ISSN (print) : 2589-9120
ISSN (online) : 2589-9139

International Journal of Medical Science and Applied Research (IJMSAR)

Available Online at: https://www.ijmsar.com

Volume – 2, Issue – 1, January - February - 2019, Page No. : 05 -11

Effects of Two Different Abutments Diameter on Microgap after Cycling Loading and Thermocycling

[1]Ezatollah Jalalian, [2]Shirin Lavaf, [3]Gholamreza Esfahanizadeh, [4]Chakameh Rezaei, [5]Amir Ali Shirian

Department of Prosthodontics, Tehran Medical Sciences, Islamic Azad University, Tehran, Iran.

Corresponding Author: Chakameh Rezaei, Tehran Medical Sciences, Islamic Azad University, Tehran, Iran.

Type of Publication: Original Research Paper

Conflicts of Interest: Nil

Abstract

This study aimed at investigating effects of two different abutments diameter on micro gap and finding effect of cycling loading and thermocycling on Fixture-Abutment system and microgap when larger diameter is used in compare to using smaller diameter. In this study, a total number of 16 implants were used with 10 mm length and 3.5 diameters.

Initially, samples were mounted in circle shape acrylic producers with 19 mm diameter and 34 mm height. After cyclic load and thermocycling, interface between lowest point of abutment and highest point of fixture were randomly selected in 6 areas in 360-degree environment.

The images provided from Scanning electron microscope in Switzerland and the gap between two points was measured and was recorded as vertical misfit in micron unit. In order to analyze microgap data, t test was used in two dependent populations (3.9 mm and 5.2 mm diameter). And also, microgap mean which was obtained in all 6 points in 8 regarded implants was 0.982 ± 0.234 micron in 3.9 mm diameter and 0.776 ± 0.348 in 5.2 mm diameter. Results indicated that with increment of abutment diameter implant microgap was reduced. In two half-diameters with 3.9 and 5.2 no significant difference was observed in microgap.

Keywords: Dental implants, Dental Implant- Abutment Design, Scanning Electron Microscopy.

Introduction

One of the main problems in implant is micro leakage and micro-gap between fixture and implant Abutment. It is very important that there is no micro-gap between fixture and implant abutment because it reduces influence of microorganisms between implant and bone which can lead to biologic problems, inflammation and broken implant. [1,2] Studies reported similar amount of prevalence of this problem and prevalence of micro-gap and micro leakage has been reported by lower than 10%. [3,4] Danley et al came up with influence of microorganism of this gap for the first time. [5] Bacteria colonization of implant and abutment is dependent on accuracy in fixture and abutment integrity, torque forces and micro movement between connection elements in chewing. Many attempts put on finding secure connection between implant and Abutment. [6] Today, preventing microgap in connection place of implant and abutment is a serious challenge in order to minimize inflammatory reaction and maximize bone stability in neck area of implant. [7-9] most dental implant systems are made from two sections (implant and abutment). When Abutment is placed on under gum implant, influence of oral microorganism in space between these two sections increases risk of soft tissue inflammation and microbial colonization may cause bone resorption. Gap near to alveolar crest may cause 1mm bone loss in first year of functional loading of implant. [10-12] Studies illustrated that abutment diameter has effect on

mechanical characteristics and can cause permanent transformation and changes connection place of implant and abutment. In some studies, it was clarified that abutment with larger diameter shows better resistance against compressive forces and they are recommended in posterior areas. [13] While some other studies mentioned to similar clinical performances for different diameters. [14-16] since there is little information on effect of different diameters on marginal fit Abutment, this study was performed to investigate effect of different Abutment diameters on marginal fit after thermocycling and cycling loading in 2016 in Islamic Azad University dentistry department.

Materials and Methods

This study was performed by experimental method. According to literature, minimum sample volume in each group was 8 samples (16 samples). Applied implant system was LASAK (Czech Republic). Applied implant had 10 mm length and 3.5mm diameter. In this research, direct titanium Abutment with 3.9 mm diameter and 1.5 mm kelvar height and 5.2mm diameter and 1.5 mm kelvar height and deep Lock-Q connection with hex and one Cylindrical end was used. For providing acrylic resin, appropriate ratio of powder and liquid was applied based on factory instruction. Then in order to mount fixtures in J.M. Ney Co (acrylic generator) was used in 90 degree of survivor machine and samples were mounted when their space was 2 mm from edge of Bloomfield, CT, USA fixture outside of the acrylic Sample study included 16 implants which were similarised based on research variables. Firstly, samples were mounted in circle shape acrilic producers with 19 mm diameter and 34 mm height. Then producers were filled by clear auto-polymerized acrylic resins (Meliodent, HeraeusKulzer GmbH, Germany). Then abutment with 3.9 mm and 5.2 mm size was connected to implant and Abutment screw was fastened based on factory instruction by digital torque-meter (Lutron Electronic Enterprice CO, Taiwan) on which N25 force was enforced. On all direct mounted implant–abutment in Acrylic resin blocks. Samples were divided into two groups with 8 samples and finally data were evaluated with t test.

Results and Discussion

Equality test or difference between means of two normal populations was carried out based on observations collected from patients with teeth with 5.2 mm and 3.9 diameters. Results indicated that observation means of teeth with 5.2 diameter was lower than teeth with 3.9 diameter. In addition, results of equality test of dispersion showed that observations dispersion was higher in teeth with 5.2 diameters than teeth with 3.9 diameters. All the result showed in Table 1-3. Also it can be seen the abutment-fixture interface with different magnification in figure 1-4. Results showed that in cycling loading condition and Thermocycling condition implant micro-gap is decreased by increment of Abutment diameter. There was no significant difference in two half of Abutment with 9.3 and 2.5 diameters in micro-gap. Although dental implant has many advantages, stabilizing the bone around implant in long term need more researches. Implant systems which are used more these days, are formed from two sections of implant and abutment[1]. Based on Broggini et al in 2006, micro-gap in bone level implant causes colonization of inflammatory cells, osteoclast growth and resorption of alveolar bone when stable bacteria and bacterial leakage[17]. Today new implant systems with different kinds of connection, new properties and specific superficial characteristics are introduced aiming at minimizing failures which happens based on adaption effect of implant-abutment Interface area. [3] Side effects of incomplete Abutment and implant is increment of micro-leakage, Abutment rotation, and screw loose, and preload

decrease. [18] In vitro studies have indicated micro-gap in connection place of implant–abutment in different systems. [18] However, effect of structural characteristics of Abutment on micro-gap of abutment-implant has not been studied separately. Based on these studies, the more diameter of abutment is reduced, failure percentage is increased so this failure has effect on biology of tissues around implant and increase of abutment implant failure so based on obtained data the more Abutment diameter is decreased (3.9 diameter) the more will be percentage of micro-gap. So these two studies are compatible. Costa Martins de Sá et al studied prosthesis abutment failure strength with standard and small diameter for restoration of jaw by implant support. Finding indicated that resistance against failure in standard abutment was higher than Abutment with smaller diameter due to wider size and stress distribution. Consequently, transformation and micro-gap and micro leakage is decreased. [19] Obtained results indicated that by increased of abutment diameter micro-gap is decreased by smaller diameter and this conclusion is generalizable. Zhihong Mao et al performed a researched titled as effect of Abutment size and stabilizer screws in implant system. Rsults showed that smaller size of abutment and screw increases stress and transformation while centripetal force increases transformation more than vertical force so screw loose and then gap and leakage are increased. [20] Results of Zhihong Mao is compatible with our results considering force type and diameter difference. They both showed that by increment of abutment diameter and thickness micro-gap is decreased. Hyon-Mo Shin studied effect of diameter of implant and Abutment connection on screw connection fixed rate. Results indicated that external butt joint was better in assessing post load force than internal cone. In addition, by decrease of implant diameter, torque force while by increment of Abutment implant diameter screw stability is also increased. Result of Hyon-Mo Shin indicated that mechanical characteristics of abutment – implant interface is effective on failure and stability of connective screws and screw losing. All of these disorders in Abutment implant interface creates gap in connections. [21] According to Hyon-Mo Shin, and Abutment – implant characteristics, result of Hyon-Mo Shin is compatible with our results. Because by increment of abutment, screw stability is also increased so screw loosing is decreased so micro-gap and leakage of Abutment–implant is reduced and in this study by increase of abutment diameter micro-gap is decreased. So, considering mechanical characteristics of Abutment and implant structures, it can be concluded that results of both studies is similar to our results Nascimento et al studied saliva leakage in three connections between Abutment implant interface of different systems in under pressure and normal condition and its effect on leakage. Results indicated that microorganisms are found in internal layers of implant s however morse cone implant s have least microorganisms rather than other implants. [22] These findings are not compatible with our results which proved that increment of abutment implant improves mechanical properties of implants in cycling loading condition. Micro leakage after cycling loading and thermocycling and two cutting along with longitudinal axis of Abutment–implant indicated that with increment of Abutment diameter in implant system micro-gap and micro leakage is reduced. Lillo et al performed a research titled as Abutment resistance with different diameter and Tran mucosal Heights in Morse-Taper implants, divided 40 morse-taper implant into 4 groups with different sizes of abutments for cement-retained prosthesis. Based on results, there was significant difference between groups against failure and deformation. In addition, there was no significant difference in group 3 and group 2. Furthermore, in all Abutments, deformity was in upper area and in

Transmucosal however threads of the screw was intact. Failure occurred only in group 3 and 4. Highest machine resistance was observed in abutments with 4.5 mm diameter and 2.5 mm Transmucosal. [11] These results were due to increment of abutment implant diameter in mechanical characteristics of implants in cycling loading condition which is along with our results. By increment of Abutment diameter, deformity is decreased so micro-gap is also reduced. There was significant relationship between abutments' diameter with microcap. In this study, micro-gap was measured after cycling loading (Fig 1A and 1B) and thermocycling which is more generalizable than Lillo results. In lorezoni et al study, in order to study capability of implant seal and evaluation of marginal integrity both SIN and Ossetite were studied. Results indicated that both group had leakage in all times of study. In addition, magnifi images showed gap between implant and abutment. [23] In this study all implant s in different diameter had significant relationship with micro-gap. The more is abutments diameter was the less was micro-gap. However, in Lorezoni study, samples were not under cyclic loading. So they had no similarity with mouth area. Our findings were similar to clinical condition and its results is generalizable. Trefoils et al carried ad an investigation titled as "effect of dynamic loading on bacterial colonization in different types of connections" and studied effect of dynamic force on colonization of mouth bacteria in fixture- Abutment of dental implants with internal connection of morse taper. In this study, 40 implants were divided into two groups with 20 samples. In both groups, fixtures that were connected into standard abutments were under escherichia coli culture as microbial culture. Then samples of group 2 were studied under 50 newton load and 500000 cycle such as chewing. When fixtures became unconnected to abutment microbial samples were cultivated in good condition in abutment days. Results indicated that one of 20 implant s in group 1 and 4 from implant group 2 had micro-gap in Abutment–fixture surface which were colonized by escherichia coli. Resarechers concluded that implant s with internal connection of Morse taper prevented bacteria permeability into lower parts of Abutment-fixture. [24] In this study implant with internal morse taper connection were studied and did not conduct any study on other implants and this has effect on generalizability of finding related to other implant s and structural characteristics of abutments. their results in not compatible without findings due not to considering diameter, Abutment–implant interface with other internal connections. Tripodi et al studied leakage of Bactria in experimental research in Abutment – implant interface of Morse taper implants under loading and not loading condition. Results of the study indicated that resorption of crestal bone around implant s with morse taper connection (3.5 mm diameter) which is placed under crestal bone can be lower. [25] Results of this research illustrated that abutment – implant diameter increase improves micro leakage of implant however in Tripodi study, difference in bacterial leakage in one implant system is not influenced by mechanical characteristics of Abutment and implant but it depends of implant placement in bone. In Maurl′cio Moris study effect of force with different diameter of Abutment was positive[12] however, they lacked taking Thermocycling effect into account, similar experimental condition with mouth environment and using different diameter with different colar height. Since samples of both Abutment groups (diameter: 9.3 and 2.5) were under cycling loading and Thermocycling results are generalizable. In addition, this study indicated that by increment of abutments diameter bacteria micro leakage is reduced so mechanical characteristics of implants has role in their success. Consequently, Maurl′cio Moris results is similar to our results in spite of little difference in

deformity of both groups of Abutment diameter s and Abutment with larger diameter has less deformity however due to some lacks of this research is not that generalizable.

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Tables 1: Results of Kolmogorov-Smirnov test for 8 sample.

Diameter		Mean	Median
3.9 mm	N	8	8
	Kolmogorov-Smirnov	0.161	0.208
	P-value	> 0.150	> 0.150
5.2 mm	N	8	8
	Kolmogorov-Smirnov	0.179	0.164
	P-value	> 0.150	> 0.150

Tables 2: Descriptive statistical characteristics in 3.9 mm and 5.2 mm.

	Diameter	
	5.2 mm	3.9 mm
Mean ± Std	1.8210 ± 0.364	2.06 ± 0.2546
C.V	20.02	12.37
Min	1.185	1.654
Max	2.583	2.712

Table 3: T-test results.

			Mean	Median
Levene's test for equality of variances	F		0.04	0.23
	Sig.		0.842	0.635
T-test for equality of means	t		-3.53	-2.51
	df		14	14
	p-value		0.009	0.011
	Difference (Mean±sd)		-0.1566±0.2390	-0.1845±0.2314
	%95 Confidence Interval of the difference	-0.0711	-0.0711	-0.0335
		Upper	-0.4069	-0.4293

Figure 1: A and 1B. Cyclic loading applied to the samples.

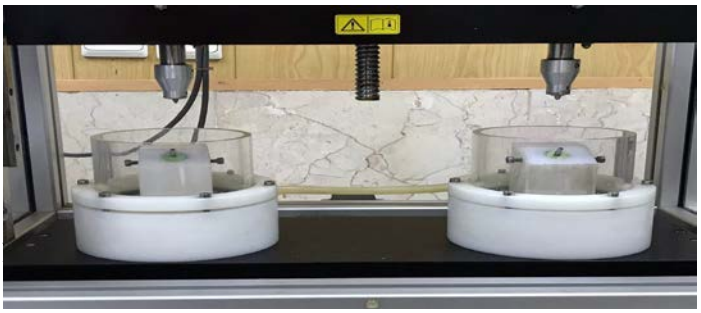

Figure 2: Abutment-fixture interface (x1000)

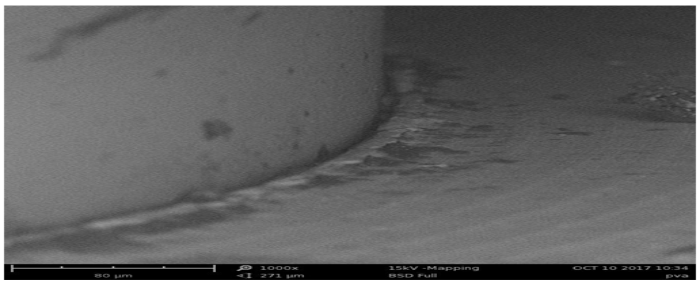

Figure 3: Abutment-fixture interface (x2000)

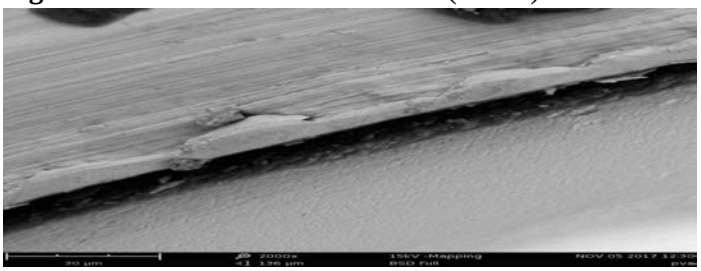

Figure 4: Abutment-fixture interface (x10000)

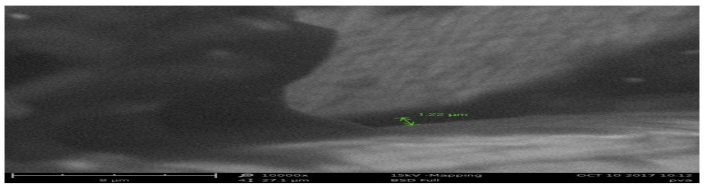

Figure 5: Abutment-fixture interface (x10000)