

## Immediately Placed Implants in Periodontally Compromised Patients: A Prospective Clinical Study

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**Abstract:** Purpose: This study was done to compare the outcome of implants placed immediately in partially edentulous periodontally compromised to periodontally healthy patients clinically and radiographically. Material and methods: Twenty immediately placed implants were followed up one year after loading clinically and radiographically. Patients were divided into 2 groups: 10 implants in group H (healthy, n=9) and 10 implants in group PD (moderate to severe chronic periodontitis, n=7). Clinical (modified bleeding index mBI, modified plaque index mPI, probing pocket depth PPD and degree of mobility using Periotest device) and radiographic parameters (Bone implant contact ratio BICR and vertical bone resorption) were assessed. Results: There were no significant differences in implant success rate between the 2 groups. Since the time of loading till the end of follow up period all implants were immobile, there was no pain or suppuration around the implants and there were no evidence of peri-implant radiolucency in the x-rays. Through all periods; there was no statistically significant difference between the two groups in the mPI or PPD, at any time point. At loading and 3 months post-loading; PD group showed statistically significantly higher mean mBI than healthy group. PD group showed statistically significantly lower mean PTVs (more stability) at time of loading (-1±2.1) and at 3 months PL (-1 ±1.8) than the H group at loading (0.5±0.7) and 3 ms PL (0.6±2) where P was 0.022 and 0.031 for L and 3 ms PL respectively. Regarding the radiographic measures, there were no statistically significant differences between the two groups in the BICR and the VBL at any time point, through all the follow up periods P value ≤ 0.05. Conclusion: Immediate implants may be successful treatment modality in partially edentulous patients suffering from moderate to severe chronic periodontitis, provided that careful debridement of the extraction sockets is done and a good maintenance protocol is followed.

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### 1. Introduction

Osseointegrated dental implants are used to provide a predictable functional and esthetic restoration for missing teeth in the general population. The standard protocol for implants used to require at least 6 months before the placement of an implant in an extraction socket.<sup>1,2</sup> But later clinical studies have demonstrated that dental implants immediately placed in fresh extraction sockets has similar long-term success rates to that of implants placed in healed sites when proper protocol was followed.<sup>3-5</sup> Despite the many advantages of immediate implants, it is still not recommended in infected sites, caused by periodontal disease or periapical lesions, because of the risk of microbial interference with osseointegration.

Although the successful use of osseointegrated implants in periodontally healthy patients has been documented in numerous studies, for long time implant placement in periodontally compromised cases was considered contraindicated or at least of increased risk of implant failure or causing complications like the periimplantitis.<sup>6,7</sup> The results indicate that longitudinal bone loss around implants

is correlated to previous experience of loss of periodontal bone support and that periodontitis susceptible subjects may show an increased implant failure rate.<sup>8</sup> Since several studies have identified similarities in the pathogenesis of periodontitis and periimplantitis,<sup>9</sup> and since the overall individual periodontal conditions were significantly correlated with the clinical conditions of the tissues around implant, some concluded that implant restoration in periodontitis patients may have a high failure rate because they are prone to inflammation around the implant, particularly when placing dental implants into partially edentulous patients.<sup>10,11</sup> At sites of implants having been in function for 3-4 years, deeper probing pocket depths and higher detection frequencies of periodontal pathogens were observed compared to sites of implants having been in function for only 1-2 years, thus providing more evidence for the spread of pathogens from teeth to implants.<sup>12-14</sup>

However, the success rates of over 300 implants, was 97-98% in previously periodontally compromised patients after 1-8 years observation period.<sup>15</sup> Furthermore, other studies have shown

favorable outcomes in subjects with history of periodontitis enrolled within proper maintenance programs,<sup>16</sup> and the presence of putative periodontal pathogens at peri-implant and periodontal sites did not appear to predict future implant failures.<sup>17-19</sup> Nevins 2001, demonstrated that periodontitis history had minimal impact on the success rate of implant restoration, and the presence of periodontal pathogens and implant failure is not necessarily correlated.<sup>20</sup> In a long term follow-up of implants in partially edentulous patients treated for periodontitis, it was demonstrated that the success rates recorded were 100% in the chronic periodontitis patients although the distribution of the microorganisms revealed no significant differences between the implants and teeth.<sup>21</sup> Although the survival of the implants was not significantly different in individuals with periodontitis-associated and non-periodontitis-associated tooth loss, a significantly greater long-term probing pocket depth, implant marginal bone loss and incidence of peri-implantitis were revealed in individuals with periodontitis-associated tooth loss.<sup>22, 23</sup>

However, the outcome of immediate implant placement in periodontally compromised patients has not been completely clarified. So the purpose of this study was to evaluate and compare the success rate of implants placed immediately in partially edentulous periodontally compromised patients to periodontally healthy cases.

#### **Hypothesis:**

Immediate implant replacement of periodontally compromised teeth is possible with the same level of success as for periodontally healthy sites.

#### **2. Material and Methods:**

A total of twenty implants of 13 and 15 mm length and 3.8, 4.5, 5.5 mm diameter were inserted immediately after extraction of maxillary and mandibular anterior and premolar teeth in systemically healthy subjects. Patients were selected from those referred to the Oral and Maxillofacial Surgery Department and Department of Periodontology at the Faculty of Oral and Dental Medicine, Cairo University. Patients were selected from whom an extraction is indicated because of a nontreatable tooth and who were willing to place implants to restore that tooth. Included subjects were both males and females ranging in age between 20 and 55 years and who were in good general health, and free of any chronic diseases and not taking any drugs that may complicate surgical operation or affect the healing process according to dental modification of Cornell medical index.<sup>24</sup> Clinical, periapical and panoramic radiographic assessments

were done for each case and models were fabricated and mounted to study the occlusion and construct the surgical stents and temporary restorations. Complete blood count as well as coagulation profiles were done for each case. After a detailed verbal explanation of the procedures with stating benefits and possible risks of the surgery, only patients who were cooperative in maintaining their oral hygiene and willing to come in regular follow up-visits for evaluation after the implant insertion were included.

Clinical assessment of periodontal status was determined in all subjects as described by Drury *et al.*,<sup>25</sup> using plaque index (PI) of Loe and Silness,<sup>26</sup> gingival index (GI) of Silness and Loe,<sup>27</sup> probing pocket depth (PPD) and clinical attachment level (CAL)<sup>28</sup> Sterile dental mirrors and explorers were used to assess plaque accumulation and gingival status, whereas standardized Michigan o periodontal probes with Williams markings were used to measure (PPD) and (CAL). The sites examined on each tooth are mesiobuccal, buccal, distobuccal and lingual. Subjects were classified as having chronic periodontitis when at least one of the four sites per tooth has (PPD)  $\geq 3$  mm or (CAL)  $\geq 2$  mm. Chronic periodontitis were further classified according to severity as mild, moderate or severe.

The subjects were divided according to the reason of tooth extraction into two groups. Group H: Nine patients who placed 10 implants were assigned in this periodontally healthy group where extraction was required for reasons other than periodontal disease (Figs. 1,2). They were diagnosed as periodontally healthy when the pocket depth around teeth in general is  $\leq 3$  mm with no bleeding on probing. Group PD: Seven patients who needed 10 implants where extraction was required for teeth associated with moderate to severe chronic periodontitis and having more than grade three-mobility, Probing Pocket Depth (PPD) was  $\geq 6$  mm and the clinical attachment level (CAL) was  $\geq 5$  mm (Figs.3,4).

Before extraction and insertion of immediate implants, subjects of both groups were subjected to full mouth supra and sub gingival debridement, root planning, with instructions for oral hygiene measures. Also, the subjects had undergone periodontal surgical procedures to eliminate or reduce the pathologically deepened pockets. Each patient underwent two main surgical procedures. The first surgery was done to insert the implants. Under local anesthesia, a buccal 3-sided full thickness flaps were raised to achieve primary wound closure over the implants. Atraumatic extraction followed by socket debridement to remove remnants of periodontal ligaments was done.



Figure 3: Periapical x-ray of a case of the PD group showing bone resorption around mandibular central incisors.

Figure 4: Picture of a case of the PD group showing bone resorption, migration and gum recession of mandibular central incisors.

Atraumatic preparations of the implant sites were made with addition of 2-mm apical to the socket in order to assure primary stability, then the implants were threaded in their places and covered with sealing screws. Primary closure was achieved using 000 black silk sutures. One hour before surgery prophylactic antibiotic was given to the patient and Amoxicillin (500mg tid), Ibuprofen (400mg tid) and Chlorhexidine (mouth rinse bid) were prescribed to the patients for the following seven days after surgery. A provisional removable partial denture lined with a resilient liner was provided to the patients after removal of the sutures. The second stage surgery was done 5 months later to uncover the implant and place the gingiva former. After 3 weeks the implants were restored using the Ceramic abutments and metal free ceramic crowns. All patients were placed on regular maintenance sessions in their recall schedule to maintain better oral environment.

The patients were evaluated clinically at the time of loading (L) and 3, 6, 9, and 12 months post-loading (PL) using the Modified Plaque index (mPI),<sup>29</sup> and Modified sulcus Bleeding index (msBI).<sup>29</sup> Probing Pocket Depth measurements in millimeters (PPD) were done gently from the free gingival margin to the depth of the pocket. All measurements were performed at four aspects of each implant using a



Figure 7: Postoperative standardized Periapical X-ray of a case of the H group.

Figure 8: Postoperative standardized Periapical X-ray of a case of the PD group.

plastic color coded periodontal probe (Premier PerioWise<sup>®</sup>asz2). (Fig.5) A quantitative evaluation of implant mobility was done using the Periotest device values PVs (Gulden, Siemens, Bensheim, Germany). (Fig.6) The Periotest displayed a digital score value (-08 to +50). According to the Periotest Operating Instruction Manual, a score of -08 to +09 is equivalent to the absence of any clinical mobility, whereas a score of +10 or above indicates a mobile implant abutment.

Radiographic examinations were obtained immediately after placement of the implant (immediate=IM), at the day of loading of the implant which is 6 months post insertion (loading=L); at 3, 6, 9, and 12 months after loading (3, 6, 9 and 12 months post loading = PL) (Figs 7,8). Customized bite acrylic templates were fabricated for each case and used in conjunction with radiographic film holder system (Rinn's XCP, Dentsply, Elgin, Illinois, USA) to standardize geometry, film placement, angulations of the beam, and source to film distance for periapical radiographs. A sensor for intraoral indirect digital radiography was used in conjunction with the Digora\* system (Orion Corporation, Soredex, Finland). The images were analyzed with BioQuant Nova Prime software (BioQuant Image Analysis Corporation, Nashville, TN, USA) for the calculation of the Bone to implant contact ratio

(BICR) and the linear bone loss assessment. The linear bone loss is the distance from the implant shoulder to the alveolar bone crest measured in mm at the mesial and distal aspects of each implant.

#### Statistical analysis:

Data were presented as mean and standard deviation (SD) values. Bone-implant contact ratio and probing pocket depth data showed normal distribution; so Student's t-test was used to compare between the two groups. Paired t-test was used to compare between linear bone resorption around the implants in each group. Repeated measures ANOVA followed by Tukey's post-hoc test were used for studying the changes through different periods within each group. Periotest values, modified sulcus Bleeding Index, Modified Plaque index and linear bone resorption data showed non-parametric distribution; so Mann-Whitney *U* test was used to compare between the two groups. This test is the non-parametric alternative to Student's t-test. Friedman's test followed by Wilcoxon signed-rank test was used to study the changes by time within each group. The significance level was set at  $P \leq 0.05$ . Statistical analysis was performed with IBM® (®IBM Corporation, NY, USA) SPSS® Statistics Version 20 for Windows (®SPSS, Inc., an IBM Company).

#### 3. Results:

Twenty implants were inserted immediately after tooth extraction in 16 patients. There were 9 patients in the periodontally healthy group, 7 patients were males and 2 were females and 7 female patients suffering from moderate to severe chronic periodontitis. Average age of patients, at time of first surgery, was 29.2 years (range 20-55 years). The average age of patients in the H group was 33.56 years (Range 20-55) while in the PD group it was 24.83 (range 20 to 40). There were 13 implants inserted in the maxilla and 7 in the mandible. In the H group there were 80% in the maxilla and 20% in the mandible, where in the PD group there were 50% in the maxilla and 50% in the mandible.

Postoperative healing was uneventful in all patients. At the time of loading, both groups were considered successful as they were all, immobile when manually examined, there were no pain or suppuration around the implants and there were no evidence of peri-implant radiolucency in the x-rays. The modified plaque index (mPI) ranged from 0 to 4 in the PD group and from 0 to 3 in the H group. In both groups; the mean mPI values significantly increased at all time points compared to loading time measurement. Through all periods; there was no statistically significant difference between the two groups in the mPI at any time point (Fig 9). The msBI ranged between 0-3 in the PD group and between 0-2

in the H group. At 18 months time after implant insertion 70 % of the H group implants remained free of bleeding and 30 % scored 1. On the other hand only 50 % of the PD group remained free from bleeding, 30 % of the implants scored 1 and 20% scored 2 in the mBI at the end of study period. At loading and 3 months post-loading; periodontally affected group showed statistically significantly higher mean BI than healthy group. At 6 months, 9 months and 12 months post-loading; there was no statistically significant difference between the two groups (Fig 10). Regarding changes with time, there were no statistically significant changes in mean BI values through all periods in both groups.

The Probing Pocket Depth (PPD) was recorded from the free gingival margin to the base of the Pocket at 4 sites around each implant. There was no suppuration detected during the PPD measurement at any time point in both groups. The highest values were measured at 12 months PL in the two groups. There were no statistically significant differences between the two groups at any time point. The repeated measure ANOVA test showed that, in the periodontally healthy group; the pocket depths were stable with time as there were no significant increases in mean PPD values between time points through the evaluation period. While in the PD group; pocket depths increased significantly at 3 months post-loading mean  $\pm$  SD ( $1.9 \pm 0.7$ mm) compared to loading measurement ( $1.5 \pm 0.3$ mm). After 6 months ( $2.3 \pm 0.8$  mm), 9 months ( $2.3 \pm 0.7$ mm) and 12 months ( $2.4 \pm 0.8$ mm) post-loading, there was further significant increase in mean PPD than that of the loading time  $P$  value  $\leq 0.001$  (Table 1). However there was a great variability between patients in these measures due to the difference in gingival recession rate that follows the alveolar bone resorption. So the PPD was not related to actual bone level and was not accurate indicator for the amount of bone resorption around the implants.

Periotest values obtained ranged from -04 to 03 in the 2 groups, which were compatible with absence of clinical mobility. Generally the mean  $\pm$  Standard deviation of the PTVs in the H group was  $0.5 \pm 2.3$  which was statistically significantly higher than the PD group which scored  $-0.6 \pm 1.7$  where  $P = 0.048$ . According to the results of Mann-Whitney *U* test for the comparison between Periotest values (PTVs) between the two groups at each time point, PD group showed statistically significantly lower mean PTVs (more stability) at time of loading ( $1 \pm 2.1$ ) and at 3 months PL ( $-1 \pm 1.8$ ) than the healthy group at loading ( $0.5 \pm 0.7$ ) and 3 ms PL ( $0.6 \pm 2$ ) where  $P$  was 0.022 and 0.031 for L and 3 ms PL respectively.



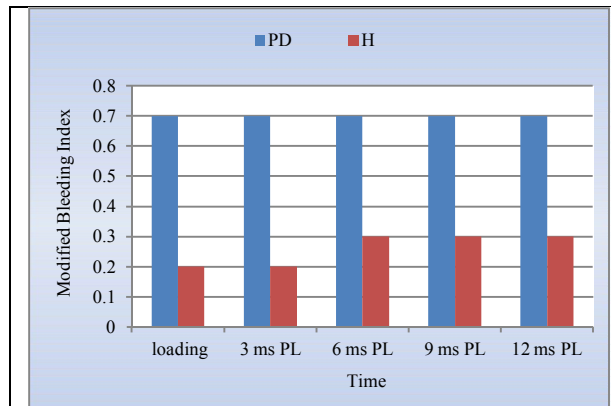


Figure 9: Histogram representing comparison between mean modified Bleeding Index of the 2 groups at each time point.

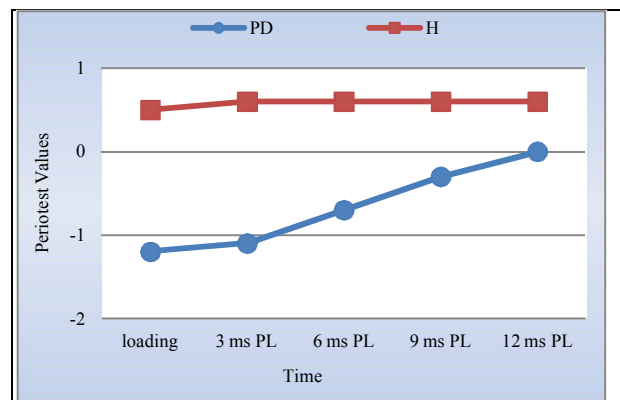


Figure 11: Line chart representing mean Periosteal mobility values in the two groups with time.

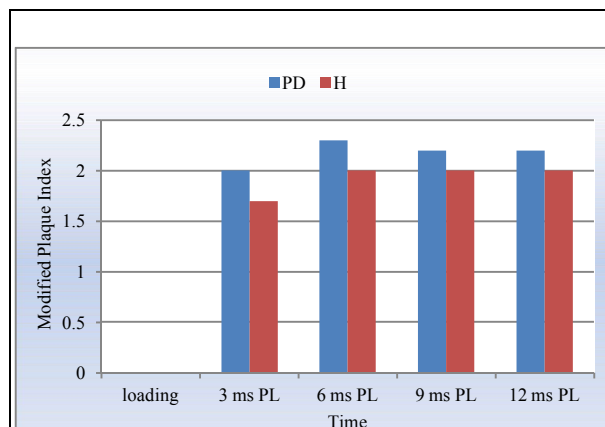


Figure10: Histogram representing comparison between mean modified Plaque index of the 2 groups at each time point.

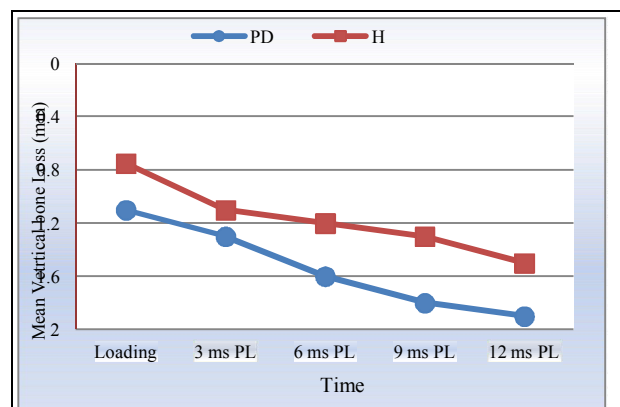


Figure 12: Line chart representing mean Vertical bone loss in the two groups with time.

But since the 6<sup>th</sup> month PL till the end of follow up period, test did not show any significant differences between the two groups at anytime point. Regarding Changes by time within each group according to Friedman's test, in H group; Implants maintained its stability throughout the observation period without significant fluctuation in the PTVs. The PD group, PTVs, were also stable from time of loading till 6 ms PL where there was no significant change in mean PTVs at 3 months ( $-1 \pm 1.8$ ) and 6 months PL ( $-0.7 \pm 1.6$ ) compared to L time measurement ( $-1 \pm 2.1$ ). But the values statistically significantly increased in the 9 ( $-0.3 \pm 1.6$ ) and 12 months PL ( $0 \pm 1.6$ ) than the L time (less stable but still totally immobile) (Fig. 11).

When the bone-implant contact was radiographically calculated as a percentage of the total implant length the values ranged from 84% to 100%. Generally the mean  $\pm$  Standard deviation of the BICR in the H group was  $94.2 \pm 5.5$  and in the PD group was  $91.5 \pm 6.9$  where there was no statistically significant difference between the two groups and the  $P = 0.095$ .

According to Student's t-test there were no statistically significant differences between the two groups in the BICR at any time point, through all the follow up periods  $P \leq 0.05$ . Regarding the change with time, the repeated measures ANOVA test showed that there were no statistically significant differences between the time points from time of loading till the end of the observation period in both groups.

The location of implant crown margin, the first crestal bone to implant contact point and the apical border of the implant were identified as reference points and the dimensions known for each implant were used as reference lengths, to compensate for magnification, in order to calculate the vertical bone loss (VBL). There was no statistically significant difference between the two groups at any time point where  $P \leq 0.05$ . The highest values were measured at 18 months after insertion which were significantly different than the loading time in both groups. In the PD group VBL $\pm$ SD at Loading was ( $1.1 \text{ mm} \pm 0.83$ ) while at 12 months PL it was ( $1.9 \text{ mm} \pm 0.73$ ). In the

C group VBL at loading  $\pm$  SD was (0.7 $\pm$ 0.96) while at 12 months PL it was (1.5 $\pm$ 1)  $P \leq 0.05$  (Fig.12). Regarding the change with time within each group, in PD group; there was no statistically significant change in mean VBL after 3 months. From 3 months to 6 months and from 6 months to 9 months post-loading; there was a statistically significant increase in mean linear bone resorption. In H group; there was a statistically significant increase in mean VBL after 3 months. From 3 months to 6 months and from 6 months to 9 and from 9 to 12 months PL, there was non-statistically significant increase in mean linear bone resorption. (Table 2) Generally there was no statistically significant difference between the two groups in the overall mean, where the mean  $\pm$  SD of the VBL was 1.2 $\pm$ 0.96 in the H group and 1.5 $\pm$  1.17 in the PD group where the P-value was 0.185.

Table 1: The mean and standard deviation (SD) values and results of Repeated measures ANOVA test for the comparison between PPD values at different time points within each group.

Group Period	PD		H	
	Mean	SD	Mean	SD
At loading	1.1 <sup>c</sup>	0.83	0.7 <sup>c</sup>	0.96
3 months PL	1.3 <sup>c</sup>	0.83	1.1 <sup>b</sup>	0.88
6 months PL	1.6 <sup>b</sup>	0.92	1.2 <sup>b</sup>	0.85
9 months PL	1.8 <sup>a</sup>	0.74	1.3 <sup>b</sup>	1.03
12 months PL	1.9 <sup>a</sup>	0.73	1.5 <sup>b</sup>	1.00
P-value	<0.001*		0.037*	

\*: Significant at  $P \leq 0.05$ , Different letters in the same column are statistically significantly different

Table 2: The mean, standard deviation (SD) values and results of Repeated measures ANOVA test for the comparison between Vertical bone resorption at different time periods within each group

Group Period	PD		H	
	Mean	SD	Mean	SD
At loading	1.1 <sup>c</sup>	0.83	0.7 <sup>c</sup>	0.96
3 months PL	1.3 <sup>c</sup>	0.83	1.1 <sup>b</sup>	0.88
6 months PL	1.6 <sup>b</sup>	0.92	1.2 <sup>b</sup>	0.85
9 months PL	1.8 <sup>a</sup>	0.74	1.3 <sup>b</sup>	1.03
12 months PL	1.9 <sup>a</sup>	0.73	1.5 <sup>b</sup>	1.00
P-value	<0.001*		0.037*	

\*: Significant at  $P \leq 0.05$ , Different letters in the same column are statistically significantly different

#### 4. Discussion:

The immediate placement of an implant after tooth extraction was offered to maintain the horizontal and vertical dimensions of the osseous tissues; preserves soft tissue contours and keeps the implants at the same angulations as the pre-existing

natural teeth. According to Becker and co-workers,<sup>30</sup> a periodontally compromised tooth could be characterized as hopeless and indicated for extraction if two or more of the following characteristics were present: loss of more than 75% of supporting bone; Probing Pocket depths  $\geq$  8 millimeters; Class III furcation involvement; hypermobility. According to Schropp *et al.*,<sup>31</sup> the width of the alveolar ridge is reduced by 50% after one year of extraction, two thirds of this reduction occurred within the first 3 months after tooth extraction and loss of crestal bone height mainly occurred within the first 3-month period after tooth extraction. So periodontal disease followed by the progressive bone resorption after extraction, will lead to overall reduction of alveolar bone volume that may interfere with implant replacement of this tooth. Obviously, patients with poor prognosis or hopeless teeth due to periodontal disease would benefit the most from immediate implant placement. However there is as yet little information available about the placement of implant in fresh socket of a tooth extracted due to periodontal disease.

In this prospective controlled comparative study, implant survival rate of 100% was observed in both groups after one year of function. There was no significant difference in the clinical manifestations and functional status of the the surrounding tissues of the implants between the two groups. These results supported the hypothesis that the immediate implant placement in periodontally compromised areas is possible with the same level of success as for periodontally healthy sites. This result was consistent with another study which found 100% success rate of immediate implants placed in infected sites.<sup>32</sup>

Evian *et al.*, performed a comparative study where they also mentioned that implant survival in patients with history of periodontal disease was not affected by immediate or delayed placement.<sup>6</sup> In contrary, Horwitz *et al.*, reported lower survival rate of implants placed in extraction sites than in implants in healed bony sites in periodontitis patient and considered implant placement in extraction site in periodontally compromised cases as a risk factor for implant failure.<sup>33</sup>

The high success rate in the present study might be due to the good selection of the cases, to the improved clinical protocol, to the control of inflammatory response, and/or to the use of implants with good surface qualities. The careful patient selection and the strict inclusion criteria, non-smokers, non-bruxers, medically free, are important factors for the implant success. Many studies showed a significantly higher incidence of biological implant complications in smokers with a history of periodontitis as compared with smokers who are

periodontally healthy.<sup>16,23,34,35</sup> The use of larger size implants with grit-blasted, acid-etched surface allowed optimal distribution of forces over as large an area as possible. Preoperative and postoperative antibiotic prescription, debridement of infected sockets after extraction and peripheral osteotomy during preparation for the implants sites were carefully done for complete removal of contaminated tissues as recommended for better success of implants in infected extraction sites.<sup>36,37</sup> All implants were totally submerged and loaded after 6 months, as combining immediate implant placement and immediate loading in periodontally compromised cases showed a marked difference in survival rates (65%) than implants immediately restored after placement in healed sites (94%).<sup>33</sup>

Although the results of the present study showed that the immediate implant success rate in periodontally compromised patients and healthy subjects was similar, only moderate to severe chronic periodontitis patients who had received treatment to control the disease were included. They were subjected to full mouth scaling and root planning, and periodontal surgical procedures to eliminate or reduce the pathologically deepened pockets. Instructions and motivation for oral hygiene measures were given to the patients before extraction and during follow up periods. Efforts for re-motivation for better plaque control and a high level of maintenance care were done at each follow up session. When dental implants were placed into partially edentulous patients, periodontal pathogens were found colonizing the dental implants within the first weeks of healing, as the residual periodontal pockets may represent niches of infection for adjacent implants,<sup>10,38</sup> hence the importance of periodontal treatment prior to implant insertion to reduce bacterial load and inflammation was emphasized. Acceptable implant outcome in periodontitis susceptible subjects was always tied to putting the patients under a high level of maintenance care.<sup>23,39</sup>

Regarding the periimplant tissue health, there was no suppuration detected during the follow up period at any time point in both groups. 70 % of the H group and only 50 % of the PD group implants remained free of bleeding till the end of study period. At loading and 3 months post-loading; PD group had statistically significantly higher mean BI than healthy group. In the H group; the Probing pocket depths were stable with time with no significant increases in mean PPD values between time points through the evaluation period, on the other hand, in the PD group, pocket depths increased significantly at 3 months post-loading compared to loading measurement, then significantly increased again in 6

months post loading than the 3 months, finally it stabilized from the 6<sup>th</sup> month to the end of follow up period. However, there were no statistically significant differences between the two groups at any time point in the Probing Pocket depth (PPD). Generally the results of the present study were similar to another study by Crespi *et al.*,<sup>40</sup> where immediate implants were placed and loaded replacing teeth with and without chronic periodontitis, and at 48 months of follow-up, dental implants in periodontally infected sockets showed no significant differences compared to implants placed in uninfected sites in plaque index and bleeding index. In a systematic review concerned with the implant placement in periodontitis susceptible patients the plaque accumulation occurred with low prevalence in most studies. Likewise, inflammatory changes of the peri-implant tissues were observed with low prevalence in most short-term studies. However, the prevalence and severity of peri-implant inflammatory reactions including marginal bone loss apparently increased with the length of the observation period.<sup>41</sup>

In recent years, the Periotest has been studied and used to evaluate the mobility of natural teeth as well as assessing the stability of the implant-bone interface.<sup>42</sup> The Periotest is a non-invasive, electronic device that provides an objective measurement of the reaction of the periodontium to a defined impact load applied to the tooth crown. The measurement is sensitive and the readings area automated and therefore objective. Keeping the above data in mind, the Periotest was chosen to clinically evaluate the osseointegration of the implants in this study. All the scores obtained during the study for both groups were compatible with absence of clinical mobility. The overall stability of the H group ( $0.5 \pm 2.3$ ) was significantly less than the overall PD group which scored  $-0.6 \pm 1.7$ . There were differences between the 2 groups at loading and 3 months PL time points, the PD having better stability. As the short implant length was found to be associated with an increased failure rate,<sup>34</sup> long implants were selected for this study. The early better stability of the periodontally compromised group might be caused by placing long implants in shorter sockets caused by bone resorption around teeth extracted due to periodontal disease. These long implants required further drilling in sound bone apical to the socket whenever anatomic land marks permit, placing longer area of the implants in this group in sound bone might have lead to better early stability. The problem in this strategy is the longer crown which leads to bad esthetic result and less than ideal crown to implant ratio. However, this stability remained constant only till 6 months then a decline

occurred in the 9 and 12 months PL than the loading time. On the other hand the H group implants maintained its stability throughout the observation period without significant fluctuation in the PTVs. Again all PTVs were constantly within the range of absence of clinical mobility.

The bone implant contact ratio was stable throughout the observation period without significant changes from time of loading till the end of a year of function in both groups. There were no significant differences between the two groups in the bone implant contact ratio or the marginal bone resorption at any time point, through the follow up period. This similar to results of a histomorphometric comparative study of BICR in dogs, where immediate implants placed into periodontally infected sockets had similar outcomes compared with those placed in control sites without periodontitis after 12 weeks of implants placement.<sup>43</sup> In another study using the Polychromatic sequence labeling of bone in dogs it was concluded that periodontal disease does not affect bone remodeling around immediate implants. Although the healing in periodontally infected sites was slower initially, it reached the levels of the non-diseased sites after 12 weeks.<sup>44</sup> Although the VBL  $\pm$  SD in the periodontally compromised group (1.9 mm $\pm$ 0.73) was greater than the control group (1.5 $\pm$ 1) at 12 months PL, statistically there was no significant difference between the 2 groups. The results of the present study were consistent with another study where immediate implants placed in periodontally infected sockets showed no significant differences compared to implants placed in uninfected sites in bone implant contact ratio as well as marginal bone level.<sup>40</sup>

### Conclusion:

Immediate implants may be successful treatment modality in partially edentulous patients suffering from moderate to severe chronic periodontitis, provided that a good maintenance protocol is followed.

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