

Objective validity of an implant-retained overdenture with a ball attachment system after marginal mandibulectomy

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Abstract

Implant-retained overdentures are known to improve oral function, but the clinical impact on patients who have had mandibular resections is still debatable. We have treated 16 patients who had such resections for oral cancer and consequent loss of the alveolar ridge, with overdentures supported by osseointegrated implants and ball attachments. To quantify their functional improvement, we evaluated their maximum bite force and masticatory performance. Their function improved significantly, (from 77.5 N - 365 N, 371% increase in maximum bite force, $p < 0.001$) and masticatory performance increased (from 2.5 - 7.7, 208%, $p < 0.0001$) after the overdentures had been inserted. While individual changes in maximum bite force showed no significant correlation, those in masticatory performance correlated significantly, which suggests that the subjects with poor masticatory function are likely to benefit from retention of an implant. These results indicate that implant-retained overdentures are an effective way to rehabilitate patients after marginal mandibular resection.

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Keywords: Implant-retained overdentures; Maximum bite force; Masticatory performance

Introduction

Wearers of removable dentures often have functional problems, typically caused by instability of their conventional dentures. Dental implants that stabilise the dentures, therefore, have been considered as treatment, and several clinical reports have indicated that patients who were dissatisfied with their old-style dentures were extremely satisfied with their retention implants, in various ways including bite force, chewing, and swallowing.¹⁻³ As patients who have had

surgical treatment tend to be stressed by poor oral function, the use of implant-supported prostheses has been increasing.⁴

Though implant-retained overdentures improve oral function and quality of life, the best way to rehabilitate patients after mandibular resection is still controversial, partly because there are several attachment systems to choose from, and partly because a reconstruction of bone and soft tissue (if any) has an effect on their oral function. To find out the most effective prosthetic rehabilitation for individual patients, comprehensive clinical studies are required.

Ball, bar-clip, and magnetic attachments have commonly been used as retention systems for implant-retained overdentures.⁵ The overdentures supported by the magnet

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system provide less retentive force and affect oral function less than those with other retention systems.³ van der Bilt et al reported that subjects who wear overdentures with ball or bar-clip systems developed more than double their maximum bite force directly after treatment.⁶ In addition, in a longitudinal study, the same group showed that bite force and masticatory function remained unaltered for 10 years.⁷ Given that in some clinical studies the amounts of peri-implant bone were preserved for long periods, the use of overdentures is considered to be relatively safe for patients who have clinical problems (such as insufficient height of bone), which lead to an unfavourable crown:implant ratio for a fixed prosthesis.^{8,9} Naert et al indicated that the ball attachment system retained the denture better and resulted in fewer soft tissue complications than the bar-clip and magnet systems. As resection of oral cancers often causes problems with soft tissues such as loss of attached gingiva, it is necessary to provide an easy-cleaning oral environment as well as functional rehabilitation for postoperative patients.

The aim of this study was to analyse the functional effect of implant-retained overdentures with the ball attachment system for postoperative patients who had had a marginal mandibular resection.

Patients and Methods

Sixteen subjects (9 men and 7 women with a mean (range) age of 69 (61–81) years, who had had a marginal mandibular resection for oral cancer, and used to wear unstable conventional dentures, were enrolled in the study (Table 1). A follow-up period of at least two years was required before the insertion of implants. No patients who had a segmental resection of the mandible, or radiotherapy, or both, were enrolled.

All operations were done at Ehime University Hospital. All implants were rough-surfaced titanium fixtures (Branemark system; Nobel Biocare, Zurich, Switzerland), and two implants/patient were placed in the interforaminal region of the mandible in a 2-stage procedure. O-ring attachments were put in place to stabilise the dentures. The maximum bite force and masticatory performance were measured one year after insertion of the prostheses, with and without the ball attachments.

Maximum bite force

Vertical interocclusal bite forces were measured bilaterally with an Occlusal Force Meter (Nagano Keiki, Tokyo, Japan). The strain gauge was positioned in the first molar region, and patients were encouraged to bite as hard as possible on the bite-force meter for a few seconds. The measurement was made three times, and the highest of the three was selected. Mean (SD) of the left and right bite force values were calculated, and analysed statistically.

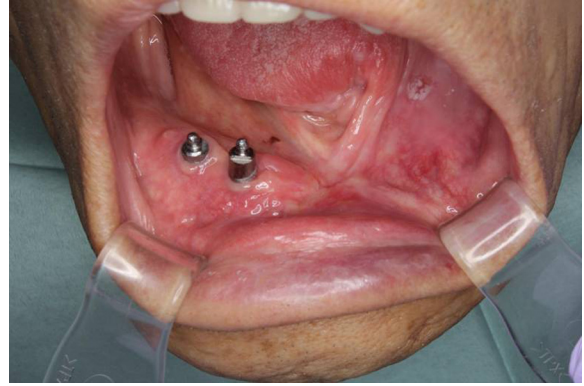


Fig. 1. The ball attachments on titanium implants. The alveolar ridge of the left mandible was severely resorbed after resection.

Masticatory performance

We measured the masticatory functions using a Masticatory Performance Evaluating Gum XYLITOL® (Lotte Co., Ltd., Tokyo, Japan). The subjects chewed the colour-variable chewing gums 120 times on either side as instructed, and then the colour was evaluated with the colour chart and rated on a scale of 0 to 10, following the assessment procedure described previously.¹⁰

Statistical analysis

The significance of the effect of treatment on the maximum bite force and the masticatory performance were analysed with a paired sample *t* test. Pearson correlation coefficients were calculated between the changes in oral function and the initial values without retention of implants. Probabilities of less than 0.05 were accepted as significant.

Results

Representative case

A 75-year-old man with oral squamous cell carcinoma of the left lower gingiva had a left-sided marginal mandibular resection. Two titanium implants were inserted in the mandible 2 years later. The sites of the implants were recorded preoperatively on a computed tomographic scan. At a second operation three months after insertion of the implant we put ball attachments on the fixtures and O-ring rubbers on the overdenture (Fig. 1).

Maximum bite force

The results of measurements of maximum bite force are shown in Figs. 2 and 3.

The mean (SD) value significantly increased from 75.5 ± 17.5 N to 365 ± 24.9 N (371% increase, $p < 0.001$) after setting the overdentures (Fig. 2). There was no significant correlation between the changes and initial values ($r = -0.0246$; $p = 0.93$) (Fig. 3).

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