Bulletin of Environment, Pharmacology and Life Sciences
Bull. Env. Pharmacol. Life Sci., Spl Issue [2] 2022 : 370-378

Online ISSN 2277-1808
Journal's URL:http://www.bepls.com
CODEN: BEPLAD

ORIGINAL ARTICLE **OPEN ACCESS**

A Clinical study to Evaluate the relative Efficacy of osstell (radio frequency analyzer) and periotest (damping capacity assessment) to Measure the Stability of Immediately loaded Dental implants

Varun Gaur[2], Puja Malhotra[1]*, Bhupinder Yadav[3]
[1-3] Department Of Prosthodontics, SGT University Santosh Dental College
E-mail: pujamal76@gmail.com

ABSTRACT

Implant stability is crucial for achieving and maintaining osseointegration. Various methods have been proposed for measuring implant stability which are usually invasive to overcome the above problem, noninvasive means of measurement can be applied easily in clinical cases with the use of Periotest and resonance frequency analysis. The present study was undertaken to evaluate the quantitative changes in Implant Stability around two piece, root form endosseous implants after placement by immediate loading protocol using resonance frequency analysis and damping capacity assessment and their correlation with primary stability measured with a calibrated wrench at the time of implant placement. A total of 100 partially edentulous patients were screened and ten patients with partially edentulous arches in mandibular posterior region were selected. Implants were placed according to the available bone as determined by CBCT evaluation. The primary stability of the implant was evaluated by using a calibrated wrench, damping capacity assessment (periotest) and resonance frequency analysis (osstell). A direct significant correlation between implant stability quotient (ISQ) and insertion torque (measured by calibrated wrench) was found at the time of implant placement. There was no statistically significant correlation between periotest values (PTV) and insertion torque (measured by calibrated wrench) observed at the time of implant placement. Both the methods employed i.e, resonance frequency analysis and periotest showed a similar trend i.e, an initial dip (at 4 weeks) followed by an increase in the stability values (at 12 weeks) in recording implant stability hence both methods proved to be reliable, non-invasive tools for assessing implant stability.

Keywords: *Implant stability, radio frequency analyzer, periotest, osstell*

Received 11.07.2022 Revised 04.09.2022 Accepted 20.10.2022

INTRODUCTION

Over the years, in implant dentistry new geometric implant designs, different surface treatments, advanced imaging and computerized planning techniques have contributed to the achievement of increased primary stability and shorter osseointegration time which in turn enhances the success of immediate loading [1]. Implant stability is crucial for achieving and maintaining osseointegration [2]. Primary stability is accomplished by mechanically engaging the implant in bone at the time of placement. Primary stability has been defined as 'a sufficiently strong initial bone–implant fixation' (Roberts 1999). To evaluate the initial bone quality and the degree of osseointegration, various methods have been proposed including histology and histomorphometry removal torque analysis, pull-and push-through tests and X-ray examination. However, due to problems of invasiveness and inaccuracy, these methods are not suitable for long-term clinical assessment.

It was originally believed that osseointegration of implant can be assessed by tapping an implant and or abutment with a metal instrument and assessing the nature of the sound. This has proven to be unsuccessful due to the inability of the operator to consistently discriminate sound in terms of specific, sensitive criteria [3]. To overcome the above problem, noninvasive means of measurement can be applied easily in clinical cases with the use of Periotest (Siemens AG, Benssheim ,Germany) and resonance frequency analysis (RFA) (osstell Mentor, Integration Diagnostics AB, Goteborg, Sweden) [4].

RFA uses the principle of when a frequency of audibility range is repeatedly vibrated onto an implant, the stronger the bone implant surface, resonance occurs in a higher frequency. Resonance frequency between 3.5 KHz and 8.5 KHz formed from the magnetic field is converted into ISQ values by Osstell ISQ™. The

transducer of Osstell ISQ has a magnetic peg on the top and is fixed to the implant fixture or abutment. When magnetic resonance frequency is released from the probe, the magnetic peg is activated. The activated peg starts to vibrate, and the magnet induces electric volt into the probe coil and the electric volt is sampled by the magnetic resonance frequency analyzer. The values are expressed as numbers between 1–100 in ISQ as Osstell™ [5].

Periotest is composed of a metallic tapping rod in a handpiece which is electromagnetically driven and electronically controlled. Signals produced by tapping are converted to unique values called "periotest values". Periotest® evaluates the damping capacity of the periodontium. It is designed to identify the damping capacity and the stiffness of the natural tooth or implant by measuring the contact time of an electronically driven and electronically monitored rod after per cussing the test surface. Periotest value (PTV) is marked from -8(low mobility) to +50(high mobility)

Although, a possible correlation between primary stability and insertion torque has been suggested in dental literature.[4] Also, both the methods of evaluation of implant stability, RFA and damping capacity have been commonly used to evaluate osseointegration. However, their accuracy, reliability and their correlation (if any) with calibrated wrench used at the time of implant placement has not been assessed.

The present study was undertaken to evaluate the quantitative changes in Implant Stability around two piece, root form endosseous implants after placement by immediate loading protocol using Resonance Frequency Analysis and Damping Capacity Assessment and their correlation with primary stability measured with a calibrated wrench at the time of implant placement.

MATERIAL AND METHODS

The present study was conducted in the Department of Prosthodontics, Crown & Bridge and Oral Implantology, Faculty of Dental Sciences, SGT University, Gurgaon to study the relative efficacy of resonance frequency analysis (osstell) device (fig 1) and damping capacity assessment (periotest) (fig 2) to measure primary stability of immediately loaded implants .To conduct this study a total of 100 partially edentulous patients were screened and ten patients with partially edentulous arches in mandibular posterior region were selected based on the following inclusion and exclusion criteria for the study. The stability of the implant was evaluated by using a calibrated wrench, damping capacity assessment (periotest) and resonance frequency analysis (osstell). Detailed treatment protocol was explained to the patient and a written informed consent indicating their willingness to participate in the study was obtained prior to the start of the study. Ethical clearance was obtained from the institutional ethical committee and scientific review board holding a number SGTU/FDS/24/1/362.

Pre –operative assessment:

Routine blood investigations were carried out before the surgery to rule out any systemic disease or bleeding disorder. Osseous architecture of the proposed site was evaluated. Diagnostic impressions were made for preparation of the study and working casts using irréversible hydrocolloid impression material (Marieflex ,Septodont). Occlusal relationship was recorded using modelling wax (Y-Dents, India). The diagnostic models were mounted on a semi adjustable articulator (Hanau –wide vue) following facebow transfer. A diagnostic stent was fabricated in the conventional manner to aid in placement of implants at the time of surgery.

Implant selection

The implant size was selected both in width and length according to the available bone as determined by CBCT evaluation. Screw type tapered form Titanium alloy grade 5 (Ti6Al4V) endosseous implants (two piece) were used. These implants were tapered, double threaded with spiral tap and Alumina oxide blasted/ Acid etched surface treatment (Adin Toureg-S).

Presurgical protocol:

Oral prophylaxis was done before the scheduled implant placement. Subjects were adviced to use 0.2% chlorhexidine gluconate mouthwash, twice daily. A single dose of 1000 mg Augmentin (Amoxicillin +Clavulonic acid) was given one hour prior to the surgery.

Surgical implant placement

On the day of surgery, the patient were anesthetized by local infiltration with 2% lignocaine with adrenaline 1:2, 00,000. A midcrestal incision was given followed by elevation of Full-thickness mucoperiosteal flaps that was kept small to preserve the periosteal vascular supply. The implant site was prepared and implant was placed according to the manufacturer's protocol. Adin tourage -S implants were placed & abutment placed immediately (fig 3).

Fabrication of the Provisional Restoration in immediately loaded Implant.

The provisional restoration was fabricated and adjusted to clear all centric and eccentric contacts. A well-polished provisional restoration was then cemented with eugenol free temporary cement (freeginol – GC)

for a period of 12 to 16 weeks. After 12 to 16 weeks of uninterrupted healing, the provisional restoration was replaced by a permanent porcelain fused to metal restoration.

Implant stability evaluation

Primary implant stability was measured by the calibrated wrench at the time of implant placement. Implant stability quotient was measured by using Osstell instrument (Integration Diagnostics AB, Goteborg, Sweden) (fig 5) at the time of implant placement (baseline),4 weeks and 12 weeks post operatively. Implant stability was measured by using periotest instrument (fig 4) at the time of implant placement (baseline),4 weeks and 12 weeks post operatively.

Statistical Analysis

The quantitative data was represented as Mean ± Standard Deviation and the categorical was represented as frequencies and in percentage. The comparison of quantitative data was done using, Post-hoc Bonferroni test, Pearson Correlation test and One-way ANOVA test wherever applicable.

RESULT AND DISCUSSION

Depicts the Insertion Torque value of 10 Endosseous Implants observed at time of Implants placement. All 10 Endosseous Implants showed good primary stability and could be immediately loaded (table 1). The mean Insertion Torque observed at the time of implant placement was 49.5Ncm with the maximum value 55Ncm and minimum value 45Nc.Table 2(a): Depicts the implant stability quotient (isq) values of 10 endosseous implants at the time of implants placement showing mesial, distal, buccal, lingual values and their mean values. The acceptable range for implant to be considered having stability is 55-85 isq value. The recorded is q values of all cases lie within this range indicating good primary stability. the mean implant stability quotient (isq) for 10 endosseous implants observed at the time of implant placement was 72.4 isq with the maximum 80 isq value and minimum 56 isq value . Table 2(b): Depicts the implant stability quotient (ISQ) of 10 endosseous implants 4 weeks post implants placement. the mean implant stability quotient (ISQ) for 10 endosseous implants observed 4 weeks post implant placement was 63 ISQ with the maximum 73 ISQ value and minimum 52 ISQ value. Table 2(c): depicts the implant stability quotient (ISQ) of 10 endosseous implants 12 weeks post implant placement. the mean implant stability quotient (ISQ) for 10 endosseous implants observed 12 week post implants placement was 74 ISQ with the maximum 80 ISQ value and minimum 64 ISQ value.

Table 3: depicts comparison of mean implant stability quotient (ISQ) with mean insertion torque obtained using calibrated wrench at the time of implant placement showing p-value and correlation. The values show that there is statistically significant correlation between implant stability quotient (ISQ) and insertion torque values at the time of placement of implants.

Table 4: depicts the comparison of mean implant stability quotient (ISQ) values at the time of placement of endosseous implants with an interval difference of 4 and 12 weeks of post immediate loading. The mean implant stability quotient (ISQ**)** was 72.63 values at the time of implant placement, at 4^{th} week it was 63.4and 74.90 at 12^{th} week of post immediate loading. There was statistically significant decrease in mean implant stability quotient (ISQ) values at 4^{th} week and statistically significant increases in mean implant stability quotient (ISQ) values at 12^{th} week post immediate loading.

Table 5(a): represents the periotest values (PTV) of 10 endosseous implants at the time of placement. The mean periotest values at the time of implant placement were -2.3 with minimum value -1.0 and maximum value -3.2. As evident from the table, the periotest values are observed to be within the acceptable range. Therefore all implants exhibited good primary stability.

Table 5(b): depicts periotest values of 10 endosseous implants after 4 weeks of implant placement. The mean periotest values at the time of implant placement was -1.9 with minimum value -1.0 and maximum value -1.6. As seen in the table, periotest values are observed to be within the acceptable range (0 to -8). Therefore all implants exhibited good primary stability.

Table 5(c): represents periotest values (PTV) after 12 weeks of implant placement. The mean periotest values at the time of implant placement was -2.6 with minimum value -2.2 and maximum value -3.4. As observed in the table, periotest values are found to be within the acceptable range (0 to-8). Therefore all implants exhibited good primary stability.

Table 6: represents comparison of mean PTV values and insertion torque values obtained using calibrated wrench at baseline. There was a correlation between mean periotest values (PTV) and insertion torque values but it was not statistically significant.

Table 7: Represents the comparison of mean periotest values (PTV) at the time of placement of implant with an interval difference of 4 and 12 weeks of post immediate loading. There was no significant difference in the mean periotest value (PTV) at the time of placement of implant, after 4 weeks of implant placement and after 12 weeks of implant placement. Although, the periotest values remained within the acceptable range of 0 to -8 indicating implants with good primary stability.

Implant dentistry has grown exponentially in the recent years. Today implant supported prosthesis form a very important and popular treatment modality in dentistry and have been very rightly called as the "third dentition." However, in spite of the advantages and the popularity of this field, one major drawback remains that is "Time". The time gap associated with conventional implantology i.e, the healing period of 3 to 6 months between the surgical and prosthetic phase can act as a major deterrent for patients seeking prosthetic treatment [6].

Time is very precious, therefore to replace one's missing tooth replaced in a day's appointment with a tooth like fixture is a very appealing option for the patient. 'Tooth in a day' is the concept and goal of modern day dentistry i.e. to return patients to oral health and function in a predictable fashion [7].

Instead of having to wait for 4-10 months, required by traditional protocols, patient can receive their implant supported prosthesis within 1-72 hours after surgery The immediate loading protocol was followed wherein loading was done within 48 hrs of implant placement as per guideline given in third ITI consensus as described by Cochran in 2004 .As per recent fifth ITI consensus statement by Gallucci immediate loading was done within a week. Henry and Liddelow in 2008 conducted a study on immediate loading in implants [8]. They concluded that substantial evidence exists to demonstrate high survival rates of immediate loading protocols and it may be recommended for certain clinical situations. Otherwise, Excessive stresses due to excessive loading on the healing tissues would induce micromotion i.e. lateral movements that may eventually lead to fibrous integration rather than the much desirable osseointegration [9]. Therefore, primary stability is of utmost importance here. Hence, it becomes all the more crucial to assess the primary stability and then decide upon the loading protocol to be followed.

Researchers have devised various methods to assess primary stability at the time of surgery. Presently, Primary implant stability can be measured by either invasive or non-destructive methods. Histomorphologic research, tensional test, push-out/pull-out test and removal torque test are classified as destructive methods. Non-destructive methods Include Percussion Test, Radiography, Cutting Torque Test, Insertion Torque Measurement while placing implants, Periotest®(Siemen AG, Benshein Germany),and Resonance Frequency Analysis(RFA)(Meredith 1998) [10].

Insertion torque values have been used to measure the bone quality in various parts of the jaw during implant placement (O'Sullivan, et al. 2004) [11]. Insertion torque has been the most popular means of evaluating implant stability. However, it can not be used to assess secondary implant stability or implant stability at any other time during the course of the treatment. Ikumi and Tsutsumi, used the calibrated wrench to register the Insertion torque, finding a statistically significant relationship between the insertion torque and bone density measured in Hounsfield units [12].

Meredith *et al.* [13] reported the use of resonance frequency analyzer (based on the principle of tuning fork) to evaluate implant stability. The first commercial product of the resonance frequency analyzer (RFA) was Osstell (Osstell AB, Göteborg, Sweden), followed by Osstell Mentor and recently Osstell ISQ was introduced.

Periotest (Siemens AG, Benshein, Germany) was originally devised by Dr. Schulte to measure tooth mobility. Teerlinck, *et al*. (1991) used this method to overcome destructive methods in measuring the implant stability [14]. Periotest evaluates the damping capacity of the periodontium. It is designed to identify the damping capacity and the stiffness of the natural tooth or implant by measuring the contact time of an electronically driven and electronically monitored rod after percussing the test surface. The value for Damping Capacity assessment as recorded PTV should be within range -8 to 0 to be implant stable [15]. Both these instrument are on invasive and specifically designed to evaluate implant stability at any time during the treatment.

The present study was conducted to evaluate and compare the accuracy of the two commonly used instruments to evaluate implant stability measurements. Both the instruments are based on different principles i.e, RFA and Damping capacity. Immediately following implant placement, implant stability values with a calibrated wrench, resonance frequency analysis measurements with an osstell instrument (Integration Diagnostics AB, Goteborg, Sweden) and damping capacity assessment with periotest (Medizintechnik Gulden e. K. .Modautal/Germany) were recorded. The implants were loaded immediately, within 72 hours with a provisional acrylic resin restoration. Damping capacity assessment (table 5a, 5b, 5c) and resonance frequency analysis (table 2a, 2b, 2c) were conducted at subsequent follow up visits (0, 1, 3, month post operatively). Garber DA et al and Shiigai Tatsuo stated implants placed with an insertion torque with ≥45Ncm showed good primary stability of implants. All 10 implants placed in our study showed an Insertion Torque of ≥45Ncm i.e insertion torque ranged from 45 to 55 Ncm (table 1). Hence all implants showed good primary stability and were indicated for immediate loading.

At immediate post implant placement i.e. baseline the mean values of primary stability measured by calibrated wrench, resonance frequency analysis and periotest was 49.5Ncm, 72.6 ISQ and., -2.3 periotest

value respectively. Following this, both the ISQ values (table 4) and periotest values (table 7) first decreased at four weeks and then increased by 2.54 ISQ and -2.3 periotest value as observed on 12th week follow up visit. The results in this study are in accordance with a previous study conducted by Shokri Mehran and Daraeighadikolaei Arash, they confirmed a similar decrease in ISQ value at fourth week. This stability reduction has been attributed to the bone remodeling which is said to occur stage between the second and the fourth week.In the present study, a significant correlation between insertion torque and RFA at the time of implant placement (baseline) was observed (table 3) i.e, as insertion torque increased, RFA also increased. These results are in agreement with the results showed by Magno Filho LC, Cirano FR et al [16].

The value for damping capacity assessment as recorded by Periotest (PTV) should lie within acceptable range of -8 to 0 for the implant to be considered stable. Periotest value (PTV) in all our cases were within acceptable range. At fourth week the mean values for implant stability was -1.9 (PTV). This method confirmed a decrease in implant stability after four weeks of implant placement compared to stability recorded at baseline. The results in our study are in favor of previous studies conducted by Oh JS, Kim SG, Lim SC, Ong JL they concluded that the periotest value (PTV) value was lower at 6 weeks when compared with data collected at 3 weeks after implantation.

In the present study, no significant correlation was found between insertion torque and PTV (table 6) as noted at the time of implant placement (baseline). As the insertion torque increased, PTV did not increase correspondingly in all cases.

Table 1: Evaluation of implant stability at the time of implant placement (baseline)

S.No.	Subjects	Implant site	Insertion Torque (Ncm)
1.	Subject 1	36	55
2.	Subject 2	46	45
3.	Subject 3	36	55
4.	Subject 4	13	50
5.	Subject 5	12	45
6.	Subject 6	12	45
7.	Subject 7	13	45
8.	Subject 8	23	45
9.	Subject 9	46	55
10.	Subject 10	47	55

Table 2(a): Evaluation of implant stability quotient (isq) values at the time

S.No.	Subjects	Implant site	Age/ Sex	Mesially M	Distally D	Buccally B	Lingually L	MEAN ISQ
1.	Subject1	36	40/M	80	82	80	80	80
2.	Subject2	46	40/M	78	78	78	78	78
3.	Subject 3	36	37/F	79	79	79	79	79
4.	Subject 4	13	42/F	75	75	75	75	75
5.	Subject5	12	23/M	56	56	56	56	56
6.	Subject 6	12	42/M	63	71	71	71	64
7.	Subject 7	13	49/F	70	70	70	70	70
8.	Subject 8	23	49/F	76	70	70	76	72
9.	Subject 9	46	32/M	74	74	75	74	74
10.	Subject10	47	32/M	77	77	76	76	76

Table 2(b): Evaluation of implant stability quotient (isq) values

S No.	Subjects	Implant site	Age/ Sex	Mesially M	Distally D	Buccally B	Lingually L	MEAN
1.	Subject 1	36	40/M	62	63	63	63	62
2.	Subject 2	46	40/M	73	74	74	73	73
3.	Subject 3	36	37/F	72	72	72	73	72
4.	Subject 4	13	42/F	60	58	58	58	58
5.	Subject 5	12	23/M	53	53	52	53	52
6.	Subject 6	12	42/M	60	60	65	65	60
7.	Subject 7	13	49/F	63	66	63	63	63
8.	Subject 8	23	49/F	63	66	63	67	63
9.	Subject 9	46	32/M	64	64	66	64	63
10.	Subject 10	47	32/M	63	64	63	64	64

Table 2(c): Evaluation of implant stability quotient (ISQ) values

S No.	Subjects	Implant site	Age/ Sex	Mesially M	Distally D	Buccally B	Lingually L	MEAN
1.	Subject1	36	40/M	72	77	77	77	74
2.	Subject2	46	40/M	78	78	78	78	78
3.	Subject 3	36	37/F	83	80	80	80	80
4.	Subject 4	13	42/F	62	68	68	68	64
5.	Subject5	12	23/M	60	63	63	60	74
6.	Subject6	12	42/M	73	74	73	73	72
7.	Subject 7	13	49/F	75	74	75	75	74
8.	Subject 8	23	49/F	70	70	72	70	70
9.	Subject 9	46	32/M	72	72	72	72	72
10.	Subject10	47	32/M	72	72	72	72	72

Table 3: mean implant stability quotient (ISQ) with torque at the time of implant

		INSERTION TORQUE
RFA at the time of placement of implant (baseline) - mean	Pearson Correlation	0.882
	p-value	0.001**
	Number	10
Pearson Correlation test * Correlation is significant at 0.05 level. ** Correlation is significant at 0.01 level.		

Table 4: mean implant stability quotient (ISQ) values at the time of placement of endosseous implants

parameters	**Mean**	**Std. Deviation**	**F-value**	**p-value**
RFA At The Time Of Placement Of Implant – Mean	72.63	4.83	12.554	0.002**
RFA After 4 Weeks Of Implant Placement – Mean	63.45	5.65		
RFA After 12 Weeks Of Implant Placement – Mean	74.90	3.75		
One-way ANOVA test *Significant ($p<0.05$) ** Highly significant difference ($p<0.01$)				

Table 5(a): Evaluation of periotest value (PTV) of implants at the time of placement.

S No.	Subjects	Implant site	Age/ Sex	Periotest value (PTV)
1.	Subject1	36	40/M	-2.4
2.	Subject2	46	40/M	-2.1
3.	Subject 3	36	37/F	-2.5
4.	Subject 4	13	42/F	-2.2
5.	Subject5	12	23/M	-1.0
6.	Subject 6	12	42/M	-2.9
7.	Subject 7	13	49/F	-2.5
8.	Subject 8	23	49/F	-2.6
9.	Subject 9	46	32/M	-2.5
10.	Subject10	47	32/M	-3.2

Table 5(b): Evaluation of periotest values (PTV) after 4 weeks post implant placement.

S No.	Subjects	Implant site	Age/ Sex	Periotest value (PTV)
1.	Subject1	36	40/M	-2.0
2.	Subject2	46	40/M	-2.0
3.	Subject 3	36	37/F	-2.0
4.	Subject 4	13	42/F	-2.0
5.	Subject5	12	23/M	-1
6.	Subject6	12	42/M	-2.0
7.	Subject 7	13	49/F	-1.4
8.	Subject 8	23	49/F	-1.8
9.	Subject 9	46	32/M	-1.6
10.	Subject10	47	32/M	-1.6

Table 5 (c): Evaluation of periotest values (PTV) after 12 weeks of implant placement.

S No.	Subjects	Implant site	Age/ Sex	Periotest value (PTV)
1.	Subject1	36	40/M	-2.5
2.	Subject2	46	40/M	-2.7
3.	Subject 3	36	37/F	-2.5
4.	Subject 4	13	42/F	-2.2
5.	Subject5	12	23/M	-2.2
6.	Subject6	12	42/M	-2.2
7.	Subject 7	13	49/F	-3.0
8.	Subject 8	23	49/F	-3.0
9.	Subject 9	46	32/M	-2.8
10.	Subject10	47	32/M	-3.4

Table 6: mean periotest values (PTV) with the insertion torque values at the time of implant

Parameter		**INSERTION TORQUE**
PTV value Immediately after placement	Pearson Correlation	0.512
	p-value	0.061
	Number	10

Table 7: Mean periotest values (PTV) at the time of placement of endosseous implants

PTV value	Mean	Std. Deviation	F-value	p-value
Immediately after placement	-2.3	0.78	2.009	0.480#
After 4 weeks	-1.9	1.38		
After 12 weeks	-2.6	1.18		
One-way ANOVA test # Non-significant difference *Significant (p<0.05)				

Fig 1: Periotest instrument

Fig 2: Osstell instrument

Fig 3: Implant placement

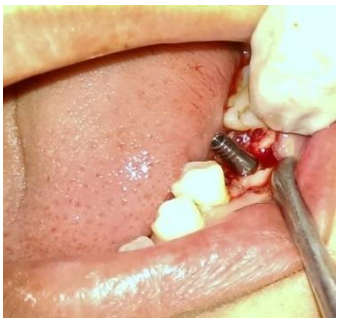


Fig 4: Recording periotest values

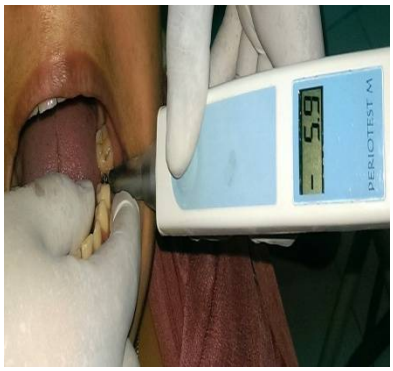
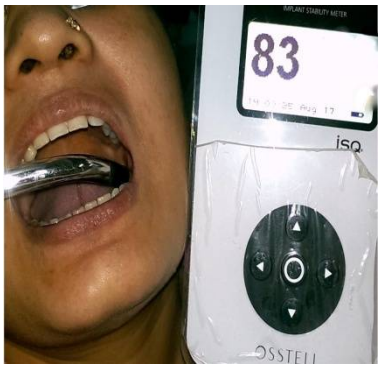


Fig 5: recording osstell values



CONCLUSION

A direct significant correlation between Implant Stability Quotient (ISQ) and Insertion torque (measured by calibrated wrench) was found at the time of implant placement. There was no statistically significant correlation between Periotest values (PTV) and Insertion torque (measured by calibrated wrench) observed at the time of implant placement. Both the methods employed i.e, Resonance Frequency Analysis and Periotest showed a similar trend i.e, an initial dip (at 4 weeks) followed by an increase in the stability values (at 12 weeks) in recording implant stability hence both methods proved to be reliable, non invasive tools for assessing implant stability.

REFERENCES

1. Fawad Javed, George E. Romanos B. (2010). The role of primary stability for successful immediate loading of dental implants. A literature review. J dent. 32(5): 612–620.
2. Romanos GE. (2004). Surgical and prosthetic concepts for predictable immediate loading of oral implants. J Cal Dental Association. 32: 991–1001.
3. Irinakis T,Wiebe C. (2009). Initial Torque Stability of a New Bone Condensing Dental Implant: A Cohort Study of 140 Consecutively Placed Implants. J Oral Implantol. 35: 277-282.
4. Bruno Salles et al. (2010). Influence of high insertion torque on implant placement - an anisotropic bone stress analysis. Braz dent J.21(6): 508-14.

5. Shiigai, Tatsuo (2007). Pilot study in the identification of stability values for determining. The Journal of Oral Implantology.33.890-895
6. Wang TM, Lee MS, Wang JS, Lin LD. (2015). The effect of implant design and bone quality on insertion torque, resonance frequency analysis, and insertion energy during implant placement in low or low- to medium-density bone. Int J Prosthodont. 28(1): 40-7.
7. Di Stefano DA, Arosio P, Piattelli A, Perrotti V, Iezzi G. (2015). A torque-measuring micromotor provides operator independent measurements marking four different density areas in maxillae. J Adv Prosthodont. 7(1): 51-55.
8. P J Henry, G J Lidelow. (2008). Immediate loading of dental implants. Australian Dental Journal.; 53:(1l): S69–S81.
9. Szmukler-Moncler S, Piattelli A, (2000). Considerations preliminary to the application of early and immediate loading protocols in dental implantology. Clin Oral Implants Res. 11(1): 12-25.
10. Meredith N, Friberg B, Sennerby L, Aparicio C. (1998). The relationship between contact time measurements and PTV values when using the Periotest to measure implant stability. Int J Prosthodont.;11(3): 269-75.
11. O'Sullivan D (2000). Measurements comparing the initial stability of five designs of dental implants: a human cadaver study. Clin Implant Dent Relat Res. 2(2): 85-92.
12. Meredith N (1998). Assessment of implant stability as a prognostic determinant Int J Prosthodont. ;11(5): 491-501.
13. Meredith N, Friberg B, Sennerby L, Aparicio C.(1998). The relationship between contact time measurements and PTV values when using the Periotest to measure implant stability. Int J Prosthodont. ;11(3): 269-75.
14. Chavez H.(1993). Assessment of oral implant mobility. J Prosthet Dent. 70(5): 421-6.
15. Filho LC, Cirano FR, Hayashi F, Feng HS, Conte A, Dib LL .(2014). Assessment of the correlation between insertion torque and resonance frequency analysis of implants placed in bone tissue of different densities. J Oral Implantol. ;40(3): 259-62
16. Wang TM, Lee MS, Wang JS, Lin LD. (2015). The effect of implant design and bone quality on insertion torque, resonance frequency analysis, and insertion energy during implant placement in low or low- to medium-density bone. Int J Prosthodont. 28(1): 40-7.

CITATION OF THIS ARTICLE

V Gaur, P Malhotra, B Yadav . A Clinical study to Evaluate the relative Efficacy of osstell (radio frequency analyzer) and periotest (damping capacity assessment) to Measure the Stability of Immediately loaded Dental implants. Bull. Env.Pharmacol. Life Sci., Spl Issue [2]: 2022: 370-378