Short Communication

A Preliminary In Vivo Trial of Load Transfer in Mandibular Implant-Retained Overdentures Anchored in 2 Different Ways: Allowing and Counteracting Free Rotation

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This in vivo pilot methodologic study used 3 patients to investigate load transfer in mandibular implant-retained overdentures anchored in 2 different ways: allowing (gap condition) and counteracting (contact condition) free rotation. Load cells and strain-gauged abutments were used to evaluate occlusal load, load transmitted to the nonworking-side mucosa, and stress on the working-side abutment, in both contact and gap conditions. The occlusal load was reduced and load was shifted from abutments to mucosa in the gap versus the contact condition. In the contact condition, patients reported more comfort and felt that they could exert greater occlusal force. *Int J Prosthodont 2006;19:574–576.*

Anchorage of a mandibular implant-retained overdenture to 2 ball attachments is a simple and reliable treatment.[1,2] Recent studies have highlighted the importance of free denture rotation around the axis connecting the attachments in increasing the success rate of mandibular implant-retained overdentures.[3,4] On the other hand, attachments that counteract rotation provide a sense of greater denture stability and better comfort for the patient. This pilot in vivo methodologic study employed strain gauges and load cells[5] to investigate the difference in load transfer between 2 prosthetic designs that either allowed (gap condition) or counteracted (contact condition) prosthesis rotation.

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Materials and Methods

The study was approved by the University of Turin Ethical Committee. Three patients who had been wearing a maxillary removable complete denture and a mandibular implant-retained overdenture anchored to 2 ball attachments (Nobel Biocare) for at least 7 years were recruited for the study. Each had one abutment of height 5.5 mm and another of height 4 mm (Nobel Biocare). Two titanium matrices (Ti-alloy cap, 2.25 mm; Nobel Biocare) were cemented inside the metal frame of the denture, which contacted the abutments to counteract the free rotation of the overdenture.

Instrumentation and Recording Technique

Four 0.9-mm-long strain gauges (Micron Instruments) were attached to the external circumference of a 4-mm titanium abutment, parallel to its long axis. By means of appropriate signal elaboration, the bending movement running through opposite sensors could be reconstructed.

To evaluate the load transmitted to the nonworking-side mucosa, a pressure sensor (Interlink Electronics) was placed beneath the denture base at the level of the second premolar and first molar (Fig 1).

A 0.2-mm-thick load cell (Interlink Electronics), embedded in 2 layers of acrylic resin and shaped so as to remain stable during biting tests, was used to measure the occlusal load.

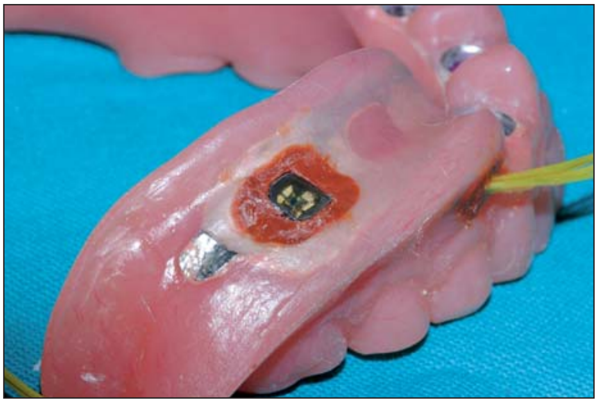

Fig 1 Pressure sensor placed beneath the denture base at the level of the second premolar and first molar.

Fig 2 Gap condition. The cylinders housing the attachments were milled to leave a space of 1 mm between the metal frame and abutments, thus allowing free rotation.

Table 1 Mean (Minimum to Maximum) Values Recorded in the Contact and Gap Conditions (mV/V)

	Occlusal load cell	Working-side abutments	Nonworking-side mucosa
Contact condition			
Patient 1	2.47 (1.45–3.48)	0.88 (0.12–2.01)	4.65 (3.15–5.56)
Patient 2	1.12 (0.38–1.64)	0.90 (0.50–1.55)	1.16 (0.83–1.62)
Patient 3	6.76 (3.78–10.53)	2.09 (0.53–4.71)	0.51 (0.25–0.93)
Gap condition			
Patient 1	1.97 (1.09–2.90)	0.86 (0.10–1.95)	4.80 (3.70–5.81)
Patient 2	0.90 (0.45–1.42)	0.65 (0.13–1.19)	1.32 (0.25–2.62)
Patient 3	3.60 (2.07–5.39)	1.48 (0.47–2.52)	0.47 (0.25–0.74)

The strain-gauged abutment was screwed onto the working-side implant with 20-Ncm torque, and the contact overdenture with a pressure sensor for the mucosa was inserted. The load cell was interposed between the second premolar and first molar. Patients performed six 10-second masticatory cycles, biting on the load cell, with a 5-second pause between cycles.

On the same day, the contact overdentures were converted to the gap condition. The cylinders housing the attachments were milled to obtain a 1-mm space between the metal frame and abutments, thus allowing free rotation (Fig 2). The biting test was repeated.

Results

The mean maximum value for each masticatory cycle was examined to compare stress on the working-side abutment and masticatory load distribution to the nonworking-side mucosa in the 2 anchorage modalities (Table 1). Table 2 shows the differences in the values recorded in the gap and contact conditions.

Discussion

Some differences in load transfer were evident between the 2 prosthetic designs, although Oetterli[3] observed that the retention mechanism of mandibular overdentures has little influence on the long-term treatment outcomes. In the gap condition, the masticatory load was reduced by between 20% and 47% compared to the contact condition. This suggests that in the gap condition, the denture rotates freely and offers less resistance to the occlusal force, whereas the contact condition provides greater denture stability and allows patients to feel more comfortable and exert greater occlusal force. It should also be noted that the rapid change from the contact to the gap condition may not have allowed patients to achieve the required prosthetic adaptation.

Table 2 Difference Between Values in the Gap vs Contact Conditions

	Occlusal load cell	Working-side abutments	Nonworking-side mucosa
Patient 1	–20%	–2%	+3%
Patient 2	–20%	–28%	+14%
Patient 3	–47%	–30%	–8%

The gap condition resulted in decreases of 2%, 28%, and 30% in the stress values recorded on the working-side abutment in the 3 patients. The different load distribution patterns caused by the different anchorage modalities, as well as the reduced masticatory force in the gap condition, may explain this result.

At the nonworking-side mucosa, the values recorded in the gap condition increased slightly (+3% and +14%) in 2 patients, but decreased (–8%) in the third patient. This latter reduction may be a consequence of the fact that this patient showed the largest decrease (–47%) in masticatory load in the gap condition.

Conclusions

The inherent limitations of this pilot methodologic study preclude any definitive clinically relevant conclusions. Nonetheless, it may be suggested that when a mandibular implant-retained overdenture is retained by attachments that counteract free rotation, a greater occlusal force may be exerted because of the perceived better denture stability. When an implant-retained overdenture is retained by attachments that allow free rotation, the occlusal load is reduced and shifted from the abutments to the mucosa. It is difficult to assess whether the loads responsible for the values recorded in vivo have any influence on the longevity of the restoration, and a comprehensive study employing this methodology could provide valuable insights into the real implications of different prosthetic designs for mandibular implant-retained overdentures.

Acknowledgments

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Literature Abstract

Evaluation of blending effect of composites related to restoration size

The purpose of this study was to evaluate the influence of restoration size on blending, initial color difference, and translucency of resin composites on the blending effect of resin composites. Four sets of 10-mm-diameter resin composite disks were made: single composite (1CS) and 2-composites (2CS) (2-mm-, 4-mm-, and 6-mm-diameter inner resin composites). The outer ring mimicked hard dental tissue with different cavity sizes. Five shades of commercial resin composites were studied. The lighter of the resin composite specimens was used as the inner composite in 2CS and shifted toward the darker composite—the smaller the diameter of the inner composites the greater the shift. Six observers (4 dental clinicians and 2 scientists) did visual color assessments without any color deficiency in a D50 lighting booth. Observers compared 1 2CS or 2 1CS at a time. Results were expressed in a 1 to 5 scale: 1: mismatch/totally unacceptable, 2: poor match/hardly acceptable, 3: good match/acceptable, 4: close match/small difference, and 5: exact match/no difference in color. The blending effect was calculated as a difference in mean score (mean category values) for a 2CS and corresponding 1CS pair. Color and translucency for 1CS were measured using a spectrophotometer. Linear regression was used to determine correlation coefficients among visual assessments as well as among visual assessments and color difference metrics. The mean scores by observer ranged from 1.1 to 1.8 and was 1.3 (0.6 SD) for all observers together. Corresponding mean scores for 2CS ranged from 2.2 to 2.6 and was 2.4 (1.4 SD) for all observers. This confirmed the existence of blending effect with some resin composites. Blending effect increased with a decrease in restoration size, decrease in color difference, and increase in specimen translucency.

Paravina RD, Westland S, Imail FH, Kimura M, Powers JM. *Dent Mater* 2006;22:299–307. **References:** 36. **Reprints:** Dr Rade Paravina, Department of Restorative Dentistry and Biomaterials, The University of Texas Dental Branch at Houston, 6516 MD Anderson Boulevard, DBB 465 Houston, TX 77030 3402. E-mail: rparavina@uth.tmc.edu—*Alvin G. Wee, OSU College of Dentistry, Columbus, OH*