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ORIGINAL ARTICLE

Comparison of Implant Stability Before Prosthetic Loading of Two Dental Implant Systems

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Abstract Dental implantology is the state of the art technique to replace missing teeth. Implant stability of implant jeopardizes its longevity and success of treatment. This study evaluates the implant stability of implant before and after 4 months of the implant placement, but before prosthetically loading it. Ten two-stage implants of Life care and Nobel Biocare dental implants were placed in 20 patients. Digital OPG was taken on the day of implant placement. After 4 months, at the time of second stage surgery, the implant stability was evaluated by the Periotest instrument. Four months after the implant placement, Periotest evaluation showed a mean of 1.9, which indicated that implants were well osseointegrated and stable. Even before prosthetically loading the two-stage implant, crestal bone loss of 0.6–0.9 mm occurred around the implant. The smooth polished collar design of the implant may have contributed to crestal bone loss.

Keywords Implants · Collar design · Crestal bone loss · Periotest

Introduction

Various methods of replacing missing single or multiple teeth, have been developed. Endosseous implants have come up in a big way to resolve this problem. It has become an acceptable alternative to the traditional prosthodontic treatment.

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Branemark's [1] studies of over 15 years with 90 % success, as reported in Toronto conference in 1982, initiated the present breakthrough in implantology. Many implant designs have been developed by various companies to achieve greater degree of osseointegration. One of the major concerns has been the amount of crestal bone loss along the implant surface, as it jeopardizes the longevity and success of the implant prosthesis. Crestal bone loss has been attributed to implant design, local bacterial colonization, biological width and mechanical stresses acting on the crestal bone around the implant.

Various implant crest modules or neck collar designs are being studied and proposed to reduce crestal bone loss. Many of the implant systems have a polished collar design to aid in reducing plaque accumulation and to promote biologic seal around the implant collar. Such collar design may itself be contributory to crestal bone loss. Prosthetic loading of implant may aggravate the crestal bone loss, initially.

Keeping this in mind, a study was undertaken to evaluate implant stability occurring before prosthetic loading of two dental implant systems 4 months after the implant placement. [2–4].

Purpose of the Study

To compare the implant stability before prosthetic loading of two dental implant systems.

Aims and Objectives

1. To determine the implant stability before prosthetic loading of EZ implant.
2. To determine the implant stability before prosthetic loading of replace select implant.

3. To compare the implant stability before prosthetic loading of two dental implant systems.

Selection Criterias

Inclusion criterias:

1. Patients with age between 25 and 35 years.
2. Patients who are medically fit, with no systemic diseases and can come for regular postoperative follow up.
3. Subjects with adequate bone support for implant placement.
4. Implant placed in mandibular posterior region (36 or 46).
5. Patients with overall good periodontal condition.

Exclusion criterias:

1. Patients with any periapical and oral pathological conditions.
2. Patients who have undergone corticosteroid therapy.
3. Patients with osteoporosis or any other bone disorders.
4. Pregnant woman.
5. Patients with smoking habit.

Materials and Methods

1. Life care dental implant system (System-A, EZ Implant).
2. Nobel Biocare dental implant system (System-B, Replace Select).
3. Periotest instrument (Periotest S 3218 Medizintechnik Gulden).

Method

Twenty dentate subjects with one or two missing teeth were selected (Fig. 1). The study procedure was explained to the subjects with prior consent of the subjects the study will be further conducted.

The implant size was selected by using the manufacturer's X-ray indicator stencil on Digital OPG, CT-Scan and study casts. Patient was prepared for surgery under local anaesthesia. Crestal incision was given for full thickness flap reflection, to expose the implant site. After marking the implant site by surgical stent pilot drill was used, followed by twist drill, 2-caliber and final drill up to the decided depth and diameter. Under internal and external coolant though physiodispenser. The implants were inserted first by using finger key, followed by cardanic ratchet key with proper torque.

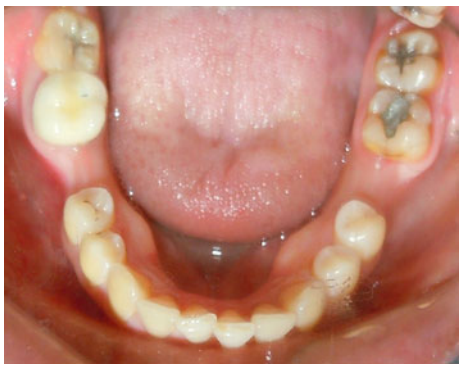

Fig. 1 Preoperative intra oral photograph showing missing teeth in posterior region

The implants were placed at the level of alveolar crest. A cover screw was placed to close the opened implant site. The flap was closed with tight sutures to achieve watertight closure. The patient was prescribed antibiotics and analgesics for 1 week, post-operatively. Digital OPG X-ray was taken. Check up visits and post operative instructions given (Fig. 2).

All necessary investigations before implant placement was carried out. Ten EZ implants were placed using life care dental implant system by following proper manufacturer's instructions and other ten replace select implants were placed using Nobel Biocare dental implant system by following proper manufacturer's instructions.

Implant stability was measured by Periotest instrument immediately after implant placement and 4 months after

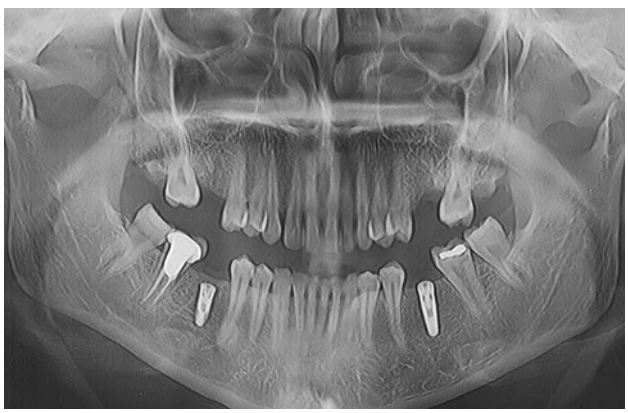

Fig. 2 Orthopantomograph showing Life care and Noble Biocare implant placed in 46 and 36 region respectively

implant placement with implant mount in place [2–4]. The readings were correlated with a grading scale provided by manufactures of Periotest instrument (Fig. 3).

All readings were filled in the proforma for the study as given below and results were analyzed (Tables 1, 2).

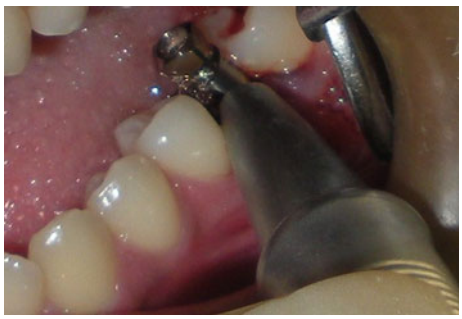

Fig. 3 Periotest handpiece in place to measure stability value

Table 1 Periotest values for system-A

Sr.no.	Patients	Implant size	Implant site	A	B
1.	A	3.75 × 11.5	36	0	−2
2.	B	4.2 × 13	36	1	−2
3.	C	3.3 × 13	33	0	−4
4.	D	3.75 × 13	34	2	−3
5.	E	4.2 × 13	35	1	−4
6.	F	3.75 × 13	45	1	−3
7.	G	3.75 × 13	46	1	−3
8.	H	4.2 × 11.5	46	3	+1
9.	I	4.2 × 11.5	36	0	−2
10.	J	3.75 × 13	36	3	+1

A—Periotest value immediately after placement, B—Periotest value after 4 months

Table 2 Periotest values for system-B

Sr.no.	Patients	Implant size	Implant site	A	B
1.	A	4.3 × 13	36	0	−2
2.	B	4.3 × 13	36	+3	+1
3.	C	4.3 × 13	46	1	−2
4.	D	4.3 × 13	46	1	−2
5.	E	4.3 × 16	36	1	−3
6.	F	4.3 × 13	36	1	−3
7.	G	4.3 × 16	36	1	−3
8.	H	4.3 × 10	46	0	+1
9.	I	4.3 × 10	36	0	−3
10.	J	4.3 × 10	36	2	−3

A—Periotest value immediately after placement, B—Periotest value after 4 months

Results

Four months after surgical implant placement, implant stability and degree of osseointegration was evaluated by using Periotest. The readings observed of the Periotest value as shown in Table 3 and (Fig. 4). The average Periotest value was −1.9, which denotes substantial stability and degree of osseointegration. The range of Periotest values was −8 to −1. Negative readings denote higher stiffness and higher degree of osseointegration. Four months after the implant placement, Periotest evaluation showed a mean of −1.9 for system-A and mean of −2.1 for system-B, which indicated that implants were well osseointegrated and stable (Fig. 5).

Discussion

Considerable scientific evidence exists, demonstrating the long term success of osseointegrated implants according to the biologic principals proposed by Branemark [5]. Branemark's [5] protocol recommends the complete healing of the alveolar bone before placing an implant after tooth extraction; requires waiting period of 6–12 months. Evidence exists that about 45 % [6, 7] or even more of the alveolar crest may be lost as a consequence of bone resorption, with the majority of resorption occurs in first 6 months after extraction. The loss of alveolar bone volume may induce the clinician to perform a ridge augmentation procedures or place a short length implants. Both these procedures have been reported to be associated with a less favourable long term clinical success rate [5].

Periapical and panoramic radiographs are the most frequently used imaging modalities in implant dentistry, are proposed based on the clinical needs [8–10].

Ramp and Jeffcoat [2] hypothesized that osseointegration can be quantified by sensing the mechanical impedance (mobility) of the implant. To test this hypothesis, a total of 24 identical were placed in the mandible and allowed heal for 3 months. Manual percussion and mobility tests were performed. The author concluded that, typically, successfully functioning implant are immobile and exhibit a clear, ringing sound when percussed, while failing implants tend to be mobile and elicit a dull sound. The use of these clinical parameters to evaluate the clinical success and failure of implant is well established in the literatures [2].

In the present study all the 20 implants, exhibited typical 'Crystal ringing sound' on percussion, immediately after the placement of implant and 4th month post-operatively and mobility was measured by Periotest instrument. The mobility of the implant, immediately after the placement of implant and 4th month post-operatively was absent. These

Table 3 Comparison of Periotest values for system-A and system-B immediately after placement and after 4 months

$n = 10$	Implant stability				
	System-A Mean ± SD	System-B Mean ± SD	Student's unpaired t test value	p value	Significance
A—Periotest value immediately after placement	1.20 ± 1.13	1.00 ± 0.94	0.43	$p > 0.05$	Not significant
B—Periotest value after 4 months	−2.10 ± 1.79	−1.90 ± 1.59	0.26	$p > 0.05$	Not significant

By applying Student's unpaired t test there is no significant difference between mean values of implant stability Periotest value immediately after placement and Periotest value after 4 months in Life care implants and Noble Biocare implants (i.e. $p > 0.05$)

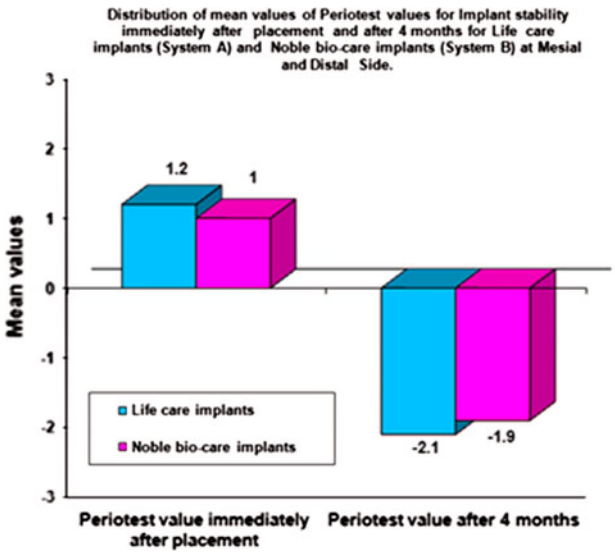

Fig. 4 Mean graph

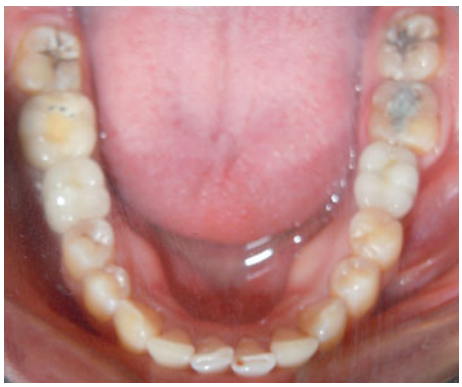

Fig. 5 Well osseointegrated and stable implant in function (postoperative)

data are in compatible to the previous literatures [2] which described that the co-relation exists between the osseointegration and mobility and percussion test.

This study was undertaken to observe the implant stability and the amount of crestal bone loss, occurring at the end of 4 months after placing the implants, before loading it prosthetically. There is a direct correlation between implant stability and crestal bone loss. Greater the crestal bone loss, lesser the implant stability. The implants used in this study were two-stage, root-form, threaded implants i.e. EZ implants and replace select implants were placed. Implants were made of pure Titanium with TPS coating, except at the collar region of the crest module. The crest module collar had 2 mm of smooth polished parallel surface.

The implant stability was measured by Periotest instrument. Periotest was described by Schulte [2]. It measures the dampening effect against objects by a percussion rod that is electronically guided by a microcomputer. A force of 12–18 N is developed on a piston rod that impacts an implant, 04 times per second for 04 times (16 impacts). The more stable the implant, the quicker the percussion rod rebounds back in the handpiece.

The microcomputer calculates the time that the rod is in contact with the implant and converts it into Periotest value readings. These values range from −8 to +50 numbers. Negative values indicate that the implant is stable and well osseointegrated. A study conducted by Truhlar et al. [11] and Misch [12] found that the Periotest instrument is capable of assessing implant stability.

In this study, at the end of 4 months after implant placement and before prosthetic loading, the average value of Periotest for Life care system was −2.1 and for Noble Biocare system −1.9. These values denote significant implant stability and osseointegration.

The radiographic evaluation of crestal bone loss was done by digital OPG, with standardized parameters. The resorption of crestal bone around endosseous implants is an area of concern with all available implant systems. There is a lack of agreement on why there is crestal bone loss around the implant neck, that too more, during the 1st year of implant service. Various authors have suggested reasons for it. The implant crest module design of the neck influences the amount of crestal bone loss.

The smooth polished machined collar of the implant is meant to reduce plaque accumulation and is not a load-bearing zone. The cortical bone is stronger to compressive stresses and weaker to shear stresses. A smooth collar does not transfer compressive stresses, but results in shear stresses to the crestal bone, which results in lack of mechanical loading and stimulation. This lack of stimulation results in

bone loss. The implants used in this study EZ implant had 1.5 mm of smooth polished collar design with micro threads, replace select had 1.5 mm smooth collar without micro threads. The junction of smooth collar and rough TPS coated threaded portion lies about 2 mm below the crest of bone at the time of implant placement, as the implants were placed at the level of crest. Thus, the smooth collar design may account for the initial crestal bone loss, even before loading the implant.

Conclusion and Summary

A study was undertaken to evaluate implant stability occurring 4 months after implant placement in two implant systems, before loading it. Even before loading, the crestal bone loss occurred around implant. More stress should be given on developing implant collar design to reduce the initial crestal bone loss.

The limitation of the present study was that the sample size was small consisting of 20 patients and the 4 month post operative follow up is a short duration, hence a study with a large sample size with longer follow up time period is required to analyze the results.

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Conflict of interest None.

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