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Research Article

DELAYED VS IMMEDIATE IMPLANT LOADING: A COMPARATIVE CLINICAL AND RADIOLOGICAL STUDY

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A B S T R A C T

Background: In dentistry and oromaxillofacial surgery, the use of dental implants is today a firmly established method of functional masticatory rehabilitation of edentulous segments of the jaws. From empirical considerations, it was estimated that a minimum period of three months in the mandible and six months in the maxilla was necessary for satisfactory implant healing.
However, the competing procedure of immediate loading of screw-retained implants soon developed in parallel with this.
Aim & objectives: Primary objectives of the study was to compare the clinical & radiological outcome of delayed and immediate implant loading.
Material and Method: This prospective study included 20 patients, 10 in each group. Group(A) delayed implant loading & Group(B) immediate implant loading. The criteria's evaluated were radiological assessment of the bone loss(mesial and distal crestal bone), clinical assessment of pocket depth and clinical assessment of stability at 3, 6, 12 & 18 months.
Observation: The crestal bone loss was higher at 12 and 18 months on mesial side of implant and at 18 month on distal side of implant, statistically significant in the immediate loading group when compared to delayed loading group. No significant difference was observed in pocket depth & stability between both the groups.
Conclusion: The loading of the implants can be done immediately irrespective of the number and anatomical area, provided the torque of 40Ncm is achieved.

INTRODUCTION

Implant dentistry has grown leaps and bounds in recent years after the successful introduction of osseointegration concept by Prof. P.I.Branemark in the early 1960s. For the success in implant dentistry, we should ideally evaluate primary outcome of an implant-prosthetic complex as a whole. This can be achieved by evaluating success at the implant level, peri-implant soft tissue, prosthesis and level of patient's satisfaction[1].

Branemark established a protocol of a two stage surgical procedure in which implant was submerged during first surgical stage and maintained in that unloaded environment for a period of minimum 3 months in mandible and 6 months in maxilla. This was followed by second stage surgical procedure in which prosthetic abutment was connected .However their manoeuvre had some shortcomings like microgap between implant and abutment which eventually resulted in crestal bone loss and long extended edentulous period[2].

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In 1979 Ledermann revolutionised era of implant dentistry with successful immediate loading implants, in which implant is placed followed by prosthetic abutment connection and temporization in a single appointment. This technique eliminated chances of microgap between the implant and abutment which ruled out the possibility of peri implant bone loss as seen in delayed implant loading[2]. More advantages include less tissue trauma, reduced overall treatment time, decreased patient anxiety and discomfort, high patient acceptance and better function and aesthetics[3].

Ongoing scientific reports from various clinicians have continued to make it clear that immediate implant loading can be accomplished safely in all areas of the mouth provided that bone quality is sufficient to ensure the initial stability of 40Ncm and those patients scrupulously follow postsurgical instructions[4]. This has been suggested as a beneficial treatment protocol over conventional technique, in terms of improved clinico –radiological outcomes.

Primary objectives of the study was to compare the clinical & radiological outcome of delayed and immediate implant loading. The criterias evaluated were radiological assessment

of the bone loss (mesial and distal crestal bone), clinical assessment of pocket depth and clinical assessment of stability.

MATERIALS AND METHODS

This prospective study was performed in the Department of Oral & Maxillofacial Surgery of Vidhabha Youth Welfare Society Dental College and Hospital, Amravati. The necessary approval was procured from the institutional ethics committee. The sample of 20 patients was derived from the population of patients who reported to the department for replacement of the teeth. Awritten consent was procured from all the patients included in the study.

Subjects eligible for inclusion were all above 16 years of both genders, patients with single or multiple edentulous areas, ASA Class I and relatively healthy ASA class II patients, patients free of periodontal diseases and patients having sufficient amount of residual alveolar ridge. Patients unable to give or not willing to consent, ASA class III and class IV category patients, pregnant females or lactating mothers, patients having habits of smoking, tobacco & betalenut chewing, patients on any drug which will compromise osseointegration were excluded from the study.

The patients were classified in two groups of 10 each. First Group (A) delayed implant loading & second Group (B) immediate implant loading. Routine blood investigations, Intra oral periapical All the subjects were thoroughly evaluated clinically and radiographically (IOPA), Orthopantomograph (OPG) & Radio visuograph (RVG), Complete oral prophylaxis & Diagnostic cast were done for all patients included in the study.

After placement of implant, immediate loading was done only in those cases where we got initial stability with insertion torque above 40Ncm, otherwise delayed loading was preffered was achieved making it a single stage surgery, the procedure in the study was performed by same surgeon. The necessary surgical protocol for asepsis and infection control and maintenance in the post operative phase were followed strictly.

Data was collected at defined interval of 3 months, 6 months, 12 months and 18 months during the subsequent follow up & comparison was done amongst both the groups on the basis of clinical examination & radiographically to access peri-implant bone loss. Entire observation was done by the same observer to prevent bias. The parameters accessed were pocket depth, Stability, Crestal bone levels.

Crestal bone levels was calculated by formula: Corrected crestal bone level = measured bone level x (actual implant length /measured implant length).

Statistical analysis

Statistical analysis was carried out using SPSS v 16.0 statistical software.Baseline characteristics of the participants were compared using Chi-square test. Mann-whitney U test was used to compare mean pocket depth & bone loss between study & experimental groups at 3, 6, 12 & 18 months.Chi-square test was used for the comparison of stability of implants between study & experimental groups at 3, 6, 12 & 18 months.Repeated measures ANOVA with post-hoc boneferroni test was used for within group comparison of mean scores of pocket depth & bone loss at 3,6, 12 & 18 months in both the groups.

RESULTS & OBSERVATIONS

Table 1 Baseline Characteristics of Participants

	Delayed (freq[%] or mean [SD])	Immediate (freq[%] or mean [SD])	P* value	Significance
Gender Male female	6 (60.0%) 4 (40.0%)	5 (50.0%) 5 (50.0%)	0.50	NO
Jaw maxilla mandible	6(46.2%) 7(53.8%)	10(66.7%) 5(33.3%)	0.44	NO
Side Right Left	6(46.2%) 7(53.8%)	5(33.3%) 10(66.7%)	0.70	NO
Age	32.40(10.22)	28.80(8.76)	0.13	NO

*- Chi Square Test

Table 2 Comparision Of Mean Score Of Pocket Dept & Bone Loss Between Both Experimental Groups

	Delayed mean [SD]	Immediate mean [SD]	P* value	Significance
PPD at 6 months	0.92mm(0.18)	0.69 (0.58)	0.19	NO
PPD at 12 months	0.82mm(0.51)	0.66 (0.58)	0.44	NO
PPD at 18 months	0.73mm(0.38)	0.59 (0.47)	0.43	NO
BLM at 3 month	-1.01 (0.33)	-1.01 (0.50)	0.99	NO
BLM at 6 month	-0.70 (0.41)	-0.85 (0.26)	0.25	NO
BLM at 12 month	-0.40 (0.31)	-0.67 (0.28)	0.03	YES
BLM at 18 month	-0.11 (0.18)	-0.31 (0.19)	0.01	YES
BLD at 3 month	-0.87 (0.45)	-0.62 (0.57)	0.22	NO
BLD at 6 month	-0.65 (0.39)	-0.50 (0.45)	0.38	NO
BLD at 12 month	-0.45 (0.31)	-0.28 (0.30)	0.17	NO
BLD at 18 month	-0.03 (0.08)	-0.18 (0.22)	0.03	YES

*-Mann-Whitney u test

Table 3 Comparision of Stability of Implants Between Both Experimental Groups

	Delayed (freq[%])	***Immediate (freq[%])***	***P* value***	***Significance***
Stability at 3 months Present Absent	*13(100.0%) 0(.0%)*	*14(93.3%) 1(6.7%)*	*0.53*	*NO*
Stability at 6 months Present Absent	*13(100.0%) 0(.0%)*	*14(93.3%) 1(6.7%)*	*0.53*	*NO*
Stability at 12 months Present Absent	*13(100.0%) 0(.0%)*	*14(93.3%) 1(6.7%)*	*0.53*	*NO*
Stability at 18 months Present Absent	*13(100.0%) 0(.0%)*	*14(93.3%) 1(6.7%)*	*0.53*	*NO*

*- Chi Square Test

Table 4 Effect of Time on Pocket Dept in Both Experimental Groups

Repeated measures ANOVA summary	**Delayed**	**Immediate**
P value	0.31	0.30
Statistically significant (P<0.005)?	NO	NO

Table 5 Effect of Time on Bone Loss on Mesial Site in Both Experimental Groups

Repeated measures ANOVA summary	Delayed	Immediate
P Value	< 0.001	<0.01
Statistically Significant(P<0.05)	Yes	Yes

Table 6 Effect of Time on Bone Loss on Mesial Site in delayed loaded implant

Test Details	Mean 1	Mean 2	P Value	Significant?
3 Month Vs. 6 Month	-1.01	-0.70	0.23	NO
3 Month Vs. 12 Month	-1.01	-0.40	<0.01	YES
3 Month Vs. 18 Month	-1.01	-0.11	<0.001	YES
6 Month Vs. 12 Month	-0.70	-0.40	<0.01	YES
6 Month Vs. 18 Month	-0.70	-0.11	<0.01	YES
12 Month Vs. 18 Month	-0.40	-0.11	<0.05	YES

Table 7 Effect of Time on Bone Loss on Mesial Site in Immediately loaded implant

Test Details	Mean 1	Mean 2	P Value	Significant?
3 Month Vs. 6 Month	-1.01	-0.85	1	NO
3 Month Vs. 12 Month	-1.01	-0.67	0.12	NO
3 Month Vs. 18 Month	-1.01	-0.31	<0.05	YES
6 Month Vs. 12 Month	-0.85	-0.67	<0.01	YES
6 Month Vs. 18 Month	-0.85	-0.31	<0.001	YES
12 Month Vs. 18 Month	-0.67	-0.31	<0.01	YES

Table 8 Effect of Time on Bone Loss on Distal Site In Both Experimental Groups

Repeated measures ANOVA summary	Delayed	Immediate
P Value	< 0.001	<0.01
Statistically Significant(P<0.05)?	Yes	Yes

Table 9 Effect of time on Bone Loss on Distal Site in Delayed Loaded Implant

Test Details	Mean 1	Mean 2	P Value	Significant?
3 Month Vs. 6 Month	-1.87	-0.65	0.15	NO
3 Month Vs. 12 Month	-1.87	-0.45	<0.05	YES
3 Month Vs. 18 Month	-1.87	-0.03	<0.01	YES
6 Month Vs. 12 Month	-0.65	-0.45	0.37	NO
6 Month Vs. 18 Month	-0.65	-0.03	<0.01	YES
12 Month Vs. 18 Month	-0.45	-0.03	<0.01	YES

Table 10 Effect of Time on Bone Loss on Distal Site in Immediately Loaded Implant

Test Details	Mean 1	Mean 2	P Value	Significant?
3 Month Vs. 6 Month	-0.65	-0.50	0.11	NO
3 Month Vs. 12 Month	-0.65	-0.28	0.06	NO
3 Month Vs. 18 Month	-0.65	-0.18	<0.05	YES
6 Month Vs. 12 Month	-0.50	-0.40	0.08	NO
6 Month Vs. 18 Month	-0.50	-0.18	<0.05	YES
12 Month Vs. 18 Month	-0.28	-0.18	0.18	NO

DISCUSSION

Implants have revolutionized the art and science of modern dentistry giving a new lease of life to the restorative aspects in day-to-day practice. It has transformed into a reliable and predictable treatment modality for fully and partially edentulous arches[68].

The successful outcome of any implant procedure is surely dependent on the interrelationship of the various components of an equation that includes the biocompatibility of implant material,macroscopic and microscopic nature of the implant surface,the status of the implant bed in both a health (noninfected) and morphologic (bone quality) context,the surgical technique per se,the undisturbed healing phase, the subsequent prosthetic design and long-term loading phase.This reconciles consideration of design, materials used, location of implants and anticipated loading, together with hygienic and cosmetic considerations.

The placement of implant has evolved using two surgical approaches. The submerged (two stage) and non submerged approaches (one stage). The original surgical protocol established by Branemark consisted of submerging an implant and maintaining a nonloaded implant environment for 3 to 6 months[1]. Shortcomings of this procedure include microgap present at or below the alveolar crest and slightly above the soft tissue & long duration of treatment[31].

Patients demands to shorten the treatment period and to avoid an edentulous condition encouraged the introduction of an non submerging of implant i.e immediate loading implant protocol[1]. Various researcher CA Babbush[5] in 1986, Jemt T[9] in 1991, Røynesdal AK[27] in 1999 and Misch CM[46] in 2004 proved immediate loading as a valuable method for implant placement loading. This treatment protocol aims at maintenance of the hard and soft tissues, a shorter treatment period with a stable and fixed long term interim restoration on the day of surgery. In this technique abutment is attached at the time of implant placement, no microgap exist at or below the alveolar crest between the implant and restoration.

It has been proposed that peri-implant marginal bone loss is more extensive around two stage implants than around one stage implants as a result of the location of the microgap[42]. Advantages of immediate loading are reduction in alveolar ridge resorption and overall treatment time,offers an acceptable restoration esthetically, increased patients acceptance, quicker return of function, removable prosthesis is avoided that may interfere with healing or simultaneous bone grafting and/or may require additional maintenance during the healing period, potentially superior soft tissue profile when accompanying immediate dental implant placement, reduced surgical trauma and ease of surgery[68].

In our study 28 implant were placed in 20 patients,10 patients in each group i.e according to inclusion criteria and patients were prepared for surgery and informed that immediate loading will be decided after placement of implant intra-

operatively, only in those cases where we got initial stability with insertion torque above 40Ncm, otherwise delayed loading was done. In delayed implant loading group 13 implants were placed and in immediate implant loading group 15 implant were placed. We compared three parameters radiographically and clinically i.e radiological assessment of the bone loss (mesial and distal crestal bone), clinical assessment of pocket depth and clinical assessment of stability for both the groups at interval of 3, 6, 12 and 18 months.

In our study probing pocket depth for delayed loading implant group were(mm) 0.92, 0.82 and 0.73 at the intervals of 6, 12 and 18 months and for immediate loading implant group it was(mm) 0.69, 0.66 and 0.59 at intervals of 6, 12 and 18 months whereas study done by Paula N. Small[32] in 2000 found more probing pocket depth as compared to our study which was 4.27mm in first year and decreases in the ninth year and Heydenrijk, Kees[42] in 2003 found probing pocket depths were > 3 mm.

All implants were stable in delayed loading group (100% success rate), no clinical mobility were seen, 3 months, 6months 12 months and 18 months follow up period but one implant out of 15 from immediate loading group (93.3% success rate) were lost, because of poor case selection and improper osteotomy preparation and rest all implants were stable and no clinical mobility seen in others at 3 months, 6 months 12 months and 18 months follow up period.

Gavriel Chaushu[33] in 2001 reported success rate of 82.4% in immediate loading and 100% in non immediate, Similarly in a study of James Chow[34] in 2001 success rate 98.3% was observed in immediate loading of implants in mandible, Mark Bischof[44] in 2004 reported 98.4% and 97.7% success rate, Tiziano Testori[49] in 2004 also reported good results 97.4% immediate loading of implants in both jaws, whereas Col M. Viswambaran[67] in 2014 reported 93.3% success rate in immediate loading implants in mandible. P value for delayed loading group and immediate loading group were p=0.53. Statistically no significant difference were found in both groups.

In our study bone loss when compared for both the groups radiographycally, in delayed loading group (Group A) bone loss on mesially were -1.01 (-1.22 to -0.81; 95% confidence interval) at 3 months, -0.70 (-0.94 to -0.45; 95% CI) at 6 months, -0.40 (-0.59 to -0.22; 95% CI) 12 months and -0.11 (-0.22 to -0.00;95% CI) at 18 months and bone loss distally were -0.87 (-1.15 to -0.60;95% CI) at 3 months, -0.65 (-0.89 to -0.41;95% CI) at 6 months, -0.45 (-0.64 to -0.26;95% CI) at 12 months and -0.03 (-0.08 to -0.02;95% CI) at 18 months.

For immediate loading group (Group B) bone loss on mesially were -1.01 (-1.34 to -0.71; 95% CI) at 3 months, -0.85 (-1.02 to -0.69;95% CI) at 6 months, -0.67 (-0.85 to -49;95% CI) at 12 months and -0.31 (-0.43 to -0.20;95% CI) at 18 months and bone loss distally were -0.62 (-0.91 to –0.23;95% CI) at 3 months, -0.50 (-0.72 to -0.19;95% CI) at 6 months, -0.28 (-0.43 to -0.07;95% CI) at 12 months and -0.18 (-0.28 to -0.02;95% CI) at 18 months .

Comparatively more bone loss were reported by Flemming Isdor[25] in 1998 [bone] loss after 6, 12, and 18 months were 1.1, 1.5 and 1.8 (average bone loss was 2.4) and Judith Maria Pinheiro Ottoni[51] in 2005 in 1 year bone loss were 1.57 ± 0.97 mesially and 1.92 ± 0.85 distally.in control group and 1.36 ± 0.59 mesially and 2.44 ± 1.29 distally experimental group at 24 month follow up period.

The study conducted by James Chow[34] in 2001 found marginal bone loss does not exceed 1.0 mm after the first year and 0.2 mm in the following years, Eivind Andersenin[36] in 2002 found mean marginal bone loss range -0.83 to +1.54 mm, Leslie Laing Gibbard[37] in 2002 found mean annual bone reduction was 0.069 mm at mesial sites, 0.070 mm at distal sites and Joseph Y. K. Kan[39] in 2003 mean marginal bone change at the end of 12 months were –0.26 ± 0.40 mm mesially and –0.22 ± 0.28 mm distally these all reported less bone loss as compared to our study.

Roy H.Yoo[55] in 2006 reported mean changes of -0.±1.5 and -0.6 ± 1.4 in the bone levels at mesial and distal sites. Similarly, Col M. Viswambaran[67] in 2014 mean crestal bone loss ≥1.5 mm during the first year after loading and ≥0.2 mm/year thereafter within normal limits.

Our study is also in agreement with this observation and confirmed the findings of previous clinical studies in which mean crestal bone loss ≥1.5 mm during the first year after loading and ≥0.2 mm/year thereafter is considered to be one of the major success criteria.

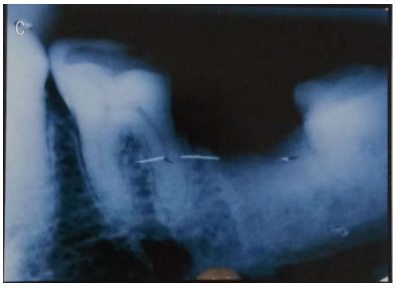
CONCLUSION

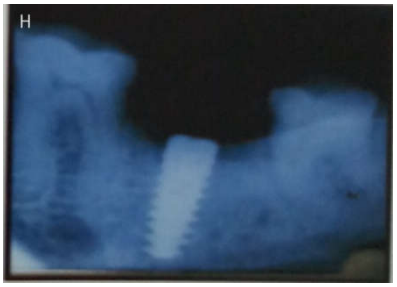
The loading of implants can be done immediately irrespective of the number and anatomical area provided the insertion torque of 40Ncm is achieved; reducing the tissue trauma, reduced overall treatment time, decreased patient anxiety and discomfort, high patient acceptance and better fuction and aesthetics, making the entire procedure a single stage surgery. At the time of implant insertion due to nature of bone if some difficulty is encountered inadvertently and if it is not possible to achieve initial stability with insertion torque of 40 Ncm delayed loading is advicable with a close follow up of patient.

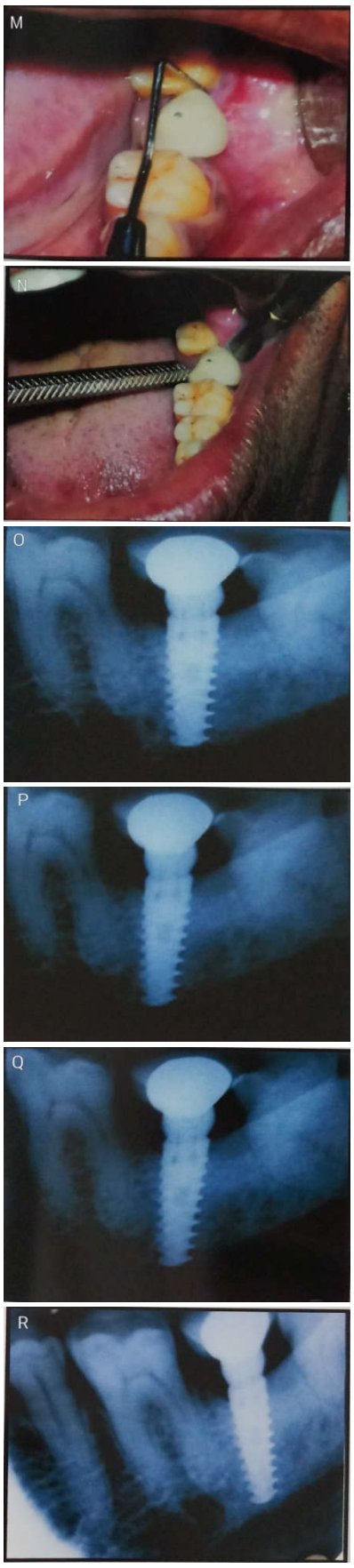
If quality of the bone is good and initial implant stability with insertion torque of 40 Ncm is achieved, implant should be slightly supracrestal, so that there is no difficulty in fixing abutment due to overhanging bony margins. If in case implant goes slightly sub-crestal, the overhanging bony margins should be reduced to facilitated implant abutment fixture. This manuever will remove the microgap at the implant abutment interface, which rules out the possibility of peri implant bone loss as seen in delayed implant loading. The periodontal status if maintained in general, does not affect the implant by the formation of new pockets around.

Due to the small sample size and short duration of the study; the term survival rate and success in terms of osseointigration, stability, pocket formation and bone loss can not be concluded, a long term multicentric study with bigger sample size should be analysed.

Case 1

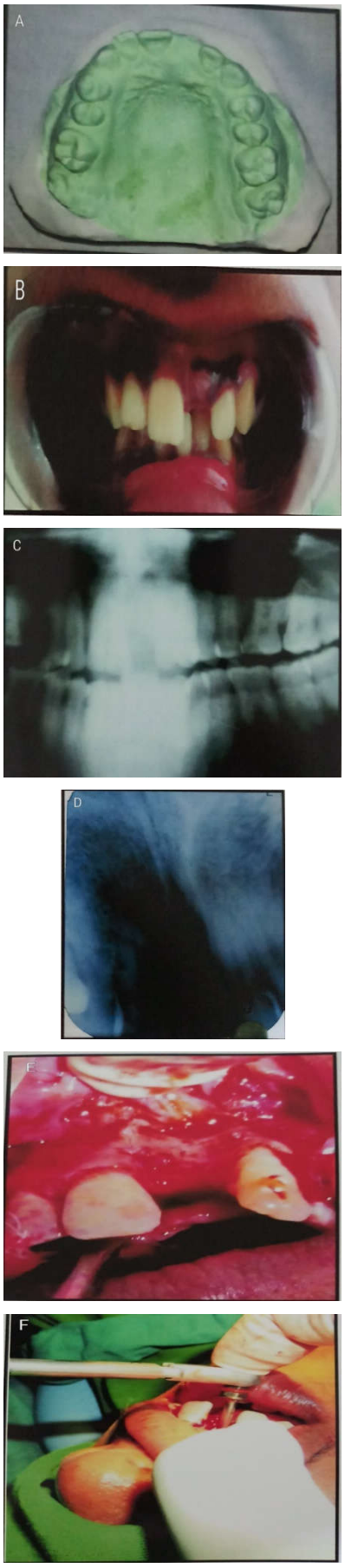


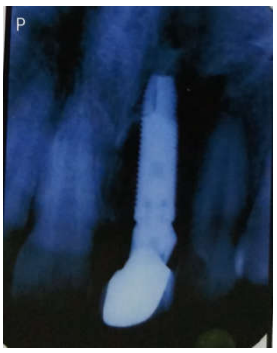




***A**-Diagnostic cast ;**B**-Pre-op ;**C**-IOPA; **D**-OPG ;**E**-Torque Rachet; **F**- Intraop; **G**- Closure; **H**- Immediate postop; **I**-After 3 months Abutment placement ; **J**-Abutment placement after 3 months; **K**-Crown placement after 3 months ;**L**-Occlusion; **M**-Pocket dept William's graduated Probe; **N**-Stability; **O**-3 Months; **P**- 6 Months; **Q**- 12 months ; **R**- 18 months*

Case 2





***A**-Diagnostic cast; **B**-Preop; **C**-Preop OPG; **D**- Preop IOPA; **E**-Intraop**; F**-Torque Rachet; **G**-Immediate Abutment Placement; **H**-Temporary crown ; **I**- Permanent crown after 3 months; **J**-Pocket depth; **K**- Stability; **L**-Occlusion ;**M**- 3 Months; **N**- 6 Months; **O**-12 Months; **P**- 18 Months*

Reference

1. Papaspyridakos P, Chen CJ, Singh M,Weber HP and Gallucci GO. Success criteria in impant dentistry:a systemic review. *J Dent Res*.2012 mar;91(3):242-8.
2. Romanos G, froum S, hery C, choon cho S and Tarnow D.Survival Rate Of Immediately vs delayed loaded implants: Analysis of the current Literatur. *Journal of Oral Implantology* 01/2010; 36(4):315-24.

3. Javed F, Romanos GE. Role of primary stability for successful immediate-loading of dental implants. A literature review. *J Dent* 2010; 38:612–620.
4. Horiuchi K, Uchida H, Yamamoto K, Sugimur M. A Immediate Loading of Brånemark System Implants Following Placement in Edentulous Patients: A Clinical Report. *Int J Oral Maxillofac Implants* 2000;15: 824–830.
5. Babbush CA, Kent JN, Misiek DJ. Titanium plasma-sprayed (TPS) screw implants for the reconstruction of the edentulous mandible. *J Oral Maxillofac Surg*. 1986 Apr;44(4):274-82.
6. Jemt T, Lekholm U, Adell R. Osseointegrated implants in the treatment of partially edentulous patients: a preliminary study on 876 consecutively placed fixtures. *Int J Oral Maxillofac Implants*. 1989 Fall;4(3):211-7.
7. Van Steenberghe D, Lekholm U, Bolender C, Folmer T, Henry P, Herrmann I, Higuchi K, Laney W, Linden U, Astrand P.Applicability of osseointegrated oral implants in the rehabilitation of partial edentulism: a prospective multicenter study on 558 fixtures. *Int J Oral Maxillofac Implants*. 1990 Fall;5(3):272-81
8. Adell R, Eriksson B, Lekholm U, Brånemark PI, Jemt T.Long-term follow-up study of osseointegrated implants in the treatment of totally edentulous jaws. *Int J Oral Maxillofac Implants.* 1990 Winter;5(4):347-59.
9. Jemt T, Laney WR, Harris D, Henry PJ, Krogh PH Jr, Polizzi G, Zarb GA, Herrmann I. Osseointegrated implants for single tooth replacement: A 1-year report from a multicenter prospective study. *Int J Oral Maxillofac Implants.* 1991 Spring;6(1):29-36.
10. Teerlinck J, Quirynen M, Darius P, Van Steenberghe D. Periotest : An Objective Clinical Diagnosis of Bone Apposition Toward Implants. *Int J Oral Maxillofa*c Implants. 1991 Spring;6(1).
11. Quirynen M, Van Steenberghe D, Jacobs R, Schotte A and Darius P.The reliability of pocket probing around screw-type implants. *Clinical Oral Implants Research* 1991 October ;2(4) : 186–192 .
12. Quirynen M, Naert I, van Steenberghe D. Periodontal aspects of osseointegrated fixtures supporting an overdenture. A 4-year retrospective study. *J Clin Periodontol* 1991 Nov; 18(10) :719-28.
13. Zarb GA and Schmitt A. The longitudinal clinical effectiveness of osseointegrated dental implants in anterior partially edentulous patients. *Int J Prosthodont* 1993; 6:180-188.
14. Zarb GA and Schmitt A. The longitudinal clinical effectiveness of osseointegrated dental implants in anterior partially edentulous patients. *Int J Prosthodont* 1993; 6:189-196.
15. Laney WR, Jemt T, Harris D, Henry PJ, Krogh PHJ, Polizzi G, Zarb GA, Herrmann I. Osseointegrated Implants for Single-Tooth Replacement: Progress Report From a Multicenter Prospective Study After 3 Years. *Int J Oral Maxillofac Implants* 1994;9:49-54.
16. Cordioli G, Castagna S, Consolati E. "Single-Tooth Implant Rehabilitation: A Retrospective Study of 67 Implants. Int. *J Prosthodont*.1994; 7:525-31.
17. Lekholm Ulf, Steenberghe DV, Herrmann I, Bolender C, Folmer T, Gunne J, Henry P, Higuchi k, Laney WR and Linden U. Osseointegrated Implants in the Treatment of Partially Edentulous Jaws: A Prospective 5-Year Multicenter Study. *Int J Oral Maxillofac Implants* 1994;9:627-635.
18. Al-sayyed A, Deporter DA, Pilliar RM, Watson PA, Pharoah M, Berhane K and Carter S. Predictable crestal bone remodelling around two porous-coated titanium alloy dental implant designs. A radiographic study in dogs. *Clinical Oral Implants Research* September 1994 ;5(3): 131–141.
19. Malevez CH, Hermans M and Daelemans PH. Marginal bone levels at Brånemark system implants used for single tooth restoration. The influence of implant design and anatomical region Clinical Oral Implants Research Volume 1996 June ;7(2): 162–169, .
20. Chiapasco M, Gatti C, Rossi E, Haefliger W, Markwalder TH. Implant-retained mandibular overdentures with immediate loading. A retrospective multicenter study on 226 consecutive cases. *Clin Oral Impl Res* 1997;8:48-57.
21. Ericsson I, Randow K, Nilner K, Petersson A. Some clinical and radiographical features of submerged and non-submerged titanium implants. A 5-year follow-up study. *Clin Oral Implants Res.* 1997 Oct;8(5):422-6.
22. Tarnow DP, Emtiaz S, Classi A. Immediate loading of threaded implants at stage 1 surgery in edentulous arches: ten consecutive case reports with 1- to 5-year data. *Int J Oral Maxillofac Implants.* 1997 May-Jun;12(3):319-24.
23. Becker W, Becker BE, Israelson H, Lucchini JP, Handelsman M, Ammons W, Rosenberg E, Rose L, Tucker LM, Lekholm U. One-step surgical placement of Brånemark implants: a prospective multicenter clinical study. *Int J Oral Maxillofac Implants.* 1997 Jul-Aug;12(4):454-62.
24. Collaert B, De Bruyn H. Comparison of Brånemark fixture integration and short-term survival using one-stage or two-stage surgery in completely and partially edentulous mandibles. *Clin Oral Implants Res.* 1998 Apr;9(2):131-5.
25. Isidor F, Dr Odont. Mobility Assessment with the Periotest System in Relation to Histologic Findings of Oral Implants. *Int j oral maxillofac implants* 1998;13:377–383.
26. Van Stenbergh D and Gnacenaert EI. The first two-stage dental implant system and its clinical application. *Periodontology* 2000, 1998;17 : 89-95.
27. Røynesdal AK, Ambjørnsen E, Haanæs HR. A Comparison of 3 Different Endosseous Nonsubmerged Implants in Edentulous Mandibles: A Clinical Report. *Int J Oral Maxillofac Implants* 1999;14:543–548
28. Ekfeldt A, Carlsson GE, Börjesson G. Clinical evaluation of single-tooth restorations supported by osseointegrated implants: a retrospective study. *Int J Oral Maxillofac Implan*ts. 1994 Mar-Apr;9(2):179-83.
29. Noack N, Willer J, Hoffmann J. Long-term results after placement of dental implants: longitudinal study of 1,964 implants over 16 years. *Int J Oral Maxillofac Implants.* 1999 Sep-Oct;14(5):748-55.
30. Abrahamsson I, Berglundh T, Moon IS, Lindhe J. 48 Peri-implant tissues at submerged and non-submerged titanium implants.. *J Clin Periodontol.* 1999 Sep;26(9):600-7.
31. Hermann JS, Buser D, Schenk RK and Cochran DL. Crestal bone changes around titanium implants. A

histometric evaluation of unloaded Non-Submerged and submerged Implants in the Canine Mandible. *J Periodontol* 2000;71:1412-1424.
32. Small PN, Tarnow DP .Gingival Recession Around Implants: A 1-Year Longitudinal Prospective Study. *Int J Oral Maxillofac Implants* 2000;15:527–532.
33. Chaushu G , Chaushu S, Tzohar A, Dayan D. Immediate Loading of Single-tooth Implants: Immediate Versus Non-immediate Implantation. A Clinical Report. *Int J Oral Maxillofac Implants* 2001;16:267–272.
34. Chow J , Hui E, Liu J, Li D, Wat P, Li W . The Hong Kong Bridge Protocol. Immediate Loading of Mandibular BrAnemark Fixtures Using a Fixed Provisional Prosthesis: Preliminary Results. *Clinical Implant Dentistry and Related Research* 2001; 3(3).
35. Siddiqui AA, John Y, Ismail H, Kukunas S. Immediate Loading of Dental Implants in the edentulous mandible: A Preliminary Case Report From an International Prospective Multicenter Study. Compendium / October 2001; 22(1).
36. Andersen E, Reidar H, Bjørn H, Knutsen M. Immediate loading of single-tooth ITI implants in the anterior maxilla: a prospective 5-year pilot study. *Clin. Oral Impl. Res.* 281–287.
37. Gibbard LL, Zarb G. A 5-Year Prospective Study of Implant-Supported Single-Tooth Replacements. *J Can Dent Assoc* 2002; 68(2):110-6.
38. Ericsson I, Nilner K. Early Functional Loading Using Brånemark Dental Implants. *Int J Periodontics Restorative Dent* 2002;22:9–19.
39. Kan YK, Rungcharassaeng K, Lozada J. Immediate Placement and Provisionalization of Maxillary Anterior Single Implants: 1-Year Prospective Study. *Int J Oral Maxillofac Implants* 2003;18:31–39.
40. Lambrecht JT, Filippi A, Doz P, Künzel AR, Schiel HJ. Long-term Evaluation of Submerged and Nonsubmerged ITI Solid-Screw Titanium Implants: A 10-year Life Table Analysis of 468 Implants. *Int J Oral Maxillofac Implants* 2003;18:826–834.
41. Balshi TJ, Wolfinge GJ. Immediate Loading of Dental Implants in the Edentulous Maxilla: Case Study of a Unique Protocol. *Int J Periodontics Restorative Dent* 2003; 23:37-45.
42. Heydenrijk K, Raghoebar GM, Meijer HJA, Stegenga B. Clinical and Radiologic Evaluation of 2-Stage IMZ Implants Placed in a Single-Stage Procedure: 2-year Results of a Prospective Comparative Study. *Int J Oral Maxillofac Implants* 2003;18:424–432.
43. Chatzistavrou M, Felton DA and Cooper LF. Immediate loading of dental implants in partially edentulous patients: A clinical report *Journal of Prosthodontics.* 2003 March ;12(1): 26–29.
44. Bischof M, Nedir R, Szmukler-Moncler S, Bernard JP and Samson J. Implant stability measurement of delayed and immediately loaded implants during healing. A clinical resonance-frequency analysis study with sandblasted-and-etched ITI implants. *Clin. Oral Impl. Res.* 2004;15 / 529–539.
45. Block M, Finger I, Castellon P and Lirettle D. Single Tooth Immediate Provisional Restoration of Dental Implants: Technique and Early Results. *J Oral Maxillofac Surg* 2004;62:1131-1138.
46. Misch CM. Immediate loading of definitive implants in the edentulous mandible using a fixed provisional prosthesis: the denture conversion technique. *J Oral Maxillifac Surg* 2004;62:106-115.
47. Castellon P, Block MS, Smith MB, Finger IM. Immediate loading of the edentulous mandible: delivery of the final restoration or a provisional restoration--which method to use?. *J Oral Maxillofac Surg*. 2004 Sep;62(9 Suppl 2):30-40.
48. Morton D, Jaffin R, Weber HP. Immediate Restoration and Loading of Dental Implants: Clinical Considerations and Protocols. *Int J Oral Maxillofac Implants* 2004; 19(SUPPL):103–108.
49. Testori T, Fabbro MD, Gain F, Francetti L, Taschicri S, Weiustein R. Immediate occeusal loading the same day or the day after implant placement: comparison of 2 different time frames in totally edentulous lower jaws. *Journal of Oral Implantology* 200;,30(5).
50. Nkenke E, Fenner M, Vairaktaris EG, Neukam FW, Troger MR. Immediate Versus Delayed Loading of Dental Implants in the Maxillae of Minipigs. Part II: Histomorphometric Analysis. *Int J Oral Maxillofac Implants* 2005;20:540–546.
51. Maria J, Ottoni P, Mansini R. Correlation between placement torque and survival of single-tooth implants. *Int J Oral Maxilofac Implants* 2005; 20:769-776.
52. Ryser MR, Block MS, and Mercante DE. Correlation of Papilla to Crestal Bone Levels Around Single Tooth Implants in Immediate or Delayed Crown Protocols. *J Oral Maxillofac Surg* .2005;63:1184-1195.
53. Abboud M, Koeck B, Stark H, Wahl G, Paillon R. Immediate loading of single-tooth implants in the posterior region. *Int J Oral Maxillofac Implants.* 2005 Jan-Feb;20(1):61-8.
54. Massimo Del, Fabbro , Testori T, Francetti L, Taschieri S. Systemic review of Survival Rates for Immediately Loaded Dental implants. *Int J Periodontics Restorative Dent* 2006;26:249–263.
55. Yoo RH, Chuang SK. Changes in crestal bone levels for immediately loaded implants. *Int J Oral Maxillofac Implants* 2006;21:253-261.
56. Lindeboom JA, Frenken JW, Dubois L, Frank M, Abbink I, Kroon FH. Immediate loading versus immediate provisionalization of maxillary single-tooth replacements: a prospective randomized study with Bio Comp implants. *JOMS* 2006;64:936-942.
57. Penarrocha M, Carrillo C, Boronat A, Martí E. Early loading of 642 Defcon implants: 1-year follow-up. *J Oral Maxillofac Surg*. 2007 Nov;65(11):2317-20.
58. Horwitz J, Zuabi O, Peled M, Machtei EE.Immediate and delayed restoration of dental implants in periodontally susceptible patients: 1-year results. *Int J Oral Maxillofac Implants*. 2007 May-Jun;22(3):423-9.
59. Susarla SM, Chuang SK, Dodson TB. Delayed Versus Immediate Loading of Implants: Survival Analysis and Risk Factors for Dental Implant Failure. *Journal of Oral and Maxillofacial Surgery.* 2008 Feb;66(2):251-255.
60. Peñarrocha M, Boronat A, Garcia B. 44 Immediate loading of immediate mandibular implants with a full-arch fixed prosthesis: a preliminary study. *J Oral Maxillofac Surg.* 2009 Jun;67(6):1286-93.

61. Gallucci GO, Morton D, Weber HP. Loading Protocols for Dental Implants in Edentulous Patients. *Int J Oral Maxillofac Implants* 2009; 24(SUPPL):132–146.
62. Romanos GE. Bone Quality and the Immediate Loading of Implants-Critical Aspects Based on Literature, Research, and Clinical Experience. *Implant dentistry* 2009;18(3).
63. Baig MR, Rajan G. Immediate placement and loading of implants in anterior maxilla using an altered screw-retained implant fixed prosthesis. *Indian J Dent Res,* 2010:21(2).
64. Roma G, Singh S.P, Gurleen A, Kanika A ."Overview: Immediate And Delayed Loading of Implants''. *National Journal of Medical and Dental Research, April-June 2013;1(3): 70-78.*
65. Troiano M. Prospective multicentre study of immediate occlusal loading of implants in edentulous mandibles. *Annals of Oral & Maxillofacial Surgery* 2013 Feb 01;1(1):6.
66. Karthik K, Sivaraj S, and Thangaswamy V. Evaluation of implant success: A review of past and present concepts *J Pharm Bioallied Sci.* Jun 2013; 5(Suppl 1): S117–S119
67. Viswambaran CM, Arora GV, Gupta SH, Dhiman RK, Thiruvalluvan MN. A clinico radiographic study of immediate loading implants in rehabilitation of mandibular ridges. *E medical journal a med forces india* 2014;30: 1-9.
68. Abichandani SJ, Ramesh Nadiger. Maxillary immediate implant loading: A comprehensive review. *Journal of Dental Implants* Jan - Jun 2013 Vol 3 Issue 1.
69. T. albrektsson, G. Zarb, P.Worthington and A.R. Eriksson.The long-term efficacy of currently used dental implants: A review and proposed criteria of success. *JOMI* 1986 (11-25).

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