ORIGINAL RESEARCH

Determination of Immediate-loaded Single Implants' Stability with Periotest

Kyatsandra N Jagadeesh[1], Sudhanshu Kumar[2], Anuj Singh Parihar[3], Jasvinder Kaur[4], Randhir Kumar[5], Kunal Kumar[6]

Abstract

Aim and objective: The aim of this study was to determine the stability of immediate-loaded single implants with periotest.

Materials and methods: In this *in vivo* study, dental implants with a length ranging from 10 to 13 mm and diameter of 3.0–4.2 mm were utilized. Stability of dental implant was evaluated using the Periotest® M handheld device before loading, at 1 month, 3 months, 6 months, and 1 year.

Results: Implants 11.5 mm in length had the highest mean periotest value (0) after placement, whereas 10 mm-long implant had a value of −0.31 and 13 mm had a value of −0.48. After 1 month, 10 mm had a value of 1.23, 11.5 mm had a value of −0.32, and 13.0 mm had a value of −0.24. After 6 months, 10 mm had a value of 1.78, 11.5 mm had a value of −0.4, and 13.0 mm had a value of −0.41. After 1 year, 10 mm had a value of −0.54, 11.5 mm had a value of −0.51, and 13.0 mm had a value of −0.48. There was an unconstructive relationship between implant length and the average periotest score. There was also an unconstructive association between the implant diameter and the mean periotest value.

Conclusion: The implant with long and greatest diameter had higher stability. Periotest can be used to determine dental implant stability.

Clinical significance: Periotest is useful in determining dental implant stability. Large-scale studies may be helpful in obtaining useful results.

Keywords: Dental implant, Periotest, Stability.

The Journal of Contemporary Dental Practice (2020): 10.5005/jp-journals-10024-2900

Introduction

Since its innovation, dental implant has witnessed several developments to be more beneficial for patients with long time continued existence.[1] The purpose of dental implant is to achieve few operational criteria as follows: should diminish the outcome of shear forces on the implant bone boundary in order to preserve marginal bone,[2] should encourage bone development and/or aid in bone healing, and should achieve preliminary stability that lessens micromotion and the waiting period for loading the implant.[3]

There are different shapes of dental implants, such as smooth cylindrical, tapered, and threaded cylindrical.[4] The most common site of insertion for tapered implants is the anterior region, whereas in posterior region, both smooth cylindrical and threaded cylindrical implants can be utilized safely.[5] Threaded dental implants are added in order to improve initial stability. They are also utilized for distributing stress effectively. More stress exists at the thread–bone interface, and it decreases from the crest to root the of the thread.[6]

Nowadays, direct loading type or early functional loading type dental implant systems are utilized. Primary implant stability is greatly affected by length, width, design, bone quality, insertion torque, and micromotions at the bone implant interface.[7] The periotest provides a more consistent method for diagnosing the implant status by calculating the levels of subclinical mobility. It is an electronic instrument that utilizes ultrasonic vibrating probe in order to determine the micromobility of the implant.[8] This study was conducted to determine the stability of immediate-loaded single implants with periotest.

Materials and Methods

The present *in vivo* study was carried out in the Department of Periodontics and Oral Implantology. The study included 60 patients aged 18–58 years in both genders. The inclusion criteria were patients with missing maxillary anterior teeth (less than 3), patients who were edentulous for not less than 6 months, and patients with good bone quality. Exclusion criteria were patients with systemic diseases such as diabetes mellitus, hypertension, or bleeding disorders; smokers; pregnant women; patients not giving consent; and those with insufficient bone quantity. Institutional ethical consent was obtained prior to the study. All patients were informed about the study in understandable language, and written permission was obtained. The study was conducted by two trained investigators from June 2017 to November 2019.

[1]Department of Prosthodontics and Implantology, Sree Siddhartha Dental College, Sree Siddhartha Academy of Higher Education, Tumakuru, Karnataka, India

[2]Department of Dentistry, Jawahar Lal Nehru Medical College and Hospital, Bhagalpur, Bihar, India

[3]Department of Periodontics, People's Dental Academy, People's University, Bhopal, Madhya Pradesh, India

[4]Department of Prosthodontics, Swami Devi Dayal Dental College, Barwala, Haryana, India

[5]Department of Periodontics, Patna Dental College and Hospital, Patna, Bihar, India

[6]Department of Dentistry, Patna Medical College and Hospital, Patna, Bihar, India

Corresponding Author: Anuj Singh Parihar, Department of Periodontics, People's Dental Academy, People's University, Bhopal, Madhya Pradesh, India, Phone: +91 8827047003, e-mail: dr.anujparihar@gmail.com

How to cite this article: Jagadeesh KN, Kumar S, Parihar AS, *et al.* Determination of Immediate-loaded Single Implants' Stability with Periotest. J Contemp Dent Pract 2020;21(11):1245–1248.

Source of support: Nil

Conflict of interest: None

A demographic profile of each participant was recorded. For all patients, careful clinical assessment was performed. The current study utilized dental implants with a width of 3.0–4.2 mm and a length of 10–13 mm. We used Noble Biocare dental cylindrical-shaped dental implants for all cases but did not use bone graft. Implant screws were made tight with a manual torque wrench to make sure a torque of 40 N cm. Primary implant stability was calculated using Periotest® M handheld apparatus prior to load.

The periotest device was utilized for measuring the stability of implants in the second stage. During the second stage, healing posts were attached to the implants, and the patient was seated so that the jaw would be in a horizontal posture to the floor. The probe was leveled at a right angle to the post, and its contact was made as close to the bone crest as possible. All of the implants were tested in lateral directions. Readings taken by the device registered the same values at three consecutive times. Patient's prostheses and over dentures were removed during the evaluation. A periapical radiograph was taken in each case. A radiographic value (RV) from 0 to 10 was assigned to each implant. A value of 0 was given to implants with no radiographic crestal bone loss, and a value of 10 was assigned to those with total radiographic bone loss.[9] Participants were recalled often, and implant stability was reviewed using Periotest® M handheld electronic appliance. Clinical stability (periotest), survival rate, and radiographic coronal bone defects (CBD) were evaluated at delivery of the definitive superstructures (CBD) after 1 month, 3 months, 6 months, and 1 year.[7] The mean values recorded by both investigators were considered for statistical evaluation.

The obtained results were tabulated and statistically evaluated. p value < 0.05 was significant.

Statistical Analysis

Data were entered in MS excel sheet and evaluated using SPSS version 21 (IBM, Chicago, USA). Correlation of implant length and implant diameter by total mean periotest score was performed through the use of Spearman's ρ correlation coefficient. p value $<$ 0.05 was considered statistically significant.

Results

Table 1 shows that among the 60 patients, 28 (46.7%) were males and 32 (53.3%) were females: 24 (40.0%) patients were included in the age-group of 18–28 years, 16 (26.6%) in 29–38 years, 12(20.0%) in 39–48 years, and 8(13.3%) in 49–58 years. The difference was considerable (p value < 0.05).

Figure 1 indicates that there were 12 patients with 13 × 4.2 mm dental implants, 10 had 13 × 4.2 mm implants, 8 had 11.5 × 4.2 mm implants, 8 had 13 × 3.5 mm implants, 6 had 13 × 3.0 mm implants, 5 had 11.5 × 3.5 mm implants, 4 had 10 × 3.5 mm, another 4 had 10 × 3.0 mm implants, and 3 patients had 11.5 × 3.0 mm implants.

Table 1: Demographic profile of patients

Gender	*Number*	*p value*
Male	28 (46.7%)	0.81
Female	32 (53.3%)	
Age groups (years)		
18–28	24 (40.0%)	0.01
29–38	16 (26.6%)	
39–48	12 (20.0%)	
49–58	8 (13.3%)	

Table 2 presents that of 60 patients, 54 patients had periotest values (PTVs) between −0.8 and 0 at placement which decreased to 50 after 3 months. After 1 year, the number further decreased to 44. There were six patients having PTVs between +1.0 and −9.0 at placement which decreased to 0 after 1 year. No patient had PTVs between +10.0 and −50.0 at placement which increased to 4 after 1 year.

Table 3 demonstrates that 11.5 mm-long implants had the highest mean periotest value (0) after placement, whereas 10 mm-long implant had a value of −0.31 and 13 mm had a value of −0.48. After 1 month, 10 mm had a value of 1.23, 11.5 mm had a value of 0.32, and 13.0 mm had a value of −0.24. After six months, 10 mm had scores of 1.78, 11.5 mm had scores of −0.4, and 13.0 mm had scores of −0.41. After 1 year, 10 mm had scores of −0.54, 11.5 mm had scores of −0.51, and 13.0 mm had scores of −0.48.

Table 4 shows that there was a negative correlation between implant length and the mean periotest value. The dissimilarity was nonconsiderable (p value > 0.05).

Table 5 indicates that, at placement, maximum periotest value (−0.11) was seen with implant diameter of 3.0 mm, and minimum value (−0.42) was seen with implant diameter of 3.5 mm. After 1

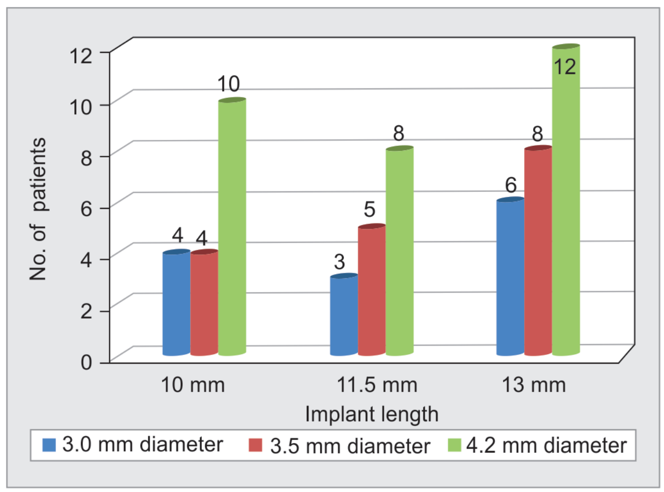

Fig. 1: Distribution of patients based on implant length and diameter

Table 2: Periotest value of dental implants at different interval of time

	Periotest value			
Time interval	*−0.8 to 0*	*+1.0 to 9.0*	*+10.0 to 50.0*	*Total*
At placement	54	6	0	60
After 1 month	54	4	2	60
After 3 months	50	0	6	56
After 6 months	48	0	4	52
After 1 year	44	0	4	48

Table 3: Distribution of implant length by the mean periotest value

	Implant length			
Time interval	*10 mm*	*11.5 mm*	*13.0 mm*	*Total*
At placement	−0.31	0	−0.48	−0.3
After 1 month	1.23	−0.32	−0.24	0.72
After 3 months	0.46	−0.32	−0.21	−0.04
After 6 months	1.78	−0.4	−0.41	1.43
After 1 year	−0.54	−0.51	−0.48	−0.5

Table 4: Correlation of implant length by total mean periotest score

Implant length	*Mean periotest*	*Spearman's rho correlation coefficient*	*p value*
10.0 mm	1.70	−0.24	0.914
11.5 mm	−1.82		
13.0 mm	−1.06		

Table 5: Distribution of implant diameter by the mean periotest value

	Implant diameter			
Time interval	*3.0 mm*	*3.5 mm*	*4.2 mm*	*Total*
At placement	−0.11	−0.42	−0.38	−0.32
After 1 month	2.20	0.21	−0.38	0.74
After 3 months	−0.52	−0.28	1.14	−0.02
After 6 months	1.51	2.16	−0.30	1.44
After 1 year	−0.58	−0.47	−0.52	−0.51

Table 6: Correlation of implant diameter by total mean periotest score

Implant length	*Mean periotest*	*Spearman's rho correlation coefficient*	*p value*
3.0 mm	2.12	−0.72	0.872
3.5 mm	0.72		
4.2 mm	−0.64		

year, a minimum value of −0.58 was seen in implant with minimum diameter of 3.0 mm.

Table 6 demonstrates that there was a negative correlation between implant diameter and the mean periotest value. The dissimilarity was nonsignificant (p value > 0.05).

Discussion

Dental implants are routinely utilized in prosthetic treatment for replacing missing few or multiple teeth. Earlier endosseous or root implants were considered best because of high success rate and less patient discomfort when compared to other implants.[11] Dental implants are available with different thread shapes, such as standard V thread, square thread, buttress thread, reverse buttress thread, and spiral thread.[11] Based on thread shape, there is variation in stress distribution. With V shape or square shape, there is less stress, whereas buttress-shaped thread generates more stress at the implant–bone interface.[9] This study was conducted in order to determine the stability of immediate-loaded single implants with periotest. The periotest has the benefits of contributing to reproducible findings by measuring the stages of subclinical mobility.[9]

In the present study, we included 60 patients requiring dental implants in maxillary anterior region, with age ranging from 18 to 58 years, of which 28 were males and 32 were females. Twenty-four patients were in the age-group of 18–28 years, 16 in 29–38 years, 12 in 39–48 years, and 8 in 49–58 years.

Periotest is intended to assess tooth mobility through detecting the damping capacity of periodontal ligament at first time. The structure of periotest is a hand piece with a built-in metal slug. Periotest calculates the time needed for the tapping head to create contact with the tooth with an accelerometer. The software on the instrument correlates the contact time with tooth mobility. The periotest scores vary from −8 to +50.16. The lower values represent more rigidity. It is affected by both implant size and bone quality.[9]

Oh et al.[13] evaluated the utility of periotest and Osstell Mentor in assessing implant stability on four dogs. PTVs and implant stability quotient (ISQ) were measured at the time of implantation and at 3 and 6 weeks after implantation. The PTV score was inferior, and ISQ score was superior at six weeks. The PTVs of the maxilla were superior to the mandible, and the ISQ values of the maxilla were inferior to the mandible. Based on the new peri-implant bone formation rate (NBFR), the 6-week group illustrated superior bone deposition in contrast to the 3-week group. The NBFR was superior in the maxilla in comparison to the mandible. There was no considerable disparity among PTV and ISQ when compared to NBFR.

We found that maximum patients (12) had 13 × 4.2 mm dental implants followed by 13 × 4.2 mm implants (10), 11.5 × 4.2 mm implants (8), and 13 × 3.5 mm (8) implants. Kastala et al. has divided 17 patients into two groups based on the implant type. The primary implant firmness was calculated at the time of implant insertion, and secondary stability was calculated at 3–4 months via RFA device OSSTELL ISQ. There was no statistically significant difference in primary and secondary stabilities. Among mesiodistal stability and implant diameter in MIS seven groups, a positive relationship was p value < 0.05.[14]

Bilhan et al. and Khalaila et al. assessed the reliability of periotest in measuring implant stability, and they concluded that the periotest has an admirable intra- and interobserver reliability in checking implant stability similar to our results.[15,16] Al-Jetail et al. evaluated the efficacy of Osstell™ and periotest in detecting implant stability, and they found that both systems are proving to be sensitive in diagnosing the implant stability.[17]

We observed that there was an unconstructive association between the implant length and the mean periotest value. We found that implant stability increases as implant length increases, although this was not statistically significant. We also noticed that, at placement, maximum periotest value (−0.11) was seen with implant diameter of 3.0 mm, and minimum value (−0.42) was seen with implant diameter of 3.5 mm. Lowest value of −0.58 was observed in the implant having a smallest diameter of 3.0 mm after 1 year. There was a negative correlation between implant diameter and the mean periotest value. We found that, at placement, each implant had maximum stability at the time of insertion, and as the time passes, the stability of dental implants decreases. The main cause of tooth loss in the present study was poor oral hygiene and nonrestorable teeth due to caries. Obagbemiro et al. also demonstrated a negative correlation among the implant length, diameter, and the mean periotest values. There was a directly proportional relationship between implant quality and implant stability.[18]

Lagdive et al. compared 10 two-stage implants of Life Care and Nobel Biocare dental implants in 20 patients. Implant stability was evaluated through the use of the periotest instrument after 4 months of implant placement, and it was observed that the smooth polished collar design of the implant resulted in the crestal bone loss.[19] Truhlar et al. suggested that the periotest is useful in evaluating the status of osseo-integration at second-stage surgery and found that mean periotest values were −3.82 ± 3.04 for type I bone, −3.70 ± 3.06 for type II bone, −3.31 ± 3.18 for type III bone, and −1.29 ± 3.57 for type IV bone.[20]

This study is helpful, since we utilized the periotest in evaluating the stability of immediate-loaded single implant with respect to diameter and length. It was concluded that the periotest is a reproducible and useful method for checking implant stability. There was greatest implant stability in long implants with greatest diameter. The drawback of the present study is small sample size. Different shaped implants were not considered in the study.

Conclusion

The authors found that there was maximum implant stability in long implants with maximum diameter. periotest can be utilized for assessing dental implant stability.

References

1. Sun HL, Wu YR, Huang C, et al. Failure rates of short (≤10 mm) dental implants and factors influencing their failure: a systematic review. Int J Oral Maxillofac Implants 2011;26(4):816–825.
2. Negm SA. Implant success vs implant survival. J Dent 2016;6(2):1–5. DOI: 10.4172/2161-1122.1000359.
3. Shukla S, Chug A, Mahesh L, et al. Implant design influencing implant success: a review. Int J Dent Res Develop 2016;4(6):39–48.
4. Bhandari MA, Vats N. Effect of surface design and morphology on primary stability of dental implant: a systematic review. EC Den Sci 2019. 401–409.
5. Abuhussein H, Pagni G, Rebaudi A, et al. The effect of thread pattern upon implant osseointegration. Clin Oral Impl Res 2010;21(2):129–136.
6. Rokn A, Ghahroudi AR, Mesgarzadeh A, et al. Evaluation of stability changes in tapered and parallel wall implants: a human clinical trial. J Dent (Tehran) 2011;8(4):186–200.
7. Lorenzoni M, Pertl C, Zhang K, et al. Immediate loading of single-tooth implants in the anterior maxilla. preliminary results after one year. Clin Oral Implants Res 2003;14(2):180–187. DOI: 10.1034/j.1600-0501.2003.140207.x.
8. Turkyilmaz I, Mc Glumphy EA. Influence of bone density on implant stability parameters and implant success: a retrospective clinical study. BMC Oral Health 2008;8:32. DOI: 10.1186/1472-6831-8-32.
9. Cranin AN, DeGrado J, Kaufman M, et al. Evaluation of the periotest as a diagnostic tool for dental implants. J Oral Implantol 1998;24(3):139–146. DOI: 10.1563/1548-1336(1998)024<0139:EOTPAA>2.3.CO;2.
10. Gupta RK, Padmanabhan TV. An evaluation of the resonance frequency analysis device: examiner reliability and repeatability of readings. J Oral Implantol 2013;39(6):704–707. DOI: 10.1563/AAID-JOI-D-11-00099.
11. Sachdeva A, Dhawan P, Sindwani S. Assessment of implant stability: methods and recent advances. Brit J Med Med Res 2016;12(3):1–10. DOI: 10.9734/BJMMR/2016/21877.
12. Pimentel Lopes de Oliveira GJ, Leite FC, Pontes AE, et al. Comparison of the primary and secondary stability of implants with anodized surfaces and implants treated by acids: a split-mouth randomized controlled clinical trial. Int J Oral Maxillofac Implants 2016;31(1):186–190. DOI: 10.11607/jomi.4212.
13. Oh JS, Kim SG, Lim SC, et al. A comparative study of two noninvasive techniques to evaluate implant stability: periotest and Osstell mentor. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2009;107(4):513–518. DOI: 10.1016/j.tripleo.2008.08.026.
14. Kastala VH, Ramoji Rao MV. Comparative evaluation of implant stability in two different implant systems at baseline and 3–4 months intervals using RFA device (OSSTELL ISQ). Indian J Dent Res 2019;30(5):678–686. DOI: 10.4103/ijdr.IJDR_446_17.
15. Bilhan H, Cilingir A, Bural C, et al. The evaluation of the reliability of periotest for implant stability measurements: an *in Vitro* study. J Oral Implantol 2015;41(4):e90–e95. DOI: 10.1563/AAID-JOI-D-13-00303.
16. Khalaila W, Nasser M, Ormianer Z. Evaluation of the relationship between Periotest values, marginal bone loss, and stability of single dental implants: a 3-year prospective study. J Prosthet Dent 2019;S0022–3913(19):30587. DOI: 10.1016/j.prosdent.2019.08.023.
17. Al-Jetail S, Al-dosari AA. Assessment of Osstell™ and Periotest® systems in measuring dental implant stability (*in vitro* study). Saudi Dent J 2011;23(1):17–21. DOI: 10.1016/j.sdentj.2010.09.003.
18. Obagbemiro KO, Ajayi YO, Akeredolu PA, et al. The effect of implant characteristics on the implant stability of immediately loaded single implant cases: a prospective study. J Dent Implant 2018;8(2):48–53. DOI: 10.4103/jdi.jdi_12_18.
19. Lagdive SB, Lagdive SS. Comparison of implant stability before prosthetic loading of two dental implant systems. J Indian Prosthodont Soc 2013;13(4):450–454. DOI: 10.1007/s13191-012-0248-0.
20. Truhlar RS, Morris HF, Ochi S, et al. Assessment of implant mobility at second stage surgery with the Periotest: DICRG interim report no. Implant Dent 1994;3(3):153–156. DOI: 10.1097/00008505-199409000-00002.