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Evaluation of Osseointegration Following Placement of Mini Implants

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Abstract

Aim: The aim of the present study was to evaluate osseointegration following placement of mini-implant by clinical and radiographic assessment around the implant over a period of 6 months. **Materials & Methods:** A total of eight patients aged 16-50 yrs were selected for the study. 11 Mini-implants (2.4mm in diameter and 13mm in length) were placed, eight in the anterior region and three in the posterior region. Implants were placed in the prepared site using ratchet at 30Ncm. Provisional crown was fabricated and placed in non-functional loading. Definitive crown was delivered after 4-6 months of healing. The following clinical parameters namely modified plaque index, modified gingival bleeding index, probing pocket depth, mobility and radiographic findings (marginal bone loss and peri-implant radiolucency) were used to assess the success of osseointegration at baseline, 3rd and 6th month postoperatively. The results were tabulated and subjected to statistical analysis. **Results:** The increase in mean probing pocket depth from baseline to 3rd and 6th month were found to be statistically significant. **Conclusion:** Mini-implants may serve as a useful option to rehabilitate a single missing tooth in compromised alveolar ridge. Osseointegration as assessed by clinical and radiographic findings was found to be successful.

Key Words

Osseointegration; implants; radiolucency; pocket depth; mobility

INTRODUCTION

Edentulism is increasing dramatically in the adult population inspite of increased awareness and proper oral hygiene maintenance. Missing teeth can cause loss of self-esteem and have an impact on social interaction. The diminished masticatory efficiency accompanying tooth loss can compromise nutritional status, putting clients at higher risk for chronic illness like diabetes, cancer, hypertension and heart disease. Various treatment modalities for replacement of missing teeth are available like removable partial denture, fixed partial denture made of different materials. Implant placement is a viable option in the treatment of partial and full edentulism and has become an integral facet of periodontal therapy. The implant retained prosthesis provides greater stability, improved biting and chewing forces and higher client satisfaction than a conventional denture.[1] A primary reason is the maintenance of alveolar bone by the stress and strain applied to the bone surrounding implants, as the implants stimulate the bone and maintain its dimensions in a manner similar to healthy natural teeth. Currently, endosseous dental implants have revolutionized the fields of implants and periodontics. Endosteal implants are more frequently used system which includes a range of sizes, shapes, coatings and prosthetic components. Implant length and width can be chosen to fit the available bone and the prosthetic components can be selected in a size and angle to accommodate the final restorations.

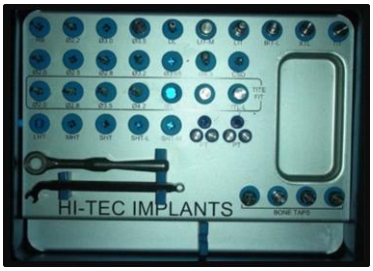

Fig. 1: Implant Kit

Fig. 2: Physiodispenser and Reduction Gear Hand Piece


Fig. 3: Radiographic Assessment pre-Operative


Fig. 4: Armamentarium


Fig. 5: Pre-operative View


Fig. 6: Pre-operative View Missing 35


Fig. 7: Initial Marking Done Using Round Bur


Fig. 8: Osteotomy Done Using Pilot Drill


Fig. 9: Implant Placement in The Prepared Osteotomy Site


Fig. 10: Implant Placement Completed Using Ratchet


Fig. 11: Immediate Post-operative View of Implants


Fig. 12: Occlusal View of Implant


Fig. 13: Provisional Crown


Fig. 14: Occlusal View of Provisional Crown

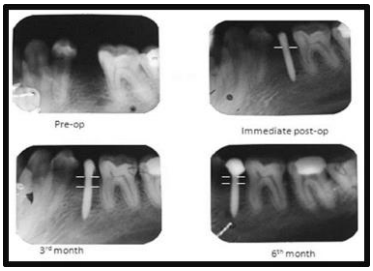

Fig. 15 Radiographic Assessment of Marginal Bone Loss

Today implants are the preferred treatment of choice for replacement of missing teeth except for a very few absolute contra-indications. The major factor that hinders the placement of implant is lack of adequate bone width and interdental space. Placing conventional implants in a narrow

interdental space without orthodontic tooth movement has the potential risk of bone loss to the adjacent teeth, especially along the root surface facing the implant. Thus mini-implants are a new treatment modality and an alternative to the conventional implants in compromised sites with inadequate bone width and interdental space.[2] The present study was undertaken to evaluate osseointegration following placement of mini-implants based on clinical (assessment of mobility) and radiographic assessment (presence or absence of periapical radiolucency and bone loss) at baseline (on the day of surgery), 3rd and 6th month post-operatively.

MATERIALS AND METHODS

The present study was conducted in the Division of Periodontics, Rajah Muthiah Dental College and Hospital, Annamalai University, Chidambaram, Tamilnadu. Eight systemically healthy individuals (six males and two females) requiring replacement of missing teeth with implant supported fixed prosthesis were included in the study. All patients were treated with one-piece mini-implants (13mm length and 2.4mm diameter) 8 implants were placed in the anterior and 3 in the posterior region. Pretreatment clinical and radiological assessments were carried out and patients were selected based on their medical and dental history and their oral hygiene status. A clinical case record sheet was formulated for all patients and maintained. All patients were informed about the surgical procedure and consent forms in their language were sort.

Inclusion Criteria

- Alveolar ridge with minimum dimension of 5.5 – 6.0 mm (buccolingually).
- Edentulous span of atleast 5.5- 6.0 mm.
- Bilaterally stable occlusion.

Exclusion Criteria

- Medically compromised individuals.
- Severe intermaxillary discrepancy.
- Severe parafunctional habits.
- Poor oral hygiene.

Pre-surgical Evaluation

A study model and working cast were prepared for all patients under study. The length of edentulous span was measured in the study model. The width of edentulous ridge was measured by ridge mapping using endodontic file. The height of edentulous ridge was measured using panoramic radiographs (FIGURE3) from the crest of the ridge to the adjacent anatomic landmark.

Clinical Assessments

Clinical parameters such as plaque index, sulcus bleeding index, periodontal index, pocket depth, marginal bone loss, and implant stability were recorded at baseline, 3rd and 6th month following implant placement.

RESULTS

A total of seven patients (six males and one female) aged 16-50yrs were selected for the study. Out of 8 implants placed, six in the anterior and two in the posterior region. Clinical and radiographic assessments were recorded at baseline, 3rd and 6th month post-operatively. The results thus obtained were tabulated and subjected to statistical evaluation. All the data were analysed using a software program (SYSTAT, vision 12). The mean and standard deviation of clinical parameters and radiographic findings at the 3rd and the 6th were compared using paired t-test.

Table1: The mean and standard deviation of clinical parameters of implants placed in the anterior region

Clinical parameters	Plaque Index	Gingival Bleeding Index	Probing Pocket Depth	Clinical Mobility
Mean±SD at 3rd month	0.54±0.29	0.45±0.36	2.66±0.51 mm	Score 0
Mean±SD at 6th month	0.62±0.20	0.45±0.18	3.33±0.51 mm	Score 0

The implants placed in the anterior region showed mean plaque score of 0.54±0.29 and 0.62±0.20 at the 3rd and 6th month respectively. Though there was an increase in plaque score, it was found to be statistically insignificant (P value 0.363). The mean gingival bleeding index score was 0.45±0.36 and 0.45±0.18 at the 3rd and 6th month respectively with no change in the score from 3rd month to 6th month follow-up. The probing pocket depth of 2.66±0.51 and 3.33±0.51 were observed at the 3rd and 6th month with a significant increase (P value 0.02) in probing depth at the 6th month. Clinical mobility was absent for the implants placed in the anterior segment at the 3rd and 6th month.

Table 2: The mean and standard deviation of marginal bone loss around anterior implants

Marginal bone loss	Mesial	Distal
Mean±SD at 3rd month	2.9±1.3mm	3.1±1.3mm
Mean±SD at 6th month	2.4±1.0mm	2.6±0.9mm
t value	2.71	2.71
P value	0.04	0.04

The mean and standard deviation of the marginal bone loss at the mesial aspect of the implants in the

anterior region was 2.9±1.3mm at 3rd month and 2.4±1.0mm at 6th month. The mean and standard deviation of the marginal bone loss at the distal aspect of the implant was 3.1±1.3mm at 3rd month and 2.6±0.9mm at 6th month. Paired t-Test comparing the bone loss at the 3rd and 6th month shows a significant reduction in marginal bone loss at the 6th month post-operatively (p value 0.04) indicating osseointegration.

DISCUSSION

Dental implants are now considered the treatment of choice for replacement of all forms of tooth loss. Implants of standard diameters have certain limitations like reduced alveolar ridge volume caused by bone resorption, reduced mesiodistal interdental space in case of congenitally missing incisors. The availability of mini-implants ranging from 1.8mm to 2.4mm in diameter and FDA approval for use as definitive prosthesis support and retention has opened new dimensions in oral implant rehabilitation for replacement of teeth in compromised sites. Smith and zarb[3] postulated the following criteria for the success of endosseous implants:

- No evidence of peri-implant radiolucency as assessed on an undisturbed radiograph.
- The mean marginal bone loss is <0.2mm annually after first year of service.
- By these criteria, a survival rate of 85% at the end of a 5 year observation period is the minimum level for success.

Reddy MS, Wang IC[4] studied the radiographic determinants of implant performance. The recommendations of the 1978 Harvard consensus conference on dental implants utilized the following criteria:

- Mobility less than 1mm in any direction.
- No peri-implant radiolucency
- Bone loss not greater than 1/3rd of the implant length.

Schnitman and Shulman and the author calculated bone loss by counting threads of implant fixture. The present study was undertaken to evaluate osseointegration following placement of mini-implants. A total of 7 patients with age group of 16-50 years were chosen for the study based on the selection criteria. 8 Mini-implants (diameter 2.4mm and length 13mm) of one-piece implant design were used, six in the anterior segment and two in the posterior segment. Clinical parameters including modified gingival index, modified plaque index, probing pocket depth, mobility and radiographic findings (marginal bone loss and peri-implant radiolucency) were used to assess the success of osseointegration at baseline, 3rd and the 6th month postoperatively. Plaque retention was found to be very minimal around two-stage implants. Following the use of single-piece implant with a provisional crown, plaque retention gained clinical importance. In our present study modified plaque index by Mombelli *et al.*, was used to assess the oral hygiene status around the implants. The mean plaque index score was 0.53±0.24 and 0.56±0.22 respectively at the 3rd and the 6th month. Though there was an increase in plaque index score between 3rd and the 6th month, it was not statistically significant (p value 0.68). This increase in mean plaque score from baseline to 3rd and 6th month might be related to overcontoured provisional restoration. Present study was carried out to assess the soft tissue status around implants during 3rd and 6th month period based on the criteria of Mombelli *et al.*[5] There was an increase in mean bleeding score from 0.40±0.32 and 0.43±0.17 which was in contrast to earlier studies by Degidi M *et al.*,[6] who assessed the soft tissue status of immediately loaded small diameter implants in relation to missing maxillary lateral incisors. They concluded that out of the 30 subjects studied, bleeding on probing was found to be 19.4% at the end of 6th month which reduced to 17.9% at the end of 3rd year. This disparity between the results might be related to the corresponding increase in the mean plaque index score as assessed earlier. Sekine *et al.*, stated that clinical mobility of the implants is a definite sign of failed osseointegration.[7] Barzilay I *et al.*,[8] assesed the clinical mobility of implants placed in the extraction sockets of Macaca Fascicularis using modified version of Lindhe and Nyman. In our study the clinical mobility of implants were assessed manually as suggested by Barzilay. Out of 11 implants placed, 3 implants exhibited grade III mobility during the initial period of healing and were explanted and 8 implants were stable at the 3rd and at the 6th month after placement with mobility index score as 0.

Leifkullman *et al.*,[9] assessed peri-implant marginal bone level by visually monitoring the thread at which the marginal bone seemed to be attached at the mesial and distal surface of the implant. The corresponding thread number at the level of bone attachment was recorded. In our present study, the marginal bone loss was calculated using the same fixed landmark, at which the

marginal bone seemed to be in contact. Comfort MB *et al.*,[10] evaluated the clinical performance of narrow platform implants and observed a mean marginal bone loss of 0.41±0.17mm during the first year and a mean marginal bone loss of 0.03±0.06mm between the second and fifth year. The results of the above study were similar to the present study where there was a reduction in the mean marginal bone loss from 3rd month to 6th month with the mean marginal bone loss of 2.32±0.8mm mesially and 2.47±0.87mm distally. This reduction in mean marginal bone loss observed at the 6th month was statistically significant. This reduction in the mean marginal bone loss as seen at the end of 6th month was found to be a sign of favourable osseointegration. Degidi M *et al.*, in their study evaluated the use of immediately loaded small diameter implants (3mm in diameter and 13mm in length). The mean marginal bone loss was found to be 0.49mm (n=34) as observed between baseline and 6th month. Whereas in our present study with the use of immediately loaded mini-implants (2.4mm in diameter and 13mm in length) the mean marginal bone loss was found to be 2.39mm (n=8) as observed at the end of 6th month. Absence of peri-implant radiolucency is another important criterion that decides successful osseointegration. In the present study, no peri-implant radiolucency was noted in the 3rd month and 6th month follow up periapical radiographs. In our study out of eight implants, 6 implants were placed in the anterior region and 2 implants in the posterior region. Andersen E *et al.*, in their study of single tooth implants placed in the anterior region of the maxilla with abutment placed 6 months following surgery compared the success rate and marginal bone resorption of narrow diameter self-tapping implants (3.25 diameters) and observed a mean marginal bone loss of 0.89mm 6 months following baseline. Whereas in our present study with the use of immediately loaded 2.4mm diameter implants placed anteriorly revealed a mean marginal bone loss of 2.75mm as observed from baseline to 6th month period of observation.

CONCLUSION

Seven patients (6 males and 1 female) from the outpatients of Rajah Muthiah Dental College and Hospital, Annamalai University with age group between 16-50 years were chosen for the study based on the selection criteria. 8 Mini-implants (diameter 2.4mm and length 13mm) of one-piece implant design were taken for clinical assessments, six in the anterior and two in the posterior segment.

The mean plaque index score increased from baseline to the 3rd and 6th month, and was statistically not significant. The mean gingival bleeding index score increased from baseline to the 3rd and 6th month, and was statistically not significant. There was an increase in probing pocket depth as observed from 3rd month to 6th month. There was a reduction in the mean marginal bone loss as observed (mesially and distally) between 3rd months to the 6th month. All implants were stable (without mobility) during the entire period of study. Absence of peri-implant radiolucency was observed at baseline, 3rd and 6th month postoperatively. A significant reduction in marginal bone loss around implants (mesially and distally), absence of clinical mobility of mini-implants and lack of peri-implant radiolucency at the 6th month follow-up were suggestive of successful osseointegration. The proposed treatment modality with mini-implants may serve as a useful option to rehabilitate a single tooth in both deficient ridges and in narrow interdental spaces. However, Further clinical trials with

- larger study population
- more number of mini-implants placed both in the anterior and the posterior segment.
- use of Computer tomography to assess the quality of bone, subtraction radiography to evaluate the previous loss of marginal bone
- ostell's device to check the stability of the implants

Longer follow-up are needed to validate the results of the present study.

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