A General Correlation of Primary Implant Stability between the Non-Invasive Methods Osstell and Periotest.

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Abstract

Background: Dental implants have become one of the widest spread reliable treatment options in replacing missing teeth restoring both function and esthetics. One of the important criteria for a successful osseointegration of dental implants is achieving good primary and secondary implant stability. Various invasive and non-invasive methods have been used for measuring primary implant stability. Periotest damping device, and resonance frequency analysis (RFA) with the Osstell device have been classified as non-invasive methods. Primary and secondary implant stability measurements using both devices have given a reproducible quantitative value.

Aim/ Objectives: In this clinical randomized trial, a general correlation was done between the primary implant stability recorded using Osstell and that recorded using Periotest at the day of implant installation.

Materials and Method: Eighty completely edentulous patients were recruited. A single implant was placed in the midline of the mandible and primary implant stability was tested on the day of implant installation using the Osttell and Periotest devices. The implant stability quotient values (ISQ) and the Periotest values (PTV) were collected and statistically analyzed to detect if there was a general correlation between the two devices regarding primary implant stability.

Results: There is a general weak negative correlation between the readings of the two devices with a statistically significant difference between the Osstell readings to that of the Periotest readings (r=-0.335, -0.314).

Conclusion: Periotest readings on the day of implant installation seem to be as reliable as the readings of the Osstell device for recording primary stability.

Keywords: *Dental implant, primary stability, Osstell, Periotest, correlation*

Introduction

Dental implants have become one of the most widely spread, reliable treatment options in replacing missing teeth to restore both function and esthetics[1]. One of the important criteria for a successful osseointegration of dental implants is achieving good primary and secondary implant stability[2-4]. Primary implant stability has been defined as the absence of implant mobility immediately after installation[5], which is achieved by mechanical interlocking between the installed implant and the surrounding bone[6]. Many factors can influence primary stability including; implant material used, microscopic and macroscopic morphology of the implant, bone quality/quantity, cortical thickness[7], and the surgical technique used for implant placement[8]. Secondary implant stability depends on both bone formation and bone remodeling around the implant-bone interface.

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Secondary stability is influenced by the implant surface and bone healing time, which is initiated at the implant bone interface during the healing phase[9].

Good primary implant stability is a key factor for the selection of the loading protocol to be followed[10], and it is a crucial factor in the decision of immediate loading[5,11,12].

Various invasive and non-invasive methods have been used for measuring primary implant stability such as; histomorphometric analysis, tensional tests, push/pull outs tests, insertion and removal torque tests, percussion tests, radiographic analysis, damping capacity assessment using Periotest device, and resonance frequency analysis (RFA) using the Osstell device[13-23].

Primary and secondary implant stability measurements using both devices have given reproducible quantitative values.

Periotest was first introduced by Schulte 1983[24] originally designed to measure the signs of stress absorption around the periodontal ligament of natural teeth as a measure of mobility[25]. Recently, it has been used to measure stability of dental implants. Periotest is a hand-held device consisting of a small computer with a hand piece that has an electro-magnetically driven tapping rod on the inside. The tapping rod would contact the tooth or implant and the contact time between the tapping rod and the implant or teeth is calculated into a Periotest value (PTV) ranging from -8 (low mobility/ good stability) to +50 (high mobility/low stability) PTV units. Periotest has been used successfully to detect changes around the bone implant-surface and determine the success of osseointegration[26,27].

The Osstell device uses resonance frequency analysis (RFA) to measure implant mobility and stiffness which is interpreted as the Implant Stability Quotient (ISQ) value. ISQ values range between 1 (low stability) and 100 (highest stability). First studies using RFA were carried out by Meredith et al 1996[22]. The Osstell device used was an electronic fork that converts the KHz (Kilo Hertz) to ISQ values. Recently, the new magnetic RFA has a transducer, which is a metallic rod with a magnet on top that is screwed to the abutment or implant. The magnet is excited by a magnetic pulse from a wireless probe. After excitation, the peg vibrates freely, and the magnet induces an electric voltage in the probe coil. That voltage is the measurement signal sampled by the resonance frequency analyzer, which gives the implant stability quotient value (ISQ). RFA has been used to evaluate changes in the healing patterns for different loading protocols during the initial weeks of implant healing[12].

In this clinical randomized trial, a general correlation was done between the primary implant stability recorded using both the Osstell and Periotest devices on the day of implant installation.

Materials and Method

The study proposal was approved from the Ethical committee of the Faculty of Dentistry Cairo, University on June 13, 2016 (Ethical Approval Number: 16/6/10).

Eighty completely edentulous patients were recruited from the outpatient clinic of the Prosthodontics Department, Faculty of Dentistry, Cairo University. Patients were seeking to install implants in the mandible to improve the retention of their prosthesis. Patients' age ranged from 50 to 69 years. Overall, 56 males and 23 females were included in this clinical trial with mean age of 62.5 years for males and 59.6 years for females.

Any systemic condition that contraindicated implant placement was considered to be an exclusion criteria. Patients with glycosylated hemoglobin above eight were excluded from the study. An informed consent was signed and approved by all patients.

All patients included had either newly fabricated complete dentures, or previous dentures with acceptable retention, stability and occlusion. Patients had implant installation after a six-week period of adaptation with their new prostheses. CBCT examination was done before implant surgery.

Implant Installation

Patients were prescribed a dose of 2 gm of Amoxicillin 2 hours before surgery. Implants installed in this study were Zimmer Dental (Implants ZDI, Tapered screw vent Indiana America) of diameter 3.7 mm, and length 10 mm. Drilling was carried out using the Zimmer dental kit following the manufacturer's instructions. ISQ was measured using Osstell (Osstell,

Integration Diagnostics Ltd., Sävedalen, Sweden). A smart peg was screwed to the installed implant, and one ISQ value for the buccal surface was recorded following the manufacturer's instructions. Implants with an ISQ value of less than 60 were excluded from the study, as an ISQ value of 60 or above was considered to be one of the inclusion criteria.

This was followed by Periotest M measurements (Medizintechnix Gulden e. K., Modautal, Germany) (figure 1). The Periotest M was used on the mid-buccal surface perpendicular to the long axis of the screwed smart peg as described by the manufacturer, and one reading was recorded (Figure 2).

The fitting surface of the dentures were modified and relined using soft liner GC Soft-Liner, GC Corporation, Tokyo, Japan). Patients were recalled after 1 week for suture removal and further modification of the denture.

Osstell and Periotest readings were collected and statistically analyzed to detect if there was a general correlation between the two device readings regarding the primary implant stability on the day of implant installation. Data management and statistical analysis were performed using Statistical Package for Social Sciences (SPSS) version 21. Data were explored for normality using Kolmogrov-Smirnov test and Shapiro-Wilk test. Pearson correlation were used to detect any correlation between the surfaces of Osstell readings and Periotest readings. P-values ≤ 0.05 were considered significant.

Table (1): Correlation between the buccal (B), surfaces of the Osstell readings (ISQ) and the Periotest readings (PTV).

	Periotest (PTV)	
Osstell (ISQ)	**Pearson Correlation**	**p value**
B	-0.335	0.003

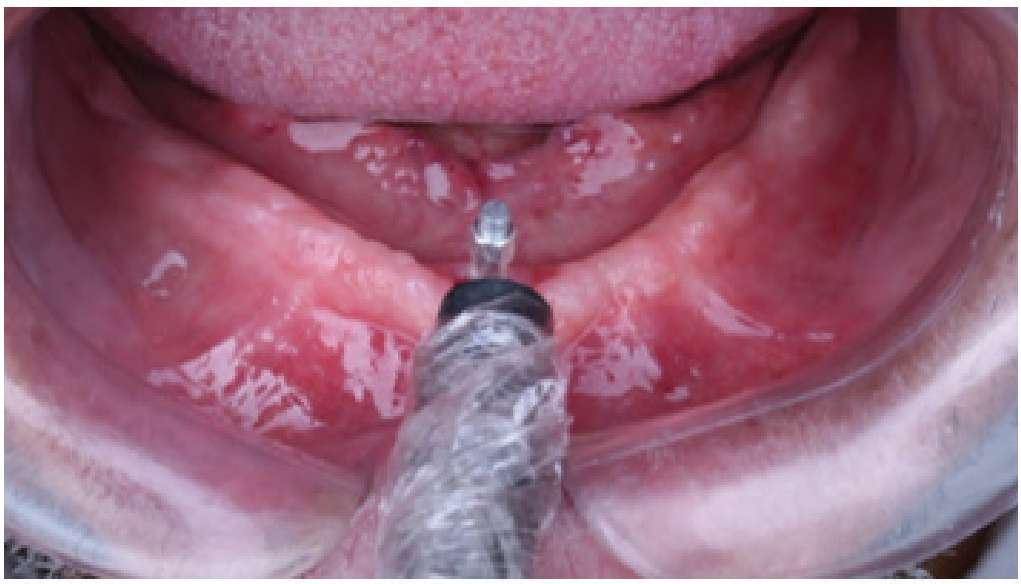


Figure (1): primary implant stability recorded using osstell

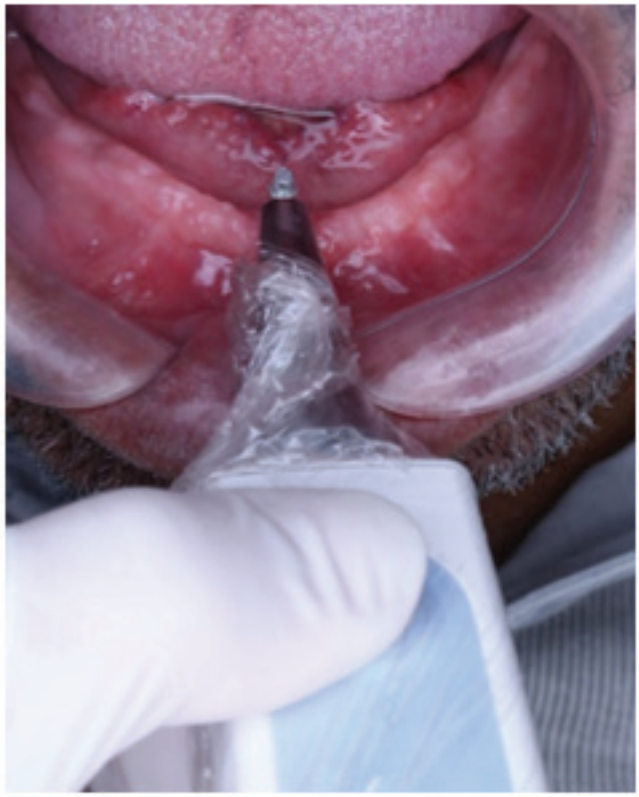
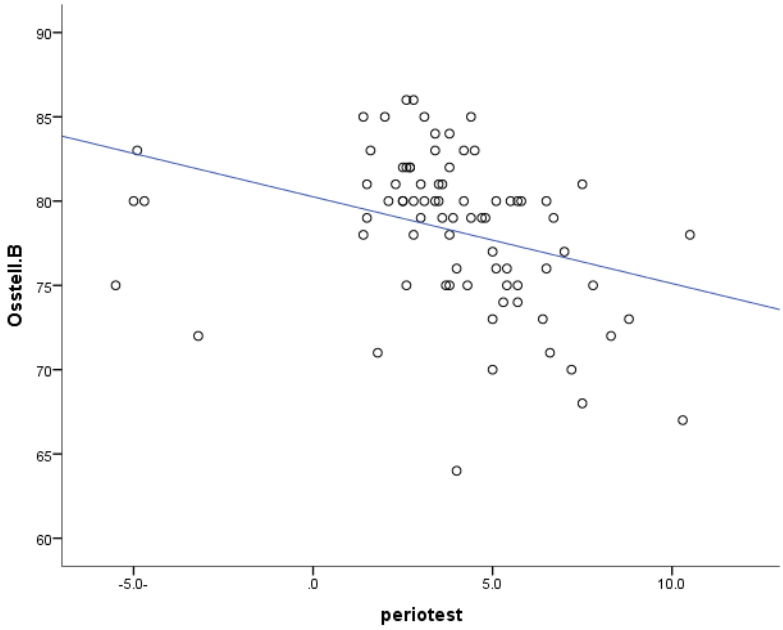


Figure (2): primary implant stability recorded using periotest

Figure (3): Showing a negative correlation between the Osstell readings at the buccal surface and the Periotest readings, which was statistically significant p≤0.005.



Results

When the Osstell and the Periotest readings were correlated, there was a negative weak, statistically significant correlation p=0.003, r=-0.335 (Table 1, figure 3).

Discussion

The increased demand for a non-invasive technique to detect and monitor implant stability has resulted in a higher usage of the Osstell and the Periotest devices. In the present study, the main aim was to try to find a correlation between the Osstell and Periotest readings while keeping all of the factors as constant as possible. Implants with the same length and diameter (3.7 mm x10 mm) were installed in the midline of the mandible, and primary implant stability was recorded using the same smart peg screwed to the implant.

The only variable that was difficult to control for both devices was the inter-operator and inter-instrument variable. During Periotest recording, the instrument was held horizontally at the mid-buccal surface of the screwed smart peg, with a valid distance of 0.6-2.5 mm between the tapping rod and the smart peg surface as recommended by the manufacturer. Olive and Aparicio 1990[28] reported that Periotest readings were sensitive to the position of the Periotest application on the surface of the abutment and the angulation of holding the instrument: A change in position of 1 mm of the Periotest striking may change the PTV readings between 1 and 2. Therefore, all efforts were done to fix the distance and angulation when using the Periotest device. As for the Osstell device, the measuring probe had to be held at a distance of 1-3 mm from the smart peg at an angle of 90 degrees 3mm above the soft tissue as per the manufacturer's instructions.

When the Osstell readings and Periotest readings were correlated in this clinical trial, there was a statistically significant negative correlation between the readings, indicating that measuring the primary stability with both devices yields comparable results. This is in agreement with a clinical study conducted by Oh and Kim 2012[10] [10], which concluded that both devices can be used to predict primary stability and loading protocols. Other in-vitro studies revealed good negative correlations between ISQ and PTV[29-31] [32-34]. The results of the present study confirms that clinically, an increase of the Osstell readings resulted in more negative (-) values of the Periotest indicating good primary stability.

The Periotest device has shown to be more sensitive to intra-observer and intra-operator errors which have made its reliability questionable when compared to the Osstell device[23]. However, the Periotest device is able to measure the primary implant stability directly at the abutment as it does not required the use of a smart peg to be screwed to the implant as the Osstell device. Therefore, the Periotest device presents a much easier and cheaper option to measure primary implant stability.

Conclusion

Periotest readings on the day of implant installation seem to be clinically as reliable as the Osstell readings for recording primary stability of dental implants.

Ethical Clearance- Taken from ethical committee - Faculty Of Dentistry –Cairo University

Source of Funding- Self

Conflict of Interest - Nil

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