Support Ratio Between Abutment and Soft Tissue Under Overdentures: A Comparison Between Use of Two and Four Abutments

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Purpose: The purpose of this preliminary in vivo study was to compare force distribution on abutments (tooth or implant) and tissues supporting overdentures with two or four abutments.

Materials and Methods: A convenience sample of five subjects with tooth and/or implant-supported overdentures was enrolled. Recordings were completed on each subject using a force-measuring system mounted on a metal framework with four anteroposterior spread abutments (A), four abutments with denture bases (B), and on two anterior abutments with denture bases (C). The tissue-support ratio (TSR) was calculated as (A−B)/A or (A−C)/A.

Results: TSR values changed 1.5 to 2 times when the number of abutments was reduced from four to two.

Conclusion: The amount of tissue strain on the posterior residual ridge increased when the number of abutments was reduced. Int J Prosthodont 2017;30:242–244. doi: 10.11607/ijp.5104

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verdentures (OVDs) provide increased denture stability and may contribute to reduced residual ridge resorption when compared to conventional complete dentures.1 Since implants or tooth abutments are generally encountered in the anterior region, functional forces on OVDs are distributed both to abutments and to distally extending edentulous ridges. To reduce bone resorption, the addition of supporting abutments in the posterior area has been recommended. Adding posterior abutments for support of removable prostheses can also increase occlusal support.2

While tissue support ratio (TSR) is reported to be about 30% in bounded edentulous areas,3 the TSR in edentulous areas with two anterior abutments compared with four abutments distributed in the anterior and posterior remains unclear. This preliminary in vivo study evaluated TSR with two or four abutments supporting OVDs.

Materials and Methods

Five subjects (two men and three women; mean age 73.4 ± 6.5 years) were recruited for this preliminary study. Informed consent was obtained and study approval was granted by the ethics board of Osaka University Dental Hospital. Two subjects each had two natural abutments and two implant abutments, while three subjects each had four implant abutments with bounded saddle configurations (Table 1).

TSR was measured using a previously reported miniature strain gauge system2 with loads added in 10-N increments up to 100 N using a force transducer (LMB-A-100N, Kyowa Electric) located at the center of the framework vertical to the occlusal plane.2–3 Obtained mean strain values were used to calculate TSR values (%).3 The measuring system metal framework was mounted on four anteroposterior spread abutments only (A), on four abutments with denture base (B), and on two anterior abutments with denture base (C) (Fig 1). Recordings were repeated five times for each condition.

TSR was calculated using the equation of (A − B)/A or (A − C)/A. Statistical differences were analyzed with paired t test using SPSS version 22 (IBM). P < .05 was considered statistically significant.
Results

TSR ratio did not significantly change as the applied load was increased, as shown in Fig 2. In the mandible and maxilla, the TSR was about twice as high when two abutments were used as when four abutments were used.

The average TSR under 100 N of load was 31.1% ± 6.6% (range 21.7–40.1%) with four abutments, irrespective of tooth or implant support. However, with equivalent loads using two anterior implants, the TSR was 60.0% ± 16.1% (range 36.7–85.8%) (Table 2).

Discussion

Although OVDs have the advantage of improving prosthesis support, there is still potential for bone resorption in the tissue-bearing area. Since the amount of bone resorption appears to be related to force transferred to the residual alveolar ridge, a significantly lower TSR with four abutments than with two anterior abutments suggests a possible decreased risk for bone resorption (Fig 3). It is quite appropriate to strategically place additional implants in the posterior edentulous space, regardless of whether anterior abutments are implants or natural teeth.

Table 1  Condition of the Subjects

<table>
<thead>
<tr>
<th>Subject</th>
<th>Arch</th>
<th>Denture</th>
<th>Abutment placement</th>
<th>Anterior area</th>
<th>Posterior area</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Maxilla</td>
<td>IOD</td>
<td>2 implants</td>
<td>2 implants</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Mandible</td>
<td>IOD</td>
<td>2 implants</td>
<td>2 implants</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Mandible</td>
<td>IOD</td>
<td>2 implants</td>
<td>2 implants</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Maxilla</td>
<td>TIOD</td>
<td>2 teeth</td>
<td>2 implants</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Maxilla</td>
<td>TIOD</td>
<td>1 tooth and 1 implant</td>
<td>1 tooth and 1 implant</td>
<td></td>
</tr>
</tbody>
</table>

IOD = implant-supported overdenture; TIOD = tooth- and implant-supported overdenture.

Table 2  Average TSR (%) for IOD and TIOD

<table>
<thead>
<tr>
<th>Subject</th>
<th>Overdenture</th>
<th>TSR with 2 abutments</th>
<th>TSR with 4 abutments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>IOD maxilla</td>
<td>36.7</td>
<td>21.7</td>
</tr>
<tr>
<td>2</td>
<td>IOD mandible</td>
<td>66.3</td>
<td>36.7</td>
</tr>
<tr>
<td>3</td>
<td>IOD mandible</td>
<td>58.1</td>
<td>28.1</td>
</tr>
<tr>
<td>4</td>
<td>TIOD maxilla</td>
<td>85.8</td>
<td>40.1</td>
</tr>
<tr>
<td>5</td>
<td>TIOD maxilla</td>
<td>53.3</td>
<td>28.8</td>
</tr>
</tbody>
</table>

IOD = implant-supported overdenture; TIOD = tooth- and implant-supported overdenture; TSR = tissue-supporting ratio.

Fig 1  (a) Metal framework. (b) Metal framework with denture base.

Fig 2  Tissue-supporting ratio (TSR) under different loads in a representative subject (Subject 5).

Fig 3  Average tissue-supporting ratio (TSR) of all subjects (P < .05).
The highest TSR was recorded in Subject 4, with two anterior tooth abutments in the maxilla. The reason for this higher TSR could be explained by the inclination and compressibility of the periodontal ligament, resulting in reduced support to vertical forces.

Preliminary results indicate that adequate anterior-posterior placement with a combination of four natural or implant abutments will result in improved retention, bracing, and support. With just two anterior abutments, improved retention and bracing but only limited support is observed.5

Conclusions

Within the limitations of this preliminary study, it appears that the amount of tissue strain on the posterior residual ridge would almost double when the number of abutments is reduced from four to two.

Acknowledgments

The authors reported no conflicts of interest related to this study.

References


Literature Abstract

Oral Health and Human Papillomavirus-Associated Head and Neck Squamous Cell Carcinoma

Approximately 90% of oropharyngeal cancers are squamous cell carcinoma (SCC). Human papillomavirus (HPV) has been known since the mid-1990s to have a correlation with SCC. However, the relationship of human papillomavirus, smoking, and poor oral health with increased risk of squamous cell carcinoma in the head and neck region has rarely been studied. In this study, postclinical diagnosis interview data and tumor HPV status from the Carolina Head and Neck Cancer Study (population-based case-control study, 2002–2006) were used to estimate the association between smoking and oral health in HPV-positive (n = 102) and HPV-negative patients (n = 145) with SCC. To determine HPV status, p16INK4a (p16) immunohistochemistry was used. The results showed that (1) routine dental examinations were associated with a decreased risk of HPV-negative SCC and HPV-positive SCC; (2) tooth mobility increased the risk of HPV-negative cases slightly more than the risk for HPV-positive cases; (3) > 10 pack-years of smoking were associated with an increased risk of HPV-negative SCC (strongly associated) and HPV-positive SCC (lesser association); and (4) gender was not a factor in the disease incidence. The authors concluded that the findings suggest an association between poor oral health and frequency of dental examinations among HPV-positive and HPV-negative SCC. Cigarette smoking is still a significant modification factor in SCC.

—Ansgar C. Cheng, Singapore