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CLINICAL AND IN-VITRO STUDY TO EVALUATE THE BACTERIAL GROWTH AROUND IZI IMPLANTS

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ABSTRACT:

Objective: This study aimed to evaluate the bacterial growth around Issa Zirconia Implants (IZIs), designed as a single piece, which is implanted with single surgical technique.

Materials and Methods: The research sample consisted of 30 IZIs that were installed into jaws of patients whom are 20-55 years old from the reviewers to Dental Implant Clinic in Department of Fixed Prosthetic at Tishreen University. Thirty of smears from the plaque in the gingival tissue around the thirty implants were taken by sterile special holders (one smear per implant). The bacterial transplantation of the samples was carried out on Petri dishes within the specialized bacterial analysis laboratories. The results were statistically analyzed using SPSS software.

Results and Discussion: The results of the bacterial examination showed that there was no bacterial growth in 26 samples after 48 hours of bacterial transplantation, while strepto coccus was found to be insignificant in four samples after several hours of germination. The statistical study showed that the percentage of insignificant bacterial growth is 13.33% while the percentage of no growth is 86.7%. **Conclusion:** IZIs are considered as implants that do not help bacterial growth around them and thus help to keep the surrounding soft tissue healthy.

Key words: Bacterial growth, Dental implants, Dental Plaque, Peri Implant Biofilm

INTRODUCTION:

The success of dental implants depends on the maintenance of osseointegration, which is defined as direct contact between the living bone and the surface of the implant without causing any injury [1]. Despite the relatively high success rates of dental implants, exceeding 90% in partial or total renal failure as reported in studies, some studies have demonstrated the role of bacterial plaque buildup in tissue inflammation around the implant and its harmful effects on the hard and soft tissue around the dental implants as one of the most important factors causing implant failure [2-3].Late implant failure can be caused by an incompatibility between the implant and the bone tissue in the next stage of bone formation either due to over loading or microbial infection [4].

Although the main problem of dental implants is solved: the occurrence of osseointegration by using implants of specific properties, well treated surfaces and appropriate surgical technique, the soft tissue inflammation surrounding the implants due to plaque buildup on the abutments of the sub-gingival area is a major **cause** to implants failure [5-6].

Clinically, Biofilm can be diagnosed near the abutment in the Inflammation of the mucosa around the implants, which later develops into the destruction of the alveolar bone in the contact area with the implant threads. There is agreement on the full similarity of the soft connective tissue surrounding the implant above the bone level to what it is around normal teeth except for the absence of Sharpe fibers that do not enter the surface of the

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implant while entering the surrounding cementum. [7].

These factors and other factors vary according to implant systems:

- Designs of implants or total structure (screw or cement fixation, single- or two- surgical stages).

- Type of surface or microstructure (commercially pure titanium, titanium alloys, plasma-sprayed titanium or hydroxideabatite-coated surfaces, acid treatment or combination thereof).

- The degree of softness or roughness of the surface.

- Various forms of used abutments [8].

Therefore, the presence of these differences between the teeth and implant materials directly and indirectly affects local germs. Dental implants are the best option to restore missing teeth over the past decades, and there are two main ways to insert implants into the bone [9]:

- Two - phase surgical technique: The procedure is usually done in two steps. The first step is surgery to stabilize implants within the bone for 3-6 months during which osseointegration occurs. The second step is a small surgical procedure in which the visible part which is the abutment and permanent crown are placed.

- Single - phase surgical technique: The technique is the least common in the implant systems. This procedure is done in one step. The implant is placed within the bone and the abutment is fixed at the same time to remain prominent in the mouth through the gingival tissue. After a healing period of 3-6 months, the crown is placed permanently.

Dental implants can be equally successful using either technique if the situation was diagnosed and the exact location of the implant is accurately selected [10], but Single-stage surgical technique provides the following features:

- Shortening of additional surgical intervention.

- Shortening treatment time.

- Reducing the patient's financial expenses.

Although several studies have proved that both Single- stage surgical technique and two - stages technique are similarly effective in addition to the previously mentioned features [10]; some advocates or practitioners claim that the two - stages technique increases the rate and speed of osseointegration by isolating the implant from the oral environment and protecting it from bacterial invasion during the healing phase. Hence, the importance of this research comes from the fact that it studies the bacterial growth around zirconia implants, which are designed as one

piece, and is installed according to the single - stage technique.

Previous studies

- The researcher Meier,et al [11] and his colleagues did a laboratory study including five samples of each of the following:

•Glass (control; surface roughness Ra = 0.24 µm)

• Feldspathic ceramic (Ra = 0.26 µm)

• Glass-infiltrated alumina (Ra = 1.33 µm)

•Zirconia reinforced Glass-infiltrated alumina (Ra = 1.34 µm)

• Tetragonal stablelized zirconia Y-TZP (Ra = 0.26 µm).

Specimens were exposed to sterile human saliva for 15 minutes and bacterial adhesion was documented with four different groups of streptococci. The materials properties, the surface roughness and the content of glass samples had a weak effect on the bacterial adhesion.

- An in vitro study was conducted on 10 samples of zirconia with surface roughness values of 0.76 µm and titanium with surface roughness values of 0.73 µm, by Scarano,et al [6]. When examining the samples with the scanning electron microscopy, they reported that zirconia disks placed on a removable device in the mouth showed a lower accumulation of plaque than titanium disks, even with similar surface roughness. The bacterial adhesion rate of the zirconia disks was 12.1%, which is low compared with the bacterial adhesion rate on titanium disks which reached 19.3%.This was due to lower electrical conductivity in zirconium compared with titanium.

- An In vivo and in vitro study was made by Rimondini, et al [13].

- Polished zirconia disks (Ra = 0.18µm)
- High-polished zirconia disks (Ra = 0.04µm)
- Commercially pure titanium disks of the second class (Ra = 0.22µm).

✓ In vitro test (7 specimens of each material): the adhesion of S-mutans to polished zirconia disks was significantly more than in high -polished zirconia and titanium.

✓ In vivo test (10 subjects): the growth of bacteria (cocci and rods) on zirconia disks was significantly less than that on titanium disks.

- In 1989, Nakazato and his colleagues studied several types of samples in vivo [14]:

- Single-crystal alumina (Ra = 0.090 µm)
- Polycrystal alumina (R = 0.854 µm)
- Hydroxyapatite (Ra = 0.518 µm)

- Pure titanium (Ra = 0.142 µm)
- Heat-polymerized acrylic resin (Ra = 0.109 µm)
- Partially stabilized polycrystal Zirconia (Ra = 0.369 µm).

Disks of each material were set on the gingival tissue by using removal devices without using the toothbrush. The disks were then removed after 4 and 48 hours. The disks were subjected to scanning electron microscope (SEM),and Microbiologic examination, but no significant differences were observed between the surfaces of all materials in terms of bacterial invasion.

Aim of The Study

The current study aims to examine microbial growth on single piece zirconia implants, which are installed by using single - phase surgical technique.

MATERIALS AND METHODS:

The study sample consisted of 30 Issa Zirconia Implants (IZIs), which were installed by the single-stage surgical technique for a group of patients aged 20-55 years attending the Dental Clinic of the Dentistry Faculty in Tishreen Universit

Materials:

- Sterile disposable special trays Fig. (2a-2b).

- Mirrors, tweezers and probes for clinical examination.

- Petri dishes equipped and specialized for bacterial transplantation prepared by the specialized laboratory and numbered by the number of swabs from 1-30 Fig.(1).

- A Sony-type imaging camera for study follow-up.

- SPSS program to analyze the results statistically.

Methods:

- 30 smears from the plaque in the gingival tissue around the 30 implants were taken by sterile treys (one smear per implant).

- The bacterial transplantation of the specimens on Petri dishes was done within specialized bacterial laboratories (Fig. 3a-3b).

- Laboratory results were prepared and analyzed statistically using the SPSS program.

RESULTS:

The oral cavity contains a wide and complex variety of microbes. These microorganisms, characterized by enormous diversity, live on the different surfaces of the natural mouth, bacteria accumulate to form a biofilm on both hard and soft mouth tissues. Bacterial adhesion is very important for oral bacteria.
Oral bacteria include streptococcus, *Actinomyces, Veillonella, Fusobacterium, Porphomonas, Prevotella, Treponema, Nisseria,*

Haemophilis, Eubacteria, Lactobacterium, Capnocytophaga, Eikenella, Leptotrichia. Peptostreptococcus, Staphylococcus, Propionibacterium [15].

Most of these microorganisms exist in the oral cavity, interacting with each other. Oral bacteria have developed mechanisms for sensing their environment, while maintaining a dynamic balance between bacteria and the host's natural defense system [16]. When the immune system is highly efficient, it constantly monitors bacterial colonies and prevents the penetration of pathogenic bacteria into localized tissue [17].

The clinical success and longevity of the dental implants within the bone are largely controlled by maintaining the hard and soft tissues surrounding the implant. The early loss of this area around the implant is associated with the continuous decline in the surrounding soft tissue. Thus, the success of implants depends on preventing the formation of biofilm. At this point. the role of the material from which the implant is manufactured should be highlighted. For this reason, research studies have tried to find a material that prevents bacterial adhesion or allows it to be formed at lower limits.

In this study, the collection and growth of microorganisms around IZI implants, which were installed by a single-stage surgical technique for a group of patients aged 20-55 years and continued in the mouth for at least 4 months, have been investigated. Thirty smears were taken from the plaque in the gingival tissue around the thirty implants (One smear per implant). The bacterial transplantation of the samples on Petri dishes was performed within specialized bacterial laboratories (Fig. 3a-3b).

The results of the microbial examination as shown in Table (1) showed no bacterial growth in 26 samples after 48 hours of transplantation, while strepto coccus was found to be insignificant in four samples after several hours. The statistical analysis of the results using SPSS showed that the percentage of bacterial growth is insignificant (13.33%) while the percentage of the absence of any growth is 86.7% (Table 2). If these laboratory results are compared with clinical examination and observation which shows no signs of inflammation, we see no significant importance for any bacterial growth around IZIs.

This may be due to the nanostructure of the zirconia, which allows its surface to be polished. Thus, a high degree of surface smoothness inhibits the bacterial adhesion, and the formation of biofilm, compared to other materials from which the implants are made, particularly titanium.

The results of this study are consistent with Scarano et al [6], Where the percentage of bacterial growth was 12.1% in comparison with titanium 19.3%. This result was explained by

lower electrical conductivity of zirconia compared to titanium. The results of our study are also consistent with the researcher Al-Ahmad et al [18]. There was less "accumulation" of bacteria on different surfaces of zirconia than titanium, which means that zirconia is superior to titanium in terms of biofilm formation.

The results of this study coincide slightly with Brakel et al [19], where there was no significant difference between zirconia and titanium in terms of bacterial adhesion ratio. However, the lowest percentage of adhesion was on zirconia abutments. This study may be different from Meier et al. 2008, as it concluded that the properties of materials and surface roughness had a weak effect on bacterial adhesion. The reason was that he compared similar materials of ceramic material of a smooth surface with very low roughness, and the roughness of the surfaces of these materials was close to (µm 1.34-0.24) as did Scotti et al[20], who found similarity in bacterial growth on both glass and zirconia.

CONCLUSION:

We conclude from the previous results that IZIs due to surface properties (Degree of refinement, high smoothness, and low electrical conductivity) largely prevent bacterial adhesion, thus preventing the formation of biofilm on the surface of the abutment, thereby reducing the risk of gingivitis around the implants, which is the major responsible for the failure of implant- supported prostheses.

REFRENCES:

1. Branemark P, Adell R, Breine U, Hansson B, Lindstrom J, Ohlsson A. Intra-osseous anchorage of dental prostheses. Experimental studies. Scand. J. Plast. Reconstr. Surg. 1969; 3: 81–100
2. Lindquist L, Carlsson G, Jemt T. A prospective 15-year follow-up study of mandibular fixed prostheses supported by osseointegrated implants. Clinical results and marginal bone loss. Clin. Oral Implant. Res. 1996; 7: 329–336.
3. Quirynen M, De Soete M, van Steenberghe D. Infectious risks for oral implants: A review of the literature. Clin. Oral Implant. Res. 2002; 13 1–19
4. Piattelli, A.; Vrespa, G.; Petrone, G.; Iezzi, G.; Annibali, S.; Scarano, A. Role of the microgap between implant and abutment: A retrospective histologic evaluation in monkeys. J. Periodontol. 2003; 74: 346–352.
5. Elter C, Heuer W, Demling A, Hannig M, Heidenblut T, Bach F, Stiesch-Scholz M. Supra- and subgingival biofilm formation on implant abutments with different surface characteristics. Int. J. Oral Maxillofac. Implant. 2008; 23: 327–334.
6. Scarano A, Piattelli M, Caputi S, Favero GA, Piattelli A. Bacterial

adhesion on commercially pure titanium and zirconium oxide disks: An in vivo human study. J Periodontol 2004; 75: 292–296.

7. Berglundh T, Lindhe J, Jonsson K, Ericsson I. The topography of the vascular systems in the periodontal and peri-implant tissues in the dog. J. Clin. Periodontol. 1994; 21: 189–193.
8. Tesmer M, Wallet S, Koutouzis T, Lundgren T. Bacterial colonization of the dental implant fixture-abutment interface: An in vitro study. J. Periodontol. 2009; 80: 1991–1997.
9. Rasoul G, Hesamuddin E, Akram A. Comparison of the Marginal Bone Loss in One-stage versus Two-stage Implant Surgery. J Dent (Shiraz). 2017; 18(4): 272–276.
10. Esposito M, Grusovin MG, Chew YS, Coulthard P, Worthington HV. Interventions for replacing missing teeth: 1- versus 2-stage implant placement. Cochrane Database Syst Rev. 2009; 8(3): CD006698. doi: 10.1002/14651858.CD006698.pub 2.
11. Meier R, Hauser-Gerspach I, Lüthy H, Meyer J. Adhesion of oral streptococci to all-ceramics dental restorative materials in vitro. J Mater Sci Mater Med 2008;19: 3249–3253.
12. Scarano A, Piattelli M, Caputi S, Favero G, Piattelli A. Bacterial adhesion on commercially pure titanium and zirconium oxide disks: An in vivo human study. J. Periodontol. 2004; 75: 292–296.
13. Rimondini L, Cerroni L, Carrassi A, Torricelli P. Bacterial colonization of zirconia ceramic surfaces: An in vitro and in vivo study. Int J Oral Maxillofac Implants 2002; 17: 793–798.
14. Nakazato G, Tsuchiya H, Sato M, Yamauchi M. In vivo plaque formation on implant materials. Int J Oral Maxillofac Implants 1989; 4: 321–326.
15. Jenkinson H F, Lamont R J. Oral microbial communities in sickness and in health. Trends Microbiol. 2005; 13: 589–595.
16. Los Alamos National Library. ORALGEN. Livermore: 2009. Library LAN ed.
17. Avila M, David M, Ojcius & Özlem Y. The Oral Microbiota: Living with a Permanent Guest: DNA Cell Biol. 2009; 28(8): 405–411.
18. Al-Ahmad A, Al-Ahmad M, Faust J, Bachle M, Follo M, Wolkewitz M, Hannig C, Hellwig E, Carvalho C, Kohal R. Biofilm formation and composition on different implant materials in vivo. J. Biomed. Mater. Res. B Appl. Biomater. 2010; 95: 101–109.
19. Van Brakel R, Cune M, van Winkelhoff A, de Putter C, Verhoeven J, van der Reijden W. Early bacterial colonization and soft tissue health around zirconia and titanium abutments: An in vivo study in man. Clin. Oral Implant. Res. 2011; 22: 571–577.

20. Scotti R, Kantorski KZ, Monaco C, Valandro LF, Ciocca L, Bottino MA. SEM evaluation of in situ early bacterial colonization on a Y-TZP ceramic: A pilot study. Int J Prosthodont 2007; 20: 419–422.

TABLES:

Number of Specimen	Kind of Bacterial growth	Time of the test
1	No growth	48 hours
2	Un important Simple growth	Few hours
3	Un important Simple growth	Few hours
4	No growth	48 hours
5	No growth	48 hours
6	No growth	48 hours
7	No growth	48 hours
8	No growth	48 hours
9	No growth	48 hours
10	No growth	48 hours
11	No growth	48 hours
12	Un important Simple growth	Few hours
13	Un important Simple growth	Few hours
14	No growth	48 hours
15	No growth	48 hours
16	No growth	48 hours
17	No growth	48 hours
18	No growth	48 hours
19	No growth	48 hours
20	No growth	48 hours
21	No growth	48 hours
22	No growth	48 hours
23	No growth	48 hours
24	No growth	48 hours
25	No growth	48 hours
26	No growth	48 hours
27	No growth	48 hours
28	No growth	48 hours
29	No growth	48 hours
30	No growth	48 hours

Table (1) shows the results of bacterial transplantation of the research sample

	Frequency	Percent	Valid Percent	Cumulative Percent

No growth	26	86.7	86.7	86.7
Unimportant simple growth	4	13.3	13.3	100.0
Total	30	100.0	100.0	

Table (2) shows the percentage of bacterial growth

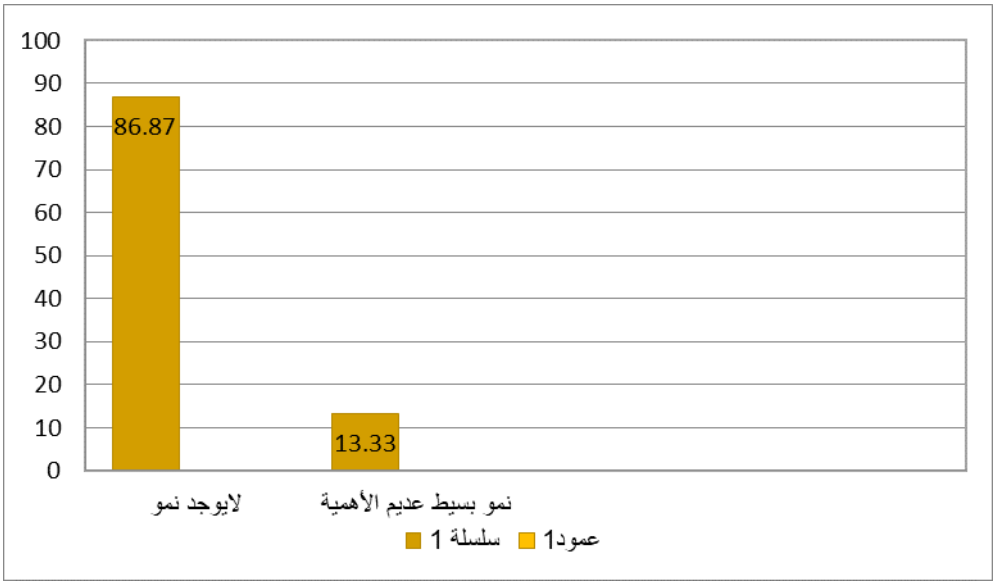

Figure (1) Diagram showing the percentage of bacterial growth