Magnetic Attachment for Implant Overdentures: Influence of Contact Relationship with the Denture Base on Stability and Bending Strain

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This study evaluated how the contact height between the magnetic attachment and denture base influences stability and bending strain. An implant modified with strain gauges and a magnetic attachment mounted in an acrylic resin block were used to characterize systems with varying degrees or heights of contact with the abutment. Bending strain under lateral loading increased significantly as the contact height decreased. In the no contact and resilient contact groups, magnetic assemblies separated at reduced bending strain in all loading conditions. The contact height of the magnetic attachment influenced the stability and the amount of bending strain on the implant. *Int J Prosthodont 2013;26:563–565. doi: 10.11607/ijp.3481*

The attachment of an implant-supported overdenture (IOD) is designed to provide retention, support, and stability[1] to improve its masticatory efficiency; thus, its stability is a critical factor in patient satisfaction.[2] Magnetic attachments generally offer low stability, so the nature of their contact with the denture base becomes highly relevant in maximizing this stability. The purpose of this study was to evaluate how different contact heights between the magnetic attachment and denture base influence the stability of the attachment and the bending strain imparted to the implant.

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Materials and Methods

An implant (3.75 × 10 mm, Nobel Biocare) connected to an abutment (height: 5.5 mm, Magfit IP-B, Aichi Steel) was embedded into an acrylic resin block simulating the edentulous ridge (60 × 10 × 25 mm) (Palapress Vario, Heraeus Kulzer) (Fig 1).[3] A magnetic attachment (retentive force: 800 gf; Magfit DX, Aichi Steel) was mounted in an acrylic resin block (22 × 8 × 12 mm) simulating the denture base. Five groups were investigated: *(1)* no contact (control group, Fig 2a); contact relation in the *(2)* upper (Fig 2b), *(3)* middle (Fig 2c) and, *(4)* lower (Fig 2d) 1.5 mm of the abutment; and *(5)* a specially designed resilient contact (a plastic ring inserted onto the abutment with slight dimensional misfit, Aichi Steel) (Fig 2e). A space of 1 mm between the denture base and alveolar ridge simulated the compressible mucosa.

A 10-degree lateral load of 20 N (simulating occlusal force)[4] was applied 10 times to the denture base at 0, 5, or 10 mm from the center of the implant, a force sufficient to separate the assemblies under loading. Two miniature strain gauges (KFG-02-120-C1, Kyowa) were attached to the implant surface 2 mm below the platform to measure bending strain.[5] Mean bending strain (MBS) values from each testing condition were compared statistically using analysis of variance and post hoc analysis.

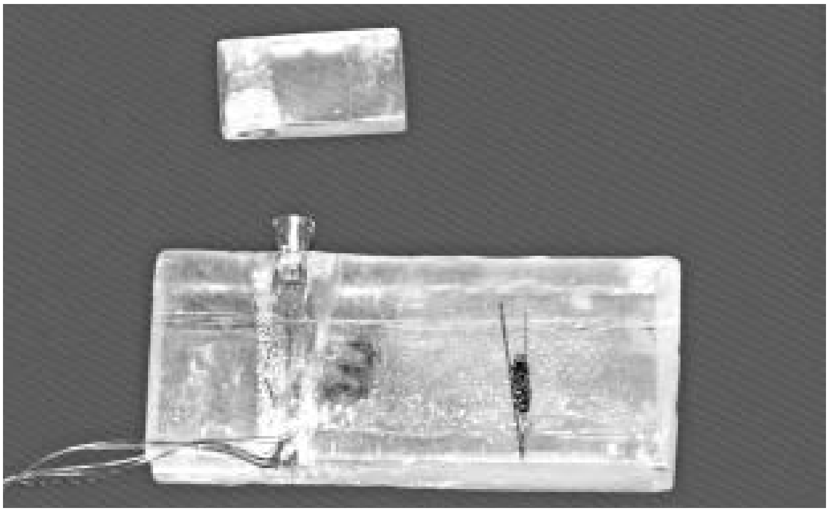

Fig 1 Specimen components: implant and magnetic attachment embedded in separate cubic acrylic resin blocks.

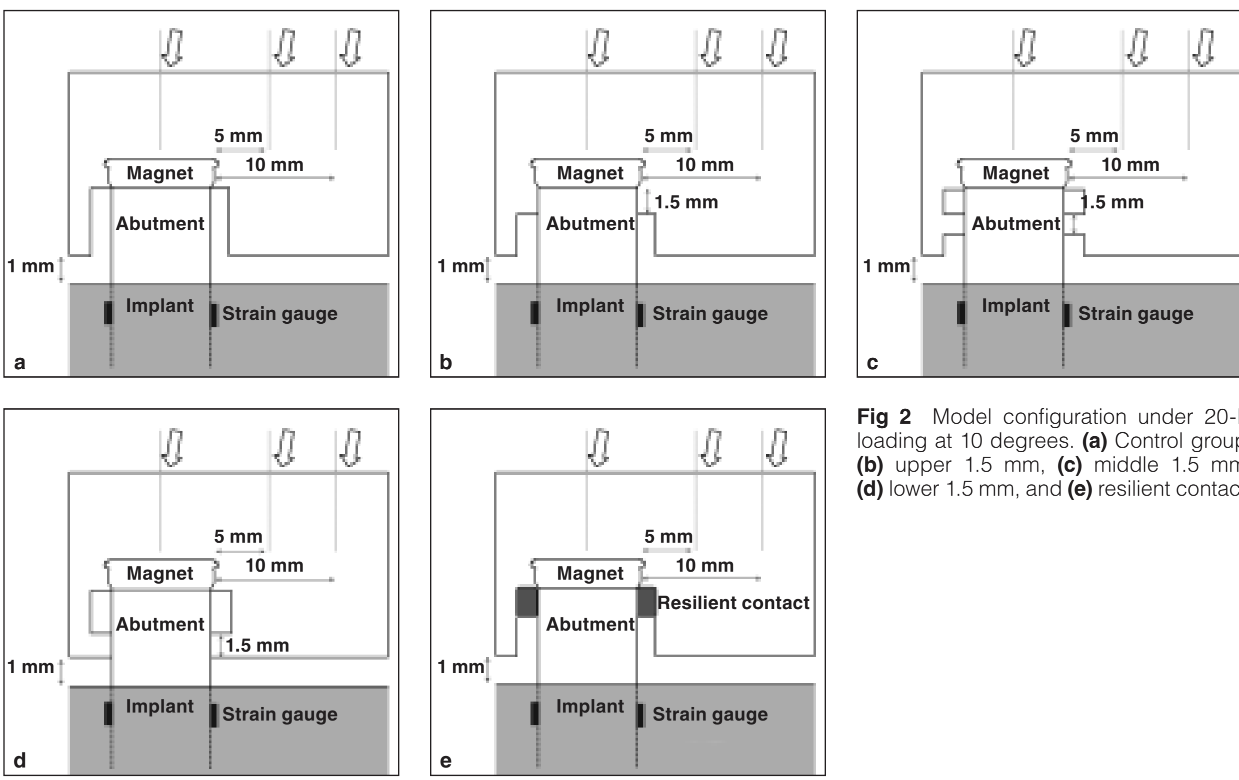

Fig 2 Model configuration under 20-N loading at 10 degrees. **(a)** Control group, **(b)** upper 1.5 mm, **(c)** middle 1.5 mm, **(d)** lower 1.5 mm, and **(e)** resilient contact.

Results

At the 0-mm loading point, MBS was highest with contact in the lower 1.5 mm and lowest with contact in the upper 1.5 mm (Table 1, Fig 3), with no significant difference between the remaining assemblies. In contrast, at the 5-mm loading point, the rank order of MBS was (highest to lowest): lower 1.5 mm > middle 1.5 mm > upper 1.5 mm > resilient = control (Fig 3). Intergroup differences were significant in all cases except for the control vs resilient comparison.

At the 10-mm loading point, the rank order of MBS was qualitatively similar to that at 5 mm, with significant differences in all but the control vs resilient and middle vs upper comparisons.

Moving the loading point laterally in the control and resilient contact groups decreased MBS but led to denture instability; thus, even low lateral forces separated the denture assembly. Conversely, the lower contact point demonstrated a particularly high stability and resistance to separation; consequently, MBS on the implant dramatically increased.

Table 1 MBS Exerted on the Implant (Microstrain) at Different Contact Heights (mean ± SD)

Group	0 mm	5 mm	10 mm
Control	90.98 ± 15.25	53.90 ± 4.49	28.19 ± 6.95
Upper (1.5 mm)	38.60 ± 6.92	109.86 ± 6.85	118.60 ± 3.33
Middle (1.5 mm)	81.26 ± 10.90	146.38 ± 2.70	122.20 ± 3.09
Lower (1.5 mm)	120.04 ± 9.47	249.90 ± 10.81	262.67 ± 6.67
Resilient contact	79.72 ± 9.74	54.62 ± 2.43	21.97 ± 3.07

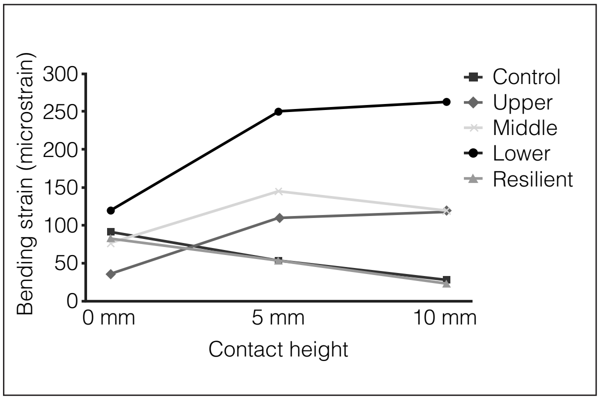

Fig 3 Bending strain exerted on the implant at different contact heights.

Discussion

This study has determined that IOD stability is increased by a rigid contact compared with a resilient contact. The measurements in the groups with contacts at the upper and middle 1.5 mm were not significantly different at the 10-mm loading point, which may indicate that a high, rigid contact provides more resistance to denture rotation. However, higher stability was correlated with increased bending strain on the implant, elevating the mechanical risk.

In all loading conditions, the denture attachment separated completely in the resilient contact and control groups, irrespective of MBS. Therefore, the resilient contact was unable to provide adequate IOD stability, perhaps because the morphology of the magnetic attachment was unable to provide sufficient mechanical interlocking or frictional contact, unlike that offered by stud or ball/O-ring attachments.

To simplify the clinical conditions, a homogeneous and rectangular acrylic resin block embedded with an attachment connected to the implant and an additional rectangular block were used to simulate the denture base. Moreover, the mucosa was excluded between the prosthesis and alveolar ridge, which may compromise stability. These may represent limitations of this study, and further studies are needed to confirm the observations regarding IOD stability under clinical conditions.

Conclusion

Within the limitations of this study, the contact between a magnetic attachment and a denture base was found to improve stability at the cost of imparting bending strain on the implant.

Acknowledgment

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

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