Measuring the Load-Bearing Ratio Between Mucosa and Abutments Beneath Implant- and Tooth-Supported Overdentures: An In Vivo Preliminary Study

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The aim of this study was to establish a method for in vivo examination of the load-bearing ratio between mucosa and abutments beneath an overdenture. Two patients wearing a four tooth–supported or a four implant–supported overdenture were enrolled in this study. Recordings were performed with the metal framework only or with a metal framework and a denture base. The force value with the framework only was designated as 100%, and the tissue-supporting ratio (TSR) with the denture base was calculated. The TSR was approximately 30% to 40% in both subjects, regardless of the load. These data suggest that measurement of a TSR beneath an overdenture is feasible. *Int J Prosthodont 2011;24:43–45.*

Since implant-supported overdentures (IODs) receive support from both the implants and mucosa on the residual alveolar ridge, IOD success is considered closely related to occlusal force distribution to prevent implant overloading and to reduce bone resorption beneath the denture base.[1,2] The vertical and lateral forces exerted onto abutments in patients with tooth-supported overdentures (TODs) have been reported previously, and some studies have attempted to estimate occlusal force distribution in IODs using finite element methods.[3–5] However, the actual in vivo load-bearing ratio between natural teeth or implants and the underlying mucosa beneath overdentures is unknown. Thus, the aim of this study was to establish a method for in vivo examination of the load-bearing ratio between the mucosa and abutments beneath overdentures.

Materials and Methods

A 74-year-old man with an IOD and a 70-year-old woman with a TOD participated in this study. Both subjects gave their informed consent, and the study was approved by the ethics committee of Osaka University. The patient with the IOD had four implants placed on both sides of the mandible at the molar and canine sites, while the patient with the TOD had four natural tooth abutments with root capping on both sides of the maxilla at the molar and canine sites.

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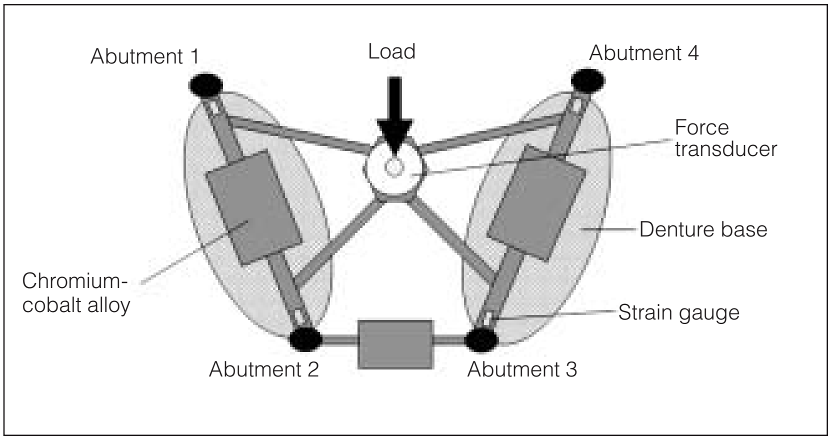

Fig 1 Schematic illustration of the metal framework.

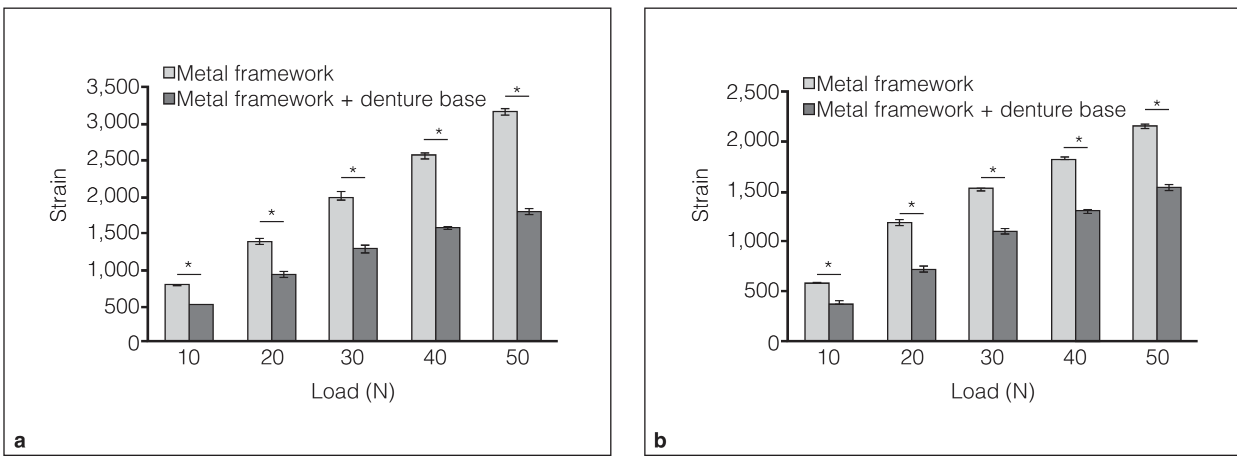

Fig 2 Sum of the strain value for **(a)** the IOD and **(b)** the TOD. A significant difference was found for each load (*P < .05).

Table 1 Tissue-Supporting Ratio (TSR) for the IOD and TOD at Different Load Values

	TSR (%)	
Load (N)	IOD	TOD
10	34.73	36.28
20	32.53	38.46
30	36.01	27.32
40	39.35	29.10
50	43.67	28.55

IOD = implant-supported overdenture; TOD = tooth-supported overdenture.

An experimental chromium-cobalt metal framework (Cobaltan, Shofu) was fabricated on a working model (New Plastone, GC) for each patient, which connected to and rested on each implant or abutment tooth. The framework was designed to increase the deformation under loading by designating differences in thickness where the framework came into contact with the implant or abutment tooth. Miniature strain gauges (KFG-03-120-C1-11, Kyowa Electric) were attached on the occlusal surface of the framework close to each implant (Fig 1). These gauges were used to estimate strain values near the abutment.

Loads were applied through a force transducer (LMB-A-50N, Kyowa Electric) located at the center of the framework, and output from the strain gauges was recorded (PCD-300A, Kyowa Electric). Recordings were performed with the metal framework only or with the metal framework and denture base. The denture base was designed to cover only the residual ridge area. Loads were applied progressively up to a maximum of approximately 50 N, and strain values were plotted at 10, 20, 30, 40, and 50 N.

The mean strain value (MSV) converted to load value was calculated from the output strain value according to the calibration. The baseline condition was considered as the metal framework only (designated as 100%). The tissue-supporting ratio (TSR) was calculated by dividing the MSV for the metal framework and denture base by that for the metal framework only under each loading condition. Statistical differences were determined by the Student *t* test using SPSS v 11 (IBM). A *P* value < .05 was considered statistically significant.

Results

The sum of the strain value converted into load for the IOD is shown in Fig 2a; the results with the TOD are shown in Fig 2b. In both data sets, MSV for the metal framework only increased proportionally as the applied load increased, and the MSV for the metal framework and denture base was significantly lower than that for the metal framework only at each load. In both patients, the TSR was approximately 30% to 40%, regardless of total load up to 50 N (Table 1).

Discussion

In this study, both the IOD and TOD exhibited similar TSR values. It is possible that the deformation becomes constant if the denture base area exceeds a certain value. In this situation, the TSR would decrease when the load increases. However, only loads up to 50 N (the typical maximum masticatory force in edentulous patients) were measured, and therefore, this hypothesis is unable to be confirmed.

Even if there are limitations in TSR up to a certain functional load, each implant beneath the denture base may stand against the load without disintegration. On the other hand, the load distributed to the underlying bone through the mucosa would be limited by the implant support, which may reduce the chance of bone resorption.

Conclusion

Since the results indicate that measurement of TSR in an IOD and TOD is feasible, it may be possible to evaluate different impression techniques in terms of functional force distribution capability or to determine the required minimum denture base area for preventing bone resorption in future studies.

References

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Literature Abstract

The occurrence of sleep-disordered breathing among patients with head and neck cancer

The purpose of this cross-sectional study was to assess the incidence of obstructive sleep apnea (OSA) in patients who were treated for head and neck cancer by surgical resection and compare them with the general population. A subgroup of head and neck cancer patients who underwent radiation therapy was also compared with those that did not. Twenty-four patients were recruited that had cancer surgery in the following areas: soft palate (n = 2), larynx (n = 7), supraglottic larynx (n = 4), tongue base (n = 7), and pharynx (n = 4). The patients were asked to fill out a sleep questionnaire; they then had their Body Mass Index calculated and had a routine polysomnography. Patients with a Respiratory Disturbance Index (RDI) 15 to 40 or a minimum O_2 saturation between 75 and 90 were classified as having mild to moderate OSA. Patients with an RDI > 40 or minimum O_2 saturation of < 75 were classified as having severe OSA. Patients with an RDI < 15 and a minimum O_2 saturation of > 90 were classified as not having OSA. Statistical analyses were carried out using the chi-square and Fisher exact test. Results revealed that 91.7% (22 of 24) had an RDI of > 15 or a minimum O_2 saturation of 90%. Of these 22 subjects, 16 (72.7%) had recognizable symptoms. Ten of the total 24 subjects received radiation therapy, all of which were classified as having OSA, compared to 11 of 14 (78.5%) in the non–radiation therapy group. This study shows a higher percentage of OSA in patients treated for head and neck cancer compared to the normal population (9.1% males). Limitations of the study include use of a nonvalidated instrument, no justification for use of RDI cut off for OSA, and a small study population that might not represent actual head and neck cancer patients in that region. The authors suggest that a patient who has undergone treatment for head and neck cancer should be assessed for clinical symptoms of OSA. Identification and treatment of patients for OSA who have head and neck cancer may be an important factor to improve quality of life post–cancer treatment.

Friedman M, Landsberg R, Pryor S, Syde Z, Ibrahim H, Caldarelli DD. *Laryngoscope* 2001;111:1917–1919. **References:** 13. **Reprints:** Michael Friedman, MD, 30 North Michigan Avenue, Suite 11107, Chicago, IL 60612, USA—*Alvin G. Wee, Omaha, NE*