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ORIGINAL RESEARCH

Objective Assessment of Implants Stability placed in Fresh Extraction Socket using Periotest Device

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ABSTRACT

Objective: To present our experience of using periotest (PT) device for measuring implant stability in immediate implants placed in fresh extraction sockets.

Materials and methods: We used a PT device to measure for 10 implants placed in 10 patients over a period of 18 months. All the implants were placed immediately after extraction. The minimum follow-up period was 6 months with PT readings taken at 4th, 5th and 6th months (stage I) and after restoration at 7th, 8th and 9th months.

Results: Negative values are generally considered good. This means the implant is well osseointegrated and can be loaded. The PT values for the maxillary tooth were lower than those for the mandibular tooth. A stable mandibular implant presents PT value readings between –2 and +2. A stable maxillary implant presents PT value reading between –4 and –2.

Conclusion: PT enables us to assess osseointegration noninvasively and objectively in any situation. PT helps us to optimize our decision whether or not an implant is ready for functional loading.

Keywords: Immediate implant, Periotest, Implant stability.

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INTRODUCTION

Immediate implants were first clinically described by Shulte and Heimke (Shulte W et al; 1970) and were later confirmed by histological data[1] (Krump JL et al; 1991, Barzilay et al; 1991). The main criteria in immediate implant placement is primary stability. This primary stability can be achieved by engaging the implant 2 to 3 mm beyond the apex of extraction socket. Stability is essential for optimal oral implant function. Osseointegration must be verified at the moment the transmucosal abutments are connected to the endosseous fixtures and before fabricating the prosthesis. Osseointegration is basically a histological concept and only partially clinical and radiological. Several studies have shown that this process consists of a gradual increase in the amount of bone in direct contact with the implant surface overtime. The quantity and quality of bone formed at the interface is of utmost importance in determining the holding power of an implant. It can prove difficult to clinically evaluate the state of implant integration only by manual testing of mobility or use of radiology. But the question that remained unanswered was, is there any quantifiable indication as to when an implant is stable enough to load? Is there a method by which we can assess the course of the bone integration process noninvasively and objectively? We believe that periotest (PT) may be the answer. An advanced yet easy to use technology. PT can allow dentist to optimize their decision whether or not an implant is ready for functional loading.

PT PRINCIPLE

In this study, we examined reliability of assessing implant stability with PT. PT is a dental measuring instrument used for assessment of osseointegration of dental implants. The PT scale ranges from –8 to +5. The lower the value, the greater the stability/dampening effect of the measured implant. The PT method was developed by Schulte[2] and coworkers at the university of Tubingen and has been described by d'Hoedt et al.[3] These authors state that the PT dynamically measures the reaction of the periodontium to a defined impact load. Being accurate and reproducible, and having a small long-term drift, the PT value indicates periodontal damping and correlates closely to clinical mobility of the tooth.[4] The underlying design principle of PT function is as follows, an electrically controlled rod weighing 8 g taps the implant four times per second at a constant speed. The rod is decelerated when it touches the implant. The greater the implant solidity, the higher the deceleration and thus the higher the dampening effect of the surrounding tissues. After tapping the spot, the rod recoils. A faster recoil indicates increased damping. The contact time per impact between the rod and the tooth or implant lies in the range of a millisecond and represents the real measuring parameter. In practice, the method does not use the measured contact time in milliseconds as values, but is based on a numerical scale ranging from –8 to +50, determined by mathematical calculation. PT measurements were made after 4th month with abutment connection.

PT value range	Interpretation
–8 to 0	Good osseointegration, the implant is well osseointegrated and can be loaded
1 to 9	Clinical examination is required; in most cases, implant loading is not yet possible
10 to 50	Osseointegration is insufficient, implant must not be loaded
Interpretation of the PT values	
PT – 0	Negative values are generally good The implant is well osseointegrated
PT – 0 to 9	Clinical examination is necessary, e.g. the values measured in the posterior mandible are generally lower than in the maxilla
PT ± 10	Suspicious—alarming

MATERIALS AND METHODS

In the Department of Oral and Maxillofacial Surgery at Santosh Dental College and Hospital NCR, Delhi, we measured PT values for 10 implants placed in 10 patients over a period of 18 months. All the implants were placed immediately after extraction. In all, six immediate implants were placed in maxilla and four implants were placed in mandible. The minimum follow-up period was 6 months with PT value taken at the 4th, 5th, 6th months (stage I) and after prosthesis 7th, 8th and 9th months.

Criteria for the Selection of the Patients

A. The inclusion criteria for selection of patients: The patients were of 20 to 60 years of age, tooth fracture or avulsion of the tooth following trauma, all those cases of a recurrent failure of endodontic therapy, patients with failed transplant tooth surgery, external root resorption, any chronic inflammatory periodontal disease.
B. The exclusion criteria:
   a. *Systemic factors*: Heavy smokers, blood dyscrasias, tobacco chewers, drug abusers (addicts), psychiatric individuals with disorders, immunocompromised candidates, uncontrolled diabetes mellitus (DM), alcoholics (chronic alcohol taking patients).
   b. *Local factors*: Insufficient interarch distance, unfavorable implant axis orientation, inadequate bone apical to proposed extraction, acute periapical pathology at the site of extraction.

HOW PT WORKS?

In 1997, Medizintechnik Gulden acquired from Siemens AG exclusive rights for the manufacture and sale of PT device used in this study. Advance the handpiece as horizontally as possible (± 20°) and in a right angle to the center toward the implant to be examined. Deviations from (Fig. 4) perpendicularity might result in a slightly minor PT value (–1). The maximum deviation angle from the orthoradial direction of percussion is 45°. Always take the measurement with the patient sitting upright (standard position) or lying position. Multiple measurements on a patient should always be taken in the same direction of percussion and position of the patient. During the measurement, the sleeve of the handpiece should not touch the tooth/implant. The valid distance between the handpiece and the tooth/implant extends from 0.7 to 2.0 mm. After tapping the implant/tooth PT value is generated and shown on display. Six consecutive measurements were recorded after the correct placement of the abutment on the implant. The series of six measurements for each implant were taken. The mean was calculated and rounded off to the closest number.

SURGICAL PROTOCOL

A strict asepsis protocol was observed. The oral cavity was cleaned with Betadine solution and the surgical field was isolated with sterile gauze to prevent bacterial and saliva contamination.

After obtaining informed consent all procedures were performed under local anesthesia, teeth were extracted atraumatically. An aseptic surgical technique was utilized.

OBSERVATIONS AND RESULTS

Table 1 indicates the site and etiology of teeth loss , while evaluating we found that 40% of our cases were due to retained roots, 40% due to failed endodontics, 10% due to trauma and 10% due to caries This also shows us the sites of implants placement 80% in maxilla and 20% in mandible. In all the cases the PT values were obtained after the 4th month postinsertion. Table 2 shows the PT values after 4th,

Table 1: Site and etiology of tooth loss

Site	Etiology			
	Caries	Trauma	Failed endodontic	Root stump
Maxilla				
Central incisor	0	1	1	3
Lateral incisor	0	0	1	0
Canine	0	0	0	0
Premolar	0	0	1	1
Molar	0	0	0	0
Mandible				
Central incisor	0	0	0	0
Lateral incisor	0	0	0	0
Canine	0	0	0	0
Premolar	0	0	0	0
Molar	1	0	1	0
Total	1	1	4	4

Table 2: Periotest (PT value): Implant placement after stage I surgery (4th, 5th, 6th months)

S. no.	*Site of implant*	*4th month*	*5th month*	*6th month*
1.	Maxillary right central incisor	25 to 27	10 to 12	0 to 10
2.	Maxillary left central incisor	32 to 28	12 to 15	0 to 8
3.	Maxillary left central incisor	28 to 28	8 to 10	0 to 6
4.	Maxillary left central incisor	28 to 30	18 to 18	0 to 8
5.	Maxillary left central incisor	30 to 28	20 to 14	–2 to 10
6.	Maxillary left central and lateral incisor	28 to 24	18 to –14	–2 to –6
7.	Mandibular right first molar	34 to 32	21 to 26	–2 to 10
8.	Mandibular left first molar	30 to 28	20 to 22	–3 to 12
9.	Mandibular left first molar	32 to 28	22 to 24	–2 to 10
10.	Mandibular left second premolar	30 to 28	22 to 12	–2 to 2

Table 3: Periotest (PT value): Evaluation of postloading after stage II (7th, 8th, 9th months)

S.no.	*Site of implant*	*7th month*	*8th month*	*9th month*
1.	Maxillary right central incisor	16 to 18	4 to 8	–4 to –2
2.	Maxillary left central incisor	18 to 20	2 to 6	–2 to –4
3.	Maxillary left central incisor	14 to 8	6 to 4	–2 to 0
4.	Maxillary left central incisor	18 to 16	6 to 4	–2 to 0
5.	Maxillary left central incisor	12 to 10	2 to 6	0 to –1
6.	Maxillary left central and lateral incisor	8 to 12	4 to 8	0 to 1
7.	Mandibular right first molar	14 to 12	6 to 8	0 to 2
8.	Mandibular left first molar	12 to 6	6 to 4	–2 to –3
9.	Mandibular left first molar	10 to 6	6 to 4	–2 to –2
10.	Mandibular left second premolar	18 to 12	8 to 6	2 to 2

5th, 6th months postimplant insertion and Table 3 shows at 7th, 8th, 9th months after restoration. After comparing the PT values of 4th, 5th, 6th months, we have seen that the PT values were decreasing and, i.e the reading was coming in negative values. The PT values for the maxillary teeth were lower than the mandibular teeth which indicates that implant takes longer time in maxilla to osseointegrate as compared to mandible. In all the cases, after a follow-up of 2 years shows a negative value of PT which was quite significant in terms of good osseointegration.

DISCUSSION

Early detection of a failing implant before fabrication of a prosthesis is advantageous to avoid modifications or unnecessary repetitions. PT measurements after second stage surgery may help the clinician to identify failed implants that are borderline (i.e with a very thin fibrous capsule) and those in which digital testing for mobility or intraoral radiology may not be sensitive enough to detect problems. Interfacial osteogenesis is a gradual process, and the recommended healing time of 5 to 6 months for maxillary implants and 3 to 4 months for mandibular implants is an empirical routine based on average results of wide clinical experience. Experiments in rabbits have shown great individual differences in the bone apposition rate at the interface around titanium implants especially during the first 6 months after implant placement.[5] Even in same individual, variations in osteointegration occur from site to site. The results of this investigation appear to indicate that the PT method can be a very useful clinical parameter to identify, after a regular healing period, those implants that despite being immobile are not stable enough for loading. Because of poor bone quality, immature bone, or not enough bone contact at the interface, full loading of these implants would involve a high-risk of load-related failure. On the contrary leaving them temporarily unloaded or subloaded could allow the formation of a mature interface for later use. PT values obtained during or immediately following abutment connection can be valuable in developing prosthetic strategies. If most or all of the implants have high PT values, it would be sensible to remove transepithelial abutments, leaving the fixtures dormant for an additional period of 3 to 6 months.

CASE PRESENTATION (FIGS 1 TO 4)

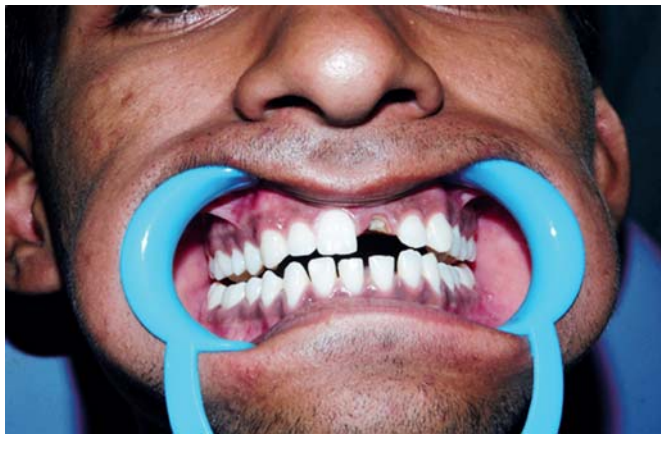

Fig. 1: Preoperative photograph showing root stump of 21

Fig. 2: Preoperative OPG showing angulation of root of 21

Fig. 3: The length (9 mm) of extracted tooth is measured using vernier caliper

Fig. 4: PT being done at 4th month

CONCLUSION

The PT was done in every case in our study and our results coincided with the fact that the PT values for the upper jaw were lower than those for the lower jaw in case of the periimplant bone resorption or in the areas with poor bone quality an increase in the values have been observed (Buser et al 1990b);[6] (Cho 1994 Kim 1995, Truhlar et al 1997, Cramin et al 1988). In majority of cases, the signs of osseointegration were interpreted by PT values after 4 months postinsertion. The first case done in this study was followed for about 2 years, show a negative value which is quite significant in terms of good ossteointeration. PT enables us to assess osseointegration noninvasively and objectively. It helps us to optimize our decision whether or not an implant is ready for functional loading/restoration.

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