Clinical and Radiographic Comparison by Analyzed Cone Beam CT Between One Stage and Two Stage Dental Implants

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Abstract

The aim of this study is to evaluate the relationship between the periodontal clinical parameters and alveolar bone loss rate (ABLR) values in one and two stage dental implants using dental tomography

A total of 40 dental implant was applied to patients, 20 a one-stage surgical procedure (group I) other 20 two-stage surgical procedure (group II), who had a single missing tooth in the lower jawbone. All clinical measurements were recorded at before loading (T0), after loading at the 3 rd month (T1) and after loading at the 6 th month (T2). Alveolar bone loss rate (ABLR) values were evaluated at T0 and T3 using dental tomography because of minimal artifacts and distortions.

In our study, PPD was found to be significantly high in group I than group II at T1 and T2. There was a significant relation between the mPI and ABLR at T2 in Group I, also KSTI and ABLR at T0 in Group II.

The data of this study confirms that; one stage surgery procedure PPD is high than two stage surgery procedure. Larger scale studies, particularly in peri-implantitis cases, may shed more light on this subject.

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Introduction

Dental implants have been used successfully and commonly in recent years as an alternative treatment for removable and fıxed dental prostheses in cases of partial and total toothlessness.[1-3] Biological complications (peri-implantitis, peri-implant mucositis) may occur around dental implants.

Peri-implant mucositis is a reversible inflammatory reaction, which is observed in the soft tissue surrounding the dental implant. Peri-implantitis, on the other hand, is an inflammatory disease that affects the tissues surrounding the dental implant and results in the loss of the supporting bone.[4-5]

ABLR is affected different surgical technique (one and two stage protocol). One-stage implants, is not requirement for two-stage surgery. One-stage implants also provide cost and time benefit, possibility of early loading, and accessibility for clinical monitoring during the Osseo integration period. Two-stage surgery required a two-piece implant system consisting of implant, which is submerged during the first surgical procedure, and the trans - mucosal abutment, which is connected to the implant during the second surgical procedure. This surgical technique was encouraged to avoid preloading and to minimize the bone resorption around an implant during the early phase of healing.[6]

In recent years, a consensus has been reached with respect to the fact that the marginal

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bone loss that occurs around the dental implant in the first year in particular has been an important parameter in the evaluation of the success of the dental implant.[7–9] In the past, an initial ABLR of 1 mm after the first year, and a progressive annual bone loss of 0.2 mm after 5 years, was considered to be successful. However, with the current advancements and new technologies in implant dentistry, we should strive both for bone loss close to zero. Radiographic evaluation is very important to determine ABLR. However, two-dimensional radiographic techniques have multiple limitations (superimpositions of adjacent anatomical structures, distortion, and magnification) mainly addressed by the introduction of three-dimensional imaging techniques such as cone beam computed tomography (CBCT).[10] because it is very important to provide the standardization of the radiographic method used in bone measurement.[7–9] Therefore, it has lately been recommended that a 3D dental tomography be used in the radiographic evaluation of dental implant application.

The aim of this study is to state the relationship between the periodontal clinical parameters, and ABLR values obtained using dental tomography in one and two stage dental implant.

Materials and methods

Study population

The present study conducted 4o healthy patients (24 men and 16 women; mean age, 30,750 +/- 8,583years) who had one tooth absent on lower jaw, at Department of Periodontology, Dicle University, Diyarbakir, Turkey, between 2010 and 2011. Inclusion criteria of patients who had one tooth absent on the lower jaw and did not have bad mouth hygiene, bruxism, or tooth grinding; had not had previous dental implants; had previously undergone chemotherapy or radiotherapy; had any addictions, such as alcohol, cigarettes, and medications; had any pathological state in the jawbones observed clinically or radiographic; those who were not suspected of pregnancy/gestation and/or who were not pregnant as well as those who never used any antibiotics and/or anti-inflammatory medications in the last three months were incorporated into the patient population.

Study design

Randomized prospective study was designed in which a one-stage surgical procedure (group I) was applied to 20 patients with one tooth absent on the lower jaw, and a two-stage surgical procedure (group II) was applied to 20 other patients with one tooth absent on the lower jaw.

Surgical procedures

In the pre-op evaluation, the obtained dental tomography images of the region in which a dental implant was planned to be placed consisted of the sectioning performed in the axial, coronal and sagittal directions. Thus, the ideal sizes of the dental implant to be placed in that region had already been determined.

In the surgical procedures, 20 tissue levels of the same sizes (12mm) and diameters (4.8 mm) were applied to Group I, while Group II received bone level dental implants of, again, the same sizes (12mm) and diameters (4.8mm). In the wake of the surgery, it was recommended that the patients receive a cooling process with ice from the skin area corresponding to the dental implant region, right after which a non-steroidal anti-inflammatory-analgesic tablet (550 naproxen sodium mgr., 2×1), an antibiotic tablet (1gr amoxicillin + beta clavulanic acid, 2x1), and disinfectant mouthwash (0.12% of chlorhexidine gluconate, 2×1) were prescribed to be used for a period of one week.

Clinical measurements

In periodontal and clinical parameters, such as PPD, modified plaque index (mPI), modified gingival index (mGI), modified bleeding index (mBI), keratinized soft tissue index (KSTI), and M were used to assess implants.. The measurements for the clinical parameters were taken BL (T0) process and were repeated in the 3rd (T1) and 6th month AL (T2).

For each implant included in the research group, a dental tomography was taken in the (T0) and (T2). The alveolar bone level around the implant and the implant size were measured from the mesial, buccal, distal and lingual areas.

The implant size was identified by measuring the distance between the implant size and the points determined as the most apical portions of the implant. The bone level, on the other hand, was determined by measuring the distance between the most apical point of the implant and the most coronal points of the bone on the implant. The arithmetic mean of these four

measurements (X1, X2, X3, and X4) was calculated, and the actual bone level for the implant was determined. ABLR was calculated through the following formula[11]:

$$\text{Actual bone level} = \frac{X1+X2+X3+X4}{4}$$

$$\text{ABLR} = 1 - \frac{\text{(actual bone level)}}{\text{Implant Size}} \times 100$$

Statistical Analysis

The assumption of normal distribution of the data was analyzed using the Kolmogorov-Smirnov test, and the homogeneity of the data was analyzed with Levene's test. The repeated measures ANOVA test was used for within-group comparisons of the repeated measures at three different times (beginning, third month, and sixth month), and when statistical significance was found, the Bonferroni multiple comparison test was used to determine the difference between the results for each period. The relationship between the variables was investigated using Spearman Rank Correlation Analysis. Intergroup differences were analyzed using two-sample t-test.

Results

The clinical and radiological data obtained were examined and analyzed comparatively between the groups. Statistically significant differences in a negative direction were found between PPD at T0 and T2 (p = 0.009) (Table 1).

	T0 - T1		T0 – T2		T1- T2	
	Difference	p	Difference	p	Difference	p
PPD	-0,275	0,6316	-0,700	0,009*	-0,425	0,4503
mPI	0,138	0,231	0,138	0,2567	0,000	1,000
mGI	-0,037	1,000	-0,025	1,000	0,0125	1,000
mBI	-0,338	0,330	-0,163	0,475	0,175	0,651

Table 1. The time-dependent change results of the clinical parameters of the sampling region of Group I.

*p<0.05, **p<0.01. PPD, pocket probing depth; mPI, modified plaque index; mGI, modified bleeding index mBI; keratinized soft tissue index, KSTI

A significant positive correlation was established between PPD -mPI (p = 0.046); mGI - mSBI (p = 0.014); at T0; PPD - mGI (p = 0.020); mPI - mGI (p = 0.003); mPI - KSTI (p = 0.026); at T1; PPD - mSBI (p = 0.001) at T2 (Table 2).

	T0		T1		T2	
	R	p	R	P	R	P
PPD-mPI	0,459	0,046*	0,216	0,347	0,220	0,338
PPD-mGI	0,117	0,611	0,535	0,020*	0,345	0,133
PPD-mBI	0,048	0,834	0,060	0,794	0,773	0,001*
PPD-KSTI	0,365	0,112	0,122	0,594	0,146	0,523
PPD-M	0,000	1,000	0,000	1,000	0,000	1,000
mPI-mGI	0,141	0,537	0,677	0,003*	0,071	0,757
mPI-mBI	0,071	0,758	0,189	0,409	0,314	0,171
mPI-KSTI	0,123	0,593	0,511	0,026*	0,402	0,080
PI-M	0,000	1,000	0,000	1,000	0,000	1,000
mGI-mBI	0,564	0,014*	0,320	0,164	0,391	0,088
mGI- KSTI	0,048	0,834	0,316	0,169	0,223	0,330
mGI-M	0,000	1,000	0,000	1,000	0,000	1,000
mBI-KSTI	-0,278	0,225	0,193	0,399	0,373	0,104
mBI-M	0,000	1,000	0,000	1,000	0,000	1,000
KSTI-M	0,000	1,000	0,000	1,000	0,000	1,000

Table 2. The correlation between clinical parameters in group I.

*p<0.05, **p<0.01. PPD, pocket probing depth; mPI, modified plaque index; mGI, modified bleeding index mBI; keratinized soft tissue index, KSTI; mobility, M

When the time-dependent changes in the clinical parameters in the group II were analyzed, it was found that there was a statistically significant difference in the negative direction between mBI at T0 and T2 (p = 0.023) (Table 3).

	T0 - T1		T0- T2		T1- T2	
	Difference	P	Difference	P	Difference	P
PPD	0,025	1,000	-0,212	1,000	-0,237	0,748
mPI	0,025	1,000	0,062	0,785	0,037	1,000
mGI	-0,0125	1,000	0,037	0,802	0,050	1,000
mBI	-0,225	0,349	-0,375	0,023*	-0,150	0,802

Table 3. The time-dependent change results of the clinical parameters of the sampling region of Group II.

*p<0.05, **p<0.01. PPD, pocket probing depth; mPI, modified plaque index; mGI, modified bleeding index mBI; keratinized soft tissue index, KSTI

When analyzing the relationships between the clinical parameters, it was determined that there was a significant positive

correlation between PPD - mPI (p = 0.023); mGI - mBI (p = 0.006) at T0; PPD - mBI (p = 0.018) at T1; PPD - mBI at T2 (p = 0.032) (Table 4).

	T0		T1		T2	
	R	p	R	P	R	P
PPD-mPI	0,522	0,023*	0,185	0,419	0,030	0,896
PPD- mGI	0,248	0,279	0,007	0,977	0,089	0,698
PPD-mBI	0,096	0,677	0,544	0,018*	0,493	0,032*
PPD-KSTI	0,162	0,479	0,055	0,809	0,037	0,873
PPD-M	0,000	1,000	0,000	1,000	0,000	1,000
mPI-mGI	0,098	0,669	0,284	0,216	0,049	0,831
mPI-mBI	0,220	0,337	0,119	0,604	0,170	0,458
mPI-KSTI	0,167	0,465	-0,144	0,531	0,096	0,675
mPI-M	0,000	1,000	0,000	1,000	0,000	1,000
mGI-mBI	0,637	0,006*	0,147	0,521	0,095	0,678
mGI- KSTI	0,244	0,287	0,443	0,054	0,293	0,202
mGI-M	0,000	1,000	0,000	1,000	0,000	1,000
mBI- KSTI	-0,042	0,855	0,009	0,967	0,232	0,311
mBI-M	0,000	1,000	0,000	1,000	0,000	1,000
KSTI-M	0,000	1,000	0,000	1,000	0,000	1,000

Table 4. The correlation between clinical parameters in group II.
*p<0.05, **p<0.01. PPD, pocket probing depth; mPI, modified plaque index; mGI, modified bleeding index mBI; keratinized soft tissue index, KSTI; mobility, M

For the PPD measurements, it was seen that the mean values of pocket depth between group I and II different significantly [T1 (p = 0.028); T2 (p = 0.016)] (Table 5).

	T0		T1		T2	
	T	p	T	P	T	P
PPD	1,314	0,197	2.289	0,028*	2,518	0,016*
mPI	1,423	0,165	0,325	0,747	0,935	0,357
mGI	0,366	0,716	0,671	0,506	1,038	0,306
mBI	1,099	0,278	0,995	0,326	-0,709	0,482
KSTI	-0,309	0,759	-0,607	0,547	-0,607	0,547

Table 5. The time-dependent change results of the clinical parameters of the sampling region of Group I and II.
*p<0.05, **p<0.01. PPD, pocket probing depth; mPI, modified plaque index; mGI, modified bleeding index mBI; keratinized soft tissue index, KSTI

When the time-dependent changes in ABLR were considered, it was seen that in the group I, the difference between ABLR mean values at T0 and T2 were statistically significant in the negative direction (p = 0.005) (Table 6).

	T0	T2
I. Group ABLR	4,11%±6,11	6,22%±6,66
II. Group ABLR	3,69%±4,34	4,81%±4,31

Table 6. The Radiological Data of Dental Tomography.
Mean ± standard deviation. Alveolar Bone Loss Rate ; ABLR

GROUP I: It was established that there is a statistically significant difference in the positive direction between mPI and ABLR at T2
GROUP II: It was determined that there is a statistically significant difference in the positive direction between KSTI and ABLR at T0.

Discussion

Restoring the extracted teeth via dental implants has become an increasingly popular alternative way of treatment. The success of implants is affected by the factors depending on the patient (bone amount and quality, clinical parameters) and the surgical procedure followed.[9]

The periodic assessments are quite important in terms of determining the short and long-term success and complications of the implants.[10] Our study was conducted on two groups of dental implants applied through a different surgical procedure in order to evaluate the early stage peri-implant tissue health. The probable relationship between clinical periodontal parameters, which are used to assess the success of implants, and radiological assessments (dental tomography) are investigated.

The bacterial plaque is the main etiological factor of peri-implant mucositis and peri-implantitis. Following the stimulation, gingival bleeding is regarded as a clinical sign of peri-implant diseases. [14] In our study, it was seen that there is a positive relationship between PPD and mPI; mPI and mGI; mGI and mBI. It has been an expected situation.[11, 12]

Renvert and colleagues and Sahm and colleagues recorded the parameters before treatment and after treatment at the 1st, 3rd, and 6th month, in a study conducted on individuals with peri-implantitis, and they established that the values for PPD, PI, and BI decreased in both groups and were related to each other. [11, 12] Congruent with our study, it was found that there is a positive relationship between clinical parameters.

When the time-dependent change of the clinical parameters within the groups were analyzed at T0 and T2 PPD value in Group I showed a statistically significant increase. ABLR was also determined to have increased significantly. The increase in the PPD in parallel to the amount of bone destruction has been an expected consequence.[13, 14]

When the intergroup clinical parameters were analyzed, a statistically significant difference was seen between the one stage and two stage dental implants on PPD values on T1 and T2. Studies conducted in recent years have shown that there is a significant relationship between alveolar crest placement level and structure neck (the availability or lack of a bright surface), the quantity of crestal bone in the area, and the dental implant procedure.[15, 16] previous studies have determined that marginal bone loss is greater in one-stage implants because of the micro space/cavity at the bone level of the dental implants during the two-stage surgery procedure.[17, 18]

Ericsson and colleagues applied dental implants using one and two stage surgery procedures on patients who had lost one tooth in the maxillary anterior region. At the one-year follow-up, it was seen that the amount of alveolar bone loss in the one stage surgery procedure was 0.08 mm; and in the two-stage surgery procedure group, there was a 0.05 mm alveolar bone gain.[19] In the light of these data, the PPD difference between the two groups in this study is thought to be related to the dental implant surgery procedure, the shape of the implant, and the neck of the implant structure.

Herman et al., in an experimental study they conducted on animals, applied a total of 60 implants with two different types of necks via the one stage and two stage surgical procedures. The implants were divided into six different sub-groups according to their replacement level in the alveolar crest, and as the result of the six-month-follow up, histological sectioning were performed. In consequence of the study, however, it was determined that there had been an alveolar bone loss in all the other groups except for one.[19] Similarly, we are of the opinion that the time-dependent difference between the ABLRs of both groups in our study has resulted from the difference of the procedures applied in the replacement of the implants in the alveolar bone.

In our study, the probable relationships between radiological and clinical parameters were analyzed. It was seen that there was a positive relationship between mPI and ABLR at T2 in Group I. Furthermore, it was found that there was a positive relationship between KSTI and ABLR before loading in Group II.

A total of 100 patients, 52 of who were male and 48 of whom were female, were incorporated into the study conducted by Bum-Soo Kim et al., and the keratinized mucosal width of 276 dental implants applied to these individuals was measured. Separately, the probable relationships/correlations between the obtained results and the clinical parameters were analyzed. It was determined that GI, gingival recession and alveolar bone loss within the group with insufficient keratinized mucosal width (less than 2 mm) was higher than those in the group with sufficient mucosal width. Additionally, PPD was found to be high within the group with sufficient mucosal width (larger than 2 mm).[20]

Heckman and colleagues reported that the bone loss around dental implants is related to BI, PI, and exudates, and they also reported that keratinized mucosa loss causes this inflammatory variance.[25]

Conclusions

The data of this study confirms that; one stage surgery procedure PPD is high than two-stage surgery procedure. Also different surgery procedures can affect clinical, radiographic parameters and peri-implant tissue health.

Declaration of Interest

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