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Immediate Implant Placement and Provisionalization in Esthetic Zone: A Clinical Evaluation

Raman Kumar,[1]Kausar Parwez Khan,[2]Arun Maradi,[3]Antra Yadav,[4] Kumari Neha,[1]Raghav Narayan Jha[1]

[1]Post Graduate Student, Department of Periodontology and Implantology, MMDCH, Darbhanga, Bihar, India.

[2]Associate Professor, Department of Periodontology and Implantology, MMDCH, Darbhanga, Bihar, India.

[3]Professor and HOD, Department of Periodontology and Implantology, MMDCH, Darbhanga, Bihar, India.

[4]Post Graduate Student, Department of Conservative Dentistry and Endodontics, TMDC&RC, Moradabad, Utter Pradesh, India

Corresponding Author: Dr. Raman Kumar. Email id:raman.toka@gmail.com

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Abstract

Objectives: We assessed the implant stability (a clinical indicator of the extent of osseointegration at regular intervals. We observed changes in the peri-implant soft tissues following immediate loading after placement. We measured marginal bone level changes using intraoral periapical radiographs in follow-up examinations. We also recorded the incidence of complications.

Methods: Of the patients reporting to Mithila Minority Dental College & Hospital, Darbhanga, Bihar, 20 single-tooth implants were placed in 20 patients desiring replacement of missing teeth in the esthetic zone (maxillary incisors, canines, and premolars).Implants of the Noris Medical Implant System were surgically placed. Temporary acrylic resin crownswere fabricated and cemented on the same day. The permanent prostheses were inserted 6 months postoperatively.

Results: Of20 dental implants evaluated clinically, all showed successful osseointegration over a 1-year follow-up.

Conclusion: Implants loaded immediately osseointegrate successfully. This offers an attractive alternative to conventional protocols involving a 6-month waiting period, providing several obvious advantages.However, patient selection is critical.

Keywords: Dental implant, Immediate loading, Osseointegration

Introduction: Traditional techniques for replacing teeth with dental implants involve numerous steps. It involves a dormant "healing" phase of 3-6 months following the first implant operation to allow for tissue repair and implant osseointegration. The implant isloaded with the prosthesis only after it heals sufficiently. Immediate loading of oral implants is a circumstance wherein the superstructure is attached to the implant within 72 hours after surgery.[1]

The immediate loading of dental implants has clear advantages. A extended treatment period involving the use of a temporary prosthesis can be quite inconvenient and is sometimes the reason for not considering implant-supported restorations at all.[2]

Historically, edentulousness was treated by transplanting cadaveric and animal teeth and replacing them with artificial teeth made of vulcanite or metal that could be fastened to adjacent teeth or removed by the user. Contemporary dentistry offers two separate options to address partial edentulousness: removable and fixed partial dentures.

A removable prosthesis can be withdrawn and inserted by the user. Although this provides flexibility, it has intrinsic downsides, such as difficulty in speech, changed taste perception, irritation to denture-supporting tissues, dimensional instability, and difficult maintenance.

Fixed prostheses solve several problems that removable prostheses do not, but they have some drawbacks, the most significant being that adjacent teeth must be prepared to serve as abutmentsto replace a specific tooth/teeth, sacrificing healthy tooth structure. Following the insertion of the fixed partial denture, the edentulous ridge in the pontic region tends to resorb, resulting in voids that detract from appearance. Occlusal overload of abutment teeth frequently results in periodontal deterioration and subsequent loss of abutment teeth.

Because of these issues, dental implants were developed following Branemark's unexpected discovery of the osseointegration phenomenon in 1952. Dental implantology has subsequently advanced and is regarded a highly effective and dependable mode of tooth replacement.According to standard protocols, once the dental implant is inserted in the bone, it is buried under the mucosa and left for 3-6 months to osseointegrate into the surrounding bone. During this phase, the patient should wear an interim partial denture. Later in the second stage of surgery, the abutment is connected to the implant. The final prosthesis is put only after adequate healing of the soft tissues.

This could be a psychologically distressing experience. Furthermore, from a functional standpoint, treated patients may be unable to cope with detachable prostheses during the healing process due to poor retention of provisional prostheses, or they may request an urgent treatment solution for socioeconomic reasons. The need has been seen to establish "routine" implant methods, reducing or even eliminating the healing times before loading placed implants. As a result, fixed implant-supported prostheses created using protocols for immediate (within 72 hours) or early implant loading (within a few weeks of healing) have gradually become available as additional concepts in recent years, with the goal of reducing treatment time and costs. This is a new approach as compared to "routine" protocols. The new approach provides various benefits, including better masticatory performance, reduced uncontrolled transmucosal loading by cross-arch stability, improved psychological well-being, and shortened treatment duration. The immediate loading strategy is thus a promising alternative for the treatment of such patients.

This study sought to assess the performance of implants that were put to load shortly after implantation. This was performed by assessing implant stability (a clinical sign of osseointegration) at regular intervals. We also examined changes in the soft tissues around the implant soon after insertion. Furthermore, we evaluated marginal bone level changes in follow-up exams using intra-oral periapical radiography. Furthermore, we documented the incidence of complications/failure in implants subjected to immediate loading.

Methods

Study design: Twenty sites from 20 patients were collected from the Department of Periodontology and Implantology at Mithila Minority Dental College and Hospital in Darbhanga, Bihar. The ethical committee of Mithila Minority Dental College & Hospital in Darbhanga, Bihar, authorized this study. Table 1 lists the patients' demographic features.

Inclusion criteria:

1. Patientsare conscious of oral hygiene and willing to undergo restoration with dental implants.
2. Missing teeth in the esthetic zone (consisting of maxillary incisors, canines, and premolars).
3. Adequately healed and remodeled ridge.
4. Absence of any periodontal problems in adjacent teeth.
5. Absence of supra eruption of the opposite tooth.
6. Age group 20 to 50 years.

Exclusion criteria:

1. Insufficient bone volume.
2. Severe maxilla mandibular skeletal discrepancy.
3. Drug and alcohol abuse.
4. Smokers.
5. Local radiotherapy to the head and neck region for malignancies.
6. Antiblastic chemotherapy.
7. Renal or liver disease.
8. Uncontrolled diabetes.
9. Free of periapical pathology.
10. Recent infarction.
11. Pregnancy at the time of evaluation.
12. Hemophilia, bleeding disorders, or coumarin therapy.
13. Metabolic disorders.
14. Signs of chronic bone disease.
15. Bruxism and general contraindications for surgical procedures.

Clinical parameters

Bone level: Radiograph to be checked at1 and 6 months.
Gingival health: Color, contour, andpocket depth.

Surgical procedure: Case histories were taken after written informed consent was obtained. Participants were instructed to clean their mouths with chlorhexidine 2% immediately before surgery. The patient's face was disinfected with 7.5% povidone-iodine. The oral cavity was prepped with 5% povidone-iodine, and the patient was draped according to standard surgical procedures. Local anesthesia (Lignocaine with 1:80,000 Adrenaline) was given to inhibit localized nerve supply and facilitate hemostasis.

A crestal incision was then placed with 2 releasing incisions, and the flap was elevated with a No.9 Molts periosteal elevator, taking care to prevent flap tearing. After sufficient crestal boneexposure, the surgical stent was implanted.The implant osteotomy began with a punch cut of the pilot drill through the hole in the stent, to accurately reproduce the angulation.

The stent was removed and the osteotomy wasobtaineduntil the desired depth. The angulation was checked once again with the paralleling pin, clinically and radiographically; any discrepancy was corrected subsequently. The osteotomy was then diametrically enlarged to the desired width. All steps wereperformed under constant internal and external irrigation.

After the osteotomy, the implant was carried to the site using a disposable carrier provided by the manufacturer. It was screwed in and tightened using the hardware provided in the surgical kit. We ensured that a minimum torque of 35Nm is obtained while screwing in the implant (ascertained using a “slip Ratchet”), a prerequisite for immediate loading.

The abutment was then attached to the implant with the screw provided. The flap was reapproximated and sutured. The screw hole in the abutment was blocked with wax.

An impression wasobtained using irreversible hydrocolloid and cast in die stone and sent to a prosthodontist for the fabrication of an immediate acrylic temporary crown, which was cemented on the next day. The crown was relieved of occlusal contacts.

All patients were prescribed amoxicillin (500mg, TID), metronidazole (400mg, TID), a diclofenac +paracetamol preparation (BID), and a chlorhexidine 2% mouth rinse. Patients were instructed not to bite hard on the prosthesis. Sutures were removed on postoperative day 7.The permanent prostheses were fabricated in month 6 following placement. The patients could select full ceramic or metal fused to ceramic crowns.The response to the implant and its loading, before osseointegration, was monitored over a 6-month follow-up. The parameters were recorded twice, i.e. atbaselineand at month 6.

Postoperative evaluation: Our postoperative evaluation of the immediately loaded implants included 4 parameters.

1. Implant mobility
2. Soft tissue changes
    a. Peri-implant probing depth
    b. Bleeding index
3. Height of marginal bone loss

Implant mobility: This was measured in a method similar to that used to assess tooth mobility. With 2 rigid instruments, a force was applied in the labiolingual direction. The amplitude of implant mobility was scored 0-4 (Table 2).It was measured as for a natural tooth, using a periodontal probe (UNC 15). Probing depths were recorded for each 4 surfaces, averaged to yield a mean peri-implant probing depth for each implant.

Bleeding index: We used the Silness and Loe Gingival index.[3] This index scores gingival inflammation on the facial, palatal, mesial and distal surfaces of an implant, with scores based on the presence or absence of bleeding on probing and scored between 0 and 3 (Table 3).The 4 values obtained were averaged to yield the bleeding index for that implant.

Mean marginal bone levels: Mean marginal bone levels were assessed radiographically using standard intra-oral periapical radiographs. The mean marginal bone loss level for that implant was calculated by measuring the distance between the observed crestal bone level and the implant-abutment interface at the mesial and distal implant surfaces and averaging.

In some circumstances, a magnification error occurred. In such cases, the implant's length (mm) and the distance between the observed crestal bone and the implant-abutment interface were measured using radiography. The actual implant length is known due to manufacturing norms. To adjust for magnification error, the following equation was employed to determine the corrected crestal bone levels:[4]

$$\text{Corrected crestal bone level} = \text{measured crestal bone level} \times \frac{\text{actual implant length}}{\text{Measured implant length}}$$

The measurements were classified into 0.5-mm groups.

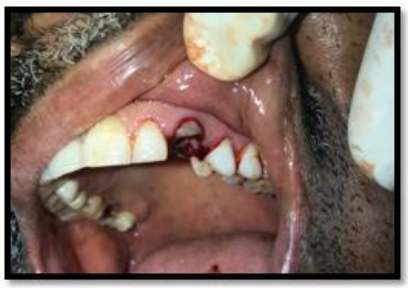

Figure 1: Pre-Operative Clinical Photographs

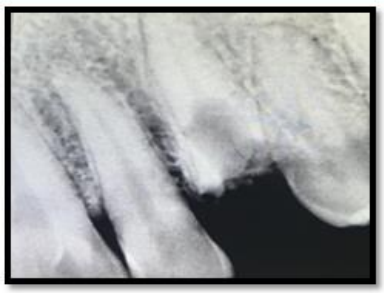

Figure 2: Pre-Operative RVG

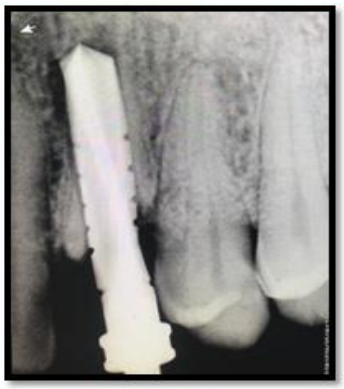

Figure 3: Osteotomy

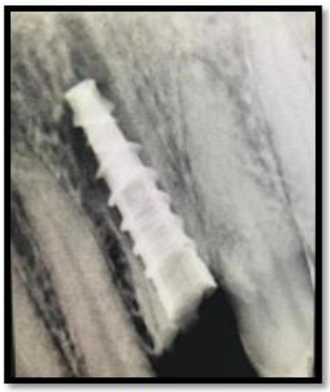

Figure 4: Implant Placed

Figure 5: Suturing Done

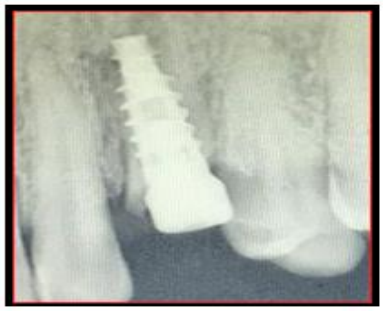

Figure 6: RVG with Gingival Former

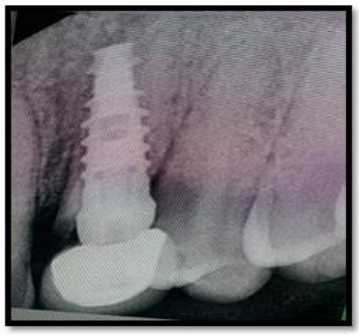

Figure 7: RVG After 6 Month

Figure 8: Clinical Photographs After 6 months

Results: At the onset (1 month), the mean mobility score was 0.05 (standard deviation: 0.224; standard error of the mean: 0.050). By month 6, the mean mobility increased substantially to 0.85 (standard deviation: 0.489; standard error of the mean: 0.109). The initial probing depth at 1 month averaged at 1.54 (standard deviation: 0.500; standard error of the mean: 0.112). After 6 months, the probing depth decreased to 1.15 (standard deviation: 0.2351; standard

error of the mean: 0.0526). Bone loss appeared consistent between 1 and 6 months, with mean scores of 1.00 and 2.00, respectively. Both showed no standard deviation or standard error, indicating a uniform observation across the study group. The bleeding index exhibited slight changes over time. At 1 month, the mean index was 1.25 (standard deviation: 0.334; standard error of the mean: 0.075). By month 6, the mean index had slightly increased to 1.30 (standard deviation: 0.299; standard error of the mean: 0.067). These findings provide insights into the progression of periodontal health within the study group over time.

Table 4 presents various parameters within the study group over time. Significant changes were observed in mobility and probing depth over 6 months, whereas the bleeding index did not change significantly between the initial and final assessments.

Table 1- Patient Data

Patient	Age(Y)	Sex	Missing Tooth	Duration ofEdentulousness	Size of ImplantUsed
A	32	M	21	12MONTHS	3.75X 11.5mm
B	25	F	12	6MONTHS	3.3X 11.5mm
C	38	F	21	18MONTHS	4.2X 10mm
D	34	M	11	12MONTHS	3.75X 11.5mm
E	24	M	13	6MONTHS	3.3X 11.5mm
F	26	F	21	6MONTHS	3.75X 10mm
G	37	M	21	14MONTHS	4.2X 11.5mm
H	39	M	14	9MONTHS	3.75X 11.5mm
I	27	M	21	16MONTHS	3.3X 11.5mm
J	33	M	12	9MONTHS	3.75X 10mm
K	38	M	25	12MONTHS	3.3X 11.5mm
L	33	F	15	6MONTHS	3.75X 10mm
M	29	F	11	9MONTHS	4.2X 11.5mm
N	27	M	22	4MONTHS	3.75X 11.5mm
O	37	F	12	9MONTHS	3.3X 11.5mm
P	41	M	13	14MONTHS	3.75X 10mm
Q	44	M	23	15MONTHS	3.3X 11.5mm
R	30	F	1	6MONTHS	3.75X 10mm

			5		
S	27	F	2 1	9MONTHS	3.3X 11.5mm
T	28	M	2 3	8MONTHS	3.75X 10mm

Table 2- Clinical Implant Mobility Scale

1	Absence of any clinical mobility with 500gms in any direction
2	Slight detectable horizontal movement
3	Moderate visible horizontal mobility
4	Severe horizontal mobility > 0.5mm
5	Visible moderate to severe horizontal movement

Table 3 - Bleeding Index Scores and Their Interpretation

FINDING	SCORE	scoresof4surfacestobeaveraged
No bleeding on probing	0	
Traces of bleeding on probing	1	
Spontaneous bleeding on probing	2	
Bleeding without probing	3	

Table 4 - Intragroup Comparison of Various Parameters of the Studied Group

Parameter	Mean difference	Std. Deviation	Std. Error of the Mean	95% Confidence Interval of the Difference		t	df	p value
				Lower	Upper			
One-month mobility - six-month mobility	-.800	.523	.117	-1.045	-.555	-6.839	19	.000*
One-month probing - six-month probing	.3950	.3710	.0829	.2214	.5686	4.762	19	.000*
One-month bleeding index - six-month bleeding index	-.050	.386	.086	-.230	.130	-.580	19	.569**

*statistically significant **statistically non-significant
a-- t cannot be computed because the standard error of the difference is 0.

Discussion: Dental implants are becoming the norm in modern dentistry when it comes to replacing lost teeth. Dental implants are a very dependable method of replacing lost teeth. The reduction of treatment time is the final criteria, to attain comfort, function, and

aesthetics.[5,6] Initially, Branemark et al.[7] advised a stress-free, 3-6 month recovery timeto achieve optimum bone healing and osseointegration before loading.Patients and clinicians found this excessive waiting period to be inconvenient, and frequently it was the reason why implant therapy was not chosen.[6,7] Rather than being supported by biological evidence, the previously specified healing period before implants can be loaded was determined by clinical observations. Furthermore, challenging circumstances were encountered in the early trials, including non-optimal patient selection with low bone quantity and quality, non-optimized implant design, short implants, non-optimized surgical protocols, and a prosthesis that was not biomechanically optimized.[8,9]Grutter and Belser (2009) reported a I-year survival rate of 97.3% and a 1-5-year survival rate of 96% after examining 1,922 implants. Immediate loading of end osseous root form implants supposedly removes the 3-6-month healing period. Earlier, micromotion due from early implant loading was hypothesized to result in fibrous encapsulation of the implant.[10,11]According to Barone et al., implants that are loaded immediately have a better bone density than that associated with implants loaded later.[10]Animal histologic analyses have shown that osseointegration occurs when implants are loaded immediately. Histologic analysis of implants loaded immediately in human subjects has shown osseointegration.[12,13,14]Dental implants' osseointegration has become predictable, yet successful esthetic outcomes do not necessarily result from osseointegration. Patients and physicians now pay close attention to the esthetic results since implant survival and success rates are still excellent. In the end, the maxillary anterior region poses the biggest difficulty in satisfying these aesthetic requirements.

Peri-implant soft tissue recession, both facially and interproximally, is a significant aesthetic concern.[5,8,10]The most frequent side effect of implants for a single tooth is gingival recession.[11,12]Implant position and inclination, gingival biotype, gingival contour, thickness and height of the facial bones, osseous scallop, interproximal bone level, and restorative form and emergence contribute to excellent esthetics. As such, the link between these parameters and peri-implant gingival esthetics has been emphasized. Comprehending these variables is essential to avoid unattractive outcomes, gingival recession, and interproximal papilla loss.

It has been determined that "regular" implant techniques are necessary, especially in order to shorten or perhaps completely eliminate the healing times prior to loading placed implants.[11]As biomaterials have been better understood, implant design and surgical protocols have improved, and in subsequent years, protocols for immediate (same-day) and early implant loading (within a few weeks of healing) have been developed to create fixed implant-supported prostheses. This is a novel approach in contrast to standard protocols.

In this prospective clinical study, we assessed the gingival and bone health following immediate loading in the esthetic zone among 20 sites from 20 patients. Here, molars were excluded because implants in the posterior region must withstand relatively high forces and loading moments in order for them to function, but missing teeth in the esthetic zone with adequately healed and remodeled ridges were included.[14]Over a six-month follow-up, the patient's reaction to the implant and its loading prior to osseointegration was observed. The study parameters were recorded six times, or once a month for six months. The characteristics of implant success were measured using standardized yardsticks. We considered the following clinical parameters: bleeding index, probing depths, and implant mobility. While implant mobility is a direct indicator of the degree of osseointegration and was measured in the current study using two dental instrument handles placed on the buccal and palatal aspects of the crown using the technique as described by Ericsson et al., the marginal bone levels were evaluated radiographically.[6]According to Misch's grading scheme, the mobility was graded.[4] Here, a UNC-15 probe was used to determine the implant probing depths. While a continuously rising probing depth is indicative of illness and bone loss, a comparatively stable probing depth is a good indicator. Early bone abnormalities, particularly those on the

face, are clinically simpler to detect with a probe than with a radiograph, which makes probing important. The absence of inflammation in the soft tissue surrounding the implant is the optimum state. An indication of inflammation is gingival bleeding upon probing. Sulcular hemorrhage has been linked to increased pocket depth and radiologic bone loss. Consequently, in order to track the patient's maintenance of oral hygiene, the gingival state surrounding the implant was documented. The bleeding index was computed using Silness and Loe's parameters.[15,16]Along the sulcus, a periodontal probe was inserted. The subsequent bleeding's appearance was noted, per Ericsson et al.[6]Measurements were made for each of the four surfaces for both parameters—peri-implant probing depths and bleeding index—averaged to get a mean value for each implant. One important determinant of implant health is the area of crestal bone. The primary cause of early crestal bone loss is typically excessive strain at the permucosal location. Reviewing potential stressors for the implant, including as occlusal variables, cantilever length, and parafunction, is indicated by this signal.

In this investigation, standard intraoral periapical radiographs were utilized to radiographically measure the mean marginal bone levels. Every follow-up consultation needs to involve determining the precise amount of bone loss. several experts have suggested several approaches to ascertain the crestal bone's height for this purpose. An Eggen film holder was utilized by Andersen et al. and Ericsson et al.[5,6] customized to eachpatient using rubber impression material. Next, using a peak loupe scale with a 7x magnification and grading to the 10th of a millimeter, the bone levels were measured on the radiograph. Misch has linked the measurement of the marginal bone levels to the implant's thread pitch.[15]We adopted the method described by Yoo et al.[17]Using the radiographs, the implant's length (in millimeters) was measured. Subsequently, the mesial and distal implant surfaces were measured for the distance between the observed crestal bone and the implant-abutment interface. Manufacturing standards allowed for the determination of the actual implant length. Most bone loss in this study happened in the first six months. This is consistent with previous studies indicating a loss of up to 1 mm in the first year. Placing implants correctly with a thickness of about 2 mm in the face bone can prevent bone loss.[18,19] Many studies have revealed that the first three months following tooth extractions are when most soft and hard tissue loss happens[20,21] and subsequently stabilizes after 1 year.[20,22]After a year, a relatively recent clinical trial discovered that the immediate vicinity of implants had mean mid-buccal recessions of 0.32 mm and interproximal recessions of 0.17 mm. Therefore, upon rapid implantation, a small, clinically tolerable amount of peri-implant tissue loss is typically anticipated. Various parameters, including gingival phenotype and flap elevation, may impact the durability of soft peri-implant tissue following rapid implantation techniques.[21,23]Additionally, the presence of less than 2 mm of keratinized mucosa surrounding implant-supported restorations is associated with a higher prevalence of mucosal recessions and peri-implantitis.[24,25,26]This might be because the implant was placed in a socket that had recently undergone extraction, which lessens the risk of alveolar bone resorption in the immediate post-extraction period. Furthermore, the crestal bone and gingival architecture are retained. Because the ensuing bone defects were filled by autogenous bone chips generated from the surrounding environment, immediate implant placement has been associated with decreased bone loss. This is consistent with Kumar et al.'s findings,[6] who noted decreased bone loss after immediate implant placement. Tabrizi et al.[17] reported similar results after evaluating bone loss in different groups;compared to the immediate implant group, the delayed implant group had considerably more bone loss.

This study evaluated the mobility surrounding the implant area, revealing a notable improvement between the one-month and six-month marks. From baseline to six months, there were notable improvements in the bleeding index. In this instance, the probing depth around the peri-implant tissue was also examined, and after one month, it decreased

dramatically to 1.1 mm from 1.54 mm. In comparison to the immediate implant group, the delayed implant group had a higher mean probing depth at six months. This might have happened because immediate implantation were marked by an occasional loss of connected gingivae. In delayed implants, the reduction in probing depth at 6 months after implant placement is consistent with the findings published by Abou-Zeid et al.[29]However, neither group's results were significant, consistent with Pellicer-Chover et al.'s[30] findings that probing depth rose in two groups non-significantly after implant loading at all observed time intervals. Similarly, Gökçen-Röhlig et al. reported non-significant differences.[31,27,32]

Using standard intraoral periapical radiographs, the mean marginal bone levels were radiographically examined in our investigation. Implants in the anterior maxilla can be loaded right away after they are inserted. Twelve months after loading, a 92% success rate was attained. In this study, we evaluated implant mobility, peri-implant probing depths, bleeding index, and mean marginal bone levels as clinical and radiologic markers of implant success. Twenty implants were inserted, and all four parameters seemed to be within healthy bounds. This is consistent with prior studies that have prospectively assessed instantly loaded implants. The results regarding the bleeding index are particularly intriguing because they show a significant decrease after the sixth month, or more specifically, following the placement of the permanent crown.This is explained by the permanent prosthesis's more advantageous anatomy than that of the temporary prosthesis. A single implant positioned in the maxillary lateral incisor area malfunctioned and was extracted after 13 months of implantation. We blame the failure on a placement method flaw that resulted in incorrect implant location and angulation.The utilization of single implants for an immediate loading process was demonstrated in this study. Implants can still accomplish osseointegration within a range of micro-movements, according to Szmukler-Moncler et al.[33]To determine if dental implants can accomplish and maintain osseointegration when loaded immediately, more research is required. Conventional implant loading procedures call for a stress-free, 3-6-month healing time, which causes problems for both the patient and physician.In this study, 19 of 20 initial implant sites showed effective osseointegration, indicating a 93.34% success rate.

Conclusion: Immediate loading of dental implants in the maxillary esthetic zone yields highly predictable results for replacing single missing teeth. However, the success of instantly loaded dental implants depends critically on patient selection. Additional studies with larger sample sizes and longer follow-up times are required to determine the protocol's therapeutic value.

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