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RESEARCH ARTICLE

Comparison of Marginal Bone Loss Between Titanium and Titanium-Zirconium Implants at Least 5 Years at Function

En Az 5 Yıllık Fonksiyon Süresiyle Titanyum ve Titanyum-Zirkonyum İmplantlar Arasındaki Marjinal Kemik Kaybının Karşılaştırılması

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ABSTRACT

Titanium (Ti) is the leading material in implant dentistry for the treatment of partial or full edentulism.. More recently, Titanium- Zirconium (TiZr) alloy has been developed for more demanding clinical conditions, as it shows greater mechanical and biological features than commercially pure Ti Grade 4. Survival of dental implants is based on the relationship between implant and oral tissues. Marginal bone level stability around implants has been used as one of the main criteria for implant success. Implant failures are often associated with implant mobility due to marginal bone loss. The aim of this study was to compare Titanium and Titanium-Zirconium implants marginal bone loss values which were at function more than 5 years. Titanium and 13-17% Zr containing TiZr alloy implants included in this study. Marginal bone loss measurements were performed digitally in computer software programme. TiZr alloy implants showed less marginal bone loss compared to traditional titanium implants but this difference statistically was not significant. TiZr alloy may become the dominant material in implant material choice in order to increase clinical implant success.

Keywords: dental implants, marginal bone loss, titanium zirconium implants

ÖZET

Titanyum (Ti), kısmi veya tam dişsizlik tedavisinde implant diş hekimliğinde en yaygın kullanılan materyaldir. Son zamanlarda zorlu klinik koşullar için, ticari olarak saf Ti Grade 4'e kıyasla daha üstün mekanik ve biyolojik özellikler sergileyen Titanyum-Zirkonyum (TiZr) alaşımı geliştirilmiştir. Dental implantların başarısı, implant ile ağız dokuları arasındaki ilişkiye dayanmaktadır. İmplant çevresindeki marjinal kemik seviyesi stabilitesi, implant başarısının temel kriterlerinden biri olarak kabul edilmektedir. İmplant kayıpları sıklıkla, marjinal kemik kaybına bağlı implant mobilitesi ile ilişkilidir. Bu çalışmanın amacı, 5 yıldan daha uzun süredir fonksiyonda olan Titanyum ve Titanyum-Zirkonyum implantlarının marjinal kemik kaybı değerlerini karşılaştırmaktır. Çalışmaya Titanyum ve %13–17 oranında Zr içeren TiZr alaşımlı implantlar dahil edilmiştir. Marjinal kemik kaybı ölçümleri bilgisayar destekli yazılım programı kullanılarak dijital olarak gerçekleştirilmiştir. TiZr alaşımlı implantlar, geleneksel Titanyum implantlara kıyasla daha az marjinal kemik kaybı göstermiştir, ancak bu fark istatistiksel olarak anlamlı bulunmamıştır. Klinik implant başarısını artırmak amacıyla TiZr alaşımının ilerleyen dönemlerde implant materyali seçiminde dominant hale gelebileceği düşünülmektedir.

Anahtar Kelimeler: dental implantoloji, marjinal kemik kaybı, titanyum zirkonyum

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INTRODUCTION

Since Branemark introduced the concept of osseointegration in 1977, dental implants have become a popular method for the treatment of total or partial edentulism.[1] According the AAID (American Academy of Implant Dentistry) implant treatment have been shown almost %95 success rate.[2] In a systematic review and meta-analysis including 23 studies performed in 2015, the success rate of implants was 94.6% in a total of 7711 implants (mean follow-up year 13 years).[3]

Titanium is a biocompatible material that causes little or no reaction in the tissues in which it is loaded[4] It has also been found that titanium is a material that is resistant to corrosion and allows osseointegration.[5] Branemark proved that titanium forms a permanent connection with the bone due to the titanium oxide layer and this created the concept of osseointegration today[1]. Titanium have been recognized as the gold standard in implant materials.[6] However, the stress/strength ratio of narrow diameter titanium implants were found higher than regular diameter implants, indicating higher risk of fatigue failure.[7] Implants made of titanium alloys containing zirconium (TiZr; commercially known as Roxolid; Institut Straumann AG, Switzerland) have been introduced to the market showing better mechanical properties than pure titanium while maintaining its biocompatibility.[8] This particular TiZr alloy dental implant manufactured from mixing Ti with 13%–17% of Zr.

The ICOI's (The International Congress of Oral Implantologists) Pisa Consensus defined implant success criteria as pain, mobilization, radiographic marginal bone loss and pocket depth and peri-implant disease.[9] Regarding of bone loss, Albrektsson et al. recommended that a successful implant should have a marginal bone loss of less than 1 mm in the first year and less than 0.2 mm in the following years.[10] The aim of this study was to compare the marginal bone loss between conventional titanium and TiZr implants under function at least 5 years

MATERIALS AND METHOD

This study was approved by Baskent University Institutional Review Board (Project no: D-KA24/07) and supported by Baskent University Research Fund. This retrospective study was conducted using clinical and radiographic records of patients who received dental implants between 2015 and 2018 at the Department of Oral and Maxillofacial Surgery, Başkent University Faculty of Dentistry.

Patients with posterior single tooth, same brand (Institut Straumann AG, Switzerland) tissue level implants in 4.1 mm diameter and 10 mm length were included. Patients divided into two groups with 40 implants in titanium and 40 implants in Ti-Zr group. Of the 80 implants included in the study, 44 were located in the mandible and 36 in the maxilla. Patients with uncontrolled systemic diseases, active periodontal diseases, keratinized mucosa less than 2 mm, implants required bone augmentation were excluded from the study.

Panoramic radiographs were taken via Veraviewepocs 2D (J. Morita Corp., Japan) device. Digital panoramic radiographs which were taken after the implant placement (T1) and after minimum 5 years in function (T2) were used in peri-implant bone loss evaluations. Measurements were performed digitally in ImageJ software programme (ImageJ, USA). Measurements of one of the digital panoramic radiography are shown in Figure 1 . The values were obtained by measuring the distance from the apical end of the implant to the marginal bone level separately on the mesial and distal sides, and then subtracting these values from the total implant length. Twenty percent of the radiographs were randomly selected and remeasured in order to ensure intra-observer reliability and the the Intraclass Correlation Coefficient (ICC) was calculated.

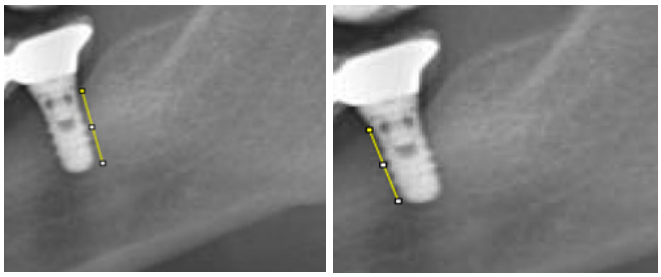

Fig 1: Distally and mesially measurements

Statistical analyses were performed with SPSS version 25.0 program. The conformity of the variables to normal distribution was examined by Shapiro-Wilk test. Mean, standard deviation, median, minimum and maximum values were used to present descriptive analyses. Mann Whitney U Test was used to evaluate the variables that were not normally distributed between Ti and Ti-Zr groups. p-values below 0.05 were considered as statistically significant results.

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RESULTS

Thirty nine patients with a total of eighty implant included in this study.Patient demographic characteristics were summarized as; 16 male (45 %) and 20 female (55 %), with an average age of 41.75 (ranging between 24 and 60 years).

The mean marginal bone loss was 1.46 ±1.038 mm in the Ti group and 1.11±0.698 mm in the Ti-Zr group. There was no statistically significant difference between the Ti group and the Ti-Zr group (p=0.101) regarding of peri-implant bone loss values. Ti and Ti-Zr implants did not show different results in the follow-up of marginal bone loss over 5 years (Table 1).

Table 1: No statistical difference between Titanium and Titanium Zirconium Group

	Titanium		Titanium - Zirconium		
	Mean±sd	**Median(Min-Max)**	**Mean±sd**	**Median(Min-Max)**	**p**
Bone loss	1,464±1,038	1,212 (0-6,289)	1,113±,698	1,11 (0-2,377)	0,101

DISCUSSION

The marginal bone around the implant is considered as a significant indicator of implant health. In the literature the most common method to measure bone loss is by radiographic evaluation. However, conventional two dimension radiographics allow to monitor only the mesial and distal aspect of bone loss. It was suggested that the peri-implant bone level measurements should be related to the original marginal bone level which was measured at implant insertion, rather than to a previous measurement.[9]

The use of Ti–Zr dental implants is well published in several in vitro and animal studies, showing similar results to Grade IV titanium dental implants.[11]

In a clinical trial by Quirynen et al., Ti–Zr alloy implants were compared to titanium grade IV implants. The marginal bone level values were found similar in the two groups, which is compatible with the results of this study.[12]

In our study, slightly less marginal bone loss was observed in titanium-zirconium implants compared to titanium implants. In their in vitro study, Sista et al. showed that more osteoblasts adhered to the 50% Ti-zr surface compared to the titanium surface and more alkaline phosphatase and osteocalcin were released. This may lead to better osseointegration and thus indirectly to less marginal bone loss.[13]

A study by Ghazal et al. in 2019, the 5-year mean bone loss of ti-zr standard implants was measured as -0.48 ± 0.67 mm, which was less than the average marginal bone loss in the ti-zr group of our study. This may be due to the fact that Ghazal et al. included only single tooth implants or excluded heavy smokers (more than 10 per day).[14]

Carlson et al, measured the 10-year periimplant marginal bone loss of conventional titanium implants as 0.9 mm .This result was close to the marginal bone loss of titanium implants in our study, but slightly less than our result.[15]

CONCLUSION

The relatively new alloy implants appear as a reliable treatment option. Ti-Zr implants showed slightly less bone loss compared to Ti group. Although this difference clinically is not significant, Ti-Zr alloy may be the dominant material in implant material choice in order to increase clinical implant success. Due to the fact that peri-implant bone loss depends on many factors, multiparameter studies with larger sample size are needed.

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