ten years follow up of immediately loaded implant assisted complete mandibular overdenture

Original Article

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ABSTRACT

Background: Dental implant stability is an influential criterion in the assessment of implants survival and could be an element of long-term prognosis. During treatment Increased implant stability implies successful osseointegration with the surrounding bone whatever diminished implant stability may diagnose a type of implantation failure. So, it is essential to evaluate the implant stability quantitatively during the treatment procedure. Peri-implantitis is characterized by clinical signs of inflammation such as increased probing depths, and bone resorption, leading to implant failure. In peri-implantitis, Changes the biofilm structure towards increased counts of pathogenic microorganisms such as Porphyromonas gingivalis, which is one of the bacteria with the highest virulence. **Aim:** clinical evaluation of immediately loaded implant assisted complete mandibular overdenture after 10 years follow up regarding implant stability, periimplant pocket depth measurement and microbial evaluation of Porphyromonas gingivalis **Materials and methods:** 5 completely edentulous male patients with maxillary conventional complete denture, and mandibular immediate loaded implant assisted complete overdenture using two implants in areas of mandibular canines with diameter 3.6 mm width and length 10 mm with O-ring attachments for retaining the overdenture, These patients were evaluated regarding dental implant stability using Osstell ISQ, clinical measurement of periimplant pocket depth (PPD) and microbial evaluation of Porphyromonas gingivalis (Pg). **Results:** After 10 years of implants placement, there was non-significant increase in ISQ of the dental implants compared to baseline readings but there was significant increase of PPD and finally non-significant increase level of Porphyromonas gingivalis. **Conclusion:** Two immediately loaded dental implants with 10mm length and 3.6mm diameter are satisfactory to assist complete mandibular overdenture opposed by conventional maxillary complete denture.

Key Words: Dental implant stability, Osstell, Peri-implantitis, Periimplant pocket depth, Porphyromonas gingivalis.

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INTRODUCTION:

Whatever the cause of tooth loss, dental implants are now the most secure solution. With a survival rate of 9095%-beyond 5 years, this treatment has shown a high level of predictability.[1]

Distinguishing between survival and success rates is critical. An implant with adequate insertion and no mobility considered a failure if it has persistent inflammation of the periimplant soft tissue. Technical and biological difficulties appear to be widespread not to mention that they can influence the patient's perspective on therapy and potentially lead to substantial financial implications. [2–4], Complications related to dental implants are becoming more common, making it more critical to find effective ways to treat and prevent them.[5,6]

While numerous methods of implant evaluation have been employed and much research have been made however, it is still difficult for dentists to determine whether an implant is stable or not. For research purposes, it is crucial to test implant stability multiple times in order to determine the long-term prognosis of implants placed using surgical and prosthetic procedures such as quick functional loading and the prompt implantation of implants in fresh sockets after extraction.[7]

Several methods developed for assessment of implant sta¬bility classified into invasive and noninvasive. The use of invasive procedures, such as histological examination (assessment of bone-implant contact in specimens), reverse torque test (RTT), removal torque analysis, and pull out/push out test, is limited to nonclinical studies because of ethical issues. On the other hand, noninvasive methods include the surgeon's eye view or inspection, radiographic analysis, Cutting torque resistance analysis (CRA), seating torque, insertion torque, Periotest, model analysis, Resonance frequency analysis (RFA), Pulsed oscillation waveform (POWF), percussion test, and magnetic technology.[8]

Radiographic evaluation, mobility, reverse-torque, and percussion are sorts of clinical procedures that are

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commonly used to check the bone-implant interface. There is little therapeutic utility in these approaches, although the estimations of integration they provide are very subjective.[9]

A dynamic vibration resonance frequency analysis (RFA) testing instrument which uses wireless technology to check implant stability is the Osstell (Osstell AB, Gotenberg, Sweden). According to the "Osstell Mentor" system, the Implant Stability Quotient (ISQ) is calculated. A "smart peg" is attached to the implant and vibrates when subjected to magnetic pulses; a "pick-up coil" detects this vibration similar to the vibrations caused by a "tuning fork,".[10,11]

Most relevant to implantation biological problems are peri-implant diseases, Mucositis and peri-implantitis were depicted as two clinical forms of these diseases; the infectious origin of these conditions is unknown. In contrast to peri-implantitis, which involves inflammation of both the soft and hard tissues surrounding an implant and is associated with bone resorption, decreased osseointegration, increased pocket depths, and suppuration, bacterially induced peri-implant mucositis is a reversible inflammatory process of the peri-implant soft tissues that does not involve the bone.[12]

The difficulty in estimating the disease's seriousness is due to the prevalence of peri-implant disorders. Possible causes of the deficiencies include research' methodological flaws and limitations.[13]

Anatomical, mechanical, iatrogenic, genetic, environmental, immunologic, and microbiologic variables all have a role in the initiation of peri-implant disease.[14]

The complex interactions of microorganisms and the polymicrobial character of peri-implant disease makes it difficult to demonstrate actual causative associations between microorganisms and the evolution of peri-implant disease from a microbiological viewpoint.[15]

Indicators of pathognomonic peri-implantitis include an elevated gingival index, a deep probing pocket, and an increase in gingival crevicular fluid (GCF) flow, all of which are caused by dental plaque biofilms that form in the sulcus around the implant. [16], It manifested itself clinically as hemorrhage and sometimes pus. This means that secondary colonizers like Fusobacterium nucleatum (Fn) can thrive after the initial colonizers which are mostly Gram-positive aerobes like Streptococcus spp. and Actinomyces spp. that have a role in altering the local environment.[17]

This bacterium functions as a "bridging species". Indeed, coaggregation enables late colonizers and peri pathogens as Porphyromonas gingivalis (Pg) to adhere. During the colonization of the peri-implant crevice, the accumulation of commensal bacteria might produce a shift in the local habitat allowing perio pathogens to colonize.[18]

Although Actinomycetemcomitans and Staphylococcus species do not significantly contribute to peri-implantitis, periodontal pathogens and Fusobacterium nucleatum (Fn) associated with it.[19]

Despite bacterial culture being the "gold standard" for diagnosing and detecting quantity of microbiota colonizing the oral cavities and periodontal tissues, not all bacteria can be cultured. Oral pathogens are often anaerobic and grow slowly, so preparing cultures can be a time-consuming process. Additionally, periodontal and peri-implant samples may have a smaller number of species grown on them if selective media are used. This agreed with the findings of Boutaga K. et al., who found the same conclusion: real-time PCR confirms the results of quantitative culture of P. gingivalis and offers substantial benefits in terms of the sensitivity and speed of detecting P. gingivalis in subgingival plaque samples.[20] Porphyromonas gingivalis is one of the aetiologic factor in periimplantitis. This bacterium is particularly capable of rapid proliferation, reproduction in host cells and it is also able to provoke immune response so-called keystone pathogen, create inflammatory reactions, which are ultimately responsible for the damages affecting the connective tissue, periodontal destruction of the host's immune system and peri-implantitis.[21]

2-Materials and methods:-

The present investigation conducted in adherence to the protocols approved by the Research Ethics Committee of the Faculty of Oral & Dental Medicine, Al-Salam University, Egypt under ethical code (Sue 010206243).

2.1 Group assignment:

Five completely edentulous male patients with age varying from 45 to 65 years old with good general health and free from any relevant systemic diseases that may influence bone resorption and healing, heavy smokers' patients were excluded. A maxillary conventional complete denture and a mandibular immediately loaded implant assisted complete overdenture were delivered to each patient. The overdentures were retained using O-ring attachments. The implants used were 3.6 mm in diameter and 10 mm in length, placed in the regions of the mandibular canines, these patients were evaluated regarding dental implant stability using Osstell ISQ, Preimplant pocket depth (PPD) measurement and microbial evaluation of Porphyromonas gingivalis by taking samples from gingival crevicular fluid (GCF) flow of the pocket surrounding the implant.

Measuring implants stability by Osstell:

The stability measured for each implant using Osstell ISQ at baseline (after implants placement) and 10 years after immediate loading of two implants at areas mandibular canines assisting complete mandibular overdenture opposed by maxillary conventional complete denture. Following the manufacturer's instructions, all implants utilized in this investigation were root form threaded dental implants. All of the smart pegs used for dental implant measurements designed by Osstell for dental implant.

The Osstell measurement:
The smart peg or transducer was used to measure the resonance frequency of the implant fixture while keeping it 1-3 mm distance, at a 90-degree angle, and 3 mm above soft tissue. A new smart peg was attached to each implant. Measurements were performed in the mesial, distal, buccal and lingual directions, for each implant. Values were given in ISQ units between 1 and 100, 1 being the lowest degree of stability. Two different observers took these measurements. For each observer, the representative ISQ of the implant is the mean of the measurements in all directions. Measurements saved and analyzed by dedicated software (Integration Diagnostics).[22,23]

2.3 Clinical evaluation of preimplant pocket depth:
Preimplant pocket depth (PPD) was measured at six sites per implant using plastic measuring probe*CPITN, R.O.R. international, Copenhagen, Denmark), measures were recorded.

2.4 Bacteriological analysis: Polymerase chain reaction (PCR test) for the detection of P. gingivalis:
Samples were collected and studied for all the patients at baseline (after implants placement) and 10 years after immediate loading of two implants. Each implant was isolated with a sterile cotton roll. A sterilized paper point carefully introduced into the maximum depth of the pocket surrounding the implant and left in position for 10 seconds. The paper point then placed in (1 ml) phosphate buffered saline (PBS) holding 0.1% silica particles. Each examined site was considered as a unit of analysis. All data collected and tabulated and statistically analyzed using SPSS program.

RESULTS:

The present study included 5 patients with 10 inserted dental implants. Means and standard deviations (SD) values of implants stability quotient measured by Osstell, clinical evaluation of periimplant pocket depth and microbiological level of Porphyromonas gingivalis for the assessed patients in each placed implant are presented in table 1, figure 1.

There was insignificant increase in implant stability 10 years after implant placement with mean value (60.1±7.71) compared to implant stability immediately after implant placement with mean value (57.70±6.67), (P Value = 0.466) as shown in table 1, Figure 1.

It was found that PPD ranged from 2 to 5 mm with a mean value (2.40 ± 0.52) mm at baseline. At 10 years post implant placement, the mean values of PPD increased to (5.0±0.82). This increases were statistically significant when compared to the baseline with (p values = 0.001). as shown in table 1, figure 1.

The relative level of Porphyromonas gingivalis was higher at 10 years after implant placement with mean value (1.23±0.16), however P-value was non significantly significant compared to baseline with mean value (1.13±0.15) (P-value = 0.180) as shown in table 1, figure 1.

Table 1 Comparison of ISQ, PCR, PPD during follow up periods.

		Baseline			10 Years			t. test	p. value
ISQ	Range	51	–	69	53	–	72		
	Mean ± SD	57.70	±	6.67	60.1	±	7.71	0.745	0.466
PCR	Range	1	–	1.5	1.1	–	1.6		
	Mean ± SD	1.13	±	0.15	1.23	±	0.16	0.745	0.466
Pocket depth	Range	2	–	3	4	–	6		
	Mean ± SD	2.40	±	0.52	5.0	±	0.82	8.510	0.001*

*P is significant at less than 0.05

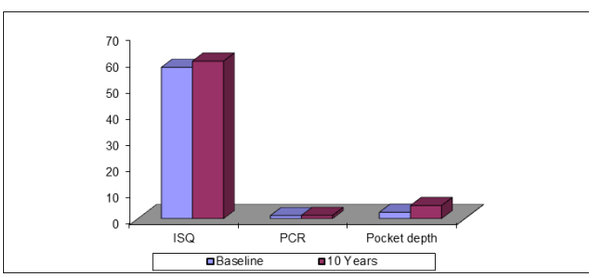

Figure 1 Distribution of mean value of ISQ, PCR, PPD during follow up periods.

DISCUSSION:

In this study five male patients were selected to exclude any influential feminine related factor and to exclude the adverse effect of the post menopause on osseointegration rather than the questionable bone density in females and all patients had age ranging from 45-65 years as patients' selection with the same age removed its effect on biting force and bone metabolism.[24]
The selected patients were in good overall health. Systemic conditions such as, uncontrolled diabetes, Sjögren's syndrome, cardiovascular disease, and osteoporosis were excluded. Added effects may be caused by the drugs used by patients can affect the tissues supporting the implants. [25]

Heavy smokers were excluded as smoking had an adversely effects of wound healing, and lowering healing response which occurred in a smoker decreases the possibility for successful optimal osseointegration.[26]
Two dental implants with ball attachments are usually sufficient in facilitating proper implant assisted overdenture functionally. The ball (resilient O-ring) attachments being a shock-absorber, pressure and torque reducer and transfers low degree of stress than bar and clips in vertical forces on a two-implant retained mandibular overdenture.[27]

Immediate loading shortens the treatment duration of patients by elimination one of the surgeries, improved esthetics, provides patients with immediate function, and increased patient satisfaction after implant insertion and successfully used with removable dentures.[28] Oral hygiene instructions were given to all patients at the beginning of the treatment and repeated through the appointments to reduce the possibility of plaque accumulation and tissue inflammations around the implants, thus further potentiate the success of the prosthetic rehabilitation and the osseointegration of the implants.[29]

To prevent inaccuracies that arise when dentists with varying degrees of clinical experience use different instruments from the same manufacturer to evaluate implant stability, it is imperative that clinicians control for numerous variables that could impact the results when collecting clinical data.[30] Resonance frequency analysis involves oscillating implants and recording the frequency at which they vibrate with the greatest amplitude. A supporting mechanism's quality, length, and material determine its resonance frequencies. Although the implant's material and length remain constant, the quality of the support (osseointegration) is strongly correlated with changes in the resonance frequency.[31]

ISQs found to be more reliable among the evaluators so, Osstell instruments seems to be precise and reliable for detecting the changes in the fixture stiffness during healing.[7] Understanding of peri-implantitis is the key of maintaining dental implants' long-term success and increasing patient outcomes with implant-assisted restorations. peri-implantitis occurred by microbial biofilms adhesion on implant surfaces, which can cause pathogenicity through direct in-situ virulence activation or by inducing low-grade chronic immune initiation, which in turn causes tissue breakdown that affects bone integration around the implant's crestal part and persists over time.[32]

Porphyromonas gingivalis plays a highly significant role in the development of periodontal diseases and peri-implantitis. It can form complex biofilms on tooth surfaces and in periodontal pockets, making it more resistant to the host immune response and conventional antimicrobial treatments. It also possesses various virulence factors that contribute to its pathogenicity, including enzymes that break down host periodontal structures, and the best characterized examples include proteases such as gingipains as well as collagenases, contributes to tissue destruction, immune evasion, and the establishment of a favorable environment for the bacterium in the periodontal pockets.[33]

In accordance with this study, Carvalho ÉBS et al and Savčić N et al., who found that Specific pathogens, including Porphyromonas gingivalis, and Tannerella forsythia, appear to be implicated in peri-implantitis, fostering an environment conducive to tissue destruction.[34,35] Considering that the literature appears to support an association between P. gingivalis and peri-implant infections that on the long run affecting the implant stability, our results have ended for the relationship between stability of the dental implant and number of Porphyromonas gingivalis populated around the dental implant, small number of peri-implant pockets in patients after 10 years from implant placement were populated by P. gingivalis, it can be explained by using paper points that may not be the optimal strategy for collecting representative bacterial samples from peri-implant locations or pockets. In many situations, the implant supra-structure may hinder good access to the peri-implant sulci, hampering the sample technique and resulting in unpredictable results this was in agreement with F. Galassi et al.[36]

All Osstell ISQ scores in this research were over 50 ISQ. The possibility of failure increases for values below 50 ISQ.(37) The implant will be more stable if the ISQ value increased throughout the long-term evaluation. In this study, the stability of the implants did not significantly improve between the two periods of follow-up, which agrees with the findings of Atsumi et al. 2007.[24,38]

This means that the implant stability is a most principal factor that figures out the long-term success of dental implants.[39] The results showed that ISQ levels are directly related to the degree of bone development.[40] Ardhani R. et al. also supported the idea that surface topography influences Porphyromonas gingivalis adhesion on biomaterials, it was proved that configuration and size of surface topography impact P. gingivalis attachment on implant materials irrespective of the materials type. This also may be one of causes that explain our results decreased number of populated Porphyromonas gingivalis around the inserted dental implants.[41]

Additionally, Savčić N. et al. discovered that there was no significant relationship between the relative levels of Porphyromonas gingivalis and recorded clinical parameters such as peri-implant probing depth (PPD), bleeding on probing (BOP), plaque index (PI), and suppuration on probing (SUP).[42]
According to recent studies, there is a strong relationship between PPD and Porphyromonas gingivalis bacterial load characteristics.(43) However another study failed to find a correlation between submucosal microbial dysbiosis and the clinical variables of interest.[44]

CONCLUSIONS

l- Two immediately loaded dental implants with 10mm length and 3.6mm diameter are sufficient to assist complete mandibular overdenture opposed by conventional maxillary complete denture.
- In the peri-implant diseases especially peri-implantitis which characterized by higher relative levels of Porphyromonas gingivalis, implant stability were not affected.

List of abbreviations:

RFA	Resonance frequency analysis
ISQ	Implant stability quotient
GCF	Gingival crevicular fluid
Pg	Porphyromonas gingivalis
Fn	Fusobacterium nucleatum
PCR	Polymerase chain reaction
PBS	Phosphate buffered saline
PPD	Peri-implant probing depth
BOP	Bleeding on probing
SUP	Suppuration on probing
PI	Plaque index
PM	Periimplant mucositis
PI	Periimplantitis

Declarations
Ethical approval and consent to participate:
Research Ethics Committee of the Faculty of Oral & Dental Medicine, Al-Salam University, Egypt under ethical code (Sue 010206243).

Consent for publication: Not applicable

Availability of data and materials:
On reasonable request, the datasets utilized and analyzed during the present study are accessible from the corresponding author.

Competing interests:
The authors declared no conflict of interest relevant to this article.

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Authors contributions:
H.S.B. Study conception and design, implants placement, data collection, sharing in writing, and revising the manuscript.
M.A.E Study conception and design, collection of bacterial samples, data collection, sharing in writing, and revising the manuscript.
M.G.K. Study conception and design, prosthesis fabrication, osstell measurement, data collection, sharing in writing, and revising the manuscript.

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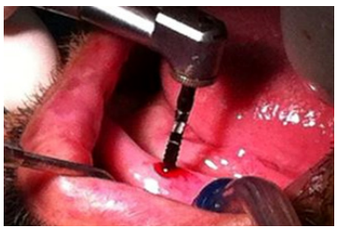

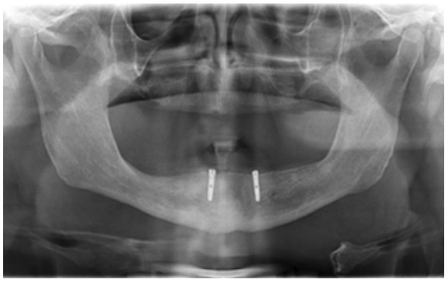

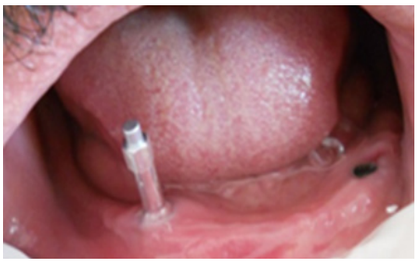

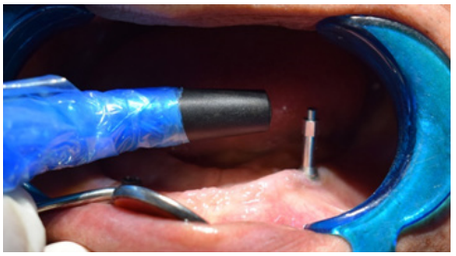

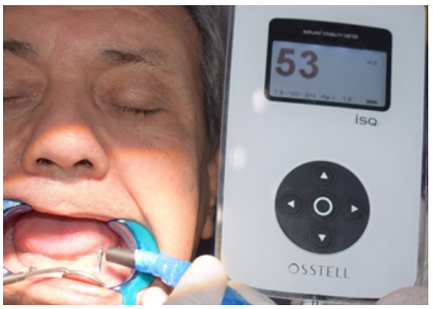

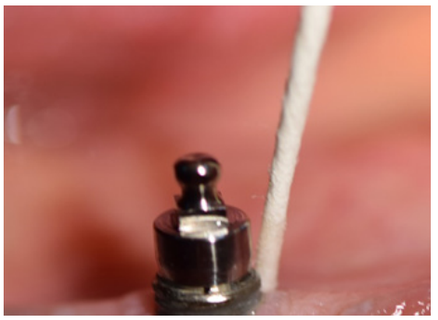

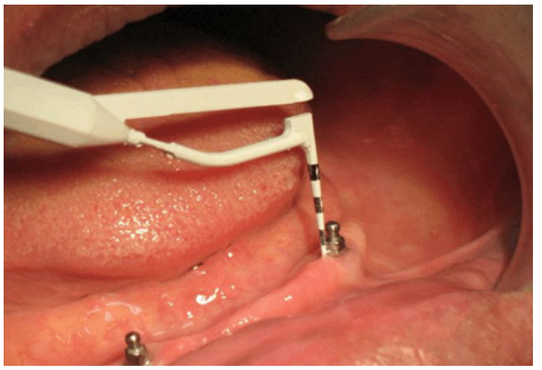

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