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# Clinical Evaluation of Primary Stability and Osseointegration of Endosseous Root Form Implants of Different Dimensions Using Periotest

KEYWORDS: endosseous implants, osseointegration, periotest, percussion methods, primary implant stability

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**ABSTRACT** *Introduction: The primary implant stability at implant placement is a mechanical phenomenon related to the quality and quantity of bone at the recipient site, the type and design of implant used and the surgical technique employed.*
*Aims and objectives: To clinically evaluate and compare the primary stability of a commercially available implant system using Periotest and percussion methods. To evaluate and compare the primary stability achieved at baseline with the osseointegration at the second stage surgery (90 days) and at the time of prosthesis delivery (120 days).*
*Materials and Methods: A total of twenty implants were placed in ten systemically healthy subjects, in the age range of 25-45 years, who presented with missing mandibular anterior teeth from lower right first premolar to lower left first premolar. Two stage rootform hydroxyapetite coated, pure titanium endosseous implants of diameter 3.3mm and implant length of 10mm & 13mm were placed. Subjects with sufficient alveolar bone volume at the implant site of > 5.5mm width labiolingually, 15mm height and type I and type II bone quality were divided into two groups depending on the length of implant placed: Group A (10mm) and Group B (13mm) . Complete blood investigation were done. Diagnostic intraoral and panoramic radiographs were taken and bone mapping was done. The Periotest values were recorded at baseline, after 90 days and 120 days.*
*Results: The mean periotest values (PTv) of both the groups were statistically significant, indicating significant primary stability. On comparison between the two groups, the PTv in Group B were highly significant, indicating that primary stability of implant increases with increase in implant length.*
*Conclusion: Primary stability of an implant is better in longer implants. The primary stability of implant is high on the day of placement, decreases by the second and third month and increases again after three months.*

**Introduction:**
The use of endosseous implants to restore lost dentition has proved to be a successful treatment modality, providing the patient with a near natural replacement. The undisturbed and unloaded healing of the bone surrounding the implants for a specified period of time prior to prosthesis application is widely accepted.1

The most important prerequisite for loading of implant is the achievement and maintenance of high primary implant stability. The primary implant stability at placement is a mechanical phenomenon related to the quality and quantity of bone at the recipient site, the type and design of implant used and the surgical technique employed. 2

To evaluate the initial bone quality and the degree of osseointegration various methods have been used. These include histologic and histomorphometric observations, percussion tests, removable torque analysis, resonance frequency analyser and pull and push through tests. The limitations exhibited by these traditional methods led to the development of one more non-destructive and non-invasive technique to evaluate the condition of implant-tissue interface by use of an electronic percussive testing device, Periotest. 3 This technique has been widely used in medical research and is accepted as a parameter for the early assessment of the implant bone interface.

The present study was conducted to clinically evaluate the primary stability of a commercially available implant system using a Periotest and percussion methods. The primary stability achieved at baseline was compared with the osseointegration at the second stage surgery (90 days) and at the time of prosthesis delivery (120 days).

**Materials and methods:**
Subjects for this study were selected from the out-patient department of periodontics. Ten subjects in the age range from 25 - 45 years were included. Subjects with acute inflammatory conditions, systemic diseases, parafunctional habits like nail-biting, bruxism, bone disorders like osteoporosis, arthritis, pregnant women, those using oral contraceptives, or any other medications and smokers were excluded. The study was approved by ethics board. All subjects signed the informed consent forms.

Twenty implants were placed in ten subjects who presented with missing mandibular anterior teeth from lower right first premolar to lower left first premolar of six months duration. Two stage rootform hydroxyapetite coated, pure titanium endosseous implants of diameter 3.3mm and implant length of 10mm & 13mm were selected to be placed. Subjects with sufficient alveolar bone volume at the implant site of > 5.5mm width labiolingually, 15mm height and type I and type II bone quality were divided into two groups depending on the length of implant placed: Group A (10mm) and Group B (13mm) . Complete blood investigation were done. Preliminary treatment planning was done using diagnostic casts and surgical and prosthetic stent was fabricated to indicate incisal edge position of the final restoration and help determine proper implant location and angulation. Diagnostic intraoral and panoramic radiographs were taken and bone mapping was done.

Initial periodontal therapy consisted of education & motivation and oral hygiene instructions. Plaque control was assessed for each subject prior to surgical phase. The surgical procedure was performed under local anesthesia with 2% lignocaine. Crestal incision was placed extending to the first molar on either side. Full thickness mucoperiosteal flaps were reflected. Osteoplasty of the crest of the ridge was done using a bone rongeur and a high-torque handpiece with surgical bur under copious cooled saline irrigation untill 5mm bone width was obtained. After marking the implant

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site by surgical stent using a round bur, a 2mm pilot drill was used followed by 2.8mm twist drill, which is the final drill for 3.3mm diameter implant. The depth of the osteotomy was 10mm on one side and 13mm on the opposite side. The implant was placed, followed by placement of cover-screw. Implant stability was checked with the help of a Periotest instrument. The Periotest handpiece sleeve was kept horizontally at right angle to the long axis of the implant, activated and readings noted. The range of Periotest values (PTv) is _8 to +50. Negative values are indicative of good stability and osseointegration.

A percussion test was also done, which is based upon vibrational acoustic science and impact response theory to estimate the level of stability and osseointegration. A clinical judgement on osseointegration was made based upon the sound heard on percussion with a metallic instrument. A clearly ringing crystal sound indicated osseointegration and a dull sound indicated no osseointegration.

The flap was closed with 3-0 vicryl interrupted sutures to achieve tight closure. The patient was prescribed antibiotics (amoxycillin 500mg thrice daily for 5days) and analgesics (ibuprofen thrice daily for 3days). Digital Orthopantomograph (OPG) and Intraoral periapical radiograph (IOPA) were taken on the day of implant placement. Sutures were removed after one week. Patient was kept on periodic review.

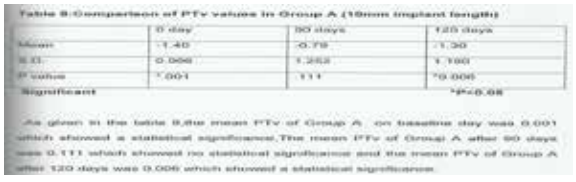
After three months (90days) of implant placement, the implant was uncovered. Stability was evaluated by Periotest and percussion test. Titanium abutments were screwed on to the implants. The male part of the abutment was screwed on to the implants. while the female part was embedded in the denture with cold cure acrylic. The denture delivery was done.

After 120 days, the stability was rechecked using the Periotest and the percussion test.

The results were tabulated and analyzed statistically.

**Results:**
The Periotest values and percussion test observations were recorded at baseline, after 90 days and 120 days. The paired t-test was used for statistical analysis. The mean PTv of Group A on baseline day was 0.001, which showed statistical significance. The mean PTv of Group A after 90 days was 0.111 which showed no statistical significance and the mean PTv of Group A after 120 days was 0.006 which showed statistical significance (Table 1).

**Table 1: Mean PTv values in Group A (10mm implant length)**



The mean PTv of Group B on baseline day, after 90 days and after 120 days was 0.000, which showed statistical significance (Table 2).

**Table 2 : Mean PTv values in Group B (13mm implant length)**

The mean PTv of Group A and Group B on baseline day, after 90 days and after 120 days was less than 0.05, which showed statistical significance. However the significance level was higher in Group B. Thus indicating that the primary stability of Group B was greater than Group A (Table 2).

The percussion method is not based on numerical data but only attribute data. Ringing suggested good osseointegration and dull suggested no osseointegration. The data obtained was represented in two-way table (Table 3). There is no significant difference in proportion of dull sound in non-osseointegrated implants of 10mm and 13mm length. The proportion of dull sound is higher in 10mm implant length than in 13mm implant length. The data suggested that 13mm length implants were better osseointegrated than 10mm length implants.

**Table 3: Two way table**

**Discussion:**
Bone quality has been described as an important predictor for the outcome of dental implant treatment. 4 Primary stability of the implant refers to the rigid fixation within the host bone cavity and absence of micromotion. The mineral bone density has significant influence on primary stability of dental implants. There is a positive association between implant primary stability and bone mineral density of the receptor site. [5]

Implant stability is considered to play a major role in the success of osseointegration. Primary implant stability at placement is a mechanical phenomenon that is related to the local bone quality and quantity, the type of implant and placement technique used. Secondary implant stability is the increase in stability attributable to bone formation and remodeling at the implant/tissue interface and in the surrounding bone. [6]

Techniques for measuring implant stability and osseointegration include; the clinical measurement of cutting resistance during implant placement and removal torque following osseointegration. Nondestructive test methods include impact based techniques such as the Periotest, the Dental Fine Tester and Resonance Frequency Analysis. [6] The Periotest has the advantage of offering reproducible findings by measuring the levels of subclinical mobility using as ultrasonically vibrating probe. The Periotest is successful in assessing the stability status of an implant. 7 It is used to evaluate the mobility of natural teeth and is claimed to be potentially reliable in assessing the stability of the implant-bone interface.[8]

The physiology of bone healing associated with endosseous implant suggests that this process occurs between 8 and 12months, and Periotest values (PTvs) tend to reflect changes in the stability of the bone-implant interface. Stability generally increases gradually from the time of uncovering to an optimal PTv that occurs at a point close to 12months. [9]

Negative PTvs are recorded (1) as implant length and diameter increased, (2) as bone density increased, (3) in certain jaw regions, (4) as the number of implants/case increased, (5) for implants stable at placement. [9]

The present study evaluated the primary stability of a commercially available implant system using a Periotest and percussion methods. It was observed that wider diameter implants have a better primary stability and osseointegrate better than smaller diameter implants as the bone implant surface contact is better in the former.

In this study on the baseline day (the day of implant insertion), after 90 days (on the day of uncovering the implant) and after

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120 days (before prosthetically loading the implant), the mean PTv were assessed. These values denoted significant implant stability and osseointegration. It was observed that the stability increased as the implant length increased.

In case of a narrow ridge where implant diameter has to be comprised a longer implant would provide a better primary stability than a shorter implant. In this study the primary stability of 13mm implant was better than that of 10mm implant.

Moreover, the primary stability of the endosseous dental implant is high on the day of implant placement, decreases by the second and third month and increases again after three months. On performing the percussion test, the dull sound indicated a non-osseointegrated implant and a ringing sound indicated an osseointegrated implants. The proportion of the dull sound was higher in the 10mm implant than in the 13mm implant, indicating that increase in length increases the stability of the implant.

The Periotest can be used as a nondestructive diagnostic aid in the detection of primary implant stability.[10] The Periotest values of a dental implant is an objective and easily applied criterion for stability assessment. It seems to be useful in the long term follow-up of implant integration.

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