 72 years. Two hundred seventy five patients had one implant-supported single crown, 16 patients had two single implant and one patient had three single implant (Table 1). The mean VAS value in all patients was 6.94±1.73 to assess the patient satisfaction level.

Table 1. Subject demographics

Subject demographics	Participating patients
Gender, n (%)	139 (50.6)
Male	136 (49.4)
Female	
Age	42.13 ± 12.53
Mean ± SD	(18-72 years)
VAS (0 - 10)	6.94 ± 1.73
Mean ± SD	
Number of implants, n (%)	
1	275 (93.9)
2	16 (5.8)
3	1 (0.3)

According to localization of the jaws, the majority of the dental implants were inserted mandible (156, 53.3%), 137 implants in maxilla (137, 46.7%). The first molar region was the most implantation edentulous area, inserting with 181 (61.9%) implants, of which 115 (39.3%) were in mandible, 66 (22.6%) in maxilla. Eighty seven (29.7%) implants were placed in the premolar region, consisting of maxilla (25, 8.6%) and mandible (62, 21.1%). Twenty-five (8.4%) implants were inserted in the second molar area in both jaw. The

distributions of the implants based on anatomic locations were shown in the Table 2.

When evaluating diameters and lengths of the dental implants, the most frequent implant diameter placed was the 4 millimeter (mm) (54, 18.4%), followed by 4.5 mm (42, 14.4%) and 4.8 mm (41, 13.9%). In 293 implants, about 84.4% (247) implants were ranged from 4 to 6 mm in diameter. Other implants had in diameter between 3 and 3.9 mm (Table 3).

Table 2. Distribution of the dental implants based on anatomic location.

	Premolar region (n/%)	First molar region (n/%)	Second molar region (n/%)	Total
Maxilla	62 (21.1)	66 (22.6)	9 (3)	137 (46.7)
Mandible	25 (8.6)	115 (39.3)	16 (5.4)	156 (53.3)
Total	87 (29.7)	181 (61.9)	25 (8.4)	

Table 3. Distribution of implants according to diameters.

	N	%		N	%
Diameter			Diameter		
3 mm	1	0.3	4 mm	54	18.4
3.25 mm	1	0.3	4.1 mm	35	12.2
3.3 mm	11	3.7	4.2 mm	13	4.5
3.4 mm	1	0.3	4.3 mm	2	0.7
3.5 mm	12	4	4.4 mm	3	1
3.6 mm	4	1.4	4.5 mm	42	14.4
3.7 mm	7	2.5	4.6 mm	12	4
3.75 mm	3	1	4.7 mm	18	6.1
3.8 mm	3	1	4.8 mm	41	13.9
3.9 mm	6	2	5 mm	8	2.7
			5.4 mm	2	0.7
			5.5 mm	10	3.6
			5.8 mm	1	0.3
			6 mm	3	1
3-3.9 mm	46	15.6	4-6 mm	247	84.4

The length in 12 mm (94, 32%) was the most frequent used implant size in the implantation, followed by 70 (23.9%) cases were in 14 mm and

56 (19.1%) were in 10 mm. The majority of the cases (220, 75.1%) were in length, ranging from 10,5 and 16 mm (Table 4).

Table 4. Distribution of the implants according to length.

	N	%		N	%
Length			Length		
8 mm	16	5.5	10.5mm	4	1.4
9 mm	1	0.3	11.5mm	26	8.9
10 mm	56	19.1	12 mm	94	32
			13 mm	21	7.2
			14 mm	70	23.9
			15 mm	1	0.3
			16 mm	4	1.4
8-10 mm	73	24.9	10.5-16mm	220	75.1

With regards to implant survival, nine (3%) implants were not osseointegrated in all implants. Five of them were located in the mandible and four in the maxilla. All survival rate in 293 dental implants was 97%.

Of these 9 failed implant, the diameter of eight implants were above 4mm and the success rate was

96.8% in implants that placed in diameter between 4 and 6 mm (8/247). Forty six implant were in diameter between 3 and 3.9 mm and only one implant failed. The success rate was found to be 97.9% in this group. The characteristics of failed implant were shown in Table 5.

Table 5. The characteristics of failed implants

Failed implants characteristics	N	(%)
Mandible	5/156	(3.2)
Maxilla	4/137	(2.9)
Total	9/293	(3)
Diameter		
3 – 3.9 mm	1/46	(2.1)
4 – 6 mm	8/247	(3.2)

DISCUSSION

The dental implant-supported prostheses, which are applied in a single posterior tooth deficiency, have become highly preferred in recent years with high success rates by patients instead of traditional fixed or removable prostheses. In a recent systematic review, Tan *et al.*¹¹ and Jung *et al.*¹² have reported the success rates of single-tooth implant supported fixed dentures in 10-year follow-up series as 84.4% and 89.1%, respectively. In some studies, it has also been reported that the diameter and length of the implant affect the survival of the implants.^{13,14}

The requirement of dental implant following tooth loss is also correlated with age. Villarinho *et al.*¹⁵ and Kim *et al.*¹⁶ reported that the mean age was 52 and 48 years, respectively in their series that inserted posterior single implants. The mean age of the patients included in our study was 42.13 years, ranging from 18 to 72 years. In this study, it was

found that the most preferred implant sizes were between 4 and 6 mm (247/293, 84.4%) in diameter and between 10,5 and 16 mm (220/293, 75.1%) in length. Of these implant size, the 4 mm (54/293, 18.4%) diameter and 12 mm (94/293, 32%) length were the most commonly used implant sizes. It has been known that the implant size may be limited by several anatomic factors, particularly the procedures on posterior dental implant placement. In maxilla, the occurrence of sinus pneumatization after tooth loss and resorption in the alveolar crest causes advanced surgical procedures such as sinus floor elevation for bone augmentation or enhance the volume of the alveolar bone with bone substitutes. The limited availability of vertical alveolar bone in the mandible impairs implant treatment without any reconstructive bone surgery.¹⁷

In the posterior area in partially edentulous subjects, decreased alveolar bone height from the

ridge to the inferior alveolar nerve are effective in determining the length of dental implant. In addition to this, Lee *et al.*¹⁸ reported that there is no linear relationship between the implant length and implant survival. Although the implants less than 10 mm in length are associated with high implant failure after loading¹⁹, it is known that the use of short implants has significant clinical advantages such as minimal overheating during drilling, minimized inferior alveolar nerve injury, maxillary sinus invasion and augmentation procedures for increasing vertical bone.²⁰

Although it has been generally known that the mandibular implants have higher success rate than maxilla^{21,22}, different results were reported by some studies. Mezzomo *et al.*²³ found to be a higher failure rate in the mandible that placed with short implants. But Monje *et al.*²⁴ reported that there is no difference in failure rates for the arch. In this study, a higher number of implants were inserted in the first molar area in the mandible (115, 39.3%) than maxilla (66, 22.6%). Similar to this result, 53.3% of all implants were placed in the posterior mandible. Of the 9 failed implants, 5 were placed in the mandibular molar region, 2 were placed in the maxillary first molar and 2 were in the maxillary premolar region. Although aforementioned studies have addressed the failure differences between mandible and maxilla in the short dental implants in the posterior, we found to be a higher failure rate in the mandible (5/156, 3.2%) versus maxilla (4/137, 2.9%).

It is known that the implant diameter has important clinical effect on the stress distribution in the cortical plates.^{7,25} In recent systematic review by Javed and Romanos⁵, they suggested that the critical factors such as surgical protocol, primary stability of implant during surgery or oral hygiene maintenance in the postsurgical period are more important than the implant diameter on the long-term survival of dental implants inserted in the posterior maxilla. When compared the narrow dental implants with wide-diameter implants, wide-diameter implants have better initial stability with increasing the surface area for osteointegration.^{26,27} Recent studies demonstrated that the narrow diameter implants are as reliable

and predictable as with standard-diameter dental implants.^{28,29} But narrow-diameter implants still have a high rate of prosthetic complications.²⁸ In present study, the majority of implant diameter used in this study was ranged from 4 to 6 mm (247/293, 84.4%). Of these 247 implants, eight implants were failed. The success rate was found to be 96.8% in this group.

Although there are some limitations, it was aimed to present the demographic and characteristics of single dental implants placed in the posterior area in this present study. According to this result, the most common implantation area was the mandibular first molar area. The 4 mm in diameter and 12 mm in length were the most used implant sizes. Single dental implants in the posterior region can be used safely with high success rates.

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CONFLICT OF INTEREST STATEMENT

None

Tek Diş Posterior Dental İmplantların Çap ve Boy Özellikleri: Retrospektif Bir Çalışma

ÖZ

Amaç: Bu çalışmanın amacı, posterior maksilla ve mandibulaya yerleştirilen tek diş implantların çap ve boy özelliklerini değerlendirmektir. **Gereç ve Yöntemler:** 2010 ile 2016 yılları arasında aynı cerrahi yaklaşım ile yapılan 293 posterior tek diş implant değerlendirildi. Hastalara ait demografik bilgiler, implantların boy ve çap özellikleri, implantların yerleştirildiği anatomik lokalizasyonlar ile hasta memnuniyeti kaydedildi. Posterior bölgeye yapılan tek diş implantların her iki yanında doğal veya protetik olarak restore edilen dişlerin olduğu implantlar çalışmaya dahil edildi. Hasta memnuniyeti vizüel analog skala (VAS) ile değerlendirildi. Değerlendirmede tanımlayıcı istatistik uygulandı. **Bulgular:** Yaşları 18 ile 72 arasında değişen (yaş ortalaması 42,13) 275 hastanın 139'u erkek, 136'sı kadın olup toplamda 293 dental implant çalışmada değerlendirildi. İmplantların çoğunluğu mandibular (156, %53,3) yerleşimliyken 137 (%46,7) implant maksilladaydı. Dişsiz birinci molar (181, %61,9) en fazla implant uygulanan bölge iken bunların 115'i

(%39,3) mandibulada, 66'sı (%22,6) da maksilladaydı. En fazla uygulanan implant çapı 4 milimetre (mm) (54, %18,4) ve boyu da 12 mm idi. Kayıp 9 implant olup implant başarı oranı %97 olarak bulundu. **Sonuç:** Çalışma sonuçlarına göre, tek diş implantlar yüksek başarı oranları sayesinde posterior bölgede güvenle kullanılabilir. **Anahtar Kelimeler:** Mandibula, maksilla, dental implant, posterior.

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