

A short term comparative evaluation of effectiveness of early loaded versus delayed loaded single tooth implants- A clinical study

Abhishek Verma¹, Irfanul Huda^{2*}, Aaysha Tabinda Nabi³, M L Bhongade⁴

¹Professor, ^{2,3}Reader, ⁴Professor and HOD, ^{1,3,4}Dept. of Periodontology, ²Dept. of Prosthodontics, ^{1,3}Buddha Institute of Dental Sciences & Hospital, Patna, Bihar, ²Patna Dental College & Hospital, Patna, Bihar, ⁴SDC, India

***Corresponding Author: Irfanul Huda**

Email: drirfanul76@gmail.com

Abstract

Introduction: To study the evaluation of effectiveness of early loaded versus delayed loaded single tooth implants.

Aims & Objectives: To compare the effect of early loading implant (7-14 days) with delayed loading implant (4-5 months) after surgery on clinical and radiographic parameters, with 6 months follow-up.

Material and Methods: 20 systemically healthy patients present with single missing tooth either in maxilla / mandible were treated with either early loading or delayed loading of single tooth implant.

Results: Significant reduction in the plaque and papillary bleeding index at 6 months post-surgery indicated satisfactory improvement in oral hygiene and gingival condition. Delayed loaded implants group had a success rate of 100%, while early loaded implant group had 90%.

Keywords: Early loading, Delayed loading, Single tooth implant.

Introduction

Success in implant therapy for replacement of one or more missing teeth has been well documented for more than three decades.¹ They have been successful largely because of the development of design and implantation procedures that results in direct bone implant interface without detectable intervening fibrous tissue.² The original surgical protocol proposed by Adell and associates (1981)³ and Branemark and co workers (1977)⁴ considered a healing period of 3 to 6 months free from functional loading as optimal to achieve a successful osteointegration. The other reasons for using this approach were to prevent apical down growth of mucosal epithelium and to minimize the risk of infection due to early loading during the initial healing period. Therefore, 3 to 6 months stress free healing period was considered to be an ultimate pre requisite for this procedure. Only on completion of this healing period, mucosa piercing abutments are placed and the supra connections connected.⁵ Over the years this original Branemark protocol for implant placement proved to have a high level of predictability and success.

The biological rationale supporting this approach resides predominantly in the fact that implants micro movements caused by premature loading during wound healing may promote connective tissue incapsulation of the implant rather than healing by direct bone to implant contact. Therefore, emphasis during last 10 years has been the avoidance of micro movements, which can prevent osteointegration.⁶ If excessive micro movement is avoided, it is possible to achieve osteointegration even in early loading condition.

Implant therapy is now well established, and there is an increasing need for shorter rehabilitation time.⁷ In the last three decades, advances in biomaterial technology and continuous clinical research have provided clinicians with

improved protocols to provide more advanced treatment options. Some of the original pre requisites of osteointegration have been reassessed to satisfy continuously increasing patient's expectation of reduced treatment time, improved esthetics and increased comfort the long term success of early loaded implant has been investigated in animal and human studies. Rocuzzo et al (2001)⁸ assessed peri-implant condition of early loaded implants in a prospective split mouth controlled study and suggested that implant may very well suitable for early loading at 6 weeks. Recently Cochran et al (2002)⁹ in a prospective multicenter cohort study involving 133 patients with 383 implants found that implants could be successfully restored after 6 weeks of loading and yielded a success rate greater than 99%, two years after prosthetic restoration.

Considerable outcome variation have been reported on immediate or early implant loading for single tooth replacement Chau Shu et al (2001)¹⁰ compared survival rates of immediately loaded single tooth implant placed in fresh extraction sockets to those of immediately loaded single tooth implant placed in healed sites. The survival rates were 82.4% and 100% for immediate and non immediate implant, respectively. Ericsson et al (2000)¹¹ reported a clinical pilot study with follow up of 18 months for 14 patients with 14 implants placed according to a single stage surgical protocol and loaded with single temporary crown within 24 hours, two implants (14%) were lost upto 5 months in function. Glauser et al (2001)¹² reported in a prospective cohort study, 41 patients with 127 immediately loaded Branemark implants placed in various jaw locations and followed over 1 year. After of prosthetic loading, 22 implants were lost in 13 patients the cumulative survival rate amounted to only 82.7%.

Currently, because of improved implant design and understanding of the physiology of mechanical status,

inherent in the jaw and bone remodeling processes, early loading of implant placed in completely or partially edentulous jaw has gained acceptance in dental practice. Considerable outcome variations on immediate or early implant loading for single tooth replacement, Ericsson et al 2000¹¹ and Proussaefse 2002¹³ have shown the results and crestal bone changes to be equivalent to those with an established conventional protocol. However, to date there are insufficient data to determine a universally acceptable opinion on early loading of implants for single tooth replacement. Therefore, the aim of the present randomized parallel design clinical trial was to compare early loaded (within 1-2 weeks) with delayed loaded (4-5 months) single tooth implant in terms of survival and success rate by assessing peri implant changes in clinical parameters, radiographic bone level and implant stability.

Aims and Objectives

1. To evaluate success rate of early loaded implant by assessing peri-implant changes in clinical parameters, radiographic bone level and implant stability.
2. To evaluate success rate of delayed loaded implants by assessing peri-implant changes in clinical parameters, radiographic bone level and implant stability.
3. To compare peri-implant changes by measuring clinical parameters, radiographic bone level and implant stability between early loaded implants and delayed loaded implants.

Materials and Methods

A total of 20 patients age range 18 to 45 years with mean age of 31.15±7.28 mm were recruited based on their need for the restoration of a single missing tooth in either jaw from the outpatient department of Periodontics, Sharad Pawar Dental College, Sawangi (Meghe,) Wardha for the present study. A total of 20 patients, each with at least one missing tooth with adequate ridge configuration were selected and were found suitable for the study. Prior to surgery the selected patients were randomly assigned by a coin flip to the test and control group, each consisting of 10 patients according to randomized parallel design the test group was treated by immediate loading implants while the control group by delayed loading implants.

The patients were enrolled in the study using the following criteria:

Inclusion criteria

1. 18 years of age or older.
2. Single missing tooth in either mandible or maxilla.
3. Absence of soft tissue and dental pathology.
4. Sufficient available bone volume at implant recipient site equal to greater than 6mm width and equal to greater than 10mm in height.
5. Type I-Type III bone quality.
6. Natural tooth adjacent to edentulous space need to have an intact occlusal surface and free from infection.

Exclusion criteria

1. Compromised general health conditions that would jeopardize the bone healing process e.g. (diabetes, osteoporosis, blood disorders, allergies to titanium.)
2. History of Uncontrolled diabetes, Osteoporosis, Malignances, Eradiation and blood dyscrasias, history of corticosteroid therapy.
3. Severe Maxillomandibular space discrepancies.
4. Severe Para functional habits (bruxism or clenching.)
5. Mental illness
6. History of alcoholism or drug abuse.
7. Excessive smoking.
8. Type IV bone quality.
9. Previously angulated implant recipient site.
10. Width of keratinized gingiva lesser than 2mm at implant site.
11. Less than 5mm of bone width based on oral examination.
12. Less than 10mm of bone height based on radiographic examination

Initial therapy

After proper examination and diagnosis, initial therapy consisted of oral hygiene instructions, supragingival and subgingival scaling, root planing under local anesthesia, periodontal surgery and occlusal adjustment if necessary was performed. Plaque control instructions was repeated until the patients achieve a plaque score of ≤ 1 . Before entering the surgical phase, diagnostic cast of each patient. Maxillomandibular relationship was evaluated.

A diagnostic wax up of the failing natural tooth and a clear acrylic resin surgical drill guide was prepared to facilitate correct implant placement. Documentation included periodontal charting on specially designed chart, periapical and panoramic radiographs and intra-oral clinical photographs.

A) Clinical measurements

Clinical data was collected at baseline, at 3 months and at 6 months after implant placement. Recording of clinical data was carried out by the operator and the cross examiner in all the patients. The cross examiner was a postgraduate student from the department of Periodontics. Mean of these values were taken for the assessment of the results.

Patient oral hygiene status was evaluated by the plaque index (Turkesy-Gilmore-Glickman Modification of Quigley-Hein, 1970) as an expression of the level of full mouth supragingival plaque accumulation. Gingival inflammation was assessed by papillary bleeding index (Muhlemann H R 1977).

B) Probing measurements

Probing measurement recorded around each implants includes probing pocket depth (PPD) and clinical attachment level (CAL). Probing pocket depth and clinical attachment were recorded at four sites. (i.e. mesial, buccal, distal and lingual) of each implants by using a calibrated manual periodontal probe (UNC 15, Hu-Friedy, Chicago, USA) and rounded off to the nearest millimeter. The implant shoulder was used as a reference line for the

location of the mucosal margin. In addition, the width of the keratinized peri-implant mucosa was assessed on mid-buccal aspect of each implant.

C) Clinical Implant Mobility Scale (CIMS) (Reteitschak KH 1989)

The Technique to assess implant mobility are similar to those used for natural tooth mobility. Two rigid instrument apply a labiolingual force of approximately 500g. by using following criteria:

1. Absence of clinical mobility with 500g in any direction.
2. Slight detectable horizontal movement.
3. Moderate visible horizontal mobility up to 0.5 mm.
4. Severe horizontal movement greater than 0.5 mm.
5. Visible moderate to severe horizontal and any visible vertical movement.

D) Radiographic measurement

Bone level was measured by using Standardized intraoral Periapical radiograph. Radiograph was obtained at each implant site and base line, 3 month, and 6 month recall visit. To assess the changes at the interproximal alveolar crestal bone height, the distance from the implant shoulder to the most coronal bone to implant contact (DIB) was determined both at the mesial and distal aspect of each implant and was expressed in mm.

Results

20 systemically healthy patients 12 males and 8 females with a mean age of 31.15 ± 7.28 years (range 18 to 5 years) presented with single missing tooth either in maxilla/mandible and were treated either with early loading (test group) or delayed loading (control group) of single tooth implant. The test group had four maxillary central incisor missing and six mandibular molar missing, which were replaced by 10 Hi-tech implants (V-TPS) by early loading protocols, while the control group had 10 mandibular molar missing, which were replaced by 10 Pitt-Easy implants (SLA0 by delayed loading protocols. The sizes of implants in test group were of 2.8x13mm in 1, and 3.7x10 mm in 1, 3.7x10mm in 5 patients, while sizes of implant in control group were of 3.25x10mm in 4 patients, 3.25x12mm in 1, 3.7x10mm in 2 and 3.7x13mm in 5 patients, while size of implant in control group were of 3.25x10mm in 4 patients, 3.25x12mm in 1, 3.7x13mm in 5 patients.

During the course of the study, wound healing was uneventful. No implants had to be removed. None of the selected patients had dropped out before the termination of the study. One implant in the test group had clinical implant mobility score (C.I.M.S) greater than two due to periapical infection. Infection subsided after one week days following antibiotic coverage. The implant become stable after two weeks of antibiotic coverage and definite prosthesis was placed after 3 weeks.

The mean plaque index (PI) and papilla bleeding index (PBI) scores at baseline, 3 months and 6 months for test and control groups are shown in table 3. The mean PI score in test group at baseline was 0.79 ± 0.08 and at 3 months it was 0.43 ± 0.11 , while in control group it was 0.79 ± 0.03 at

baseline and 0.52 ± 0.04 at 3 months. The mean plaque score was decreased at 3 months in both control group as well as test group compared to baseline, and the difference was statistically significant in both the groups. At 6 months mean PI score was slightly increased in both test (0.45 ± 0.11) and control group (0.59 ± 0.04) compared to 3 months score. However, when comparison were made between 6 month and baseline value, the difference were statistically significant in both the groups the mean PI scores during 6 PBI score in test group was 0.75 ± 0.14 , while 0.77 ± 0.33 in control group and at 3 months, it was 0.39 ± 0.07 in test group and 0.52 ± 0.06 in control group. However, at 6 months, the man PBI scores was slightly increased in both test (0.41 ± 0.07) and in control group (0.60 ± 0.06) compared to 3 months score. PBI score when compared with baseline measurements versus 3 month and 6 month postsurgical measurements by using paired t-test, we observe statistically significant decrease in papillary bleeding index scores at 3 months and at 6 months in both the groups ($p > 0.000$) (Table 3).

Clinical Parameters at 3 and 6 months Probing pocket depth (PPD)

In the test group the mean PPD at 3 months was 2.59 ± 0.28 mm and at 6 months, it was reduced to 2.45 ± 0.46 mm (Table 4), while in the control group the mean PPD at 3 month was 2.59 ± 0.28 mm, which was increased to 2.66 ± 0.52 mm at 6 month (Table 5). At 6 months the difference in mean PPD reduction was 0.14 ± 0.69 mm in test group and 0.07 ± 0.44 for the control group. Student's paired t-test indicated that both the test (early loaded implant) and control (delayed loaded implant) groups showed non-significant differences in mean PPD reductions between 3 months to 6 months. When the differences in the mean PPD reduction for the test group (0.14 ± 0.69 mm) versus control group (0.07 ± 0.44 mm) at 6 months were analysed by students unpaired t-test, non significant difference was noted. A greater reduction in mean PPD was demonstrated in test group compared to the control group.

Clinical attachment level (CAL)

In the test group the mean CAL at 3 months was 2.59 ± 0.28 mm and that at 6 months was 2.45 ± 0.46 mm. In the control group, the mean CAL at 3 months was (2.59 ± 0.28) mm and at 6 months was 2.66 ± 0.52 mm, (Table 4,5). The mean CAL gain of 0.14 ± 0.69 mm was observed in the test group, while in the control group displayed mean CAL gain of -0.07 ± 0.44 mm. The observed difference between 3 months and 6 months CAL were analyzed by students paired t-test and were found to be statistically non significant in the both the groups. At 6 months the differences in mean CAL gain was 0.14 ± 0.69 mm for the test group and 0.07 ± 0.44 mm for the control group. Students unpaired t-test indicated that both the test and control groups showed non significant difference (Table 4,5) in mean CAL gain between 3 months to 6 months. When the difference in the mean CAL gain for test group (0.14 ± 0.69 mm) Versus control group (0.07 ± 0.44 mm) at 6 months were analysed by students unpaired t-test, non

significant difference was noted, which was significantly greater in the test group than in the control group (Table 7).

Width of Keratinized gingiva (WKG)

In the test group, the mean width of keratinized gingiva (WKG) at 3 months was 3.30 ± 0.48 mm, which was increased at the 6 months to 3.60 ± 0.51 mm, (Table 4) while in control group width of keratinized gingiva at 3 months was 3.30 ± 0.48 mm, which was slightly reduced to 3.15 ± 0.66 mm in 6 months (Table 5). When the difference in the WKG for the test group (-0.30 ± 0.67 mm) versus control group (0.15 ± 0.88 mm) were analyzed by students unpaired t-test at 3 months, statistically non-significant difference was observed between the groups (Table 4,5). The mean difference of WKG at 6 months for test group (0.45 ± 0.26 mm) when compared with control (0.20 ± 0.22 mm) difference was also statistically non-significant when analyzed by students un-paired t-test. (Table 6, 7).

Radiographic findings

In the test group, the level of marginal bone at baseline was 17.2 ± 3.61 mm and was reduced to at 6 months 15.0 ± 3.71 mm, at 6 months, while in control group it was 19.20 ± 1.22 mm at baseline and reduced to 15.90 ± 1.85 mm at 6 months (Table 8). Comparing the difference of marginal bone loss in test and control group, control group showed greater amount of marginal bone loss (3.30 ± 1.63 mm) at 6 months. The difference of marginal bone loss at 6 months between the test and control group was -1.1 ± 1.31 mm (Table 8).

Implant mobility

In the test group, implant stability by mean CIMS score at 3 months was 0.70 ± 0.67 mm which reduced to 0.50 ± 0.84 mm at 6 months (Table 10). At 3 months follow up the mean difference of test and control group was 0.30 ± 0.48 mm, while at 6 months follow, up the mean difference between test and control group was 0.20 ± 0.63 mm (Table 11) and the difference was statistically non-significant.

Table 1: Distribution of single tooth edentulous sites treated with implants

Location	Number of implants	
	Test group	Control group
Maxillary central region	4	-
Mandibular molar region	6	10

Table 2 Dimensions of implants (Control group)

Dimesions (diameter and Number of implants length) (mm)	Number of implants	
	Test group	Control group
2.8x10	3	-
2.8x13	1	-
3.25x10	-	4
3.25x12	-	1
3.7x10	1	2
3.7X13	5	3

Table 3: Full mouth Plaque (PI) and full mouth Papillary bleeding Index (PBI) scores at Baseline, 3 months and 6 months follow-up (MV±SD)

Parameters	Group	Baseline	3 months	Difference	6 months	Difference
PI	Test	0.79±0.08	0.43±0.11	0.35±0.14S	0.45±0.11	0.33±0.15S
	Control	0.79±0.03	0.52±0.04	0.27±0.06S	0.59±0.04	0.20±0.05S
PBI	Test	0.75±0.14	0.39±0.07	0.36±0.11S	0.41±0.07	0.34±0.12S
	Control	0.77±0.03	0.52±0.06	0.25±0.09S	0.60±0.06	0.17±0.10S

S-Statistically Significant (P<0.05)

Table 4: Comparison of clinical parameters at implant site between 3 months and 6 months follow-up in Test group (Early loaded implants) (MV± Sd; in mm)

Parameters	3 months	6 months	Difference	P-value
Probing Pocket Depth (PPD)	2.59±0.28	2.45±0.46	0.14±0.69	0.543 NS
Clinical attachment Level (CAL)	2.59±0.28	2.45±0.46	0.14±0.69	0.543 NS
Width of Keratinized gingival (WKG)	3.30±0.45	3.60±0.51	-0.30±0.67	0.193 NS
Plaque index (PI)	0.43±0.11	0.45±0.11	-0.02±0.01	0.000 S
Papillary bleeding Index (PBI)	0.39±0.07	0.41±0.07	-0.02±0.01	0.001 S

S-Statistically Significant (P<0.05) NS- Statistically non-significant (P>0.05)

Table 5: Comparison of clinical parameters at implant sites between 3 months and 6 months Follow-up in Control group (Delayed loaded implants) (MV \pm SD; in mm)

Parameters	3 months	6 months	Difference	p-value
Probing pocket Depth (PPD)	2.59 \pm 0.28	2.66 \pm 0.52	-0.07 \pm 0.44	0.633 NS
Clinical attachment Level (CAL)	2.59 \pm 0.28	2.66 \pm 0.52	-0.07 \pm 0.44	0.633 NS
Width of keratinized Gingival (WKG)	3.30 \pm 0.48	3.15 \pm 0.66	0.15 \pm 0.88	0.604 NS
Plaque index (PI)	0.52 \pm 0.04	0.59 \pm 0.04	-0.07 \pm 0.04	0.001 S
Papillary bleeding index (PBI)	0.052 \pm 0.06	0.60 \pm 0.06	-0.07 \pm 0.01	0.000 S

Table 6: Comparison of clinical parameters at implant sites between Test group (Early loaded implants) and control group (Delayed loaded implants) at 3 months follow-up. (MV \pm SD; in mm)

Parameters	Test Group	Control Group	Difference	p-value
Probing pocket Depth (PPD)	2.59 \pm 0.40	2.59 \pm 0.28	0.00 \pm 0.15	1.00 NS
Clinical attachment Level (CAL)	2.59 \pm 0.40	2.59 \pm 0.28	0.00 \pm 0.15	1.00 NS
Width of keratinized Gingival (WKG)	3.50 \pm 0.52	3.30 \pm 0.48	0.20 \pm 0.22	0.38 NS
Plaque index (PI)	0.90 \pm 0.39	0.60 \pm 0.21	0.30 \pm 0.14	0.005 NS
Papillary bleeding index (PBI)	0.70 \pm 0.25	0.10 \pm 0.17	0.10 \pm 0.09	0.32 NS

NS- Statistically non-significant (P>0.05)

Table 7: Comparison of clinical parameters at implant sites between Test group (Early loaded implants) and control group (Delayed loaded implants) at 6 months follow-up. (MV \pm SD; in mm)

Parameters	Test Group	Control Group	Difference	p-value
PPD Reduction	2.45 \pm 0.46	2.66 \pm 0.52	-0.21 \pm 0.22	0.354 NS
CAL Gain	2.45 \pm 0.46	2.66 \pm 0.52	-0.21 \pm 0.22	0.354 NS
Width of keratinized Gingival (WKG)	3.60 \pm 0.51	3.15 \pm 0.66	0.45 \pm 0.26	0.100 NS
Plaque index (PI)	0.90 \pm 0.21	0.85 \pm 0.41	0.05 \pm 0.14	0.738 NS
Papillary bleeding index (PBI)	0.72 \pm 0.24	0.75 \pm 0.40	-0.02 \pm 0.15	0.871 NS

NS- Statistically non-significant (P>0.05)

Table 8: Comparison of radiographic bone loss at implant sites between test (Early loaded implants) and control group (Delayed loaded implants) Group at 6 months follow-up. (MV \pm SD; in mm)

Group	Amount of Bone present At baseline (mm)	Amount of Bone present At 6 Months (mm)	Amount of Bone loss at 6 Months (mm)	p-value
Test	17.2 \pm 3.61	15.0 \pm 3.71	2.20 \pm 0.63	0.000 NS
Control	19.20 \pm 1.22	15.90 \pm 1.85	3.30 \pm 1.63	0.000 NS
Difference	-2.00 \pm 1.20 (0.115,NS)	-0.90 \pm 1.31 (0.501,NS)		

S- Statistically Significant (P<0.05).

Table 10: Measurement of implant stability using clinical implant mobility Scale (CIMS) at 3 months and at 6 months in test group

S. No.	Site of Implant		CIMS score at 3 Months	CIMS score at 6 months	Difference
1		6	0	0	0
2	6		0	0	0
3		6	1	1	0
4		6	1	0	1
5	6		1	0	1
6	6		0	0	0
7		6	2	2	0
8	6		1	2	-1
9			0	0	0
10		6	1	0	1
Mean			0.70±0.67	0.50±0.84	0.20±0.63 0.08,NS)

NS- Statistically non-Significant (P>0.05)

Table 9: Measurement of implant stability using clinical implant mobility Scale (CIMS) at 3 months and at 6 months in test group

S. No.	Site of Implant		CIMS score at 3 Months	CIMS score at 6 months	Difference
1		6	0	0	0
2	6		1	0	1
3		1	0	0	0
4	1		1	1	0
5	6		0	0	0
6	1		0	0	0
7	1		0	0	0
8	6		1	0	1
9		1	1	1	0
10		6	1	0	1
Mean			0.50±0.52	0.20±0.42	0.30±0.48 0.08,NS)

NS- Statistically non-Significant (P>0.05)

Table 11: Comparison of implant stability in test and control group at 3 months and at 6 months

Parameter	At 3 months follow up			At 6 months follow up		
	Test	control	Difference	Test	control	Difference
Clinical Implant Mobility Scale (CIMS)	0.50±	0.20±	0.30± 0.48	0.70±	0.50±	0.20± 0.63
	0.52	0.42	0.08,NS)	0.67	0.84	(0.343,NS)

NS- Statistically non-Significant (P>0.05)

Discussion

In the present study, one implant in the test group showed mobility score 2 (CIMS) at two months after restoration due to peri-apical infection. However after one week antibiotic therapy, peri-apical infection resolved with decreased in implant mobility after two weeks and implant become stable. The definite prosthesis was placed after 3 weeks. It should be noted, however, that at 6 months examination, same implant presented no clinical or radiographic differences from the other implant presented no clinical or radiographic differences from the other implants. Hence, the observation of occasional complications does not seem to questioned the overall success of early loading⁸ Cooper et al (2001),¹⁴ encountered three technical complications regarding porcelain fracture, which were observed in the duration of 4 years, It was considered that the porcelain fractures might have resulted from local Premature contacts and relatively higher chewing forces in the males. No abutment screw loosening/fracture was found. These differences may result from the patient-related factors (i.e, different chewing forces) and different types of abutments/abutment screws, porcelains, and metals used.

Each subject participated in the study showed a good oral hygiene level and a healthy clinical gingival condition throughout the duration of the study. The plaque index (PI) score was low at the baseline and remained low during 6 months period (<1). This was the result of the repeated oral hygiene instructions given to the patients throughout the study period. Plaque control is essential to minimize the influence of excessive plaque accumulation on the long term stability of clinical outcomes. It has been pointed out that clinical outcome of various forms of surgical interventions are influenced by general level of oral hygiene. Papillary bleeding index (PBI) score was significantly reduced at 6 months post surgery. The influence of oral hygiene on implant success has been controversial¹⁵. However, it is generally agreed that plaque accumulation could induce negative mucosal response. In the present study on significant differences were observed in modified plaque index score at implant site in both the groups throughout the of the study period. The majority of scores were 0, implying. Since brushing to the surgical site was not recommended within the first month of implant surgery to minimize unnecessary disturbance to the healing process, oral hygiene was maintained by lightly wiping the area with a cotton swab soaked with 0.12% chlorhexidine gluconate (Peridex Procter & Gamble).

At 3 months, 5 out of 10 early loaded implants, showed score one mobility (CIMS) score, After 6 months the

mobility subsided in 3 of 5 implants and 2 implants showed score one mobility (CIMS) score. In the control group at 3 months, 5 out of 10 implants showed score one mobility and 2 implants showed score two mobility (CIMS) score. At 6 months, out of 5 implants, only one displayed score one mobility and two out of 10 showed score 2 mobility (CIMS). In the present study, the Survival rate of implants in control group (delayed loading implants) was 100% at 6 months follow-up while in test group (early loading implants) it was 90%. Findings in the present study are comparable with previous reported study. Norton (2004),¹⁶ reported 96.4% survival rate for immediately loaded implants 20.3 months (range 13-30 months). After implant placement while Cooper and colleague (2001)¹⁴ reported 96.2% survival rate for single tooth implants restored 3 weeks after the surgery. Ericsson and associates (2000)¹¹ published the results of a pilot study in which they compared the success rate of 14 implants restored immediately with single crown restoration with those of 8 implants loaded following the standard protocols. They reported survival rates of 86% in the immediate loaded group and 100% in the standard restoration group.

In the study, the mean marginal bone loss at 6 months in the test group was 2.20 ± 0.63mm, while in the control group it was 3.30 ± 1.63mm, showing significantly greater amount of marginal bone loss in delayed loaded implant group. Turkyilmaz et al (2007) reported the average marginal bone loss for the test and control group 0.7 and 0.81 mm at one year recall, and 1.06 and 1.16 mm at 4 year recall, respectively. Vigolo and colleague (2004) reported 0.8 mm marginal bone loss for implant supported single crown 4 year after implant placement. Glauser and colleague (2003), reported 1.2 mm marginal bone loss from 99 Branemark implants. In the present study marginal bone loss observed in both the groups at 6 months follow-up was higher than previous reported studies. It could have been resulted from the distribution of the implant sites, as the majority of the implant in the present study were placed (16 out 20) in the posterior region (80%) where bone quality is relatively poor.

In the present study, the mean clinical attachment level at 3 months at the test group (early loading) was (2.59±0.28) mm similar to the control group (delayed loading) and difference was not statistically significant. At 6 months the mean clinical attachment level in the test group was (2.45±0.46) mm while in the control group was (2.66±0.52) mm however, the difference between the group was not statistically significant. Weber et al (2000) found that attachment level surrounding the implants were stable over the study period and it was fluctuated over the 5 year period.

Similar observation have been made by several investigators.^{17,18}

In the present study, the soft tissues were healthy over the entire observation period both in the test and control group. In one case in test group there was temporary swelling of the peri-implant mucosa which was due to the peri-apical infection, and disappeared after resolution of the infection. The mean pocket depth at 3 months was 2.59 ± 0.28 mm in test group and 2.59 ± 0.28 mm in control group, while at 6 months in test group it mean PPD was 2.45 ± 0.46 mm and in control group was 2.66 ± 0.52 mm. Haas et al (1995), reported healthy soft tissues around the implant over the entire observation period despite the subgingival crown margin (gingival index of 0 and 1 in the last recall examination), Temporary swelling of the peri-implant mucosa was always due to a loosening of the suprastructure and completely disappeared after mechanical stabilization of the crown. The mean pocket depth was 2.2 mm. Other studies covering an equally long recall period reported similar findings with regard to soft tissue conditions.¹⁹

Most standard protocols in implant dentistry suggest a healing period of 3 months for mandible and 6 months for maxilla. However, the time required for treatment, the need for additional surgical procedures, and especially the need for indefinite periods of temporization are obstacles that sometimes prevent the patients from implant treatments. To remove these obstacles, it would be beneficial to load implants within the few weeks after implant placement. Studies regarding different types of prostheses have shown that early loading of mandibular implants can provide treatment outcomes comparable to those achieved using standard healing periods before loading. The early loading of implants supporting a full arch prosthesis in edentulous maxilla has also been studied.²⁰ However, only a few studies regarding early loading of implants- supported single-tooth crowns in the maxilla are available in the literature.²¹ In the present study, both the test and control implant showed similar clinical and radiographic results after 6 months, suggesting that 15 to 16 weeks of unloaded healing in the control group did not further improve the treatment outcome. The result of the present study, therefore, suggests that single tooth implant may be loaded with predictable outcome as early as two weeks after installation. Further, clinical and histological studies are necessary to promote clinical application of this technique.

Conclusion

Functional loading of single tooth implant as early as 1 to 2 weeks resulted 90% survival rate at 6 months follow-up and delayed loading of single tooth implant period of 4 to 5 months resulted 100% survival rate. Mean marginal bone was significantly greater in delayed loaded implants compared to early loaded implants at 6 months follow-up.

Source of funding

None.

Conflict of interest

None.

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How to cite this article: Abhishek Verma, Irfanul Huda, Aaysha Tabinda Nabi, M L Bhongade. A short term comparative evaluation of effectiveness of early loaded versus delayed loaded single tooth implants- A clinical study. *Int J Periodontol Implantol* 2019;4(3):79-87.