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Study of the Effect of Using Mini-Transitional Implants as Temporary Abutments in Implant Overdenture Cases

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In an attempt to improve patient satisfaction during the healing period after placement of implants, mini-transitional implants (MTIs) have been advocated to allow immediate use of temporary dentures and to prevent transmucosal loads over the definitive implants. Twelve edentulous patients received two screw implants each in the predetermined mandibular canine region. At the time of surgery, six patients had two MTIs placed medially to the permanent ones. The flap was repositioned allowing transmucosal penetration of MTIs. Patients left the operating room wearing their relined lower dentures. The results indicated that MTIs integrated sufficiently in bone, giving successful immediate support for the transitional prosthesis and allowing proper mucosal healing. Two of these transitional implants showed mobility three months after phase 1 surgery. After loading the final implants, patients who had MTI-supported dentures showed bone loss that was not significantly different from the control group. (Implant Dent 1999;8:152–158)

Key Words: mini-transitional implants, temporary implants, interim support, immediate support

Patients may experience hardships in mastication during the healing period after implant insertion. Problems at these transitional stages are usually caused by the lack of efficient, well-stabilized temporary prostheses.

Vassos[1] suggested immediate loading of dental implants in elderly patients in order to improve the quality of life. In contrast, others[2] have advocated that implants be left totally unloaded in order to attain osseointegration. Misch[3] recommended that implants be loaded progressively.

A supportive implant technique (emerging since 1976) offers a definitive method for the use of fixed temporary restorations using titanium mini-implants, which are loaded into immediate splinted function.[4] These mini-implants also serve as three-dimensional guides to enhance the accuracy of final implant placement.

Prevention of micromovement during the healing period is a major factor associated with the long-term clinical success of endosseous dental implants.[5,6,7] Other factors are bone quantity,[8] bone quality,[9] the use of pre- and postoperative antibiotics, atraumatic bone preparation,[10] and the experience of the surgeon.[11] The aim of this study was to evaluate soft tissue healing, mobility of temporary and definitive (final) implants, and patient satisfaction by comparing cases that received conventional implant overdentures and those that received additional mini-transitional implants (MTIs) to support transitional dentures during the healing (unloaded) period. Radiographic assessment was also performed to measure bone level changes in both groups.

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Materials and Methods

Twelve healthy male patients were selected who were free from serious medical problems. Their ages ranged from 45 to 55 years with the average being 50 years. The patients were totally edentulous having resorbed mandibular ridges. Preoperative clinical examinations and investigations were done. Conventional upper and lower complete dentures were constructed. In order to detect the bone height and proper implant location, two small spherical metallic balls were secured to the cuspid area of the lower denture. A panoramic x-ray was taken[12] with the denture in place. An overall alginate impression of the lower denture was made and a clear acrylic resin surgical template was fabricated over the cast using a plastic vacuum-forming machine. Holes were then made in the areas of the metallic balls.

Surgical Phase

Patients were divided into two groups. Group I consisted of six pa-

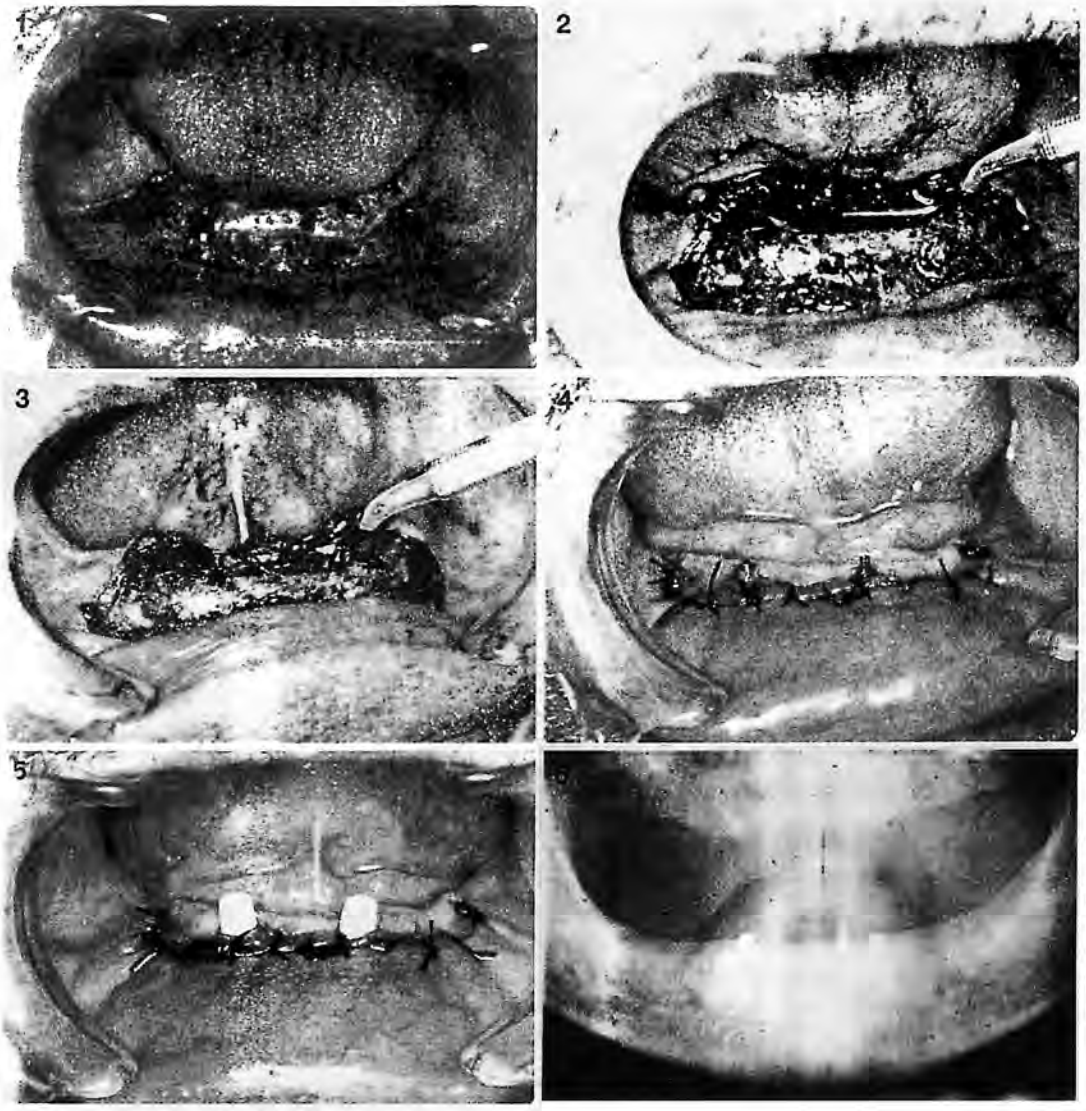

Fig. 1. Two screw-type implants inserted as having been guided by means of a surgical template. This case was part of the control group.
Fig. 2. Two endosseous implants inserted according to a surgical template. This case was part of the study group.
Fig. 3. Same case as in Figure 2. Two MTIs have been placed mesial to the two final implants.
Fig. 4. The first stage flaps have been approximated with individual sutures. The final implants remain subgingival while the transitional implants are transmucosal.
Fig. 5. Plastic prosthetic heads have been placed so as to engage the mini-implants by means of friction.
Fig. 6. A panoramic radiograph of the mandible shows the relative placements of two final implants and two transitional implants in the anterior symphysis.

tients. It served as the control group. These patients received two endosseous screw-type implants (IMTEC Co., Ardmore, OK) in the predetermined canine regions as indicated by the holes in the template (Fig. 1).

The flap was sutured and patients were allowed to wear their relined lower dentures two weeks postoperatively. Tissue-conditioning material (Viscogel, Detrey Division, Dentsply Ltd, Weybridge Surrey, England) was replaced every 2 weeks until the end of a healing period of 4 months. Group II (study group) included the other six patients who received two additional MTIs (Dentatus, NY) placed mesial to the definitive (final) implants during the first surgical phase (Figs. 2 through 10). Two slit incisions opposite to the mini-implant heads were made to allow for the transitional implants after repositioning of the flaps. Each mini-implant was covered with a special plastic prosthetic head.

The lower dentures were hollowed out in the anterior region and relined using a chairside soft lining material (Exact-On, Confi-dental Products Co., Louisville, KY). Dentures were delivered to the patients for immediate use.

Prosthetic Phase

Final implant loading was done 4 months later by reflecting the flap, removing the healing screw and inserting the ball insert (O-ring abutment) and suturing the flaps. The dentures were ground and hollowed opposite to the inserts and relined with tissue-conditioning material. After 1 week, the sutures were removed. New dentures were fabricated by conventional methods. After the try-in stage, the mandibular base with O-rings was waxed-up, flasked, packed, and cured using a conventional acrylic resin denture base material. Group II had the same procedures done and the mini-implants were unthreaded before making the final impression.

Methods of Evaluation

Visual evaluation of soft tissue healing within a 4-month period was performed by intraoral observation at 1, 2, 4, 8, 12, and 16 weeks. The criteria for assessment[13] were graded as follows: 0 = no inflammation or infection, no dehiscence, and no

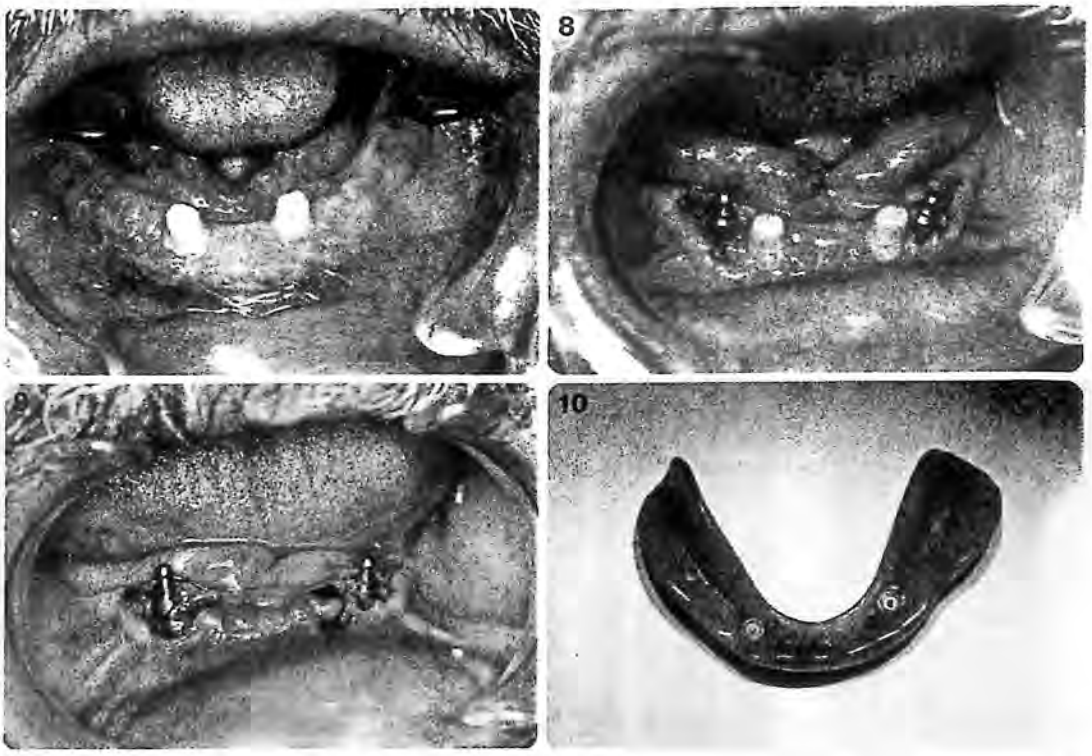

Fig. 7. Before second-stage recovery of the final implants, the MTIs with their plastic components have served to secure the transitional complete overdenture.
Fig. 8. After 4 months, second stage uncovering of the final implants has been accomplished, and the overdenture abutments have been secured to the implant fixtures.
Fig. 9. The MTIs have been removed (having served their purpose), and the final abutments are in place to secure the O-rings of the overdenture.
Fig. 10. The final complete mandibular overdenture contains the two O-rings that will be retained by the abutments of the final implants.

sloughing (excellent healing), 1 = mild inflammation or infection, mild dehiscence, and sloughing (slight redness and maximum one suture area involved), 2 = moderate inflammation or infection, moderate dehiscence and sloughing (more redness, swelling, and edema and 2–4 suture areas involved), 3 = severe inflammation or infection, severe dehiscence, and sloughing (severe redness, swelling, and edema and more than 4 suture areas involved). The results were tabulated and statistically analyzed.

Mobility of the mini-implants was evaluated manually between the handles of two instruments. Scales 0 and 1 were used to designate nonmobile stability, respectively, at 1-, 2-, 3-, and 4-month intervals.

Mobility of the definitive implants was assessed using the same technique after loading at the end of the follow-up period.

The modified Cornell Medical Index was used to assess patient satisfaction with the temporary prostheses for both groups according to comfort, fitness, appearance, ability to speak, eat, and taste, and general satisfaction. Answers to degrees of satisfaction were scored 1, 2, and 3 according to poor, fair, or good. The results were tabulated and statistically analyzed.

Radiographic evaluation of bone level changes mesial and distal to the temporary and definitive implants was assessed by standardized periapical radiographs. Means of bone level were recorded immediately after phase 1 surgery 1 and 4 months later. Radiographic evaluation around implants continued until 6 months after permanent loading. The results were tabulated and statistically analyzed.

Results

Comparing soft tissue healing between both groups (Table 1), there was a statistically significant difference in the second week postoperatively in favor of the second group.

Mobilities of the transitional implants are presented in Table 2. Only two (16.6%) of the transitional implants out of 12 temporary implants showed mobility at the third month. By comparing the mobilities of the definitive implants in both groups (Table 3) it was revealed that two implants (16.6%) in two different patients of the control group had mobility, whereas all implants (100%) within the study group demonstrated no mobility.

Patients' satisfaction within both groups (Table 4) was evaluated and scored during the transitional healing period. In the control group, 66.6% reported a poor grade satisfaction, whereas 83.3% of the study group reported a good grade satisfaction.

Bone level changes around definitive implants for both groups during the healing period were assessed (Table 5). There was a statistically significant difference (2.097; $P < 0.05$), showing less bone resorption around the implants in the study group.

After implant loading the difference of bone level changes was not statistically significant (1.44; $P > 0.05$). Changes in bone level around the transitional implants (Table 6), when assessed immediately after stage 1 surgery 1 and 4 months late showed no statistically significant difference (1.18; $P > 0.05$).

Discussion

Incision line opening is a possible consequence of wearing a con-

Table 1. Comparison of Soft Tissue Healing Between Groups I and II

		Week					
		1	2	4	8	12	16
Group I	Mean	2	2	1	0.3	0.3	0
	SD	0.89	0.89	0.89	0.51	0.51	0
Group II	Mean	1.3	1	0.3	0.3	0.16	0
	SD	0.51	0	0.51	0.51	0.4	0
t-test		1.674	2.75*	1.67	0	0.53	0

* Statistically significant, $P < 0.05$.

Soft tissue healing assessed after first stage surgery between groups I (control) and II (study) showed that there is a statistically significant difference in the 2nd week only. That is, the tissue healing in group II is best when compared after 2 weeks postoperatively.

Table 2. Evaluation of the Transitional Implants Mobility at 1, 2, 3, and 4 Months fter First Stage Surgery*

Patient No.	MTI No.	Month 1	2	3	4
1	1	0	0	0	0
	2	0	0	0	0
2	3	0	0	1	1
	4	0	0	1	1
3	5	0	0	0	0
	6	0	0	0	0
4	7	0	0	0	0
	8	0	0	0	0
5	9	0	0	0	0
	10	0	0	0	0
6	11	0	0	0	0
	12	0	0	0	0

* According to the index: 0 = nonmobile; 1 = mobile.

Mobility of the transitional implants showed that: 1st month, 100% of MTI showed no mobility; 2nd month, 100% of MTI showed no mobility; 3rd month, 83.3% of MTI showed no mobility (10 MTI), 16.6% of MTI showed mobility (2 MTI); 4th month, 83.3% of MTI showed no mobility (10 MTI), 16.6% of MTI showed mobility (2 MTI).

Table 3. Evaluation of Definitive Implant Mobility During the Period from 4–10 Months, ie after loading

Patient No.	Implant No.	Group I	II
1	1	0	0
	2	0	0
2	3	1	0
	4	0	0
3	5	0	0
	6	0	0
4	7	0	0
	8	0	0
5	9	1	0
	10	0	0
6	11	0	0
	12	0	0

* According to the index: 0 = nonmobile, 1 = mobile.

For group I (control group), two implants in two different patients showed mobility (16.6%), 10 implants showed no mobility (83.3%). For group II (study groups), all implants showed no mobility (100%).

Table 4. Subjective Evaluation According to Modified Cornell Index During the Healing Period*

Result	Group I (control)	Group II (study)
Poor	4 (66.6%)	– (–)
Fair	2 (33.3%)	1 (16.6%)
Good	– (–)	5 (83.3%)
Total	6 (100%)	6 (100%)

ventional denture during the first two postoperative weeks if the cause of the exposure was because of pressure on the implant from the prosthesis. This is a problem that may cause micromovement of the implant.[14] To attempt to overcome this deficiency, MTIs have been developed to offer immediate support for transitional prostheses.[4–12,15] The most significant difference in soft tissue healing was found to be in the first 2 weeks after phase-1 surgery.

Mucosa showed less inflammation in those patients who had immediately received their transitional dentures supported by the transitional implants. This positive result may be explained by the absence of any contact from the fitting surface of the "hollowed out and soft lined"[12] denture to the surgical site, thus allowing (1) for undisturbed healing, and (2) for the patient to function comfortably immediately after surgery. Patients who did not wear their prostheses after surgery showed more severe inflammation because of direct masticatory trauma that conveyed a transmucosal load to the recently placed implants[12] and surrounding tissues.

Transitional implants were solidly integrated and showed no mobility in the first and second months (100%); and only two of the transitional implants out of 12 showed mobility at the third month (83.6% success). This unpredictable success was probably because of a combination of the ultra small diameter (1.8 mm), the length (17.21 mm), and the shape of the temporary implant. An ultrasmall diameter allows for minimal bone destruction, whereas the length gives anchorage to the temporary implants. In agreement with Misch,[16] the screw forms, when threaded into the bone sites, had obvious macroscopic retentive elements for initial bone fixation.

Although a fibrous encapsulation was anticipated for this early implant loading, the transitional implants showed fixation without such encapsulation. Findings relating to the differences in bone loss around the definitive implants after loading were consistent with Wolf's law that states that bone development is stimulated by stress. The cushioning of masticatory forces in patients who wore their dentures 2 weeks after surgery supported by mucosa led to stress concentration in the bone surrounding dental implants and resulted in increased density of bone in those areas.[17]

Thus, this denser bone resorbed at a slower rate after loading patients who wore their dentures supported by the transitional implants deprived the bone surrounding the implant from stresses that formulate the catalyst for remodeling activity.[18] Woven bone is the fastest and first type of bone to form around an implant interface. However, it is only partly mineralized, and demonstrates an unorganized structure unable to withstand full-scale stresses.[19] The stressful stimuli after loading the definitive implant will increase both the cortical bone thickness and overall mineral content.[20] A greater patient satisfaction was reported with patients who used their transitional dentures immediately after surgery.

Implant-supported prostheses do not require extensions that interfere with muscle action. Improvement in function and the ability to eat and speak enhance the psychological well-being of the patient immediately after surgery.

Table 5. Bone Level Changes Around Definitive Implants for Both Groups Assessed During the Healing Period (0–4 months)

Patient No.	Implant No.	Group I (control)	Group II (study)
1	1	0.49	0.123
	2	0.697	0.115
2	3	7.525	0.18
	4	0.56	0.09
3	5	0.62	0.12
	6	0.83	0.17
4	7	0.45	0.107
	8	0.72	0.094
5	9	7.526	0.18
	10	0.464	0.08
6	11	0.72	0.1
	12	0.419	0.105

Bone level changes assessed in period for (0–4 months): Group I showed a mean of 1.75 mm, SD 2.69 and group II showed a mean of 0.122 mm, SD 0,035. Applying *t*-test = 2.097 which is significant statistically, $P < 0.05$. Significantly less bone resorption around permanent implants in group II (study).

Table 6. Bone level Changes for Both Groups Assessed in the Period From 4–10 months, ie After Loading*

Patient No.	Implant No.	Group I (control)**	Group II (study)***
1	1	0.157	0.203
	2	0.064	0.18
2	3	Failed	0.175
	4	0.085	0.102
3	5	0.14	0.162
	6	0.19	0.109
4	7	0.18	0.244
	8	0.19	0.122
5	9	Failed	0.164
	10	0.09	0.14
6	11	0.144	0.162
	12	0.17	0.26

* *t* test = 1.44, not significant; $P > 0.05$.

** Group I: mean, 0.141 mm; SD, 0.046 mm.

*** Group II: mean, 0.1687 mm; SD, 0.048 mm.

Conclusion

The use of MTIs allows for successful immediate support of temporary dentures. This technique offers a viable treatment option during the healing period when definitive implants are to remain unloaded. Temporary implants enable better tissue healing. In this study, patients reported greater satisfaction because of the immediate restoration of esthetics and function. This treatment improved the acceptance by patients of their transitional states of edentulism.

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