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Research Article

Evaluation of Hard and Soft Tissues around Immediately Placed Implants with Immediate Loading Versus Immediately Placed Implants with Delayed Loading: A Clinical and Radiographic Study

Waqas Naseer Ansari*, Sangeeta D Muglikar, Prerna Sanjay Ghodke, Salika Sheikh, Rashmi V Hegde

Department of Periodontology and Oral Implantology, Rangoonwala University of Dental Sciences and Research Centre, Pune, India

ABSTRACT

Evaluation of Hard and soft tissues around immediately placed implants with immediate loading versus immediately placed implants with delayed loading- A clinical and radiographic study Introduction: Teeth can be lost due to many reasons such as trauma, caries or periodontal disease. The classic and conventional protocols of implant placement usually have a waiting period of 6 months or more. In anterior aesthetic regions, it hampers patient satisfaction and confidence levels irrespective of the age or gender of the patient. To avoid this embarrassment, new protocol of immediate implant placement with immediate loading or immediate implant placement with delayed loading was developed.

Aim: The aim of the study was to evaluate the impact of immediately placed and immediately restored single tooth implant on hard and soft tissue and to compare it with immediately placed and delayed restored implants in the maxillary and mandibular anterior region.

Methods: The study was conducted on 30 patients, which were divided into 2 groups. Maxillary and mandibular anterior regions were included in the study. Based on coin toss method and insertion torque of the implants, they were divided into immediately placed with immediately loading and immediately placed with delayed loading. Soft and hard tissue parameters were measure as such, Soft tissue assessment: 1) Soft tissue thickness (measured at baseline, 1 month and 3 months) 2) Implant esthetic score (measured at 1 week, 1 month and 3 months) Hard tissue assessment–crestal bone level (measured at baseline and 3 months)

Results: Comparing Group A and Group B, there was no significant difference in the mean soft tissue thickness after 1 month and 3 months. For the implant esthetic score, there was no statistically significant difference seen between Group A and Group B. Considering Crestal bone levels, at baseline and 3 months, the levels were higher in the immediate loading cases as compared to the delayed loading cases.

Conclusion: There was no statistically significant difference in soft tissue thickness in both the groups, for the implant esthetic score, it was higher for the immediately loaded group compared to the delayed loading group. Crestal bone levels were higher for immediately loaded groups as compared to delayed loaded groups.

Keywords: Immediate placement; Immediate loading; Delayed loading; Implant placement

Abbreviations: ITI: International Team for Implantology; IOPA: Intra-Oral Peri-Apical; RVG: Radiovisuogram; CBCT: Cone Beam Computed Tomography; HCl: Hydrogen Chloride; SPSS: Statistical Package for Social Studies; ANOVA: Analysis of Variance

Correspondence to: Waqas Ansari, Department of Periodontology and Oral Implantology, Rangoonwala College Of Dental Sciences and Research Centre, Pune, India; Tel: +918169849781, E-mail:drwaqasansari@yahoo.com

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INTRODUCTION

The ultimate goal of modern dentistry is to restore normal colour, contour, function, comfort, aesthetics, speech and health, regardless of atrophy, disease or injury of the stomatognathic system.

In the past few years, dental implants have revolutionized the oral rehabilitation procedure for partially and fully edentulous patients and have become the treatment of choice to replace missing teeth. An important aspect in the field of implant dentistry was the introduction of osseointegration by Brånemark in 1977 [1].

Teeth can be lost due to a number of reasons like caries, trauma or periodontal disease. Classic and conventional protocols of implant placement usually have a waiting period of 6 months or longer for bone healing following the tooth extraction to place a dental implant. This waiting period in case of loss of anterior teeth has a negative impact on aesthetics, patient satisfaction and confidence levels irrespective of age and sex of the patient. Therefore to avoid the embarrassment of missing teeth, a new protocol of immediate placement and immediate loading or immediate placement and delayed loading was developed.

According to the systematic review by Esposito et al, patients prefer lesser time duration treatment protocols than conventional implant placement with a delayed approach which increases the treatment time [2].

The advantages are evident: a decrease in the number of surgeries and of the overall treatment time, [3,4] ideal implant orientation, [5] bone preservation in the extraction area [6-8] and optimum aesthetics of the soft tissues [9] by prevention of collapse of the underlying hard tissues. However, it has been reported that immediate implant placement may be affected by presence of infection, lack of soft tissue closure, flap dehiscence over the extraction site and incongruity between shape of implant body and socket wall leading to gaps between bone and implant [10].

Also the dimensional changes following tooth extraction occur and are not mitigated by immediate implant placement, which may lead to compromised long‐term aesthetic outcomes [11].

So taking everything into consideration a new classification system for the different timing of implant placement after extraction was proposed at the Third ITI Consensus Conference [10]. These options include the following: (a) Immediate implant placement on the day of extraction (Type 1), (b) Early implant placement after 4–8 weeks of soft tissue healing (Type 2), (c) Early implant placement after 12–16 weeks of partial bone healing (Type 3), and (d) Late implant placement after complete bone healing of at least 6 months (Type 4).

Similarly after the placement of dental implants, a 3–6 month load-free healing period has been traditionally suggested as the optimal period to ensure successful healing and osseointegration [12-17].

Hence, the present study was conducted to evaluate the impact of immediately placed implants with immediate loading as compared to immediately placed implants with delayed loading on single tooth replacement and its effect on the hard and soft tissues surrounding it in maxillary and mandibular anterior region.

MATERIALS AND METHODS

The present study comprises of analysis done on 30 implant sites in a total 30 patients which included 14 females and 16 males in an age group ranging from 21 to 52 years of age with mean age of 38 years. Patients were selected among those visiting the Out Patient Department of Periodontology and Oral Implantology. The study was approved by the Ethical committee of the institution and written informed consent was obtained from the patient.

Inclusion and exclusion criteria were followed for the allotment of patients into the respective groups. Inclusion criteria was systemically healthy patients, patients aged between 18 and 60 years of age, adequate bone height apical to tooth to be indicated for extraction (≥ 5 mm to provide good implant stability) and absence of periapical pathology and infection in tooth to be extracted. Exclusion criteria was subjects who have untreated periodontal disease, pregnant women and lactating mothers, individuals who use any form of oral substance abuse, subjects having inadequate mouth opening and any visual signs of bruxism.

The patients were divided into two groups based on coin toss method with 15 patients in each group.

Group A: Immediate placement of the implant followed by immediate loading.

Group B: Immediate placement of the implant followed by delayed loading.

The parameters assessed were:

- Soft tissue assessment.
- Soft tissue thickness (measured at baseline, 1 month and 3 months) [18].
- Implant esthetic score (measured at 1 week, 1 month and 3 months) [19].
- Hard tissue assessment.
- Crestal bone level (measured at baseline and 3 months).

Pre-treatment assessment was done, after Phase I therapy, by performing routine haematological investigations such as hemogram and blood sugar levels. Standard IOPA's using RVG with grids and diagnostic casts were made of all the patients. Surgical planning with the help of CBCT scan was done (Figure 1). Presurgical pictures were taken from (Figure 2 and Figure 3).

Figure 1: Cone Beam Computed Tomography (CBCT) machine.

Figure 2: Pre-operative assessment picture (Group A).

Figure 3: Pre-operative assessment picture (Group B).

Surgical procedure

The peri-oral area was painted with 5% betadine solution. Oral disinfection was performed using 10 ml 0.2% chlorhexidine di-gluconate mouthwash. Surgery was performed under local infiltration using 2% Lignocaine HCl with adrenaline 1:2,00,000. The involved tooth was extracted after elevating the flap by giving crestal incision (Figures 4-6), taking care not to fracture the cortical plates and implants were placed immediately into socket following osteotomy preparation (Figure 7 and Figure 8).

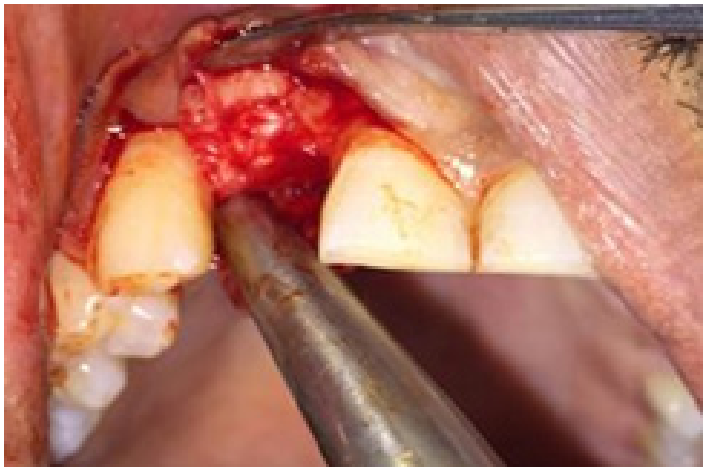

Figure 4: Flap reflection (Group A).

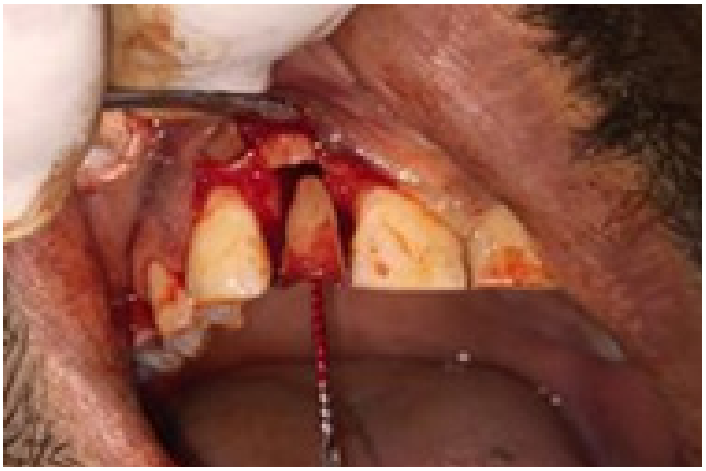

Figure 5: Atraumatic extraction done using 70 no. K file (Group A).

Figure 6: Flap reflection and atraumatic extraction done (Group B).

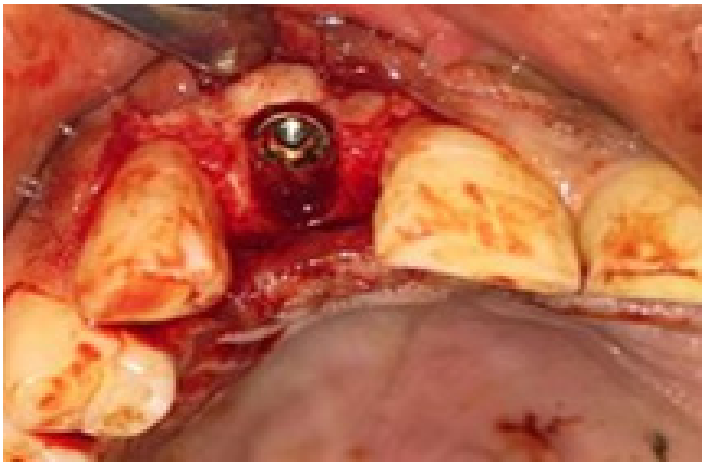

Figure 7: Implant placement done (Group A).

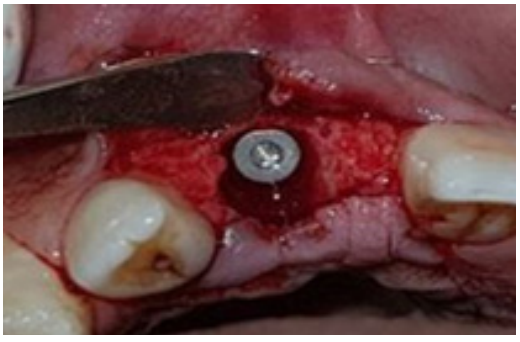

Figure 8: Implant placement done (Group B).

For implant placement, osteotomy site was prepared by a series of gradually larger drills with a speed of 800-1200 rpm was used. Chilled saline irrigation was used to prevent thermal damage. If the torque generated was less than 40 Ncm, then only delayed loading protocol was followed. Parameters were assessed, radiographs using RVG were made and sutured were placed. Postsurgical antibiotics and analgesics were given

Prosthetic phase

For Group A, immediate loading was done within 48 hours of the surgery. The abutment was connected (Figure 9) and impressions were made (Figure 10) Bite registration was recorded with wax. The temporary prosthesis was made out of heat cured acrylic resin and kept out of occlusion (Figure 11 and Figure 12). For Group B, cover screw was placed (Figure 13) and loading was performed after 3 months.

Figure 9: Provisional abutment placed and sutures given (Group A).

Figure 10: Impression made and sent to the laboratory (Group A).

Figure 11: Milled provisional abutment (Group A).

Figure 12: 1 week follow up (Group A).

Figure 13: Gingival former placed (Group B).

Soft tissue assessments were done at 1 week (Figure 12), one month (Figure 14) and 3 months (Figure 15 and Figure 16) and RVG's were made to measure the crestal bones levels at the specified follow up periods (Figures 17-20).

Figure 14: 1 month follow up (Group A).

Figure 15: 3 months follow up (Group A).

Figure 16: 3 months follow up (Group B).

Figure 17: RVG at implant placement (Group A).

Figure 18: RVG at 3 months post-implant placement (Group A).

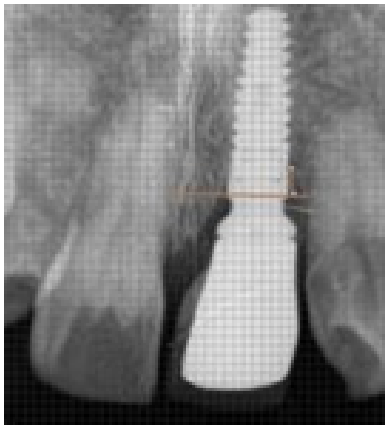

Figure 19: RVG at implant placement (Group B).

Figure 20: RVG at 3 months post-implant placement (Group B).

STATISTICS

An independent statistician performed the following tests for this study. Statistical Package for Social Studies (SPSS) 22.0, IBM Analytics, New York, USA was used to carry out the statistical tests. The data was initially tested for normality of distribution by using the Kolmogorov-Smirnov (K-S) test. The data was found to be normally distributed. Hence parametric tests were used. For comparing the mean outcomes of 2 groups the unpaired student t- test was used. The mean of 3 groups were compared using the ANOVA (Analysis of Variance) followed by the Post Hoc test. The difference in proportions was checked using the Chi- square test. All p-values<0.05 were considered to be statistically significant.

RESULTS

The present study was performed to evaluate the soft and hard tissue changes around immediately placed implants with immediate loading versus immediately placed implants with delayed loading.

Thirty patients were selected and divided into two groups based on coin toss into Group A (immediate loading) and Group B (delayed loading group). Group A involved 8 females and 7 males with the mean age of 36 years with a range of 18-64 years. (Table 1) Group B involved 6 females and 9 males with the mean age of 34 years and with a range of 25-60 years. All the patients selected for the study irrespective of their sex and age represented equally in both the groups.

Table 1: Tally for discrete variable of sex.

Group-1	Count	Percent	Group-2	Count	Percent
F	8	53.33	F	6	40
M	7	46.66	M	9	60
N	15		N	15	

All the implants were stable and none of the implants lost osseointegration during the study period in both the groups. As coin toss method was used to assign patients into their respective groups, even the insertion torque values were used to decide whether the implant should be loaded immediately or not. At the end of the study it was seen that all patients assigned to their respective groups, based on coin toss method, followed the loading protocol and none were shifted to the delayed placement group (Group B) based on insertion torque.

Soft tissue thickness which was measured at baseline, 1 month and 3 months showed the mean STT readings as Group A and B was

1.61 ± 0.042 and 1.63 ± 0.035 at baseline, 1.62 ± 0.048 and 1.63 ± 0.041 at 1 month and 1.62 ± 0.044 and 1.64 ± 0.042 at 3 months respectively (Table 2, Figure 21).

Table 2: Mean and standard deviation of the soft tissue thickness at baseline, 1 month and 3 months interval in immediate loading and delayed loading groups.

	Immediate loading			Delayed loading		
	Baseline	1 month	3 months	Baseline	1 month	3 months
Mean	1.61	1.62	1.62	1.63	1.63	1.64
Standard deviation	0.042	0.048	0.044	0.035	0.041	0.042

Intragroup comparison for Group A showed no statistical significant difference in the mean outcome of the soft tissue thickness at baseline, 1 month and 3 months interval in the immediate loading group (p-value<0.78 for all) (Table 3). Similarly Post Hoc test was also done and it was concluded that there was no statistically significant difference in the mean outcome of the soft tissue thickness at baseline, 1 month and 3 months interval in the immediate loading group (p-value=0.814,0.814 and 1 respectively) (Table 4).

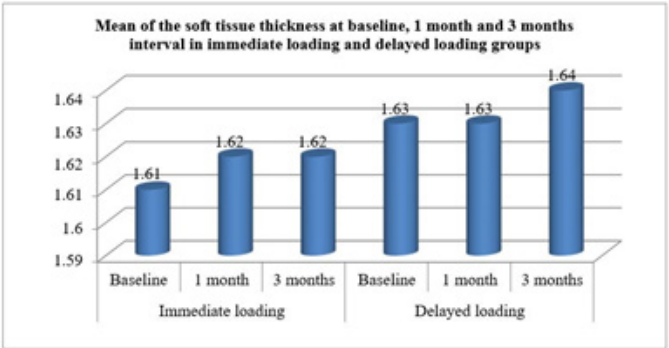

Figure 21: Graph of mean of the soft tissue thickness at baseline, 1 month and 3 months interval in immediate loading and delayed loading groups.

Intragroup comparison for Group B showed no statistical significant difference in the mean outcome of the soft tissue thickness at baseline, 1 month and 3 months interval in the immediate loading group (p-value<0.727 for all) (Table 5).

Similarly Post Hoc test was also done and it was concluded that there was no statistically significant difference in the mean outcome of the soft tissue thickness at baseline, 1 month and 3 months interval in the delayed loading group (p-value=0.814,0.814 and 1 respectively) (Table 6).

Table 3: Intra groups statistical analysis of variance (ANOVA) of the soft tissue thickness at baseline, 1 month and 3 months interval in immediate loading group (Group A).

Source of variation	Sum of squares	Degree of freedom	Variance	F value	p-value	Inference
Between groups	0.01	2	0.0005	0.2498	0.78	Not significant
Within groups	0.0841	42	0.002			
Total	0.0851	44				

Table 4: Post Hoc test for the soft tissue thickness at baseline, 1 month and 3 months interval in immediate loading group (Group A).

Group	Difference	95% confidence interval range	p-value	Inference
baseline *vs.* 1 month	0.001	-0.0297 to 0.049	0.814	Not significant
baseline *vs.* 3 months	0.01	-0.0297 to 0.0497	0.814	Not significant
1 month *vs.* 3 months	0	-0.0397 to 0.0397	1	Not significant

Table 5: Intra groups statistical analysis of variance (ANOVA) of the soft tissue thickness at baseline, 1 month and 3 months interval in delayed loading group (Group B).

Source of variation	Sum of squares	Degree of freedom	Variance	F value	p-value	Infereence
Between groups	0.001	2	0.005	0.3212	0.727	Not significant
Within groups	0.065	42	0.0016			
Total	0.0664	44				

Table 6: Post Hoc test for the soft tissue thickness at 1 week, 1 month and 3 months interval in delayed loading group (Group B)..

Group	Difference	95% confidence interval range	p-value	Inference
baseline *vs.* 1 month	0	-0.0350 to 0.0350	1	Not Significant
baseline *vs.* 3 months	0.01	-0.0250 to 0.0450	0.76	Not Significant
1 month *vs.* 3 months	0.01	-0.0250 to 0.0450	0.76	Not Significant

Comparing Group A and Group B, there was no significant difference in the mean tissue thickness after 1 month and 3 months in both the groups (p value 0.158 and 0.1229 respectively) (Table 7).

Implant esthetic scores were assessed at one week, one month and 3 months. The mean values for Group A and B were 7.9 and 7.4 (1st week), 7 and 6.8 (1 month) and 6.7 and 5.6 (3 months) respectively. (Table 8, Figure 22) Intragroup comparison for Group A showed no statistically significant difference (p-value=0.21, 0.28 and 0.14 respectively).

Table 7: Intergroup comparison of soft tissue thickness of immediate and delayed loading groups.

Time	t value	p-value	Inference
Baseline	-1.967	0.0297	Significant
1 month	-0.1702	0.158	Not Significant
3 months	-1.185	0.1229	Not Significant

Table 8: Distribution of study population based on the mean of the overall implant esthetic score in both the groups.

	Immediate loading	Delayed loading	p-value	Inference
1 week	7.9 ± 1.07	7.4 ± 0.92	0.134	Not significant
1 month	7 ± 1.06	6.8 ± 1.10	0.28	Not significant
3 months	6.7 ± 1.42	5.6 ±0.97	0.01	Significant

Intragroup comparison for Group B showed no statistically significant difference (p-value=0.38, 0.37 and 0.35 respectively). Comparing Group A and Group B, there was no statistically significant difference seen (p-value<0.25 at 1 week, p-value<1 at 1 month and p-value<0.59 at 3 months) (Table 9).

Crestal bone level was measured at baseline and 3 months. The mean crestal bone level on the mesial and distal aspect of the immediate loading cases (Group A) was significantly higher than that of the delayed loading cases (Group B) at baseline (p=0.0034 and p=0.029 respectively) (Table 10 and Table 11).

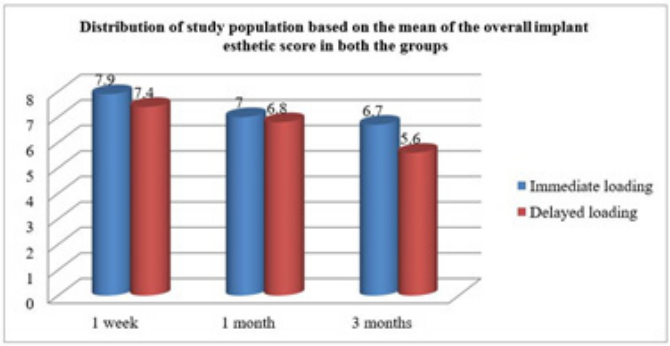

Figure 22: Graph of distribution of study population based on the mean of the overall implant esthetic score in both the groups.

Table 9: Intergroup comparison of immediate and delayed loading.

Score	Immediate loading						Delayed loading					
	1 week		1 month		3 months		1 week		1 month		3 months	
	p-value	Inference	p-value	Inference	p-value	Inference	p-value	Inference	p-value	Inference	p-value	Inference
Perfect	0.2	NS	0.2	NS	0.2	NS	0.3	NS	0.3	NS	0.3	NS
outcome	1		8		1		8		8		7	
Acceptable	0.2	NS	0.2	NS	0.2	NS	0.3	NS	0.3	NS	0.3	NS
outcome	8		8		8		5		5		7	
Compromised	0.1	NS	0.2	NS	0.1	NS	0.3	NS	0.3	NS	0.3	NS
outcome	4		1		4		5		5		8	

Table 10: Intra group analysis of the mean outcome of the crestal bone level at baseline and after 3 months in immediate loading (Group A)

Group		t value	Degree of freedom	p value	Inference
Immediate loading	Mesial at baseline and after 3 months	-6.58	28	0	Significant
	Distal at baseline and after 3 months	8.923	28	<0.000000	Significant

Table 11: Intra group analysis of the mean outcome of the crestal bone level at baseline and after 3 months in delayed loading (Group B).

Delayed loading	Mesial at baseline and after 3 months	-8.15	28	0	Significant
	Distal at baseline and after 3 months	-7.762	28	<0.000001	Significant

The mean crestal bone level on the mesial and distal aspect of the immediate loading cases (Group A) was significantly higher than that of the delayed loading cases (Group B) after 3 months (p=0.005 and p=0.002 respectively) (Tables 12 and 13; Figure 23).

Table 12: Inter group analysis of the mean outcome of the crestal bone level at baseline and after 3 months.

Immediate *vs.* delayed	Mesial at baseline	3.19	28	0.0034	Significant
	Mesial after 3 months	2.29	28	0.029	Significant
	Distal at baseline	3.91	28	0.0005	Significant
	Distal after 3 months	4.15	28	0.0002	Significant

Table 13: Mean and standard deviation of the crestal bone level at baseline and after 3 months in immediate and delayed loading groups.

	Immediate loading				Delayed loading			
	At baseline		After 3 months		At baseline		After 3 months	
	Mesial	Distal	Mesial	Distal	Mesial	Distal	Mesial	Distal
Mean	0.31	0.46	0.46	0.63	0.24	0.37	0.41	0.55
Standard deviation	0.072	0.06	0.051	0.04	0.045	0.064	0.067	0.063

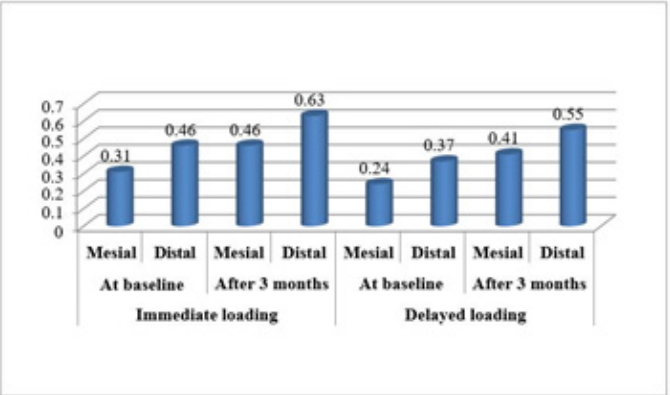

Figure 23: Graph of the mean of the crestal bone levels at baseline and after 3 months in immediate and delayed loading groups.

DISCUSSION

Replacement of missing teeth by dental implant-supported restoration has become a well-established and predictable treatment option. In the anterior zone, the success of implant therapy is not only determined by high survival rates but even more by the quality of survival, dictated by a mixture of several factors. For clinicians, several implant placement protocols are available. One of them is the immediate placement of implants into fresh extraction sockets.

Immediate placement of implants in fresh extraction socket with immediate loading has shown several advantages like less treatment time, less number of surgeries more esthetic outcomes. The same was first reported by Schulte & Heimke [20] due to reduction in the number of surgical procedures, a shorter treatment time, three dimensional implant positioning, preservation of alveolar bone at the side of the tooth extraction and soft tissue aesthetics.

According to Slagter et al. [21] short term treatment outcome was excellent following immediate placement and immediate provisionalization of dental implants in the aesthetic area for peri-implant hard and soft tissue levels. Similarly, Tonetti et al. [22] recommended immediate implant placement in selected cases.

The present clinical study was undertaken to evaluate and compare the soft tissue thickness, implant esthetic score and crestal bone loss around immediately placed implant with immediate loading versus immediately placed implants with delayed loading.

When considering soft tissue thickness, in this study there was no significant difference in the mean tissue thickness after 1 month and 3 months as compared to baseline in both the groups (p-value=0.158 and 0.1229 respectively). These results are similar to those reported by Brescovitt et al. [23], Henriette L et al. [24] and Kesteren et al. [25].

Conversely, Evans et al. [26] and Chen et al. [27] observed increased mucosal recession in immediate implant placement compared with those with thin biotype compared to thick.

Implant aesthetic score was assessed and there was no statistically significant difference in between the mean outcome of the immediate and the delayed loading group at 1 week and 1 month time interval. The difference between the mean outcome was significantly higher in 3 months in immediate loading as compared to delayed loading (p=0.010) This was in accordance with the studies of Block et al with 26 immediate and 29 delayed implants, where they found 1 mm of less recession in immediate implants than in delayed implants [28].

There were also studies contradicting the present study results, such as the study by Lindeboom et al. with 25 immediate and 25 delayed implants from which they concluded that there was no difference between the peri implant soft tissue recession in immediate and delayed implants [29]. This was also in accordance from two recent short-term studies evaluating the impact of the restorative protocol on single-tooth immediate implants in the anterior maxilla done by Slagter et al. [21].

The implant esthetic score is a summation of five soft tissue– related factors assigned scores on an ordinal scale. The weakness of the implant esthetic score is that each factor is assumed to carry equal weight in contributing to the overall score; however, this has not been demonstrated in the literature. Indeed it may be argued that, for example, mid- facial mucosal recession of 1 to 2 mm (assigned a score of 1) has more impact esthetically then the equivalent score of 1 for color or consistency of the peri-implant mucosa. The implant esthetic score is therefore not sensitive to linear changes in soft tissue levels. However in implant esthetic score, esthetic outcomes have been rank as perfect, acceptable, and compromised outcomes

which may provide the clinician greater insight into the esthetic success of the clinical techniques under scrutiny rather than comparing the mean of the score and hence implant esthetic score was selected in the present study over pink esthetic score.

The next parameter assessed was the crestal bone level which showed that, the mean crestal bone level on the mesial and distal aspect of the immediate loading cases were significantly higher than that of the delayed loading cases. (p=0.000). The study done by Edward et al. also evaluated the peri-implant crestal bone loss and also the peri-implant bone healing in which the results stated that there was no statistically significant difference in the crestal bone loss in both the groups and for the bone healing there was significant differences in the grey scale analysis. Block et al. [28] and Crespi et al. [30] presented with the same results as above. Lindeboom et al. compared the mesial and distal bone loss around immediate and delayed implants and concluded stating that bone loss on the mesial aspect was less for immediate implants, whereas bone loss on the distal aspects was the same for both the groups [29].

The results of this study evaluating the hard and soft tissue around immediately placed implants with immediate loading versus immediately placed implants with delayed loading indicated that replacement of the teeth can be successfully treated with immediate implant placement with immediate loading. No similar study attempting with immediate implant placement with immediate loading versus immediate implant placement with delayed loading have been reported till date with soft tissue assessment with implant esthetic score.

The present study attempted to do the same *i.e*, to evaluate the soft and hard tissue around immediate implant placement with immediate loading versus immediate implant placement with delayed loading and concluded that immediate placement of implants with immediate loading have successful and satisfactory results to replacement of grossly carious teeth, teeth with internal resorption and fractured teeth.

It was observed from this study that there have been certain aspects which demand more detailed observation and elucidation of the data and facts.

These may be termed as obvious limitations of the study as follows:

- The study was limited by a short follow up period of only 3 months.
- Patient centered outcomes were not evaluated.

Future studies with longer evaluation period and with larger sample size would be more fruitful and appropriate to confirm the effectiveness.

CONCLUSION

The conclusions made from this study are as follows:

Soft tissue thickness: There was no statistically significant difference in the mean outcome of the soft tissue thickness at baseline, 1 month and 3 months interval in the immediate and delayed loading group. There was no statistically significant difference in soft tissue thickness between both the groups.

Implant esthetic score: Across 1 week, 1 month and 3 months; there was no statistically significant difference seen in perfect, acceptable or compromised outcome with immediate and delayed loading groups There was no statistically significant difference seen in perfect, acceptable or compromised outcome (Implant Esthetic Score) with respect to intergroup comparison of immediate and delayed loading implant groups during the study period. There was statistically significant higher implant esthetic score in cases with immediate loading at 3 months when compared to delayed loading group.

Crestal bone loss: The mean crestal bone loss after 3 months was significantly higher than at baseline on the mesial and distal aspect in immediate and delayed loading group. The mean crestal bone level on the mesial and distal aspect of the immediate loading cases was significantly higher than that of the delayed loading at baseline and after 3 months.

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