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Clinical observation

## Clinical prognosis of single implant mesiodistal cantilevered prosthesis: A retrospective clinical study

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### ABSTRACT

**Objective:** This study aims to evaluate the prognosis of single cantilevered restoration, of which the cantilever length is less than 6 mm, retrospectively.

**Methods:** This study targeted 33 patients (20 males, 13 females) who were treated with total 35 single cantilevered restorations (mesial direction or distal direction) combined with implant installations from May 2004 to December 2012. All of the implant prostheses were single implant-supported and cantilevered (cantilever lengths were over 3 mm).

**Results:** The length of cantilevers ranged from 3.01 mm to 5.99 mm. All implants survived during the average of 47.72 months of observation period. The success rate of implants was 94.29%. The complications were peri-implantitis (8.57%) with symptoms such as swelling and bleeding and prosthetic complications (22.9%) such as screw loosening, abutment hex fracture, screw locking, and crown fracture. There was an average of  $0.04 \pm 0.14$  mm peri-implant alveolar bone loss at 1 year after loading and  $0.16 \pm 0.51$  mm at final observation.

**Conclusions:** Although single cantilevered restoration shorter than 6 mm does not induce crestal bone loss around the implant, several complications such as peri-implantitis and mechanical complications could still remain.

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### 1. Introduction

For the number of implants placed in the posterior edentulous area, placing a more number of implants would have an advantage in that it would better distribute the occlusal force [1,2]. However, if the mesiodistal space is narrow and there is limitation in anatomic structure (maxillary sinus, inferior alveolar nerve), or for economic reasons, less number of implants can frequently be installed than the number of lost teeth.

As studies on biomechanics are actively being conducted, there have been many studies on maximizing function using minimum number of implants installation. As the result, techniques have been introduced of installing small numbers of implants, compared to

the numbers of lost teeth, and supporting with the prosthetic. An implant installation method such as the “single cantilever” has been introduced, in which the mesially or distally extended form of prosthetic is used with the support of a single implant [3–5]. Cantilever prosthesis is defined as a method of installing smaller numbers of implants, compared to the number of teeth lost, and delivering the extended prosthetic above to the lost teeth.

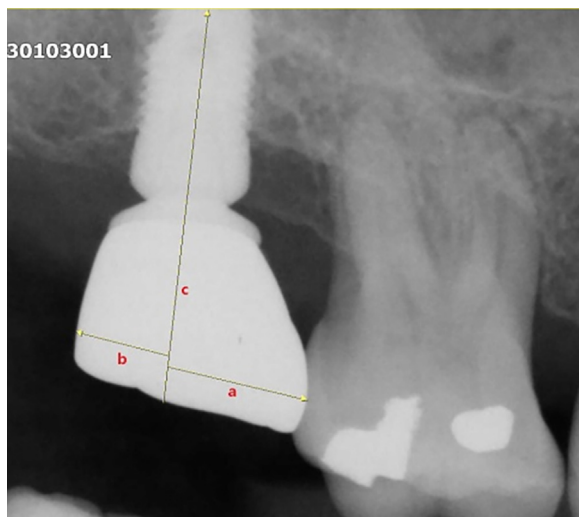
Acceptable clinical result has been reported in the cases which are two implants supporting the mesially or distally extended prosthesis. Palmer et al. conducted a study comparing cantilever and non-cantilever prosthesis with 2 supporting implants. The bone level and probing depth around the implanted area did not show statistically significant difference between the two groups [6].

There are many single implant crown treatments being performed after one implant installation. According to the location and direction of the implantation, mesiodistal cantilever which extends toward mesial or distal direction can occur. However, there are not many studies on the clinical prognosis of implant prosthesis for these cases; and the study indicating criteria for cantilever is

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**Fig. 1.** Single implant mesiodistal cantilever restoration.  
a,b: the longest length between long axis of the implant and mesial/distal margin.  
c: axis of the implant.  $|a - b| \geq 3\text{mm}$ : defined as single cantilever restoration.

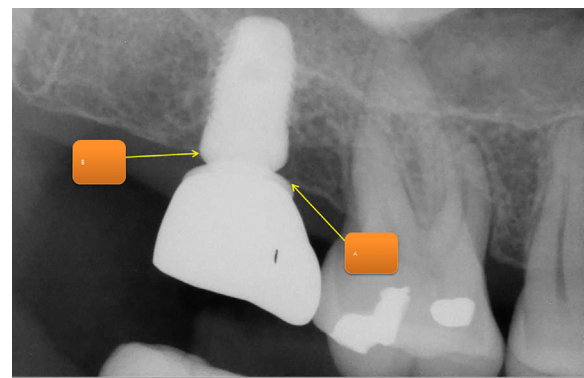
rare. Therefore, the purpose of this study is to evaluation the clinical prognosis of single implant mesiodistal cantilever restoration, which is mesially or distally extended more than 3 mm.

## 2. Methods

This study was approved by Seoul National University Bundang Hospital Institutional Review Board (IRB No. B-1405-252-110). Among the patients who were treated with implants at Seoul National University Bundang Hospital, from May 2004 to December 2012, the patients who received single implant installation and had mesiodistal cantilever prosthesis were included in this study. A total of 35 implants in 33 patients (20 males, 13 females) were included in this study. There were 17 implants installed in maxilla and 18 in mandible. For the criteria of mesiodistal cantilever, the distance between implant long axis to the furthest mesiodistal side should be 3 mm or above (Fig. 1). A variety of implants were installed; Implantium(8, Dentium Co., Suwon, Korea), GS II(6, Osstem Implant Co., Busan, Korea), Superline (10, Dentium Co., Suwon, Korea), TS III(2, Osstem Implant Co., Busan, Korea), US III(1, Osstem Implant Co., Busan, Korea), TS IV(1, Osstem Implant Co., Busan, Korea), CMI (2, Neobiotech, Seoul, Korea), Zimmer(2, Zimmer Dental., Carlsbad, CA), ASTRA(1, Dentsply Implants, PA, USA), 3I(1, BIOMET 3I, Florida, USA) and ITI(1, Straumann, Basel, Switzerland). The average length of the implant fixtures was  $9.83 \pm 1.32$  mm. The average diameter of the implant fixtures was  $5.11 \pm 0.68$  mm. The implant-abutment connection was all internal type.

All lengths used in this study were measured considering the magnification of the x-ray. As an example, when the actual length of the implant is 10 mm and the measured length according to the x-ray is 12 mm, the magnification rate is 1.2. Therefore, the mesiodistal width or bone resorption rate measured on the x-ray were considered by the magnification rate (1.2 in this example), and the actual length was found.

The amount of peri-implant alveolar bone resorption, complications related to implant surgery, the success rate and survival rate of implant prosthesis were investigated based on the medical records and radiographic images of the patients. The periapical radiograph which had been taken immediately after prosthesis delivery was



**Fig. 2.** Marginal bone loss measurement.  
A: Marginal bone level on mesial side of implant (mm). B: Marginal bone level on distal side of implant (mm) marginal bone loss(mm) on x-ray =  $(\Delta a + \Delta b)/2$ .

used to measure peri-implant alveolar bone loss at the 1 year after functional loading and the latest observation.

Nonstandardized, periapical radiographs taken at the time of prosthetic delivery were compared with those taken at the 1-year and final follow-up to determine the extent of marginal bone loss. Actual implant lengths were used to calculate magnification errors in radiographs. The mean resorption amount of the cretal alveolar bone was calculated for both the mesial and distal sides. For the radiographic measurements, the IMPAX system software program (Agfa-Gevaert Group) was used (Fig. 2).

Two expert dentists blindly measured the marginal bone loss. And statistical analyzed the correlation between the investigators with Pearson analysis. (After 1 year of prosthesis,  $p = 0.000$ , correlation = 0.860/final follow-up,  $p = 0.000$ , correlation = 0.901) The correlation between the length of cantilever and the bone resorption of marginal bone around the implant was statistically analyzed using statistic program SPSS, version 17.0 (SPSS Inc., Chicago, IL, USA). The Pearson analysis was used in order to perform correlation analysis at the significant probability of 95%. For the differences in the marginal bone loss depending on the antagonist teeth, the One-Way ANOVA test was performed. For the differences between the maxilla and mandible and between the 1st and 2nd molar teeth, the independent-samples T test was conducted.

The success criteria comprise the following determinants [7]:

1. The resultant implant support does not preclude the placement of a planned functional and esthetic prosthesis that is satisfactory to both patient and dentist.
2. There is no pain, discomfort, altered sensation or infection attributable to the implants.
3. Individual unattached implants are immobile when tested clinically.
4. The mean vertical bone loss is  $<0.2$  mm annually following the first year of function.

## 3. Results

The extended length of cantilever was investigated to be from 3.01 mm to 5.99. Among 33 out of 35 cases, the cantilever was extended mesially, and the others were distally extended. The average observation period is  $47.72 \pm 23.39$  months after functional loading, and implant failure was not observed (survival rate = 100%). According to the success criteria of Zarb and Albrektsson, there were 2 implant cases (5.71%, Patient No. 15, 20) that the peri-implant alveolar bone resorption was 1 mm or above at the final F/U, and one of these implants was removed. Therefore,

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