

# A TWO-YEAR STUDY OF IMPLANT RETAINED OVERDENTURES IN THE TREATMENT OF TOTALLY EDENTULOUS JAWS

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**Statement of problem.** Conventional denture treatment for totally edentulous patients is associated with a variety of functional and psychosocial problems. The placement of implants in the anterior region of the maxilla and mandible and the fabrication of an implant-retained overdenture might solve these problems.

**Purpose.** This study compared the marginal bone loss around the implant and evaluated the implant survival rate and complications in patients treated with overdentures retained by implants for 2 years.

**Material and methods.** Patients who had received implant-retained overdentures using a Dolder bar at Samsung Medical Center from January 1999 to June 2005 and had participated in the annual recall programs for two years were selected for this study. A total of 18 patients and 56 Brånemark system<sup>®</sup> implants were used, and their data were reviewed. Evaluations of the survival rate, bone quality, marginal bone loss, and complications were performed. The data on the Dolder bar length and clip length were measured. The change in marginal bone loss and the correlation between the marginal bone loss and bar length, clip length, or bone quality were investigated.

**Results.** Implants placed in this study showed a 100 % survival rate. The average annual bone loss was 1.12mm in the first year and 0.27mm in the second year in the maxilla, and 0.58mm in the first year and 0.22mm in the second year in the mandible. The marginal bone loss in the maxilla showed no significant association with those in the mandible. ( $P>.05$ ) There was no significant difference in marginal bone loss around implants between the first and second year. ( $P>.05$ ) There was no statistically significant relationship ( $P>.05$ ) between the marginal bone loss and bone quality, clip length, or Dolder bar length. The Dolder bar length showed a high correlation with the clip length. ( $P<.05$ ) Various complications were noted.

**Conclusion.** These results confirmed the favorable outcome for patients treated with implant-retained overdentures.

## Key Words

Overdenture, Dental implant, Bar denture, Marginal bone loss

Complete dentures are still used to treat edentulous patients. However, many patients using complete dentures suffer from functional or psychosocial problems. Examples of functional problems are a decreased stability, loss of retention, and lack of load-bearing capacity. These problems are usually increased when the dentures are fabricated for patients with severe residual ridge resorption.<sup>1</sup> In these cases, an implant-retained overdenture is a possible alternative treatment. Many authors have reported that prosthodontic treatment with an implant-retained overdenture can be successful with adequate denture satisfaction.<sup>2,4</sup> The implant-retained overdenture was reported to have fewer complications and maintenance requirements than a fixed implant-supported prosthesis in the mandible.<sup>5</sup> This suggests that an implant-retained overdenture can be a treatment of choice, particularly in patients having problems with mandibular denture retention and in the ability to tolerate a removable denture.<sup>6,7</sup> Longitudinal clinical studies, structured reviews and consensus conferences have established that the survival of the root form titanium implants is very high in the anterior mandible with a low incidence of surgical complications. Moreover, these implants were associated with a lower rate of resorption of the residual ridge in the anterior mandible.<sup>8</sup>

The survival rate of dental implants was reported to be high with this treatment modality.<sup>9,10</sup> In addition, there has been controversy regarding the choice of attachment system between bar and solitary attachments. In treating edentulous patients with implant-retained overdentures, it has been reported that bar attachments are prone to mucositis and gingival hyperplasia.<sup>11</sup> However, other studies reported that overdentures with bar attachments were easy to clean and there was no difference in the presence of plaque or peri-implant

bleeding between ball and bar attachments.<sup>12-14</sup> Other authors reported that the bar group had fewer prosthetic complications.<sup>11,15</sup> Therefore, the use of a bar as an attachment system in implant overdenture treatments is thought to be safe.

This study compared the marginal bone loss around an implant and evaluated the implant survival rate and complications in patients treated with overdentures retained by a small number of implants for 2 years at Samsung Medical Center.

## MATERIAL AND METHODS

### 1) Patient selection

Patients who received dental implants for overdentures at Samsung Medical Center were selected in this study. Twenty-eight patients were treated with implant-retained overdentures from January 1999 to June 2005. Among them, 22 patients were treated with overdentures using a Dolder bar-clip attachment. The patients visited the Samsung Medical Center annually for a recall examination and periapical radiographs. Patients who did not participate in the recall program and those with insufficient data were excluded. A total of 18 patients (7 males and 11 females) were selected in this study. The average age of the patients was 67 ranging from 34 to 82 years. Seven overdentures supported by 28 Brånemark system<sup>®</sup> implants (Nobel Biocare AB, Gothenburg, Sweden) were placed in the maxilla and 11 overdentures supported by 28 Brånemark system<sup>®</sup> implants were placed in the mandible. All patients were treated using 2 to 4 implants. Tables I and II show the patients' clinical information and data on the implants, respectively.

### 2) Treatment procedures

After the patients had been selected for the

**Table I.** Patients data and number of implants placed

Group	Patient number	Age	Sex	Number of implant
Maxilla	1	60	F	4
	2	55	M	4
	3	61	F	4
	4	63	F	4
	5	34	M	4
	6	64	F	4
	7	71	F	4
Mandible	1	72	F	2
	2	78	M	2
	3	77	F	2
	4	71	M	2
	5	55	M	2
	6	63	F	2
	7	78	F	4
	8	68	F	2
	9	71	F	4
	10	82	M	4
	11	81	M	2

**Table II.** Distributions of implants

Group	Implant length	Number of implant
Maxilla	10	11
	11.5	2
	13	15
Mandible	10	1
	11.5	3
	13	13
	15	9
	18	2

implant-retained overdenture, the implants were placed by experienced surgeons under local anaesthesia. The bone quality was assessed by the surgeons using the classification according to a previous study.<sup>16</sup> The two implants in the canine region or 4 implants in the canine region and first premolar region were placed in the edentulous jaws. A surgical stent was provided to the surgeon by a prosthodontist for optimal implant placement. The sites were prepared according to the standard

procedure for Brånemark System<sup>®</sup> implants. One stage or two stage surgical procedures were used and conventional loading protocols were used. During the healing phase, old dentures were used after being relined with tissue conditioners. The patients were prescribed a soft diet for the first week. After 3 to 6 months, the prosthodontic procedures were started. New dentures were fabricated for each patient. The attachment system was an egg-shaped Dolder bar (Cendres et Metaux SA, Biel, Switzerland). After the prosthodontic treatment, an annual recall check was carried out and intraoral radiographs were taken using parallel techniques.

### 3) Data collections

The cumulative survival rate was evaluated from a review of the patient's records using the criteria reported in a previous study, and data on the bone quality was collected.<sup>16</sup> The marginal bone level was measured by comparing the radi-

ographic examinations at implant placement and at the annual follow-up. The distance from the top of the implant body and crest of the marginal bone mesially and distally to the implant was measured and considered as the baseline data. The mean value of the mesial and distal measurements of the implants was calculated. Using the same method, the bone levels were measured at the annual recall checks. The Dolder bar length and clip length were measured after the prosthodontic treatment.

The following parameters were determined: difference in marginal bone loss in the maxilla and mandible, the difference in marginal bone loss between the 1 year and 2 year recall check, the correlation between the bar length and clip length, the correlation between the marginal bone loss and clip length, correlation between the marginal bone loss and bar length, and correlation between marginal bone loss and bone quality.

A variety of prosthetic and biological complications were noted during the 2-year observation period.

#### 4) Statistical analysis

All analyses were performed using statistical software (SAS 9.1; SAS Institute Inc, Cary, NC). The differences in marginal bone loss in the maxilla and mandible, and the correlation between the bone quality and marginal bone loss were examined using the Wilcoxon two-sample test with a Bonferroni correction. The differences in marginal bone loss between the first and second year were tested using a Wilcoxon signed rank test. The correlation between the bar length and clip length were analysed using Spearman's correlation analysis. Statistical comparisons of the marginal bone loss with regard to the bar length and clip length were carried out using Spearman's correlation analysis with Bonferroni's correction.

*P*-values < 0.05 were considered significant.

## RESULTS

No implant was lost during the 2-year observation period. All 56 implants placed were loaded and survived. The radiographic examinations showed a mean change in marginal bone height in the maxilla of 1.12mm after 1 year and 0.27mm between the 1-year and 2-year recall check. In the mandible, the mean change in marginal bone height was 0.58mm in the first year and 0.22mm in the second year. The total marginal bone loss in the maxilla and mandible after 2 years was 1.40mm and 0.81mm, respectively. There was no significant difference between the 1- and 2-year change in marginal bone height around implants in maxilla and mandible. Fig. 1 shows the distribution of changes in marginal bone height for the different period. Table III shows the bone quality, marginal bone loss, clip length and bar length. There were no significant differences in marginal bone loss found between the maxilla and mandible over the two-year observation period. In the maxillary and mandibular groups, there were no significant differences in marginal bone loss between the first and second year. There was a high correlation between the bar length and clip length in the maxilla ( $p=0.002$ ) and mandible ( $p=0.0019$ ). However,

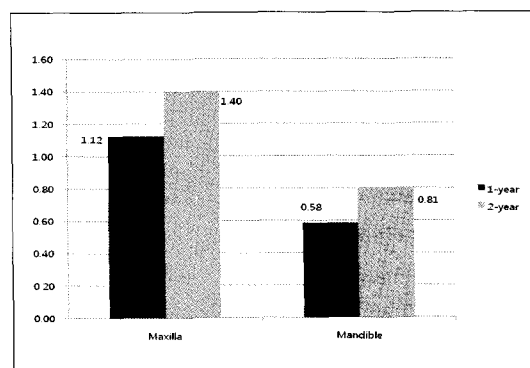


Fig. 1. Mean marginal bone loss for 2 years.

**Table III.** Bone quality, marginal bone loss, clip length, and bar length

Group	Patient Number	Bone quality	Bone loss at the first year	Bone loss at the second year	Total bone loss for two years	Clip length	Bar length
Maxilla	1	Class 3	1.66	0.23	1.89	14	16
	2	Class 1	0.84	0.39	1.23	17	20
	3	Class 3	0.00	0.00	0.00	14	17
	4	Class 3	0.99	0.00	0.99	14	17
	5	Class 3	2.60	0.75	3.35	7	11
	6	Class 3	0.00	0.30	0.30	15	18
	7	Class 3	1.79	0.24	2.03	6.5	9
Mandible	1	Class 2	0.75	0.00	0.75	7	10
	2	Class 3	0.00	0.00	0.00	7	11
	3	Class 3	1.75	1.00	2.75	10	10
	4	Class 4	0.00	0.00	0.00	6.5	9
	5	Class 1	1.60	0.25	1.85	10	13
	6	Class 3	0.00	1.20	1.20	10	13
	7	Class 2	0.00	0.00	0.00	7	10
	8	Class 2	0.00	0.00	0.00	14	18
	9	Class 3	1.93	0.00	1.93	7.5	7
	10	Class 2	0.38	0.00	0.38	13	15
	11	Class 3	0.00	0.00	0.00	14	17

**Table IV.** Complications

	Mucositis	Denture fracture	Relining	Clip change	Clip fracture
Maxilla	3	4	1	2	1
Mandible	1	1	1	3	1

statistical analysis showed no correlation between the clip length and marginal bone loss, and between the bar length and marginal bone loss. In addition, there was no positive correlation between the bone quality and the marginal bone loss.

Some patients showed various complications under the implant-supported overdenture during the 2-year observation time. These included clip fracture, clip change, relining, denture fracture and mucositis. The complications are presented in table IV.

## DISCUSSION

In this study all implants placed and loaded survived for the 2 year observation period. These 2-year results on the survival rate are in agreement with the results reported in other studies. In a longitudinal prospective study of 49 patients, the mandibular and maxillary overdentures retained by a minimum number of implants were included, and the survival rates were 100% and 75.4%, respectively.<sup>17</sup> In addition, another 5-year prospective randomized study using 2 implants in the mandible showed a success rate of 100%.<sup>14</sup> In

this study, most implants were placed in the anterior region, where the bone quantity and quality were favorable compared with the other region. This is believed to be one of the reasons for the high survival rate. In this study, only the Dolder bar was used as the attachment system. Although it was reported that there were no significant differences in survival rate between splinted and unsplinted implants supporting overdentures in the mandible,<sup>18</sup> the use of a bar as an attachment system was believed to be favourable in terms of the retention of the prosthesis.

The marginal bone loss over the 2 years in this study also agreed with the results reported in other studies. The marginal bone levels around the implants supporting the overdentures were evaluated in many studies. In a 2-year prospective study, in which 260 implants were installed in 50 edentulous jaws, the mean marginal bone loss was 1.7mm in the maxilla and 1.1mm in the mandible. Most of the bone loss occurred during the first year, and bone loss was 1.6mm in the maxilla and 1.0mm in the mandible.<sup>19</sup> In another 4-year retrospective study, 0.8mm bone loss was observed for the loaded mandibular implants connected with a straight bar during the first postsurgical year followed by a mean annual bone loss of < 0.1mm.<sup>20</sup> In a 5 year prospective study, 30 patients received 117 implants in the maxilla and 103 patients received 393 implants in the mandible. In that study, the mean marginal bone loss in the maxilla and mandible in the over the 5 year period was 0.8mm and 0.5mm, respectively.<sup>21</sup> In another study, bone loss of 1.03mm, 1.41mm, and 1.66mm was observed in the mandible 4-, 8-, and 12-years after installation, respectively.<sup>22</sup> In this study, the mean marginal bone loss showed tendency to be stable, even though the observation period was not long. However, there were no significant difference in mean marginal bone loss between the

maxilla and mandible over the 2 year period. In addition, there were no significant differences between bone loss of the first and second year. This might be due to the small number of patients or to the level of accuracy of taking radiographs and the method for measuring bone loss. Although in this study, the radiographs were taken using a parallel cone technique, more standardized methods for taking radiographs are required. Accurate and reproducible results are difficult to obtain and they require good radiographic techniques.<sup>23,24</sup> In one study, it was suggested that the deviation from a perpendicular projection relative to the long axis of the fixture should not exceed 9°.<sup>25</sup> In addition, research data indicated that a change in the vertical radiographic projection angle resulted in a change in the measured bone level by approximately 0.1mm for every degree.<sup>23</sup> A film position that is not parallel to the long axis of the implant would also give erroneous information on the marginal bone levels.<sup>26</sup>

Many authors suggested that there appeared to be no difference according to the attachment systems. Longitudinal prospective studies reported no differences in implant survival rates, health of peri-implant tissue, or marginal bone loss between the bar and solitary attachment systems used on the 2 implants retaining an overdenture.<sup>11,14,18</sup> It is believed that the direction of occlusal forces is more important than the connection of the implants. The difference in stress concentration with and without bars also appears to be small.<sup>27</sup>

In this study, the complications related to the attachment were common problems. The same tendency was observed in other studies.<sup>28,29</sup> In a retrospective study of the problems of implant prostheses, the most frequent repair was reported to involve the retentive clips, with 55% of the clinician's time being involved in replacing the retentive elements.<sup>30</sup> In this study, clip fractures

occurred in both the maxilla and mandible. Although it was suggested that there should be some freedom between the bar and clip to avoid the frequent fracture of the clip and attachment,<sup>28</sup> the results were thought to be dependent on various factors such as the condition of the ridge, the distance between implants, the type of attachment used, and the patient's masticatory force. In some studies, high relines rates were reported,<sup>28,29</sup> however in this study, only two relines were performed over the two years. In a previous study, prosthetic complications also included loosening of the abutment screws of the ball and bar attachments.<sup>31</sup> However, there were no such complications in this study. Other complications, such as corrosion, were not detected over the 2-year observation period. A previous study related clip loosening with the distance between the abutments.<sup>32</sup> In that study, the author suggested that the distance between the abutments should be no less than 8-10mm, and this space facilitates proper placement of the clips. In addition, he suggested that there is a higher possibility for clip loosening in the acrylic resin when the bar segment becomes shorter. In this study, the average clip length in the maxilla and mandible was 12.50mm and 9.64mm, respectively. Most of the bar lengths in this study were thought to be sufficient for proper placement of the clips.

In this study, the relationships between marginal bone loss and various factors such as bone quality, clip length, and bar length were not obvious. Fundamental data showing an unequivocal correlation between certain etiological factors and the scale of resorption are unavailable. Moreover, those studies that have been performed are often contradictory. It is possible that a combination of anatomic, metabolic, psychosocial, mechanical, and some unknown factors influence the scale of alveolar bone loss.<sup>33</sup> In addition, there might be individual variations in marginal bone loss. Only a lon-

gitudinal study based on adequate radiographs will determine the factors important in maintaining the bone level around the implants of the patients treated with implant-retained overdentures.

## CONCLUSIONS

A retrospective study of implant-retained overdentures over 2 year period was analyzed. This study confirmed the favorable outcome results for patients treated with implants and restored with Dolder-bar retained overdentures. Although there was no significant correlation between marginal bone loss and the other parameters in this study, there was a 100% survival rate of the implants with minimal prosthodontic complications. In the second year, the level of marginal bone loss showed the tendency of reduction. There were no statistically significant relationships between the marginal bone loss and clip length, bar length, or bone quality. Implant overdenture treatment with a Dolder bar might be recommended as a successful option for the prosthodontic treatment of totally edentulous patients.

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