

# Implant-Retained Mandibular Overdentures with Immediate Loading: A Prospective Study of ITI Implants

Claudio Gatti, MD, DMD<sup>1</sup>/Werner Haefliger, MD<sup>2</sup>/Matteo Chiapasco<sup>3</sup>

*A prospective study was conducted in which 21 patients received a mandibular implant-supported overdenture. Eighty-four ITI screw-type implants were placed in the interforaminal area of the mental symphysis (4 implants per patient). Immediately after implant placement, a U-shaped gold or titanium bar was fabricated and implants were loaded with an implant-retained overdenture. Of 21 patients treated, 19 were followed for a minimum of 25 months to a maximum of 60 months, with a mean follow-up of 37 months. Two patients dropped out during the follow-up. The overall failure rate of implants (according to Albrektsson criteria) was 4% (3/76 implants), but all implants, bars, and prostheses remained in function. Results from this study demonstrated that the success rate for immediately loaded mandibular implants is similar to that obtained in cases of delayed loading, after osseointegration has taken place. This method shortens dental rehabilitation time with relevant satisfaction for patients. (INT J ORAL MAXILLOFAC IMPLANTS 2000; 15:383-388)*

**Key words:** complete overdentures, dental implants, edentulous jaw, immediate implant loading, mandibular prosthesis, osseointegration, prospective study

One of the paradigms for successful osseointegration is the non-loading of endosseous dental implants for a period of 3 to 6 months.<sup>1</sup> In following this principle, both for submerged and non-submerged implants, clinicians have attained high success rates.<sup>2-5</sup> Yet this waiting period may inconvenience patients because of the delay of final rehabilitation and the difficulty or impracticality of wearing a conventional denture during the healing period. Recently, the results of clinical research have encouraged a progressive shortening of this healing period of implants, and immediate loading of implants has been proposed. In particular, reliable results have been reported for implant-retained mandibular overdentures with immediate loading.

As demonstrated by Ledermann<sup>6,7</sup> and Graber and Besimo,<sup>8</sup> rigid connection of 3 or 4 interforaminal implants with a U-shaped curved Dolder bar can minimize any movement or non-axial load on implants with immediate loading of a overdenture. In this situation, clinical osseointegration can take place normally. However, there is a paucity of long-term results related to this method, and the reported studies are mainly retrospective.<sup>9-12</sup>

The aim of this study was to prospectively evaluate long-term results of immediately loaded implant-retained overdentures supported by 4 ITI screw-type titanium plasma-sprayed implants rigidly connected by a U-shaped bar.

## METHODS AND MATERIALS

### Patients

Twenty-one patients, 9 males and 12 females, aged between 46 and 87 years (mean, 60.5 years), presenting with completely edentulous mandibles or residual dentition requiring extraction, were selected and treated between 1994 and 1996. The medical status of patients concerning current and previous disease history and medications was noted;

<sup>1</sup>Private Practice, Milan, Italy.

<sup>2</sup>Private Practice, Geneva, Switzerland.

<sup>3</sup>Assistant Professor and Head, Unit of Oral Surgery, Department of Dentistry and Stomatology, San Paolo Institute of Biomedical Sciences, University of Milan, Milan, Italy.

**Reprint requests:** Dr Claudio Gatti, Piazza Maggiolini 3, 20015 Parabiago (MI), Italy. Fax: +39/0331/555776. E-mail: clagatto@tin.it

**Table 1** Demographic Data and Clinical Features of Patients

Patient no.	Sex	Age	Date of implant placement	No. of implants	Implant length (mm)	Implant diameter (mm)	Failing implants	Comments
1	M	66	1/1994	2	10	3.3	2	Peri-implant infection with bone resorption > 0.2 mm/year after the first year of functional loading
				2	12	4.1		
2	F	55	3/1994	4	14	4.1	0	Lost to follow-up
3	M	59	9/1994	2	12	4.1	0	
				2	14	4.1	0	
4	M	61	10/1994	1	12	3.3	0	
				2	12	4.1	0	
				1	14	4.1	0	
5	F	61	2/1995	4	14	4.1	0	
6	F	73	3/1995	1	14	3.3	0	
				1	12	4.1	0	
				2	14	4.1	0	
7	M	50	3/1995	4	14	4.1	0	
8	F	51	5/1995	4	10	4.1	0	
9	F	60	10/1995	4	12	4.1	1	Bone resorption > 0.2 mm/year after the first year of functional loading
10	M	56	12/1995	3	12	4.1	0	
				1	14	4.1	0	
11	M	61	2/1996	1	12	4.1	0	
				3	14	4.1	0	
12	M	59	2/1996	4	12	4.1	0	
13	F	46	3/1996	4	14	4.1	0	
14	F	45	3/1996	4	10	4.1	0	Lost to follow-up
15	F	70	5/1996	3	14	3.3	0	
				1	14	4.1	0	
16	F	54	6/1996	3	14	3.3	0	
				1	12	4.1	0	
17	M	55	6/1996	4	14	4.1	0	
18	F	61	9/1996	4	12	4.1	0	
19	F	65	10/1996	2	12	3.3	0	
				2	12	4.1	0	
20	M	87	10/1996	4	12	3.3	0	
21	F	77	11/1996	4	14	4.1	0	

only healthy patients were included in this study. Jawbone quantity and morphology and skeletal interrelationships were evaluated before surgery with a profile radiograph and a panoramic radiograph. Criteria used for excluding patients from this evaluation were as follows: (1) insufficient bone volume in the interforaminal area of the mandible to receive 4 implants at least 3.3 mm in diameter and 10 mm in length; (2) severe intermaxillary skeletal discrepancy; (3) severe clenching habits or bruxism; (4) patients who already had received and lost implants in the interforaminal area; (5) drug or alcohol abuse; (6) heavy smokers (more than 20 cigarettes per day); (7) patients who had received radiotherapy to the head and neck region for malignancies; (8) patients undergoing antitlastic chemotherapy; (9) patients affected by chronic renal disease; (10) patients affected by chronic liver

disease; (11) uncontrolled diabetes; (12) hemophilia, bleeding disorders, or coumadin therapy; (13) metabolic bone disorders; (14) immunocompromised patients, including those with HIV; (15) poor oral hygiene; and (16) mucosal disease such as lichen planus.

Thirteen patients had been totally edentulous in the mandible for at least 6 months before implant placement, 5 patients had teeth extracted in the interforaminal area 2 to 6 months prior to implant treatment, and 3 patients were treated with tooth extraction and implant placement in the same session. A total of 84 implants was placed between 1994 and 1996. Only screw-type titanium plasma-sprayed ITI implants (Straumann Institute, Waldenburg, Switzerland) were used. Demographic data of patients and clinical features of implants are reported in Table 1.

## Surgical Treatment

Sixteen patients were treated under local anesthesia and premedication with diazepam (0.2 mg/kg) administered orally 30 minutes before surgery, 3 patients were treated under local anesthesia with intravenous sedation, and 2 patients received general anesthesia with nasotracheal intubation. The choice of the type of anesthesia was dictated by general health conditions, the local situation, anticipated duration of surgery, and specific patient requests.

The surgical procedure was initiated with an intraoral crestal incision extending from the molar area of one side of the arch to the opposite side, with buccal releasing incisions in the molar area to assist in identifying both mental foramina. Mucoperiosteal flaps were elevated both buccally and lingually to identify and visually control the symphysis area. When indicated, a flattening of the alveolar crest was performed with a bur under irrigation with sterile saline to obtain a flat bony base. Implant sites were prepared according to the standard ITI procedure, and 4 implants were placed anterior to the mental foramina.

## Prosthesis

The abutments for bar fabrication were immediately screwed to the implants. The mucoperiosteal flaps were then sutured. By means of transfer copings placed on the abutments, impressions were obtained immediately and casts were poured. Impressions were made by using the patient's previous prosthesis or a new prosthesis fabricated for a specific purpose, with occlusion limited to the first molars. The master cast produced in the laboratory incorporated implant analogs, on which a U-shaped Dolder bar was fabricated by soldering the bar segments to prefabricated copings. When indicated, cantilevers no longer than 5 mm were used posterior to the terminal implants.

One day after surgery, the bar was connected to the abutments. The accuracy of the bar fit was checked in the mouth visually to ensure that all the copings fit passively on the abutments. Passive fit of the bar was confirmed if the tightening of 3 consecutive screws did not cause any clinically detectable elevation of the last unscrewed coping on the opposite side. This procedure was repeated starting from the opposite side of the bar, and the same results had to be obtained. If passive fit was achieved, the bar was definitively screwed to the abutments. Overdentures incorporating clips were immediately placed, and the implants were functionally loaded. The overdentures were fabricated so as to avoid soft tissue support and with reduced lingual and buccal flanges to prevent soft tissue trauma resulting from postoperative edema.

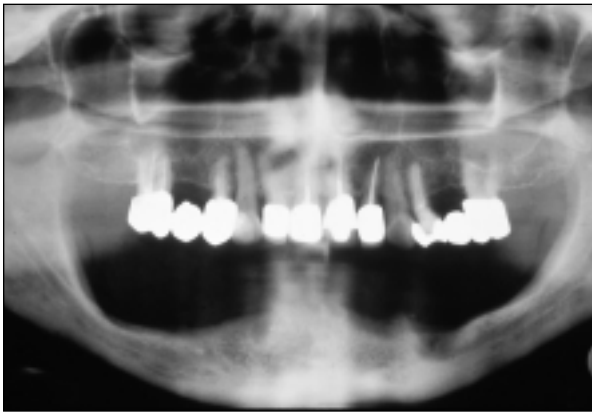
All patients received oral antibiotics and non-steroidal analgesics for 6 to 8 days postoperatively and were provided with detailed instructions concerning oral hygiene (mouthwashes with 0.2% chlorhexidine). Sutures were removed 8 to 10 days after surgery and follow-up visits were scheduled for 2 weeks and 1, 3, 6, and 12 months after surgery during the first year and annually thereafter. At each annual recall, the overdentures and bars were removed and each implant was evaluated individually.

The following clinical parameters were recorded: (1) radiographic assessment of marginal bone loss and (2) mobility of the implant. Radiographic examination was conducted annually using panoramic films. Crestal bone level was recorded as the most coronal direct bone-implant contact. Measurements were made for mesial and distal implant sites by means of a transparent millimeter ruler, measuring the distance between the apex of the implant to the most coronal bone-implant contact on the radiograph. The measurements were made to the nearest one-half millimeter. To correct dimensional distortion, the apparent dimension of each implant was measured on the radiograph and compared to the actual implant size. Because it was frequently difficult to measure differences of less than 0.5 mm and thus to obtain mean values of vertical bone loss, the overall change in bone level was measured comparing the radiograph taken 1 year postoperatively with the most recent one, and dividing this value by the number of years of observation.

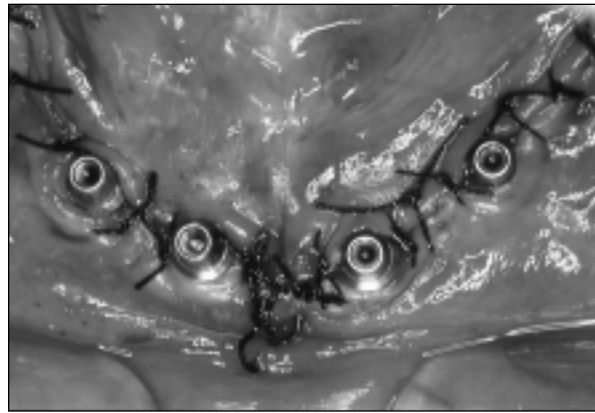
Implant mobility was assessed using the handles of 2 dental mirrors. Success criteria applied in this study were as follows:

1. An individual, unattached implant was immobile when tested clinically.
2. A radiograph did not demonstrate any evidence of peri-implant radiolucency.
3. Vertical bone loss was less than 0.2 mm annually following the implant's first year of service.
4. Individual implant performance was characterized by absence of signs and symptoms such as pain, injection, neuropathies, paresthesia, or violation of the mandibular canal.
5. In the context of the above, a 95% success rate was expected.<sup>13,14</sup>

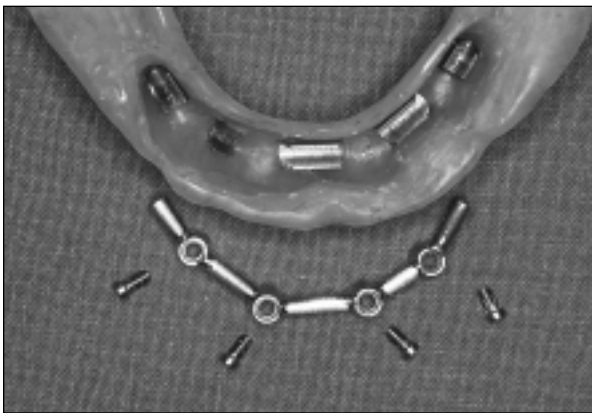
In this study, peri-implant probing was not performed because a great deal of controversy still exists with respect to the correlation between probing depth and implant success rates.<sup>15-20</sup> A representative patient experience is presented here in Figs 1a to 1e.



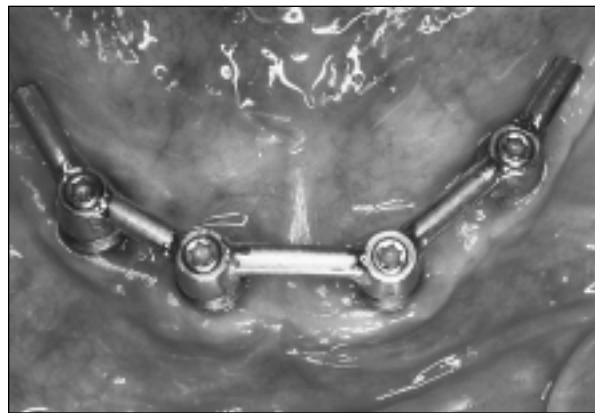
**Fig 1a** Preoperative panoramic radiograph.



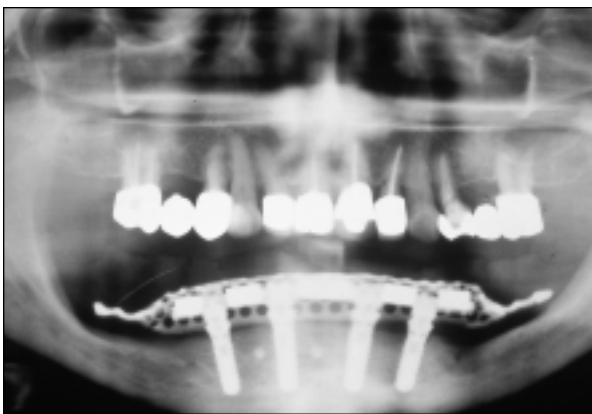
**Fig 1b** Intraoral situation immediately after implant placement with trans mucosal abutments for bar fabrication.



**Fig 1c** The bar and screws with the implant-retained overdenture just before placement.



**Fig 1d** Clinical appearance 30 months after prosthetic loading.



**Fig 1e** Panoramic radiograph 30 months after definitive prosthetic rehabilitation.

**Table 2** Life Table Analysis Showing Cumulative Survival Rates of Implants

Time	No. followed	No. failed	No. withdrawn	CSR
Loading to 1 year	84	0	4	100%
1 to 2 years	80	2	4	97.4%
2 to 3 years	74	1	8	96%
3 to 4 years	65	0	28	96%
4 to 5 years	37	0	29	96%
5 years	8	N/A	N/A	N/A

CSR = cumulative survival rate.

## RESULTS

Of 21 patients treated and 84 implants placed, 2 patients (8 implants) were lost to follow-up. Follow-up of the remaining 19 patients ranged between 25 and 60 months (mean, 37 months). Of the 76 implants followed, 3 implants in 2 patients were considered failures because of vertical bone loss greater than 0.2 mm per year after the first year of functional loading. Among these, 2 implants in 1 patient presented with peri-implant infection, which was treated successfully by curettage and polishing, but showed a residual bone loss of approximately 3 mm around the affected implants. Nevertheless, all implants and bars remain in function. The cumulative survival rate of implants at the end of the follow-up period was 96% (Table 2).

## DISCUSSION

Traditionally, the main prerequisites for osseointegration have been primary stability and absence of loading for a period of between 3 and 6 months.<sup>1</sup> The method described in this study, which utilizes 4 implants rigidly connected by a curved, U-shaped bar provides good stability for the implants, despite the immediate loading. Thus, implants were usually not exposed to macromovements that could compromise osseointegration, as found by a number of authors.<sup>6-8,11,12</sup>

Success rates in this study (96%) were based on success criteria proposed by Albrektsson et al<sup>13</sup> and are comparable to those reported in the literature for implant-retained overdentures with delayed loading.<sup>15,16,21-24</sup> For implant-supported overdentures with delayed loading, no correlation has been found in the literature between success rate and type of connecting system used.<sup>25</sup> Moreover, with 2-stage procedures, the common belief that distribution of a load to an increasing number of implants will decrease the magnitude of stresses in the bone around each implant<sup>26,27</sup> has not been confirmed by other authors.<sup>28</sup> In contrast, in the case of immediate loading the number of implants placed, their distribution, and the type of rigid connection appear to be critical.<sup>6-8,11,12</sup> The choice of 4 implants and a U-shaped bar to rigidly connect them is based on the idea that this number may offer sufficient stability and significantly reduce movement that could compromise osseointegration. No evidence is reported in the literature of lesser numbers of implants being sufficient to offer stability to withstand the mechanical demands of immediate loading. Similarly, there are no data in the literature that demonstrate that a higher number of implants can improve implant survival.

There is limited literature analyzing the role of implant geometry and surface preparation on long-term success rates of immediately loaded implants. Only one retrospective study compared the clinical outcome of 4 different implant systems with different designs and surfaces,<sup>11</sup> and no statistically significant differences in implant success rates were found. In the present study, no correlation was found between implant dimensions and success rates, although the sample analyzed is too small to obtain statistically significant results. The critical length and diameter of immediately loaded implants require further investigation.

The use of a U-shaped bar seems to be necessary to minimize rotational movements and to transfer loads to the implants primarily in a vertical direction.<sup>6-8,11,12</sup> This may provide the basis for immediate loading of endosseous implants without compromising osseointegration. Other designs, such as Akermann bars with a round profile or Dolder bars with an oval profile in a straight alignment, may not prevent rotation of the denture and subsequent non-axial loads to the implants.<sup>6-8,29,30</sup> Further research is needed to determine the minimum number of implants and the type of connecting system needed for immediate loading.

It is very important to stress the fact that this technique has been applied only in the interforaminal region of the mandible, where good bone quality is frequently found. In particular, this method was applied only in Class I, II, or III bone quality according to the Lekholm and Zarb classification.<sup>31</sup> Following this indication, marginal bone loss values around implants in this study were consistent with those reported by other authors in instances of delayed loading.<sup>10,13,17,18,32,33</sup> In contrast, maxillary bone is often characterized by lower density. In a 3-year follow-up reported by Hutton et al,<sup>34</sup> the implant failure rate was 3.3% for mandibular implant-supported overdentures and 27.6% for maxillary implant-supported overdentures. Possible applications of immediately loaded implants in the maxilla require further investigation.

Radiographic evaluation of peri-implant bone loss by means of panoramic radiographs may be criticized because of the imprecise methodology. Intraoral radiographs are certainly more precise, but it should be stressed that, in the case of completely edentulous patients presenting with relevant mandibular atrophy, periapical radiographs may not always be feasible because of the very superficial insertion of the muscles in the floor of the mouth and because patients frequently exhibit related discomfort.

## CONCLUSION

The results of this prospective study confirmed that endosseous implants supporting mandibular overdentures can be safely loaded immediately after placement, as previously reported by other retrospective studies.<sup>6-11,12</sup> This procedure can substantially reduce the time of prosthetic rehabilitation without jeopardizing long-term results and with relevant patient satisfaction. Success criteria proposed by Albrektsson et al<sup>13</sup> were fulfilled by the results of this study.

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