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Evaluation of the Implants Primary Stability in Immediate and Delayed Treatment Protocols and the Permissible Teeth Mobility Utilizing Periotest M Device and the Reliability of Manual Teeth Mobility

Shahad A. Mezher Al-Obaidy Maha A. Ahmed

[1] *Department of Periodontics, College of Dentistry, University of Baghdad, Baghdad/Iraq*

Abstract

Aims of the study: To evaluate the difference in primary stability of dental implants measured by Periotest M device between immediate and delayed treatment protocols groups. Evaluate and compare the permissible mobility of teeth corresponding to the DIs with the primary stability of the implants by using Periotest M. Finally, to evaluate the reliability of tooth mobility measurements of corresponding teeth to dental implants by clinical judgment according to Miller`s classification (subjective) with their values utilizing Periotest M (objective).

Materials and Methods: A total of (100) dental implants distributed in (35) males and (45) females, age ranged from (20 – 59) years. The clinical periodontal parameters (Plaque index, Gingival index and Probing pocket depth) were evaluated for (100) corresponding teeth to dental implants. The primary stability of dental implant fixture was measured by Periotest M device.

Results: Statistical analysis showed highly significant differences in mean periotest values of dental implants between immediate and delayed groups, in addition between between dental implants in delayed treatment protocol group with their corresponding teeth, while non -significant difference between dental implants in immediate group and corresponding teeth non-. Non –significant positive correlation between mean Periotest values of teeth with gingival index and plaque index. The reliability (80%) between the grades of manual judgment of teeth mobility with the scores of Periotest values.

Conclusions: Primary implant stability measured by Periotest M device was higher in delayed treatment protocol group than immediate treatment protocol group. There were differences in periotest values between primary implants stability and their corresponding teeth mobility. From the good result of reliability can be depend on Miller`s method to measure tooth mobility as this method is easy, fast and not costly as the Periotest M device.

Keywords: Primary implants stability, treatment protocols, Periotest M, tooth mobility.

INTRODUCTION

Periodontal diseases are divided into two common categories depend on whether there is attachment or bone loss, these are gingivitis and periodontitis **[1]**. Even a tooth with a healthy periodontium is mobile to a certain range, and this mobility is termed as physiological tooth mobility. This mobility depends on biophysical properties of periodontium and the amount of alveolar bone. Evaluation of tooth mobility can be done by using either subjective or objective methods. Subjective assessment of tooth mobility is examiner dependent and subjective to bias **[2]**. Miller **[3]** described the most commonly used clinical method in which the tooth is held firmly between two instruments and moved back and forth. Mobility is scored from (0 to 3). Periotest M device can be reliably used to assess tooth mobility objectively **[2]**. Implant dentistry considered as a progressive development compared to all other dental disciplines especially in the introduction of novel surgical techniques **[4]**. Primary implant stability can be defined as a function of local bone quality and quantity, the geometry of an implant, the placement and surgical technique used, and the precise fit in the host bone. Thus, the main goal after dental implant surgical procedures is represented by reaching a sufficient primary stability that ensures high success rates **[5, 6]**. Implant placement at the time of extraction is an alternative treatment protocol to the original protocol of Branemark which recommends complete healing of the alveolar bone before placing a dental implant after tooth extraction. The immediate placement of dental implant after extraction had comparable survival rates as the delayed placement protocol [7]. Periotest was originally designed to measure the damping characteristics of the periodontium around the natural teeth, but it is used more widely to measure the stability of implants **[8]**. The objectives of the present study were that the Periotest M device was used for the first time in research in Iraq. In addition, to evaluate the reliability of mobility measurements of corresponding teeth to dental implants by manual judgment according to Miller`s classification (subjective) with their values utilizing Periotest M (objective).

MATERIALS AND METHODS

The study human sample included (80) patients indicated for dental implant (DI) treatment who were collected from the attendace to the Dental Implantology Unit / Department of Oral and Maxillofacial Surgery in the Teaching Hospital / College of Dentistry – University of Baghdad, and from Baghdad Smile / Specialized Dental Clinics. A total of (100) dental implants distributed in (35) males and (45) females, age ranged from (20 – 59) years, they divided into two groups according to the types of treatment protocols, group included (40) patients with (50) dental implants in delayed treatment protocol with their (50) corresponding teeth, and second group included (40) patients with (50) dental implants in immediate treatment protocol, with their (50) corresponding teeth, participated in this study.

Inclusion Criteria

Patients who are partially edentulous and requiring bounded tooth replacement by implant in anterior, premolar or molar regions of both jaws.

Patients had natural corresponding tooth to DI with tooth mobility (TM) measured by Periotest value (PTV) in scale range equal to grade (0) manually according to Miller`s classification [9].

Treatment protocols (delayed, immediate) in different implant procedures.

No history of trauma from occlusion.

According to the SAC classification (S=Straightforward, A=Advanced, and C=Complex), [10], Straightforward and Complicated cases, were included for DIs in this research.

No history of orthodontic treatment (for preceding 6 months – 1 year).

Exclusion Criteria

Patients with periodontitis.

Patients with parafunctional or occlusal habits.

Pregnancy women, lactating women and women on menstrual cycle and hormonal contraceptive.

Patients on chronic anti-inflammatory, cytotoxic and anti-microbial medications (for preceding 3 months).

Crown, bridge, orthodontic appliance and partial denture in site of corresponding tooth to DI.

Patients with previous periodontal treatments that may affecting on teeth mobility (for preceding 6 months).

Patients with any systemic diseases that influence on bone healing such as Osteoporosis and diabetes mellitus.

Smokers.

Chronic Alcoholism.

Preoperative assessment and surgical procedure

The participants were informed fully about the purpose and the methods used for the research, what their participation in the research entails and what risks, if any, are involved, and their participation were in a voluntary way. If they decide to take part, they asked to sign a consent form, and even that they were still free to withdraw at any time and without giving reason.

All participants received motivation and instructions then scaling and polishing (5-7) days before the surgical treatment. At the day of surgery, detailed personal information, dental and medical history, clinical extraoral and intraoral examination were taken for all patients participated in this study.

Clinical periodontal parameters examination were carried out.

1-Assessment of dental plaque by Plaque Index System (PLI), [11].

2-Assessment of Gingival condition by the Gingival Index System (GI), **[12]**.

3-Assessment of Probing Pocket Depth (PPD), [13].

After these examinations, only teeth without periodontitis were included in this study (teeth without clinical attachment loss and true periodontal pocket).

Preoperative orthopantomograph was taken for initial assessment and to make an overview of the maxillofacial region, including the related anatomical landmarks, vital structures. The height of the available bone at the site of planned implantation was determined, and the jaws were examined for the presence of any pathology or retained roots as they could be easily revealed by panoramic view at the implantation region.

Surgery was done under local anasthesia. In Advanced cases of immediate treatment protocol, the tooth or retained root was extracted in atraumatic way as much as possible at the same day of surgical procedure and replaced by DI fixture. In delayed treatment protocol, the implantion was done in healed site at least (6) months after tooth extraction. Reflection of full thickness mucoperiosteal three sided flap was prepared in the implantation site for DIs placement. The pilot drilling under copious isotonic saline solution irrigation (speed = 600-800 rpm, torque = 35 N/cm) was initiated until reaching the full desired length. After that, the paralleling pin was inserted in the prepared site to evaluate the correct alignment and position of DI. Then, the conventional stepped drilling technique continued in sequence until reaching the requested final drill size according to manufacturer instructions of the DI system. And, DI was inserted with the level of crest of bone and tightened until a good primary stability was achieved. This insertion was done by the motorized way at speed of (20~40 rpm) with a torque ranged between (35~50 N/cm). After DI installation, the gingival former was inserted into the body of the fixture. Then the Periotest M device was used to measure the primary stability of DI fixture and positioned at horizontal posture. The wound of the flap was sutured back in place using interrupted suturing technique in the delayed and immediate treatment protocols of DI.

The clinical tooth mobility of corresponding tooth to the DI in the same arch was measured according to Miller`s classification [9] by putting two dental instruments on either side of the tooth and applying alternating moderate pressure in the facial-lingual direction against the tooth first with one, then with the other instrument handle (horizontal TM). Finally, the mobility of (100) corresponding teeth to the DI was also evaluated by Periotest M that applied horizontally on the mid buccal surface of the tooth. The readings by Periotest M for DI primary stability and the corresponding tooth mobility were repeated twice in each case for assurance of the right measurement and then the mean value of both measurements was taken.

The relation between Miller's mobility index and PTV scores [9].

Miller's classification	Mobility index	PTV scores
No distinguishable movement.	0	-8 to +9.9
First distinguishable sign of movement.	1	+10 to +19.9
Crown deviates within 1 mm of the normal position.	2	+20 to +29.9
Mobility is easily noticeable and the tooth moves more than 1 mm in any direction or can be rotated in its socket.	3	+30 to +50

Postoperative care:

Proper antibiotics were prescribed to the patients for (5) days [Amoxicillin capsule 500 mg / 8 hourly, Metronidazole tablet 250 mg / 8 hourly] with analgesic (Panadol tablet 500 mg / 1 tablet on need). The patients were instructed to maintain biting on a sterile gauze for about half an hour postoperatively and to maintain good oral hygiene and using of Chlorhexidine mouth wash (0.2%) twice daily after the day of surgical procedure and continue for (5) days.

Statistical analysis using Statistical Package for social Science (SPSS version 24) was presented as descriptive statistics including means, standard deviations (S.D.) , range, maximum (Max.) , Minimum (Min.), statistical tables, frequency and percentages (%). Inferential statistics including Independent sample t-test, Pearson's correlation coefficient test (r), and Percentage of reliability were used in this study.

In the statistical evaluation, the following levels of significance (Sig.) were used:

Non-significant	NS	$P > 0.05$
Significant	S	$0.05 \geq P > 0.01$
Highly significant	HS	$P \leq 0.01$

We certify that this study involving human subjects is in accordance with the Helsinky declaration of 1975 as revised in 2000 and that it has been approved by the relevant Institutional Ethical Committee **[14]**.

RESULTS

The descriptive statistics of (PLI, GI and PPD) for (100) corresponding teeth to DIs in both delayed and immediate treatment protocols groups demonstrated the PLI with mean value (0.585), the GI with mean value (0.665), and PPD with mean value (0.926), (table-1).

A total of (100) natural corresponding teeth to DIs measured their mobility by Periotest M device to evaluate their permissible movement, the mean PTV was (2.248) and the range was (14.8), with minimum reading was (-5.3) and maximum reading was (9.5), as shown in (table -2).

From (table-3), A total of (100) DIs, (50) DIs in immediate treatment protocol group with mean PTV (1.282), and (50) DIs in delayed treatment protocol group with mean PTV (-2.902) which was the highest primary implant stability, and highly significant difference (P=0.000) in comparison between the mean PTV of the two groups.

As shown in (table -4), (50) DIs in immediate treatment protocol group and (50) corresponding teeth to these DIs, non- significant difference (P=0.364) was illustrated in comparison between their mean PTV. While (50) DIs in delayed treatment protocol group and (50) corresponding teeth to these DIs, highly significant difference (P=0.000) was illustrated in comparison between their mean PTV. On the other hand, the comparison between the mean PTV (-0.810) of total (100) DIs in both immediate and delayed groups with their (100) corresponding teeth of mean PTV (2.248), revealed highly significant difference (P=0.000).

Non - significant positive correlation between mean PTV of (100) corresponding teeth to implants with their mean values of (PLI and GI), were revealed in (table -5).

The reliability between the grades of manual TM according to Miller`s classification (subjective measurements) with the scores of PTV (objective measurements) of the (100) teeth corresponding to implants was (80%) coincide and (20%) not coincide, as seen in (table -6).

Table 1: Descriptive statistics of PLI, GI and PPD of corresponding teeth to dental implants.

Clinical Periodontal Parameters	No.	Mean	± S.D.
PLI	100	0.585	0.409
GI	100	0.665	0.567
PPD	100	0.926	0.430

Table 2: Descriptive statistics of PTV measured for natural corresponding teeth to DIs.

No. of teeth	Mean PTV	±S.D.	Range	Min.	Max.
100	2.248	3.219	14.8	-5.3	9.5

Table 3: Statistical analysis for PTV of primary implant stability for immediate and delayed treatment protocols groups.

Groups	No.	%	Mean PTV	±S.D.	t-test	P-value (Sig.)
Immediate	50	50 %	1.282	5.507	4.890	0.000 (HS)
Delayed	50	50 %	-2.902	2.503		

Table 4: Descriptive statistics and comparison between the PTV of DIs primary stability in both treatment protocols groups and corresponding teeth mobility.

Groups	No.	Mean PTV	±S.D.	t-test	p- value (Sig.)
Immediate implants	50	1.282	5.507	-0.912	0.364 (NS)
Corresponding teeth	50	2.094	3.054		
Delayed implants	50	-2.902	2.503	-8.881	0.000 (HS)
Corresponding teeth	50	2.402	3.402		
Total implants	100	-0.810	4.747	-5.331	0.000 (HS)
Total corresponding teeth	100	2.248	3.219		

Table 5: Correlation between mean PTV for corresponding teeth to implants with mean values of PLI and GI.

	Statistical analysis	PLI	GI
Mean PTV	R	0.178	0.126
	p-value	0.077 (NS)	0.211 (NS)

Table 6: Reliability between the grades of manual teeth mobility with the scores of PTV for the teeth corresponding to implants.

Reliability	No. (%)
Coincide	80 (80%)
Not coincide	20 (20%)
Total (%)	100 (100%)

DISCUSSION

The PLI with mean value (0.585) this result after motivations, instructions about using brushing and interdental aids during the preoperative assessment, scaling and polishing given to the patients, GI with mean value (0.665) which indicated mild inflammation due to little amount of plaque **[12]**, and PPD with mean value (0.926) demonstrated that the teeth without true periodontal pocket according to inclusion criteria (selection of teeth without true periodontal pocket), **[13]**.

The mean PTV of (100) natural teeth corresponding to DIs in anterior and posterior sites of both jaws was (2.248) which indicated normal physiological mobility of teeth which is the result of the viscoelastic characteristics of the periodontal ligament (PDL) fibers that permit a slight tooth mobility **[15]**. In this study, the permissible movement of natural teeth using Periotest M device was from (-5.3 – 9.5) PTV which fall at the PTV score from (-8 – 9.9) and this was correspond to score (0) category according to Miller`s classification of mobility index **[9]**. This result may explained as the teeth normally have a wide range of mobility, with single rooted teeth being more mobile than multi-rooted teeth. Mobility varies among individuals, and from hour to hour **[16]**.

The delayed group with mean PTV (-2.902) fall in high stability reading that ranged from (-8 - 0), while the immediate group with mean PTV (1.282) fall in medium stability reading that ranged from (1 - 9), **[17]**. The higher primary stability of implants in delayed treatment protocol group in this study measured by Periotest M device (PTV) may be related to the difference in the timing of implant placement after extraction, these results coincide with other study comparing stability of implants placed in healed sites versus implants placed immediately in extraction sockets, but the measurement of the implant stability was evaluated by Osstell device (ISQ values), **[18, 19]**. The authors found that implants placed in healed alveolar sites versus implants placed immediately after extraction exhibited superior ISQ values at all time. Also, the higher primary stability of implants in delayed group may be related to the clinically healed ridge and implant engagement to bone`s walls and apically, compared with immediate group where extraction of a tooth / root would normally result in a rather large socket (apical engagement of implant to cortical bone), impeding primary stability **[20]**. The result going in line with previous study on immediate implants which reported that the main drawback of immediate implant placement compared to implants placed at healed sites is lower primary stability **[21, 22]**.

The result of this study revealed that a non – significant difference between the mean PTV of primary stability of (50) DIs in immediate treatment protocol group with the mean PTV of (50) corresponding teeth to DIs. While, highly significant difference was demonstrated in comparison between mean PTV of primary stability of (50) DIs in delayed treatment protocol group with mean PTV of (50) corresponding teeth to these Dis. On the other hand, the comparison between the mean PTV of total (100) DIs in both immediate and delayed groups with mean PTV for their (100) corresponding teeth, revealed highly significant difference. The result may be related to that immediate implant placement have the disadvantage of difficulty in achieve adequate primary stability **[23, 24].**

The implant stability higher from teeth mobility due to the fact that teeth are not anchored directly into the alveolar bone, the PDL connects the tooth to the bone and the TM associated with the viscoelastic properties of PDL gained by S-shapes wavy coarse collagen fibers, intermediate plexus and elastic fibers in the PDL **[25]**. The result agree with **[26]**, in their study were found that implants to be significantly more stable (less mobile) as compared with natural teeth. Few clinical implant studies have used natural teeth as controls to compare changes in mobility associated with DIs **[27,26]**.

According to the result of this study, there were non - significant positive correlation between the mean PTV of (100) corresponding teeth to implants with their mean values of (PLI and GI), this because the amount of plaque was very low and with mild gingival inflammation, and this may due to scaling, motivations and instructions given to the patients during the preoperative assessment, hence, all patients participated in this study without any periodontal breakdown, attachment loss and bone destruction that may affecting on tooth mobility. Hence, the positive correlation mean that when PLI and GI of teeth increase, the PTV of teeth increase and the mobility of the teeth also will increase due to the gingival inflammation and odema.

No previous study evaluated the reliability between the two measurements methods of TM that were used in this study. The result of this study (20 %) not coincide may be due to that the Miller`s classification method relies on the visual and tactile sensation of the operator measuring TM, it is a subjective evaluation method that differ from operator to another operator **[28]**. The reliability (80%) coincide between the subjective and objective methods of TM is a good result and can be depend on Miller`s method to measure mobility. Various methods for evaluating TM have been developed throughout the previous years, but their acceptance has been limited because of the subjectivity associated with their use **[26].** In recent years, Periotest has been studied and used to evaluate the mobility of natural teeth, it`s more accurate method than Miller`s classification and the measurement of TM by Periotest was quantitative and reproducible **[28]**.

CONCLUSIONS

Primary implant stability measured by Periotest M device was higher in delayed treatment protocol group than immediate treatment protocol group. There were differences in periotest values between primary implants stability and their corresponding teeth mobility. From the good result of reliability can be depend on Miller`s method to measure tooth mobility as this method is easy, fast and not costly as compared with the Periotest M device. On the other handmeanwhile, Periotest M was simple, precise and fast to perform an objective evaluation of TM and an implant's stability.

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