ORIGINAL RESEARCH

Primary versus Secondary Implant Stability in Immediate and Early Loaded Implants

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ABSTRACT

Introduction: Dental implant is one of the predictably successful ways of teeth replacement. **Aim:** To compare primary versus secondary implant stability in immediate and early Loaded Implants. **Material and method:** 40 TS III Implant were placed in 36 patients. 20 were immediately loaded (Group I), and 20 were early loaded (Group II). Primary and secondary stability of implant was measured. Comparison of primary and secondary stability was done within the groups by paired t test and differences of primary and secondary stability by unpaired t test. **Results:** Mean Value of primary stability was 77.18 ± 7.958 and mean value of secondary stability was 87.19 ± 4.123 for the group I using paired t-test. Mean value of primary stability was 78.13 ± 6.202 and mean value of secondary stability was 88.15 ± 7.295. P value was less than 0.001 was statistically significant for group II using paired t-test. Mean value difference of primary and secondary stability examination of group I was -10.00 ± 5.552. Mean value of the difference of primary and secondary stability examination of group II was -10.02 ± 6.891. It was found to be significant with p-value < 0.05. Unpaired t-test was applied. No statistically significant difference was found for both the groups. **Conclusion-** Primary and secondary stability of immediately loaded group comparison have shown that there was the significant statistical difference and early loaded group comparison has shown that there was the significant statistical difference. But when differences of primary and secondary stability of immediate loaded and early loaded group comparison have shown that after osseointegration there is no difference in stability.

KEYWORDS: Dental implant, Implant Stability

INTRODUCTION

A dental implant is very successful treatment modality for teeth replacement. Dental implant stability is one of the important and decisive factors for implant success.[1]stability of the implant can be defined as absences of clinical mobility.[2] Stability can be divided into primary and secondary stability. Primary stability is defined as stability comes after immediately after implant placement. Secondary stability is defined as stability comes after osseointegration.[3] Single implant therapy is one of the successful treatment modality.[4] Various loading protocol was used in literature for implant loading like delayed loading, immediate loading, early loading. For a long time, it was presumed that premature loading would inhibit direct bone apposition onto the implant surface, thus compromising normal osseointegration. For this reason period of 3 to 6 month was considered before loading.[5] the protocol is termed as delayed loading. This causes the extended treatment time, second stage surgery and functional handicap. Immediate loading is defined as Immediate prosthetic reconstruction with in the first 48 hrs after implant placement without occlusal contact for two months.[5] Early loading was defined as a restoration in contac with the opposing dentition and placed at least 48 hrs after implant placement but not later than three months afterwards.[5] Both this treatment modality decreases treatment time. Various methods were given in the literature for measurement of implant stability. More than decade resonance frequency is commonly used a non-invasive method.[6] Resonance frequency analysis was used widely for determining the stability of immediate and early loading of dental implant.[7] Platform switching is the use of lesser diameter abutment on large implant platform. Crestal bone resorption is reduced by platform switching.[8]

MATERIALS AND METHODS

The study population comprised of 16 male and 20 female patients aged between the 24 to 45 years, which were recruited from outpatient Department of Prosthodontics and Implantology. 40 Implant (Osstem TS III) were used in the study.

1.Study criteria: Study criteria were divided as Inclusion Criteria, Exclusion Criteria, Study Design, Study Groups and Follow-Up Duration for study (Table 1).

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Table 1: Study Criteria
Inclusion Criteria
1. Medical and psychological fitness for minor oral surgery.
2. Natural opposing dentition and normal occlusion present in the area intended for implant placement.
3. Age 20-45 years.
4. Completely healed socket, Mandibular posterior region.
Exclusion Criteria
1. Smoking habit.
2. Diabetes mellitus.
3. A systemic disorder that is contraindicated for the minor surgical procedure.
4. Pregnancy or lactation.
5. Any irradiation in head and neck area.
6. Need for bone augmentation procedure.
7. Clinical signs of bruxism or other severe functional disorders

The patients who met the above selection criteria, possible types of treatment, along with their associated risks and benefits were told to them. No incentives were offered to the patient. Patients participated in study voluntarily. Approval of this study protocol before commencing of this study was obtained from the Ethical Committee of the Institute.The study was a randomized controlled clinical trial, comparing the primary and secondary stability of immediate and early loaded platform switched dental implant.

Study Groups

Group I:- (20) Immediately loaded implant. (Experimental)

Group II:- (20) Early loaded implant.(Control)

The actual sample size was required to be 16 in each group, but due to expected dropout, we considered 25% increase in sample size 20 in each group. 40 implant placement was done, three patients (Two from the group I and one from group II) were a dropout, so sample size remains 37 implants. All patients were subjected to the phase I therapy such as scaling and root planning for the purpose of pre-surgical preparation protocol. One week after phase I therapy, a re-evaluation was done to ensure the fitness of the subject to undergo the surgical phase. Following clinical and radiological parameters were assessed for the same.

Follow-Up Duration for study: All measurement were recorded and calculated for primary stability at baseline and secondary stability after two months.

2. Method for fabrication of surgical Stent for implant placement: DVT (Kodak 9000 3D)assessment for preparing surgical stent was done. Appropriate size virtual implant placement was done. After making a diagnostic impression, the diagnostic cast was made. On dental cast, the acrylic tooth was placed on the edentulous area in occlusion. 0.5 mm thermoplastic sheet template was formed on this model.The template was removed from the cast with acrylic tooth inside. The acrylic tooth was removed. It was poured with self-cure clear acrylic. Filled template was placed back on the model. After setting of the acrylic, the template was removed. Tooth replica made up of clear acrylic was left on the cast.

Then in the patient mouth was used. Stent guides the pilot drill. Subsequent drills were used for ossteotomy enlargement.

Method for surgical procedure: The surgical procedure was divided in Flap Design (Incisions), Flap reflection, the surgical procedure for Group I and II.

The condition of adjacent teeth, ridge condition, soft tissue condition bone in interest area CT, BT, TLC, DLC, Hb%, Random blood glucose, blood pressure, IOPA, DVT were evaluated.

Before the initiation of the surgical procedure, anaesthesia was achieved by nerve blocks with 2% lignocaine hydrochloride containing 1:80,000 concentration of adrenaline

Flap Design (Incisions): Following administration of local anaesthesia conventional flap approach was initiated by intracrevicular (sulcular) incisions using Bard-Parker number 11 and 15 surgical blades on the labial and lingual aspects with the blade directed towards the crest of the alveolar bone margin. The incision was carried as far interproximally as possible to preserve the entire interdental papillae so as to achieve primary wound closure**.**Full-thickness (mucoperiosteal) flap was reflected using a periosteal elevator to expose alveolar bone margin. Extreme care was taken to avoid flap perforation.

Surgical procedure for Group II (Early loaded group): Following a crestal incision, a full-thickness was raised. The stent was placed. Piolet drill was introduced through the stent. And the implant ossteotomy site was prepared. Paralleling pin placed for checking angulations. Ossteotomy site enlarged with the subsequent drilling. After the ossteotomy procedure, an implant with appropriate dimensions determined by the pre-surgical radiographs, DVT scan measurement and bone mapping finding, were placed with a torque of 35-45 Ncm. The final position of the implant was kept 0.5-1.0 mm subcrestal. A screw was placed on the implant. Flaps were repositioned and secured in place using (3-0) black braided silk suture. Interrupted sutures were given for the primary closure. Post-operative instructions were given to all the subjects and were instructed to report back after seven days for suture removal.

Surgical procedure for Group I (Immediately loaded group): The surgical procedure followed for the group I was same as group II except that, abutment was placed after implant placement and sutured was done around it. Post-operative instructions were given to all the patients and recalled with in 48 hrs for temporization and seven days for suture removal.

For both groups, suitable antibiotics and analgesics were prescribed.

Second stage surgery: For group II following two months of implant surgery, second stage surgery was done.The incision was given. A cover screw was retrieved, and the gingival former was placed.

Method for assessment of stability of implant: Resonance frequency measurements were recorded by using osstell ISQ (figure no. 1).Smartpeg a magnetic attachment was placed on the implant with torque 4-5

Ncm.(figure no. 2) The Smartpeg was excited by a magnetic pulse by measuring probe on the handheld instrument. The probe was held perpendicular to smartpeg.(figure no. 3). Then stability was measured.(

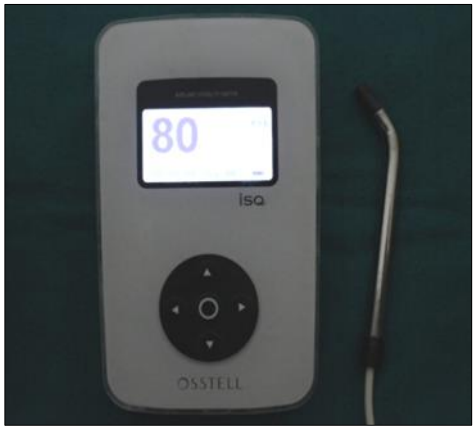


Figure no. 1. Resonance frequency analyzer (OsstellISQTM)

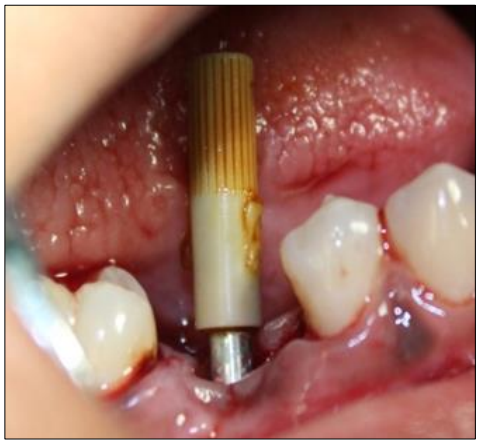


Figure no. 2 Smart Peg™ with cap

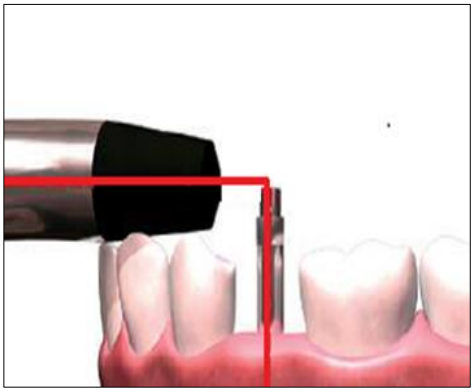


Figure no 3. Three methods for measurement of stability (schematic presentation)

figure no. 4) Measurement was taken in two different directions i.e. buccolingual, linguobuccal. The resonance frequency, which measures implant stability, is calculated from the response signal. Results were displayed on the instrument as the Implant Stability Quotient (ISQ), which is scaled from 1 to 100. Higher the numbers, the greater the stability. Then mean of all measurements were taken for each implant.

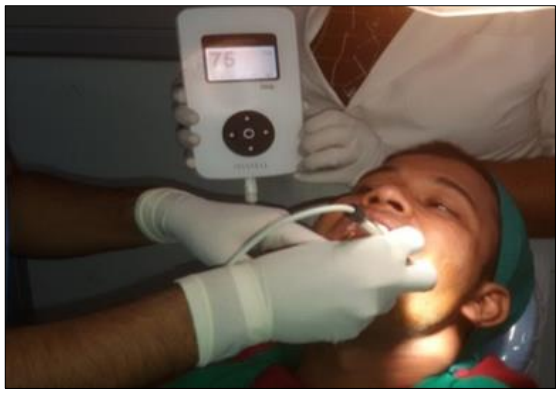


Figure no. 4. method for measurement of stability in patient

- **Primary stability of implant:** Primary stability was measured immediately after implant placement using above procedure.
- **Secondary stability of implant** Secondary stability was measured after two months of implant placement using above procedure.

Method for prosthetic procedures: Prosthetic procedures were divided into prosthetic procedures for Group I and II and post-operative Evaluation

Prosthetic procedures for Group II: After the two-month patient was recalled. Second stage surgery was performed. The incision was given to implant recipient site. The gingival former was placed for seven days. Implant level impression was made by using impression coping. Close tray impression technique was carried out with addition silicon impression material (putty and light body) for the impression of the implant. Then lab analog was placed on the impression post; the cast was made using class IV dental stone. Porcelain fused to the metal crown was made by using nickel chrome alloy and ceramic material after the lab procedure metal ceramic crown was cemented with zinc phosphate cement on the abutment of the respected implant. Care has been taken to remove excess cement. Occlusion was checked by 40-micron paper. The patient was recalled after 1and 8 days, 1,2,3,6 and 12 months.

Prosthetic procedures for Group I: Immediately after placement, implant level impression was made by using transfer coping. Close tray impression technique was carried out with addition silicon impression material (putty and light body) for an impression of the implant. The patient was recalled within 48 hrs for provisional. The temporary crown was cemented on the abutment of the respected implant with zinc phosphate cement. Care has been taken to remove excess cement. Occlusion was checked by articulation paper of 200 microns for infra-occlusion. The patient was recalled after two months for final prosthesis. The temporary crown was removed. For final prosthesis, the same procedure was followed as group II. The patient was recalled after 1and 8 days, 1,2,3,6 and 12 months.

Method for statistical analysis: The means and standard deviations (Mean ± SD) values were calculated for crestal

levels were calculated at baseline and two months. The mean data was analyzed for the statistical significance using Statistical Package for the Social Sciences (SSPS version 20, IBM, USA) software.

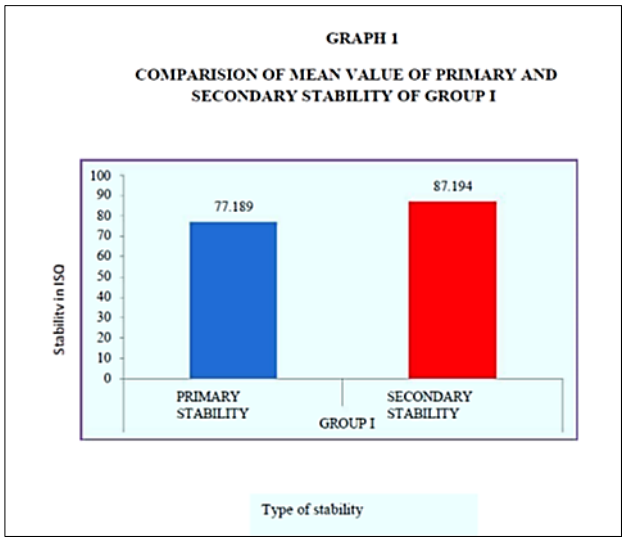
RESULTS

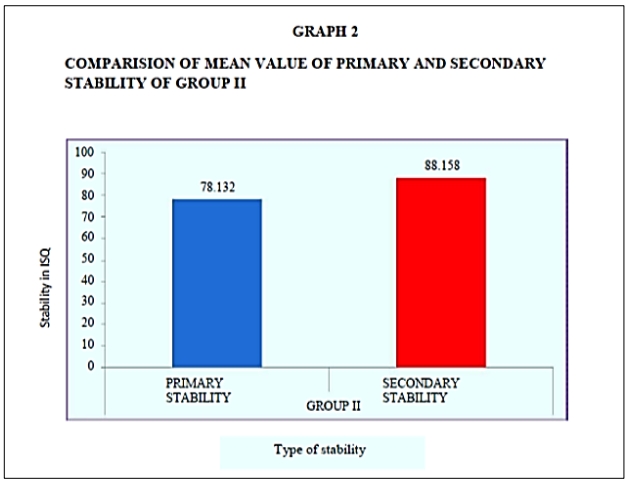
Out of 40 sites, 20 implants were immediately loaded, and 20 implants were early loaded. All 40 patients had undergone clinical and radiological bone mapping. Total three patients (2 patients from immediately loaded group i.e. group I and one patient early loaded group i.e. group II) were unable to follow the appointment after placement of the implant and subsequently dropout from the study. Implant variable are summarized as in Table no.1

Variable		Implant type	
		Immediately loaded	Early loaded
Length	7 mm	3	3
	8.5 mm	1	3
	10 mm	13	12
	11 mm	1	1
Diameter	3.5	2	4
	4 mm	15	15
	4.5 mm	1	0
Position in mandible	Right second molar	0	2
	Right first molar	12	9
	Left the first molar	4	7
	Right first premolar	1	0
	Right second premolar	1	0
	Left second premolar	0	1
Reason of tooth extraction	Root fracture	1	2
	Endodontic failure	9	9
	Trauma	1	0
	Periodontal	2	2
	Badly carious	5	6

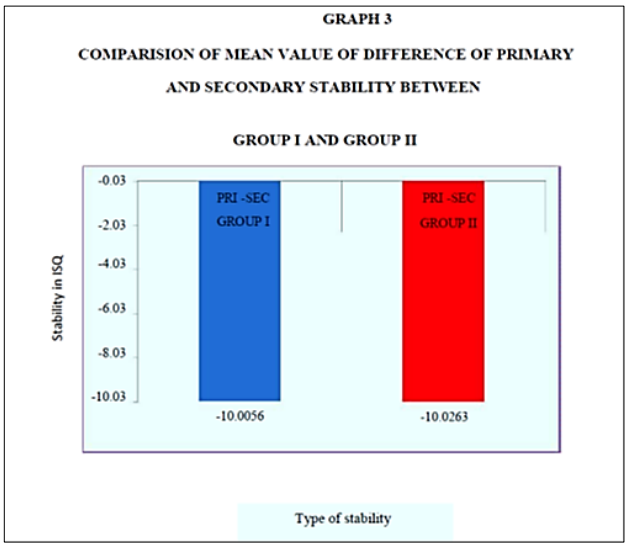
Table No. 1: Length, Diameter Of Implant Used, Region Of Placement Of Implant, Reason For Extraction Of Teeth

Graph no. 1 shows mean value of primary stability was 77.18 ± 7.958 and mean value of secondary stability was 87.19 ± 4.123. P value was less than 0.001 was statistically significant for the group I using paired t-test. Graph no. 2 shows mean value of primary stability was 78.13 ± 6.202 and mean value of secondary stability was 88.15 ± 7.295. P value was less than 0.001 was statistically significant for group II using paired t-test.





Graph no. 3 shows a comparison of the mean value of primary and secondary stability of group I and group II (mean ± sd; in ISQ). Mean value difference of primary and secondary stability examination of group I was -10.00 ± 5.552. Mean value of the difference of primary and secondary stability examination of group II was -10.02 ± 6.891. It was found to be significant with p-value < 0.05. Unpaired t-test was applied. No statistically significant difference was found for both the groups



DISCUSSION

Most of the studies were in anterior maxilla and mandible. In the posterior mandible, very studies are there. The presence of good bone quality. In the posterior mandibular region, very few studies were done comparing immediate and early loading.[7,9,10] VKokovic (2014)[9]compared clinical results of immediate and early loading of self-tapping implants placed in posterior mandibles. They concluded that the self-tapping implants inserted in posterior mandible could provide adequate primary stability value as the main factor for immediate and early loading protocol. In the present study, primary stability was measured. Hence posterior mandibular region is selected in the present study.

TS III SA (Sandblasted with alumina and Acid etched) osstem implant provides greater surface area.It fully exploits the excellent pluripotential capacity of osteoblastic cells. It shortens healing time. That is helpful for immediate loading. The body design of implant was tapered that provides excellent primary stability.[11] The final position of the implant was kept 0.5 to 1 mm subcrestal.[The 12]apical design gives self-drilling ability. Powerful self-cutting thread gives high initial stability.[13] Hence TS III SA (Sandblasted with alumina and Acid etched) osstem implant used in the study. Insertion torque used in study was 30-45 Ncm.[14]

Bone density is a key factor to take into consideration when predicting implant stability. Clinical studies showed greater survival in mandible.[15]Lekhholm and Zarb classification was considered in the study for bone density.[16]Length and diameter of implant ranges from, length: 7 – 11mm, diameter: 3.5-4.5 mm. SLA Surface shows better osseointegration[17], hence used in the study.

The concept of "platform switching" refers to the use of a smaller-diameter abutment on a larger-diameter implant collar.[18]This connection shifts the perimeter of the implant–abutment junction inward toward the centre of the implant. The mechanism by which platform switching contributes to maintaining the crestal bone height could be due to four reasons discussed 1) Shifting the inflammatory cell infiltrate away from the crestal bone. 2) Maintaining biological width and greater distance of implant abutment junction from the crestal bone level. 3) The effect of micro-gap on the crestal bone is minimized . 4) stress levels reduced in the peri-implant bone.[18] Various studies were reported in the literature which shows that there is a reduction in bone loss in platform switched dental implant.[18,19,20,21] Hence platform switched dental implant are used in present study.

Implant stability can be defined as the absence of clinical mobility.[2]That can be divided into primary stability and secondary stability. Primary stability is a considered as gold standard for implant success. It is a mechanical phenomenon. It comes immediately after placement of the implant. Various studies have shown that primary stability was very important.[1,2,3] Hence the primary stability of implant is measured in the present study. Secondary stability is a biological phenomenon; it indicates osseointegration.[3]Hence secondary stability is considered and measured in the present study. Various method are given in literature for measurement of implant stability.[1,3,6]

Resonance frequency is commonly used a noninvasive method.[6]Osstell® ISQ[22] is a portable, handheld instrument that uses the noninvasive technique.

Resonance Frequency Analysis for calculating dental implant stability in the present study was used. The system includes the use a Smartpeg™ attached to the dental implant or abutment using an integrated screw. The Smartpeg is enthusiastic by a magnetic pulse from the measuring probe on the handheld instrument. The resonance frequency, which measures the implant stability, is calculated from the response signal. Results are displayed on the instrument as the Implant Stability Quotient (ISQ), which is scaled from 1 to 100. The higher the number, the greater the stability. The role of primary stability very important in immediate loading values above 65 indicate favourable for immediate loading.[2]Hence resonance frequency analysis used in present study. Primary stability and secondary stability within of immediately loaded and early loaded group was compared, It was found that in both groups, statistically significant difference was there. But when the difference was compared between immediately and early loaded group it was not significant. The difference was 0.99. This was in agreement with a similar study performed by Tatsuo shiigai.[23] The difference was 0.33. This may be due to that after osseointegration there is no difference in stability

CONCLUSION

Primary and secondary stability of immediately loaded group comparison has shown that there was a significant statistical difference and early loaded group comparison has shown that there was the significant statistical difference. But when differences of primary and secondary stability of immediate loaded and early loaded group comparison have shown that after osseointegration there is no difference in stability.

Limitations that should be considered are

- Diameter and length of all implant was not same
- The study would have been better if immediate and early loading of the implant was done in the same patient.

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