

ORIGINAL RESEARCH

A Prospective Study to Evaluate the Clinical and Radiological Assessment of Immediate and Delayed Single Tooth Implant Placement Till 18 Months Follow-Up

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ABSTRACT

Background: The implant can be placed either immediately after the tooth extraction (Immediate) or 15 days after the tooth extraction (Delayed immediate). The purpose of this study is to evaluate the width of keratinized gingiva, thickness of peri-implant mucosa, height of interproximal papilla, probing depth, soft tissue condition and bone loss around the single tooth implants. These parameters were compared clinically and radiologically between immediate and delayed single tooth implant techniques.

Material & Methods: A randomized, prospective clinical trial was conducted to evaluate the clinical and radiological parameters of immediate and delayed single tooth implant placement at department of periodontis at Rajasthan Dental College & Hospital, Jaipur, Rajasthan. 20 (ten females, ten males) patients of both sexes with an age limit of 20-40 years were selected for the study. The single tooth implant sites were randomly selected in either the upper or lower jaw, irrespective of whether it was an anterior or posterior region. The selected patients were categorized into two groups based on immediate and delayed implant placement protocols. Assessment of soft tissues at the implant site was performed after crown cementation at baseline, 9 & 18 month by single examiner. At the follow up visits, the following parameters were assessed, width of keratinized gingiva, thickness of peri-implant mucosa, height of interproximal papilla, probing depth, soft tissue condition and bone loss around the single tooth implants.

Results: In percentage, the Width of keratinized gingiva(loss), thickness of peri-implant mucosa(gain), papilla index (gain) and Peri-implant bone loss(loss) in immediate group showed 5.7% reduction, 24.17% gain, 10.90% gain & 13.43% loss respectively and in delayedgroupitwas8.57%, 25.88% gain, 10.76% gain & 15.60 % loss respectively at18th months.The percentage of probing depth reduction in mesially, distally, buccally, and lingually at 9 months & 18 months in immediate & delayed implant was statistical non-significant.

Conclusion: We concluded that self-threaded internal hex, titanium implants placed according to a delayed or immediate technique can be used successfully over a period of 12months. High successful rates were achieved without severe peri-implant complications.

Key Words: Peri-implant complications, Immediate implant, Delayed implant, Bone-loss, Gingiva

INTRODUCTION

Single tooth implant can be placed either in healed extraction sites (delayed) or fresh extraction sockets (immediate). Traditionally a single tooth implant was placed in a healed extraction site, allowing ossification to occur in 3-6 months.¹ This delay during socket healing, coupled with the added surgical stage, was inconvenient as well as uncomfortable to the patient, who might be wearing conventional removable prosthesis.²

The first single tooth crown restoration using a Branemark implant (Nobel Biocare) was placed in December 1982.³ Since, Branemark introduced the "Osseointegration" concept, advancement has followed three paths.⁴ This has been applied to replace a single missing tooth or multiple missing teeth in various edentulous situation, new donor sites and techniques to transplant bone have given better access to patients for receiving the implants and finally, efforts have been made to reduce the treatment period.

Dental epidemiological studies demonstrate that missing teeth are commonly present in all age groups.⁵ The loss of a single tooth is regarded as a common cause of esthetic concern which leads to psychological implications and nonphysiologic occlusion, as a result of tipping of neighbouring teeth and supra eruption of opposing teeth.⁶ The clinical replacement of lost natural teeth with osseointegrated implants has represented one of the most significant advances in restorative dentistry.

The primary reason for suggesting the "Fixed Partial Denture" is its clinical ease and reduced treatment time.⁷ The patients have been advised to put their desire level of replacing missing teeth and accept the limitations of a fixed partial denture and removable partial denture. Single tooth implant survival reports have been most validated as predictable methods of tooth replacement.^{8,9} However, the most natural method to replace a missing tooth is with an implant, rather than preparing adjacent teeth.¹⁰

The implant can be placed either immediately after the tooth extraction (Immediate) or 15 days after the tooth extraction (Delayed immediate).¹¹ It was placed directly into fresh extraction sockets after preparation of the implant bed to achieve primary stability. Advantages of this technique include preservation of the alveolar bone, the ideal axial positioning of implant using the socket as a reference, eliminating the waiting period of 3-6 months, fewer surgical visits and shortened edentulous period. On the other hand, there was a potential risk factor as enhanced possibility of mismatch between the socket wall and implant, leading to fibrous tissue formation.¹

In one stage surgical procedures, flaps were sutured around the polished neck of implants avoiding the need for second stage surgical intervention.¹² Misch et al. suggested a terminology for immediate restoration or occlusal loading.⁵ In general, when this protocol was first implemented, only one-piece implants were used. However, later on, this procedure was performed with two-stage implants on which a healing abutment was placed.¹³

In implants, the criteria for success should involve the establishment of a soft tissue contour with intact interproximal papilla and a predictable gingival outcome.¹⁴ The interdental bone and papilla height were correlated according to the distance from contact point to crestal bone. If the measurement from the contact point to the crest of the bone was 5 mm, the papilla would present almost 100%. If the distance was greater than 6 mm, the papilla would present 50% or less. Based on this data, the clinician attempted to maintain 5 mm of distance from the contact point to the crestal bone, when placing the implant. The influence of mucosal thickness on crestal bone loss around implant has been reported recently.¹⁵ It is necessary, that the minimum of 3mm of peri-implant mucosa is required for the stable epithelial connective tissue

attachment around implants. A thick mucosa was resilient and therefore prone to pocket formation, while a thin mucosa was friable and thus often prone to gingival recession.¹⁶ The purpose of this study is to evaluate the width of keratinized gingiva, thickness of peri-implant mucosa, height of interproximal papilla, probing depth, soft tissue condition and bone loss around the single tooth implants. These parameters were compared clinically and radiologically between immediate and delayed single tooth implant techniques.

MATERIALS & METHODS

A randomized, prospective clinical trial was conducted to evaluate the clinical and radiological parameters of immediate and delayed single tooth implant placement at department of periodontis at Rajasthan Dental College & Hospital, Jaipur, Rajasthan. 20 (ten females, ten males) patients of both sexes with an age limit of 20-40 years were selected for the study from outpatient Department of periodontics depending on the following selection criteria.

INCLUSION CRITERIA

1. Single tooth space or space with adjacent natural tooth.
2. Adjacent teeth: intact; restored with functionally and esthetically good restorations; restored with prostheses precluding the addition of the missing tooth.
3. Patient reluctance of preparation of adjacent teeth.
4. Demonstrated maladaptive experience, or psychological reluctance to wear a removable partial denture.

EXCLUSION CRITERIA

1. Insufficient bone quality or compromised health of the local site as determined by radiographs and clinical inspection before implant placement.
2. Presence of vital anatomic structure in very close proximity to a proposed implant site.
3. Insufficient vertical inter arch space to accommodate the prostheses.
4. Incomplete facial growth and teeth eruption.
5. Inadequate mouth opening.
6. Psychoses.
7. Unrealistic esthetic expectations.

METHODS

The nature and design of the clinical trial was explained to the patients and consent was obtained for their participation. All the patients were subjected for scaling and oral hygiene instructions were given. The single tooth implant sites were randomly selected in either the upper or lower jaw, irrespective of whether it was an anterior or posterior region. The selected patients were categorized into two groups based on immediate and delayed implant placement protocols.

IMMEDIATE GROUP

Ten single tooth implants placed using immediate technique in the fresh extraction sockets.

DELAYED GROUP

Ten single tooth implants placed using delayed technique in the healed bone sites.

PRE-SURGICAL PROCEDURE

The intraoral, panoramic radiographs were taken for the preoperative evaluation of the bone quality, implant position and orientation. The diagnostic template was made which has 5 mm

ball bearing, incorporated around the curvature of the dental arch and worn by the patient during the radiographic examination, which enabled the operator to determine the amount of magnification in the radiograph.⁵

Based on the anatomical site analysis, the appropriate implant diameter and platform size was selected to best fit the single tooth edentulous area. After a preoperative workup, a diagnostic wax-up of the planned restoration and fabrication of a surgical stent was done before the implant surgery. This stent was made for proper positioning of implant shoulder and provide an ideal emergence profile with long term peri-implant hard and soft tissue support.¹⁷

IMMEDIATE GROUP

Following local anaesthesia, teeth were luxated with an elevator and extracted carefully with forceps (attempting to preserve the bone of the alveolus), and the sockets were debrided. A crestal incision connected with two vertical releasing incisions mesial and distal to the extraction site was performed with elevation of mucoperiosteal flap.¹⁸ The depth, bucco-lingual and mesio-distal dimensions of the alveolar socket were measured with ridge caliper and an implant with appropriate dimension was selected. Then implant was placed using pilot, intermediate and final drill in such a way that cover screw was corresponding to the level of the adjacent bone. Primary closure of the wound was achieved by stabilization of the flap using interrupted suture with 3-0 silk thread.

DELAYED GROUP

After achieving profound anesthesia, the mucoperiosteal flap was elevated with a crestal incision located approximately 2 to 3mm toward the lingual aspect and extended to the sulcus of adjacent teeth by intra-sulcular incision. This incision avoids the formation of scar tissue in the mid crestal area. The bucco-lingual and mesio distal implant position was partially determined by the morphology of alveolus. Then the implant was placed using pilot, intermediate and final drill in such a way that cover screw was corresponding to the level of the adjacent bone. The primary closure of the wound was achieved by stabilization of the flap with simple interrupted suture 3-0 silk thread.

Antimicrobial prophylaxis (Amoxicillin 500 mg) was given one hour before surgery and continued twice daily for 7 days. Post-surgical analgesics (paracetamol 500 mg + Aceclofenac 100 mg) were prescribed twice daily for one week and oral hygiene instructions were given. The suture was removed one week after the implant surgery.

After 3 months of implant placement, the patients were subjected to a second surgical procedure. Healing abutments were mounted on to the implants in order to condition the peri-implant soft tissues for 4-6 weeks. This healing abutment connection was done by a simple midcrestal incision.¹⁹ Later, final abutment was selected and placed at 35 Ncm by using torque wrench. The prosthetic crown was prepared, cemented with type II GIC cement and baseline data were recorded. Then the patients were recalled for further follow up at 9th and 18th month corresponding to a functional loading time of 4 months and 1 year respectively.

CLINICAL PARAMETERS

Assessment of soft tissues at the implant site was performed after crown cementation at baseline, 9 & 18 month by single examiner. At the follow up visits, the following parameters were assessed, width of keratinized gingiva, thickness of peri-implant mucosa, height of interproximal papilla, probing depth, soft tissue condition and bone loss around the single tooth implants.

RADIOGRAPHIC ASSESSMENT

Radio Visio graphs (RVG) of the implants were obtained after 2nd stage surgery during cementation of the crown. The CCD (Charge Coupled Device) of RVG was kept in precise orientation with bisecting angle technique and data was recorded. The assessment was carried out at baseline, 9th and 18th month follow up visits.

MEASUREMENTS²⁰

Peri-implant marginal bone loss mesial and distal to each implant was assessed by measuring the vertical distance between implant-abutment interface and the implant apex, also the bone level from the crest to implant apex. The difference between these two distances was defined as peri-implant bone loss.

To minimize the dimensional distortion, the apparent dimensions of the implants were measured on the radiographs and divided by the actual implant size. Corresponding bone loss in millimeter detected radiographically was divided by the magnification factor to obtain the actual bone loss.

STATISTICAL ANALYSIS

The Independent-Samples t Test procedure compares means for two groups of cases. Ideally, for this test, the subjects should be randomly assigned to two groups, so that any difference in response is due to the treatment (or lack of treatment) and not due to other factors. In the present study, $p > 0.05$ was considered as significant at 5% level of significance.

RESULTS

In percentage, the Width of keratinized gingival (loss), thickness of peri-implant mucosa (gain), papilla index (gain) and Peri-implant bone loss (loss) in immediate group showed 5.7% reduction, 24.17% gain, 10.90% gain & 13.43% loss respectively and in delayed group it was 8.57%, 25.88% gain, 10.76% gain & 15.60% loss respectively at 18th months (table 1).

Table1: Immediate and delayed group difference in (%) percentage of width, thickness of mucosa, papilla index and peri-implant bone loss at baseline, 9 and 18 months

Parameters	Immediate (%)		Delayed (%)	
	9months	18months	9months	18months
Width of keratinized gingival (loss)	4.1	5.7	5.39	8.57
Thickness of peri-implant mucosa (gain)	6.82	24.17	22.42	25.88
Papilla index (gain)	5.34	10.90	2.58	10.76
Peri-implant bone loss (loss)	7.66	13.43	9.22	15.60

The percentage of probing depth reduction in mesially, distally, buccally, and lingually at 9 months & 18 months in immediate & delayed implant showed in table no. 2.

Table2: Immediate and delayed group difference in (%) percentage of probing depth at baseline, 9 and 18 months

Pocket depth (reduction)	Immediate (%)		Delayed (%)	
	9months	18months	9months	18months
Mesially	18.13	31.86	19.32	33.30
Distally	14.31	33.30	22.95	31.83
Buccally	15.52	39.83	6.25	28.12
Lingually	14.40	25.09	5.88	18.34

DISCUSSION

Clinician and patient dependent factors may play an important role in the aesthetic outcome of the single tooth implants.²¹ Clinician dependent factors which includes proper three-dimensional implant positions and angulation, as well as appropriate contour of the provisional restoration. Patient dependent factors which include the bone level, hard and soft tissue relationship, bone thickness, and soft tissue biotype.

In this study, there was no statistically significant ($p>0.05$) difference in the width of keratinized mucosa between groups at baseline, 9 and 18 months. But there was a significant percentage difference found between two groups, in which immediate group had more significant difference of 5.8% reduction. These results concur with the studies done by Bouri et al. (2008)²², who observed that wider zone of keratinized mucosa ($>2\text{mm}$) had less plaque accumulation and mucosal inflammation. This wider zone had more resistant to forces of mastication and frictional contact that occurs during oral hygiene procedure.²³ This is agreed with present results because no severe recession and inflammation was noted between groups.

In this current study, no statistical difference was found in thickness of mucosa between groups. But on clinical examination, significant mucosal thickness was noticed after the crown placement. Henrikkson et al. (2004)²⁴ found the same results and also proved significant increase in the buccal volume of peri-implant tissue after crown placement. Kan JYK et al. (2004)²⁵ described the gingival biotype as being thick or thin. A thick biotype implies more fibrotic tissue, more vascularization that was more resistance to recession. Thin gingival tissue has less underlying bone support and blood supply and also more chances of recession. This agreed with our results that all gingival biotype in the study has greater than 1mm thickness with no recession.

In this study, there was no statistically significant difference ($p>0.05$) in mean papilla index between groups at baseline, 9 and 18 months. This is in accordance with the study done by Schropp et al. (2005)²⁶ who observed that presence of the inter proximal papilla is not influenced by early or delayed-immediate with occlusal loading following 18 months period. But in this study, the improved papilla fill was observed from the time of crown placement to 1 year period that was 10.80% in immediate and 10.78% in delayed implants. This finding is agreed in with previous reports found in the literature.²⁷⁻²⁹

In this study, there was no statistically significant ($p>0.05$) difference in mean probing depth between groups at baseline, 9 and 18 months. Probing depth was seen to be decreased from the time of crown placement to 12 months in both groups. Percentage of probing depth reduction was smaller extent 27.87% for delayed group, compared with immediate group 32.50%. In both groups, a mean probing depth was approximately 2.38 mm, found at 12 months follow-up, which may be considered to be acceptable with Schropp et al. (2005)³⁰ study which is 4 mm. However, it is reasonable to assume that probing depth not exceeding 4.0 mm are preferable to facilitate the patient's ability for self-performed plaque control as well as accessibility for proper professional peri-implant cleaning.

Analysis of the crestal bone levels assessed on RVG (Radio Visio Graph) showed that bone loss occurred at the proximal surfaces of implants within the observation period of present study in both the groups. The average mean bone loss was 1.10 mm in the immediate group and 1.28 in the delayed group from the crown placement to 12 months period. These results concur with the study done by Grunder et al. (1999)³¹ who evaluated immediate and delayed-immediate placement of the implants after 12 months of loading found that bone loss was about 0.8 mm interproximally. The present results also meet the success criteria for implant treatment proposed, in the consensus report of the

1stEuropean Workshop on Periodontology: “The criteria of success include average bone loss of less than 1.5mm during the first year after insertion of the prostheses”.³²

In order to evaluate the proper clinical parameter and biological osseointegration, a study design of larger sample size with proper selection of the patient should be needed.

CONCLUSION

We concluded that self-threaded internal hex, titanium implants placed according to a delayed or immediate technique can be used successfully over a period of 12 months. High successful rates were achieved without severe peri-implant complications. However, it is necessary to have a large sample size with proper selection of the patients are needed to evaluate the clinical and radiological parameters. Also further studies need to be carried out to evaluate the relationship between peri-implant soft and hard tissue in respect to the placement of implants.

REFERENCES

1. Izchak Barzilay, Gerald N, Graser, Bejan Iranpour. Immediate implantation of a pure titanium into an extraction socket: Report of a pilot procedure. *Int J Oral Maxillofac Implants* 1991;6:277-84.
2. Den Hartog L, Huddlestone J, Vissink, Meijer HJA. Treatment outcome of immediate, early and conventional single tooth implants in the aesthetic zone: a systemic review to survival, bone level, soft tissue, aesthetics and patient satisfaction. *Journal of Clinical Periodontology* 2008;35:1073-86.
3. Myron, Nevins. *Implant therapy*. Second edition. Quintessence publishing.
4. Rosenquist B, Grenthe B. Immediate placement of implant into extraction sockets: Implant survival rates. *Int J Oral Maxillofac Implants* 1996;11:205-9
5. Carl E. Mish, *Contemporary implant dentistry— third edition*.
6. Limor Avivi-Arber, George A. Zarb. Clinical effectiveness of implant- supported single tooth replacement: The Toronto study. *Int J Oral Maxillofac Implants* 1996;11:311-21.
7. Jan Lindhe, *Clinical periodontology and implant dentistry*. Fifth edition.
8. Ronald E. Jung, Bjarni E. Pietrusson, Roland Glauser, Anja Zembic. A systemic review of the 5- year survival and complication rates of implant-supported single crowns. *Clin Oral Impl Res*. 19, 2008; 119-30.
9. Weber HP, Crohin CC, Fiorellini JP. A five-year prospective clinical and radiographic study of non-submerged dental implants. *Clin Oral Impl Res*. 19, 2000; 11:144-53.
10. Anders Ekfeldt, LDS, Odont Dr/ Gunnar E, Carlsson. Clinical evaluation of single tooth restorations supported by osseointegrated implants: A retrospective study. *Int J Oral Maxillofac Implants* 1994;9:179-83
11. Becker BE, Becker W, Ricci. A and Geurs. A prospective clinical trial of endosseous screw-shaped implants placed at the time of tooth extraction without augmentation. *Journal of Periodontology*, 1998 Aug; 9:20-26.
12. Marco Esposito, Maria Gabriella Grusovin, Yun Sganer Chew. One-stage versus two-stage implant placement. A systemic review of randomised controlled clinical trials. *Eur J Oral Implantol* 2009;2(2):91-9.
13. Juan C. Ibanez, Marcelo J, Jahhan, Juan A. Zamar. Performance of double acid etched surface external hex titanium implants in relation to one and two stage surgical procedure. *Journal of Periodontology* 2003;74:1575-87.
14. Eugenio Rome, Diego Lops, Alessandro Rossi, Stefano Sterelli, Rozza. Surgical and prosthetic management of inter proximal region with single-implant restorations: 1-year prospective study. *Journal of Periodontology* 2008;79:1048-55.

15. Tomas Linkevicius, Peteris Apse, Dr Habil, Simonasgrybauskas, Algirdas Puisys. The influence of soft tissue thickness on crestal bone changes around implant: A1-year prospective controlled clinical trial. *IntJOralMaxillofacImplants*2009;24:712-19.
16. Joseph J. K. Kan, KitichaiRungcharassaeng, KiyotakaUmezu andJohn C. Kois. Dimensions of peri-implant mucosa:An evaluation of maxillary anterior single implants in humans. *JournalofPeriodontology*2003;74:557-62.
17. DanielBuser, WilliamMartin, Belser. Optimizing esthetic for implant restoration in the anterior maxilla: An atomic and surgical considerations. *Int J Oral Maxillo fac Implants* 2004;19(suppl):43-61.
18. LarsSchropp, LambrosKostopoulos, AnnWenzel. Bonehealing following immediate versus delayed placement of titanium implants into extraction sockets. A prospective clinical study. *IntJOralMaxillofacImplants*2003;18:189-99.
19. Peymanshahindi, ZhimonJacobson, SergeDibart, JacobPourati, Martha Nunn. Efficacy of a new technique in implant dentistry: A preliminary study. *J Oral Maxillo fac Implants*2008;23:926-934.
20. GeorgWatzak, WernerZechner, DieterBusenlechner, ChristofAmhart. Radiological and clinical follow-up of machined and anodizedsurface implants after mean functional loading for 33 months. *ClinOralImplRes*2006;17:651-57.
21. Marco Degidi, Arthur Belem Novaes, Diego Nardi. Outcome analysisof immediately placed, immediately restored implants in the aestheticarea: The clinical relevance of different inter-implant distance. *Journal of periodontology* 2008;79:1056-1061.
22. AnilBouriJr, NabilBissada, MohammadS. Al-Zahrani, FadyFaddoul, Imad Nouneh. Width of keratinized gingiva and the Healthstatus of the supporting Tissue around dental implants. *Int J OralMaxillofacImplants*2008;23(supple):116—27.
23. Abrahamsson I, Berglundh T, Wennstrom J, Lindhe J. Implant hardand soft tissues at different implant systems. A comparative study indog. *Clin Oral Implants Res*1996;7:212-19.
24. KristinaHenriksson, TorsentJemt. Measurement of soft tissue volume in association with single– implant restorations: A1-year comparative study after abutment connection surgery. *Clinical implant Dentistry and Related Research*2004;6(4):183.
25. JosephY.K.Kan,TaichiroMorimoto,KitichaiRungcharassaeng. Gingival biotype assessment in the esthetic zone: Visual versus direct measurement. *Int JPeriodontics Restorative Dent*2010;30:237-43.
26. Larsschropp, FlemmingIsidor, LambrosKostopoulos, AnnWenzel. Inter proximal papilla levels early versus delayed placement of single–tooth implants. A controlled clinical trial. *Int J Oral Maxillo fac Implants*2005;20:753-61.
27. TorsentJemt. Regeneration of gingival papilla after single-implant treatment. *IntJ Periodontics Restorative Dent*1997;17:327-33.
28. ChangM, WennstromJ, Odman,P. AnderssonB. Implant supported single tooth replacements compared to contralateral teeth. *Clin OralImplRes*1999;10:185-94.
29. Vincent Choquet, Marc Hermans, Philippe Adriaanessens, PhillippeDaelemans, Dennis. Clinical and radiological evaluation of th epapillalevel adjacent to single tooth dental implants. A retrospective study inthe maxillary anterior region. *Journal of Periodontology*2001; 72:1364-71.
30. SchroppL, KostopoulosL, WenzelA, IsidorF. Clinical and radiographic performance of delayed-immediate single tooth implant placement associated with peri-implant bone defects. A 2year prospective, controlled, randomized follow-up report. *Journal of Clinical Periodontology*;2005;32:480-87.
31. UeliGrunder, Naoki Hatano, William J. Jackson, Steffen Kohler, MarvinWerbitt.A3-year prospective multicentre follow-up report on the immediate and delayed-

- immediate placement of implants. *J Oral Maxillofac Implants* 1999;14:210-16.
32. Tomas albrektsson, Evert Dahl, Lars Enbom, Sigfrid Engevall, Bo Engquist. A Swedish multi centre study of 8139 consecutively inserted nobel pharma implants. *J periodontal* 1988 May;287-96.