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"Comparison between surface treatment and Implant Stability in Implant Retained Mandibular Overdenture" (In Vivo Study)

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Abstract

Introduction: Many studies have been conducted to compare implant stability and different surface treatment. Implant stability is affected by many other factors as implant design and geometry, type of bone and many other factors.

Purpose: The purpose of this study was to evaluate and discuss the effect of surface treatment on implant stability in respect of different time intervals.

Material and Methods: Ten completely edentulous patients were selected and received two implants with two different surface treatments in a split mouth technique. Implants with soluble blast media of hydroxy appetite (SBM) surface treatment and implants with silica acid etched surface treatment (SLA). Implant stability was measured in intervals of time, onsite, at 2 months and 3 months.

Results: In the first interval of time (onsite) SLA surface treatment shows a higher implant stability due to its high surface roughness of the implant and high implant-bone contact. After 3 months SBM surface treatment shows a higher implant stability reading due to its active ingredients that act as a reservoir of calcium and phosphate with imitate bone regeneration at implant site.

Conclusions: Within the limitation of this study, geometrically identical implants with either SBM or SLA surface have a very comparable survival rates in regarding of implant stability. Since the overall failure rate is very low, more studies with higher subjects' number and longer follow up are needed.

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Introduction:

Nowadays, dental implants represent a reliable treatment option in oral rehabilitation of partially or fully edentulous patients in order to secure various kinds of prostheses. Dental implants have become a standard procedure for single tooth replacement in the esthetic zone, providing many advantages but also challenges in sophisticated patients.

Br°anemark et al. first described the process of osseointegration more than 45 years ago [1, 2]. Their work launched a new era of research on shapes and materials of dental implants. But it was not until the last decade that the focus of biomedical research shifted from implant geometry to the osteo-inductive potential of implant surfaces.

Today, roughly 1300 different implant systems exist varying in shape, dimension, bulk and surface material, thread design, implant-abutment connection, surface topography, surface chemistry, wettability, and surface modification [3]. The common implant shapes are cylindrical or tapered [4]. Surface characteristics like topography, wettability, and coatings contribute to the biological processes during osseointegration [5] by mediating the direct interaction to host osteoblasts in bone formation.

In general, the long-term survival rates of dental implants are excellent. However, implant failures still occur in a small quantity of patients. Primary implant failure due to insufficient osseointegration occurs in 1-2% of patients within the first few months [6]. Secondary implant failure develops several years after successful osseointegration in about 5% of patients and is commonly caused by peri-implantitis [6, 7.]

Materials and Methods

Ten completely edentulous patients were selected from the out-patient clinic of the Prosthodontic Department, Faculty of Dentistry, Ain Shams University.

All the selected patients were rehabilitated by mucosa supported maxillary complete denture and implant retained mandibular overdenture. Two implants were installed at inter-foraminal region with split mouth technique. Grouping was done in to:

Group 1: Implants with soluble blast media of hydroxy appetite (SBM) surface treatment (placed in the right side of the patient).

Group 2: Implants with silica acid etched (SLA) surface treatment (placed in the left side of the patient).

Straight/Tapered threaded two pieces implants with two different surface treatments one (SLA and SBM) but same length, diameter and design (3.7 mm in diameter and 10 mm in length) were used.

The reference guide was used to select the smart peg from OSSTELL reference, each implant system had his special smart peg **(Fig.1).** Smart peg type 7, no 100380 was used.

Fig. (1): Smart peg.

After the implants were installed, the implant initial stability was measured using the 'Osstell' ISQ device[**] **(Fig.2).**

While the surgical field was still exposed.

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This device measured the implant stability through a resonance frequency analyzer and a transducer (magnetic peg).

The transducer is a metallic rod with a magnet on top that was screwed onto an implant or an abutment by smart peg holder. The magnet was activated by a magnetic pulse from wireless probe. After excitation, the peg vibrates freely, and the magnet induced an electric voltage in the probe coil. This voltage was the measurement signal sampled by the resonance frequency analyzer (RFA). The results of resonance frequency analyzer were expressed as an implant stability quotient (ISQ) on a scale from 1 to 100, which represented a standardized unit of stability. The magnetic peg was fully screwed to the implant using the peg holder, and the 'electric probe' was approximated on top of the magnetic peg, till a reading was obtained, which indicates implant stability quotient (ISQ). After all readings were recorded for all implants, the peg was removed using the peg holder**.** Then the cover screws of each implant were screwed in its place.

Fig. (2): Osstell device.

After two months patients were recalled and implants site was exposed to measure implant stability again **(Fig.3)**. Using Ostell and the smart pigs were placed again and screwed on top of the implants using smart pig holder and implant stability was measured as shown in **(Fig. 4).**

Fig. (3): Exposing the implant.

Fig. (4): Implant stability reading using OSTELL.

After 3 months using the surgical stent to mark the implant site by using lancet, the cover screw was unscrewed in the patient's mouth. At this stage the smart pigs were screwed in their places and implant stability readings using OSTELL were then recorded.

Statistical analysis:

Statistical analysis was then performed using a commercially available software program (SPSS 19; SPSS, Chicago, IL, USA). Data showed a parametric distribution. Therefore, independent t test was used to compare both groups, while comparison between different observations within the same group was performed using One-way analysis of variance (ANOVA test), followed by Tukey's post hoc test.

Results:

All patients who shared in this study received implant retained mandibular overdenture with two implants placed in the inter foramina region. Surface treatment of the implant used where; group 1is implants with soluble blast media of hydroxy appetite (SBM) surface treatment (placed in the right side of the patient) & Group 2 is implants with silica acid etched (SLA) surface treatment (placed in the left side of the patient).

Implant stability quotient (ISQ) was recorded in all implants on zero-month, 2-month and after 3-month period of time.

The effect of time on both groups, group 1(implants with soluble blast media of hydroxy appetite (SBM) surface treatment and group 2(implants with silica acid etched (SLA) surface treatment) were shown in **Table (1).**

Table (1): Comparison of mean values of percent change of ISQ in both groups in different intervals (independent t test).

	Groups	Mean	Std. Dev	Std. Error Mean	Mean difference	95% Confidence Interval of the Difference		P
						Lower bound	Upper bound	
First interval (0 to 2 months)	Group 1 (SBM)	-16.50	2.33	0.62	0.36	-1.45	2.17	0.69^{ns}
	Group 2 (SLA)	-16.86	2.34	0.62				
Second interval (2 to 3 months)	Group 1 (SBM)	26.42	4.23	1.13	3.21	0.27	6.15	0.034*
	Group2 (SLA)	23.21	3.25	0.87				
Overall (onsite to 3 months)	Group 1 (SBM)	5.52	3.80	1.02	3.14	0.75	5.54	0.013*
	Group 2 (SLA)	2.37	1.98	0.53				

ISQ = Implant stability measurement unit.

Significance level $p<0.05$, * significant, ns= non-significant

In the first interval (onsite to 2 months), a slightly higher mean percent decrease was recorded in implants with SLA surface treatments, with no significance difference ($p=0.69$). In the second interval (2 months to 3 months), a slightly higher mean percent increase was recorded in implants with SBM surface treatment, with a significant difference ($p=0.034$). Overall (onsite to 3 months), a slightly higher mean percent increase was recorded in implants with SBM surface treatment, with a significant difference ($p=0.013$).

Discussion

Patients sharing in this study were carefully selected, examined and prepared to avoid any factor that may adversely affect or delay osseointegration this was done using comprehensive medical history, clinical examination and laboratory investigation.

Since the introduction of implants in the dental field, so many trials were done to assure osseointegration and long-term service. These trials included the status of the implant site, surgical techniques, loading conditions, implant design, implant finish (surface), and primary and secondary stability. Implant stability is one of the main factors influencing implant survival rates. Factors, such as implant geometry, implant length, implant diameter, implant surface characteristics, surgical technique, and quality and quantity of local bone influence primary stability.[8]

Primary stability of the implant mainly depends on bone to implant contact. The bone quality and implant length and diameter have been assumed to be influential on the bone to implant contact and consequently on implant primary stability.[9]

This study aimed to evaluate the correlation between implant surface treatment and implant stability. The results of this study revealed a positive correlation between primary implant stability and implant surface treatment in response to intervals of time. In the first interval (onsite to 2 months) a slightly higher mean percent was recorded in implants with SLA surface treatment. In the second interval (2 months to 3 months), a slightly higher mean percent increase was recorded in implants with SMB surface treatment. Over all (onsite to 3 months), a slightly higher mean percent increase was recorded in implants with SBM surface treatment.[10]

The results of this study support the opinion that surface roughness is an important factor aiding in implant stability especially in the first interval of time representing a higher implant stability in SLA surface treatment which has higher surface roughness compared to SBM surface treatment.[11]

In addition, a higher implant stability in SBM surface treatment was recorded in an interval of 3 months. This was explained by hydroxyapatite coating resemble a reservoir of calcium and phosphate in addition to their biomimetic property which helps in the process of new bone formation around the implant .[12]

Conclusion:

Within the limitation of this study, geometrically identical implants with either SBM or SLA surface have a very comparable survival rates in regarding of implant stability. Since the overall failure rate is very low, more studies with higher subjects' number and longer follow up are needed.

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