

IMMUNOLOGICAL EVALUATION OF DIFFERENT IMPLANT ABUTMENT INTERFACES FOR COMPLETE LOWER IMPLANT ASSISTED OVERDENTURE IN CONTROLLED DIABETIC PATIENTS

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ABSTRACT

Immunological and inflammatory mechanisms perform a key role in the development and progression of type 2 diabetes mellitus. The objective of this study was to evaluate immunologically the effect of different implant abutment interface, the platform switched (PS) and platform matched (PM) implants for implant assisted complete mandibular overdenture in controlled type II diabetic patients.

Methodology: Ten edentulous controlled type II diabetic male patients were selected in a split-mouth study design, where group I represented the right side of the patient and restored with platform-switched implant while group II represented the left side of the patient and restored with platform matched implants. The patients received complete mandibular implant assisted overdenture with O-ring attachment. Saliva samples were collected to measure the level of salivary cytokines (TNF- α & IL-6) using ELISA technique. The recall visits for every patient was at the time of insertion, 3 and 6 months. The data of this study were collected, tabulated and statistically analyzed by IBM-SPSS statistics software.

Results: Comparing from denture insertion for group 1, both cytokines (TNF- α & IL-6) were significantly increased after 3 months and significantly decreased after six months, but there were insignificant differences in both cytokines from denture insertion up to 6 months. While for group 2, there was a significant increase from 0 to 3 months and from 0 to 6 months and significant decrease from 3 to 6 months. When comparing the two studied groups regarding the mean level of both pro-inflammatory salivary cytokines (TNF- α & IL-6) after 3 and six months of the new denture delivery, group II levels were significantly higher than group I levels. There were significant differences between both groups. Group I implants represented less mean of TNF- α & IL-6 levels.

Conclusion: TNF- α and IL-6 can be used as a site specific marker in monitoring early inflammatory changes in peri-implant sulcular fluid. Platform-Switched dental implant is the implant of choice particularly in controlled type II diabetic patients to control inflammatory changes around implant and avoid progression of type 2 diabetes mellitus.

KEY WORDS: Diabetes mellitus- Platform switching implants- platform matching implants - immunological study.

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INTRODUCTION

Diabetes mellitus is a chronic disease described by relative or absolute insulin deficiency and consequent glucose intolerance¹. Immunological and inflammatory mechanisms play a key role in the evolution and growth of type 2 diabetes mellitus².

Recently, there has been a growing interest in the measurement of cytokines for clinical applications. As cytokines are directly implicated in various pathophysiological conditions in humans, and their increased production is responsible for their elevated levels in different body fluids. Cytokines concentrations can reflect the severity of some diseases and can be markers of prognosis³.

It has been documented that the process of bone loss in implant-assisted overdenture is initiated upon abutment connection. Although not fully understood, marginal bone loss has been related to the implant-abutment micro gap and associated microbial contamination⁴. The presence of a micro-gap at the implant-abutment interface is resulting in bacterial colonization at the implant sulcus and this is the possible etiologic mechanism for marginal bone loss⁵. It is potential that there is bacterial leakage within the implant system, after its prosthetic connection, with subsequent penetration of bacteria and their products within the micro-gap between implant and abutment. This would cause an inflammatory process close to the crestal bone, resulting in bone support loss^{6,7}.

In an attempt to reduce marginal bone loss, implant systems have been developed where the outer edge of the implant-abutment interface (micro gap) is moved toward the center of the implant and away from the bone margin. The bacterial induced an inflammatory response is moved to the central axis of the implant away from the marginal bone and is called platform switching⁸. This type of connection moves the perimeter of implant abutment junction (IAJ) to the center of implant axis. It is possible that moving the (IAJ) inward brings out bacteria

more internally and, therefore, away from the bone crest; this would explain the limitation in bone resorption^{9,10}.

According to Carinci et al¹¹ platform switching can be achieved by using abutments with a diameter smaller than the implant neck or body width, by increasing the implant neck diameter with respect to the implant body width, using platform-switched implants and conical emergence abutments and finally using implants with a reverse conical neck referred to as Bone Platform Switching. This embraces an inward bone ring in the coronal part of the implant that is in continuity with the alveolar bone crest.

Gingival crevicular fluid (GCF) is the inflammatory exudates derived from a number of sources including serum, the connective tissue and epithelium through which GCF passes on its way to the gingival crevice. As the fluid traverse the inflamed tissue, enzymes and other molecules as well as products of cell and tissue remodeling and degradation of host and bacterial origin are collected. The cellular components of GCF are 70-80% neutrophils, 10-20% monocytes/macrophages, 5% mast cells and 5% T-lymphocytes¹².

Inflammation of the peri-implant area elicits an immune response regulated by the key cytokines (TNF, Interleukin 1 β , transforming growth factor- β , Interleukin 6, Interleukin 10) that control the progression and/or suppression of the inflammatory response. Overproduction of pro inflammatory cytokines released by monocytes/macrophages and T cells in response to microbial challenge can lead to the breakdown of the periodontal or peri-implant tissues¹³.

The measuring techniques of cytokines in the body fluids (blood, saliva, serum and plasma) are bioassay and immunoassay (such as immunoradiometric assay (IRMA) and enzyme-linked immunosorbent assay (ELISA)¹⁴.

Despite most clinical studies have reported a positive impact of platform switching on crestal bone stability, yet the data have still been controversial and inconclusive & up to date the literature still lacks providing clinical evidence about the true influence of platform switching on preserving bone and soft tissue. The purpose of this study was to evaluate and compare immunologically dental implants with different platforms.

MATERIALS AND METHODS

Ten completely edentulous controlled type II male diabetic patients with average 55 years old presented at the prosthodontic clinic Tanta University were selected for this study. The patients have sufficient inter-arch space to place the endosseous implants and superstructures. All patients with Class I angle's ridge relationship and had old dentures, suffering from poor retention of the mandibular one. The patients must be free from any other metabolic, systemic, and endocrine diseases rather than diabetes. After the patients were informed for the line of treatment and the need for their regular and frequent recall visits, they approved their treatment plan on a written consent to follow the study protocol throughout the total period of the research.

The patients referred to the physician for general check-up and laboratory investigations as Blood glucose level including, Fasting blood glucose level, Post-prandial blood glucose level. A new acrylic conventional complete denture was fabricated and duplicated to make surgical guide stent. Split mouth study design was used, each patient was represented for two groups, group I represented the right side of the patient and group II represented the left side of the patient. Two implants 3.3 mm diameter and 13 mm length (Shütz Impla implant system) were placed in the mandibular interforaminal region (figure 1), the right implant is platform switched design (Conical Hybrid Connection Implant) while the left implant is with non-platform switched design

(Dual Surface Conical Screw Implant Shütz Impla German system (ball and socket) was used in this study (figure 2). Three months later after confirmation of osseointegration (figure 3), the definitive prostheses was constructed for each patient.

Peri-implant crevicular fluid sampling and assay

To obtain the peri-implant crevicular fluid samples. The site to be sampled was isolated with cotton rolls, a saliva ejector was used and the site was dried in air. Periopaper strips (Oralflow Inc., New York, USA) were inserted into peri-implant crevice carefully until mild resistance was felt, and left for 30 seconds (figure 4). Care was exercised to avoid mechanical injury of the tissues; any strip contaminated with blood was discarded. Paper strips were immediately placed in eppendorf tubes. Each tube with the paper strip was weighted before, and after sample collection for peri-implant fluid volume calculation¹⁵. Peri-implant crevicular fluid was extracted by centrifugation and all samples were stored at -30°C until they were analyzed. The level of TNF- α was measured using TNF- α -ELISA. (TNF- α Elisa kit-96 T, BE55001 - I B L International – Hamburg, Germany) IL-6 was measured using IL-6- ELISA. (IL-6 Elisa kit-96 T, BE53061 - I B L International – Hamburg, Germany). Three measurements were taken for each patient at denture insertion, after three and six months.

The statistical analysis was carried out using Statistical Package for Social Sciences (SPSS Inc., Chicago, IL, version 15.0 for Windows). The continuous data are represented as Mean \pm SD. Normality of quantitative data was checked by measures Kolmogorov Smirnov tests of normality. Data was normally distributed, so t-test was applied for comparison of two groups and ANOVA test to compare the intervals inside the same group. The **Tukey's** test used to measure the significance. For time related variables, Paired t-test was applied. All statistical tests were two-sided and performed at a significance level of $\alpha=0.05$. The results of this analysis were tabulated and plotted as graphs

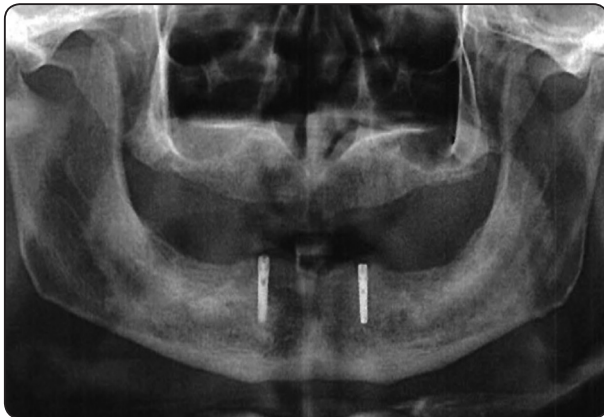


Fig. (1) Panoramic x rays showed the dental implant

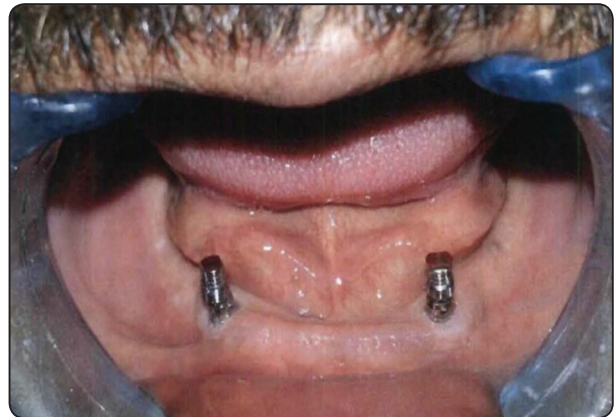


Fig. (2) Metal housing over the abutmen

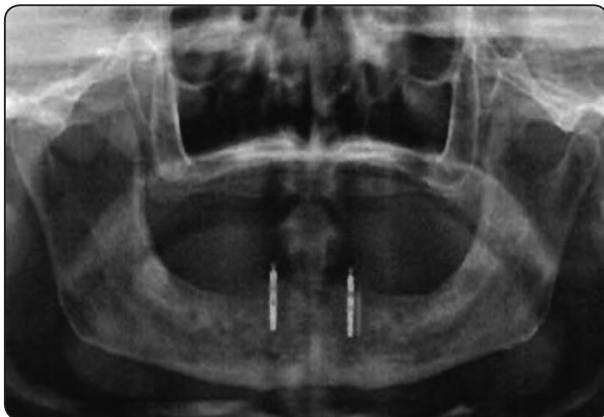


Fig. (3) Panoramic x ray showed the implant with the abutment



Fig. (4) Collection of peri-implant crevicular fluid with periopaper

RESULTS

Measuring amount of cytokines (TNF-α) in saliva as showed in table 1 graph 1

The mean difference of TNF-α level for both groups was significantly increased 3 months after denture insertion and significantly decreased when measured at 6 months . But when comparing the mean difference of TNF-α level from insertion (0 months) versus 6 months there was insignificant difference for group 1 platform switching and significant difference with group 2 platform matching .

When comparing the two groups after 3 months the mean difference was for group I (4.41±0.5971) and for group 2 (5.15±0.1649) there was no

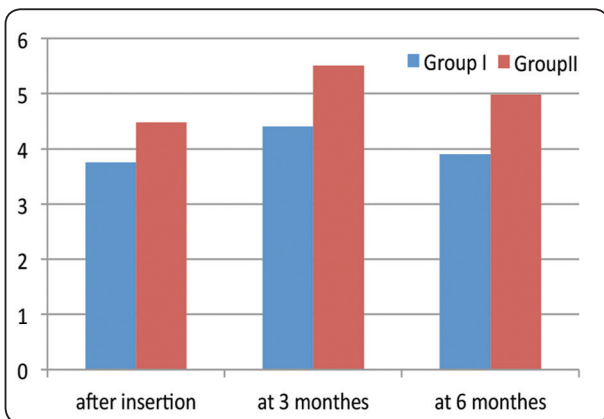
significant differences between two groups (P>0.05) .While after 6 months group 1 was (3.9±0.6667) and group 2 was (4.98±0.5633) there was significant differences between two groups (P>0.05)

TABLE (1) showed the mean level of (TNF-α) in saliva for both groups at follow up period

		Group I	Group 2	T- test	
				T	P
At insertion		3.76±0.2875	4.48±0.4467	4.29	0.1031
After 3 monthes		4.41±0.5971	5.15±0.1649	1.69	0.12396
After 6 monthes		3.9±0.6667	4.98±0.5633	3.15	0.00771*
ANNOVA	F	3.97	6.69		
	P	0.0308*	0.004367*		

Tukey's test for group I		
At insertion & 3 months	At 3months & 6 months	At insertion &6 months
0.02023*	0.01189*	0.2747
Tukey's test for group II		
At insertion & 3 months	At 3months & 6 months	At insertion &6 months
0.003325*	0.002928*	0.04513*

*Significant, (P0.05<).



Graph (1) showed the mean level of (TNF-α) in saliva in both groups at follow up period

Measuring amount of cytokines (IL-6) in saliva as showed in table 2 graph 2

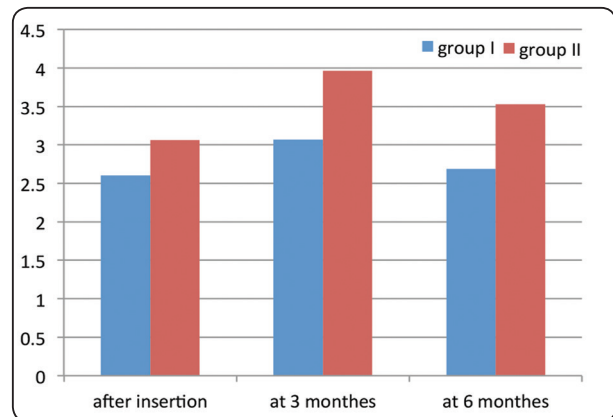
The level of IL-6 for group I and 2 was significantly increased after 3 months and significantly decreased after 6 months but from 0 to 6 months, there was no significant differences for group 1 and a significant differences for group 2.

When comparing the two groups, mean difference and standard deviation was measured after 3 months the data measured was for group I (3.07±0.1337) and for group 2 (3.69±0.5363) there was a significant differences between two groups (P>0.05). Finally, the data collected and measured after 6 months for group I was (2.69±0.1595) and for group II was (3.53±0.4029) there was a significant differences between two groups (P>0.05)

TABLE (2) Showed the mean level of (IL-6) in saliva in both groups at follow up period

	Group I	GroupII	T test	
			T	P
At insertion	2.6±0.1826	3.06±0.2836	4.31	0.1031
After 3 months	3.07±0.1337	3.69±0.5363	3.55	0.0002*
After 6 months	2.69±0.1595	3.53±0.4029	6.13	0.005*
ANNOVA	F	37.74	13.77	
	P	<0.0001*	<0.0001*	
Tukey's test for group I				
At insertion & 3 months	At 3months & 6 months	At insertion &6 months		
<0.0001*	<0.0001*	0.193483		
Tukey's test for group II				
At insertion & 3 months	At 3months & 6 months	At insertion &6 months		
0.035573*	0.02035*	0.007353*		

*Significant, (P0.05<).



Graph (2) showed the mean level of (IL-6) in saliva in both groups at follow up period

DISCUSSION

Diabetes mellitus is considered one of the systemic conditions associated with greater risks for implants failure and accelerated bone resorption however; several studies confirmed that, dental implants can be successfully used in controlled type II diabetics.

Implant abutment interface plays a substantial role in providing primary stability and strength to an implant supported restoration. Implant abutment

interface should ensure optimal load distribution to reduce peak stresses and minimize the infiltration of bacteria and contamination in microgaps¹⁶.

Platform switching diverts to the use of an abutment joined to an implant neck of larger diameter; studies mentioned that this connection relocates the perimeter of the implant-abutment junction inwards toward the central axis (the middle of the implant) improving the distribution of forces. It was developed to control bone loss after implant placement. Moreover, platform switching is also capable of moving the implant abutment junction and supposedly the inflammatory reaction medially, away from the crestal bone, and thus, preventing crestal bone loss¹⁷⁻¹⁹.

The need for detecting early inflammatory response, a clinical index usually can only determine the inflammatory response. So the implantologists are focusing on developing site specific tests of higher specificity and sensitivity which may overcome the well-known limitations of traditional measures²⁰.

Protein biomarkers and microbial profile from oral fluids could be valuable diagnostic and prognostic tools in the assessment of disease activity around dental implants. This immunologic investigation method provides comprehensive information regarding the current status and prognosis and treatment course of loaded implants as well as the analysis of patient responses to inflammatory disease. By using such information, clinicians can more efficiently determine the treatment plan or take preventive measures²¹.

With assessment of tumour necrosis alpha factor (TNF- α) and interleukin-6 (IL-6) in the crevicular fluid around healthy implants, implants with peri-implantitis, and healthy teeth. It is found that IL-6 is an important cytokine involved in the regulation of host response to tissue injury and infection^{22,23}. TNF- α is a cytokine produced mainly by macrophages. It has been implicated in the periodontal disease process because of its ability

to stimulate bone resorption and other catabolic processes²⁴.

Absorbent filter paper strips are quick and easy to use, and can be applied to individual sites and, possibly, is the least traumatic when correctly used. The methods of collection may be divided into the intracrevicular (whereas the strip being inserted into the gingival crevice) and the extracrevicular techniques (whereas the strips are overlaid on the gingival crevice region in an attempt to minimize trauma) as reported by Griffiths¹⁵.

The present study was conducted to investigate immunologically the effect of using platform-switched implants in controlled type II completely edentulous diabetic patients receiving implant assisted overdenture. The two dental implant platform showed similar increased level after 3 months of denture insertion but after 6 months ,the pro-inflammatory cytokines were decreased again but insignificantly from baseline for platform switched implant and significantly for platform matched implant. The explanation of these results is the possible exposure of the soft tissues to a portion of the seating platform in the PS or PM group may contribute to higher levels of initial inflammatory response in the initial period. This is in agreement with Petkovic et al²⁵ who reported positive correlation between TNF- α levels and the extent of peri-implant inflammation .

After 6 months ,the cytotoxins level decreased and this is in accordance with Dellavia et al²⁶ who reported that, after prolonged exposure of abutments in the oral cavity, the configuration of the implant abutment interface does not seem to affect the inflammatory cellular and molecular pattern responsible for bone loss. This explain the significant decrease of both cytokines after 6 months .

Disagree with Dellavia et al²⁶ that despite of the presence of micro-gaps at the implant prosthetic connection²⁷ , the platform switching is allowing less bacterial leakage and less bone loss^{28,29}. This is in accordance with studies that carried with Cochran

et al and Roet et al^{30,31} and it had been suggested to be related to the establishment of proper physiological–biological dimension³².

CONCLUSION

TNF α and IL-6 and are sensitive markers of inflammation around dental implants. Platform-Switched dental implant showed less pro-inflammatory level and is the implant of choice in controlled type II diabetic patients to control inflammatory changes around implant and avoid progression of type 2 diabetes mellitus.

Further clinical studies using biomarkers to monitor the physiological bone remodeling and changes in the microbiome in peri-implant sulcus are still required to help clinicians to make safe and predictable decisions in their clinical practice.

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