Metal Reinforcement of a Complete Maxillary Denture Without a Palate: A Preliminary Report

Toshihito Takahashi, DDS, PhD[a]/Yoko Mizuno, DDS, PhD[b]/
Tomoya Gonda, DDS, PhD[c]/Yoshinobu Maeda, DDS, PhD[d]

This preliminary study examined laboratory-simulated differences between maxillary complete dentures with and without a palate (palateless) as well as the effect of reinforcement of the latter design. Five types of experimental dentures and three types of reinforcements were made. Strain gauges were attached, and a vertical load was applied. The strain was statistically compared using analysis of variance ($P = .05$). Strain recordings on the palatal side of palateless dentures without reinforcement were significantly higher than in complete dentures and palateless dentures with reinforcement ($P < .05$). These preliminary observations suggest that such reinforcement with a palatal bar or metal-based palate may reduce the risk of fracture and deformation. *Int J Prosthodont 2015;28:188–190. doi: 10.11607/ijp.4045*

Maxillary complete dentures without full palatal coverage (palateless) are often prescribed for patients with a strong gag reflex and/or in the presence of large palatal tori. Different and maximum anterior palatal-area stress concentration has already been demonstrated[1] for such a denture design. However, that study also showed that reinforcement can reduce the attendant strain with less-associated deformation. Palateless dentures also lessen stress on underlying structures, while the compressive strength of denture bases is generally higher than generated tensile forces. Additional information is now needed to determine whether palateless dentures fracture easier and the kind of reinforcement needed to reduce the strain effectively enough to preclude fracture and deformation risks.

The purpose of this study was to compare the shear strain of complete dentures with and without palatal coverage and determine the effect of including a reinforcement structure.

Materials and Methods

A cast of an edentulous residual ridge (G2-402U, Nissin) covered with silicone (Fit Checker, GC) was used to provide a laboratory analog for fabricating complete dentures with and without palates.[1]

Five types of experimental denture bases were tested: *(1)* conventional complete denture (CD), *(2)* palateless denture (PD), *(3)* palateless denture with reinforcement (PDR), *(4)* palateless denture with reinforcement and palatal bar (PDRB), and *(5)* palateless metal-based denture (PMBD) (Fig 1). The reinforcements and metal base were made out of a cast cobalt-chromium (Co-Cr) alloy (Cobaltan, Shofu).

A strain gauge (KFG-02-120-C1-11L1M3R, Kyowa Electronic Instruments) was attached to the lingual (CH1) and palatal (CH2) polished surface of the anterior midline (Fig 2). A vertical load of 49 N was applied to both sides of the first premolar and first molar, respectively (Fig 3), and the shear strains were calculated.

Comparisons of the shear strains were made by an analysis of variance (ANOVA) with a post hoc comparison using the Bonferroni method ($P = .05$). All statistical analyses were performed using SPSS version 11 software (SPSS).

[a]*Assistant Professor, Department of Prosthodontics, Gerodontology, and Oral Rehabilitation, Osaka University Graduate School of Dentistry, Osaka, Japan.*
[b]*Resident, Department of Prosthodontics, Gerodontology, and Oral Rehabilitation, Osaka University Graduate School of Dentistry, Osaka, Japan.*
[c]*Assistant Professor, Department of Prosthodontics, Gerodontology, and Oral Rehabilitation, Osaka University Graduate School of Dentistry, Osaka, Japan.*
[d]*Professor, Department of Prosthodontics, Gerodontology, and Oral Rehabilitation, Osaka University Graduate School of Dentistry, Osaka, Japan.*

Correspondence to: *Dr Toshihito Takahashi, Department of Prosthodontics, Gerodontology, and Oral Rehabilitation, Osaka University Graduate School of Dentistry, 1-8 Yamadaoka, Suita, Osaka, 565-0871, Japan. Fax: +81-6-6879-2957. Email: toshi-t@dent.osaka-u.ac.jp*

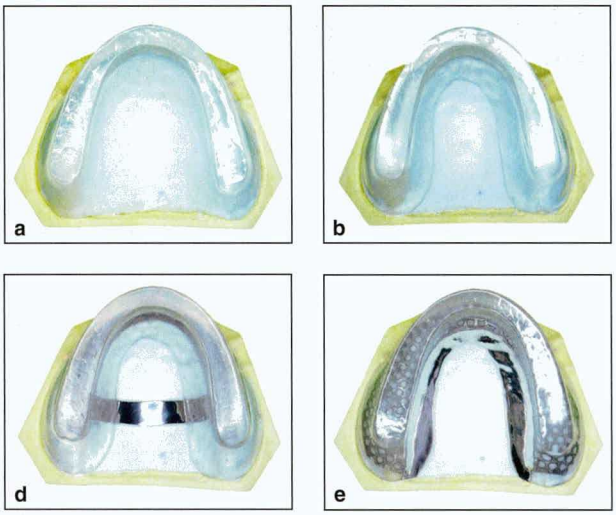

Fig 1 Photographs of experimental dentures. **(a)** Maxillary complete denture with palate; **(b)** palateless denture; **(c)** palateless denture with reinforcement (reinforcement: 4 mm wide × 0.5 mm thick); **(d)** palateless denture with reinforcement and palatal bar (palatal bar: 5 mm wide × 1.0 mm thick); **(e)** palatal metal-based denture (metal base: 7 mm wide × 0.5 mm thick).

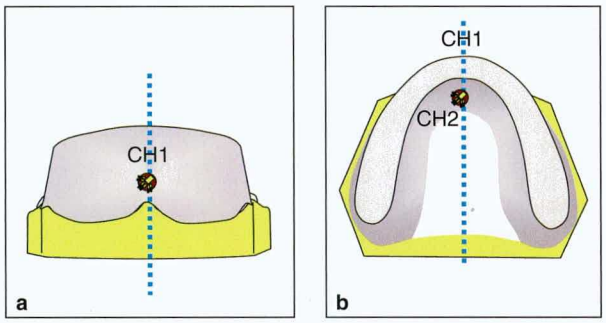

Fig 2 Schematic illustration of strain gauge positioning. **(a)** Occlusal view; **(b)** labial view. Dotted lines denote the midline of the denture. A strain gauge was attached to the polished surface both lingually (CH1) and palatally (CH2) at the anterior midline of each experimental denture.

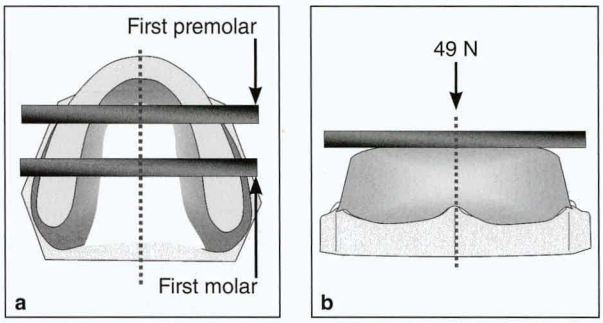

Fig 3 Schematic illustration of loading protocol. **(a)** Occlusal view; **(b)** labial view. Dotted lines represent the midline of the denture. A vertical occlusal load of 49 N was applied to the left and right side in the region of the first premolar and the first molar.

Results

In all of the tested situations, the shear strains in PD were the greatest (three times larger than CD in CH2) and those in PMBD were the smallest. The shear strains in PD were significantly higher than in CD and in other palateless dentures with metal structures ($P < .05$). The decreasing order of the shear strain for the palateless dentures was PDR, PDRB, and PMBD (Fig 4).

Discussion

Cast Co-Cr reinforcement for conventional complete dentures appears to reduce strain on the edentulous residual ridge.[2,3] Similar information is not available for a palateless denture, although its reinforcement will have the same effect seen in conventional dentures. However, a reduction of strain on the residual ridge does not automatically follow, given differences in resulting denture base deformation.[1] Moreover, it appears that strain in palateless dentures is double that of conventional complete dentures, with the former being compressive and the latter tensile.[1]

In this study, shear strains of palateless dentures were significantly higher than those of conventional dentures. Consequently, a combination of both studies suggests palateless dentures fractured more easily and shear strains were decreased by a reinforcement protocol. Palateless dentures deform buccopalatally (buccal to the palatal side) and require a rigid metal palatal structure with two types—palatal bar or metal based appeared to be effective.

In this pilot study, a palatal bar connected the first molars where occlusal force is maximal,[4] while a middle palatal bar may be better for oral functional purposes.[5] If palatal tori are located in the midpalatal region, an anterior and posterior palatal bar may be the better design choice.

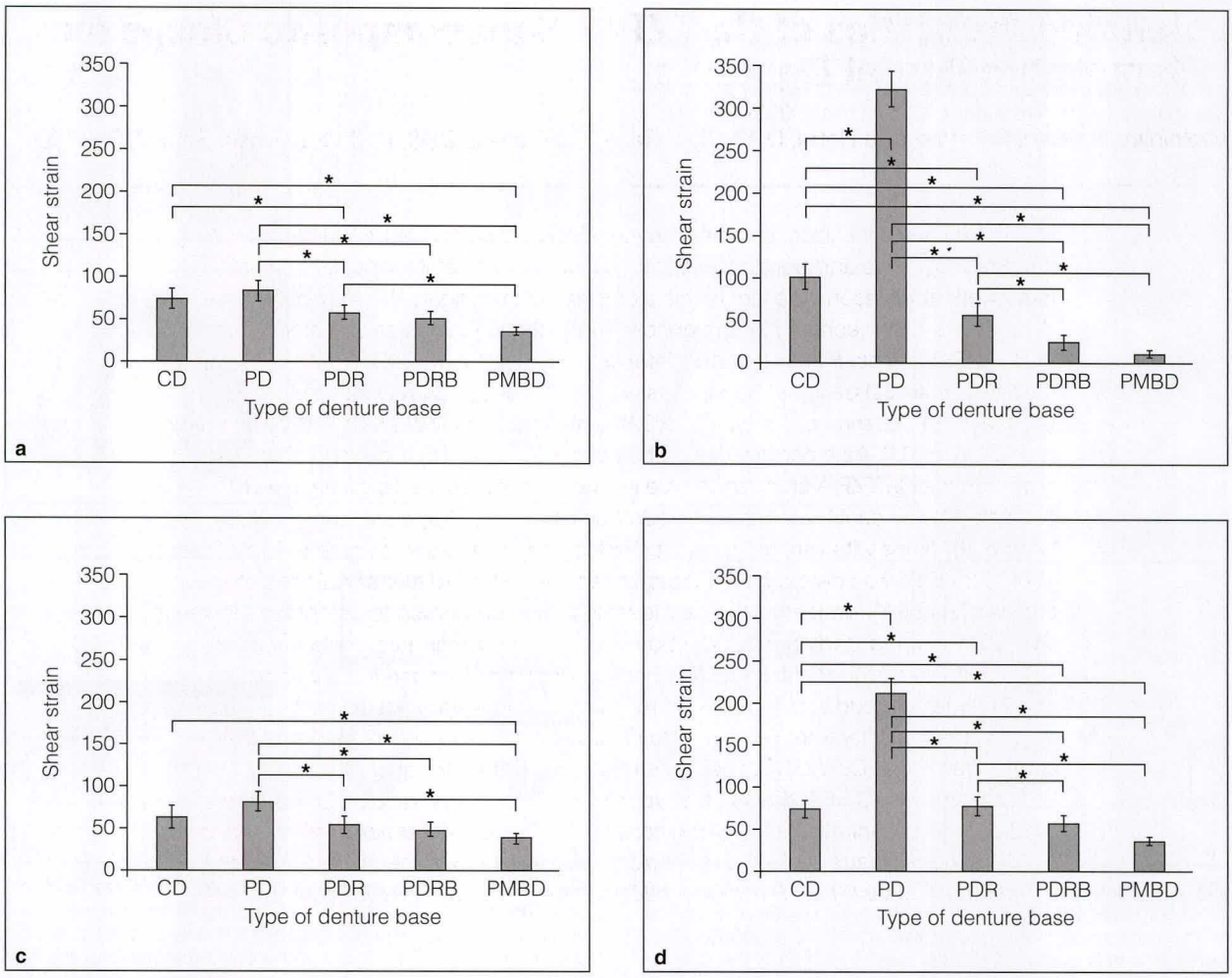

Fig 4 Strain experienced in denture bases under 49-N load. Loading and measuring positions are shown on each. Differences in mean values were analyzed using ANOVA with a Bonferroni post-test. **(a)** First premolar, lingual surface; **(b)** first premolar, palatal surface; (**c)** first molar, lingual surface; **(d)** first molar, palatal surface. CD = maxillary complete denture with palate; PD = palateless denture; PDR = palateless denture with reinforcement; PDRB = palateless denture with reinforcement and palatal bar; PMBD = palatal metal-based denture. *Significant difference ($P < .05$).

Conclusions

Within the limitations of this preliminary study's design, it is suggested that the shear strains of palateless dentures were significantly greater than with conventional dentures; metal reinforcement reduced shear strain. Palateless dentures with a metal palatal bar, or palatal metal-based dentures, are recommended to prevent denture deformation and fracture.

Acknowledgments

The authors thank the staff of the Department of Prosthodontics, Gerodontology, and Oral Rehabilitation, Osaka University Graduate School of Dentistry. The authors reported no conflicts of interest related to this study.

References

1. Mizuno Y, Takahashi T, Gonda T, Maeda Y. Mechanical analysis of a palateless denture. Int J Prosthodont 2013;26:419–422.
2. Takahashi T, Gonda T, Maeda Y. The influence of reinforcement on strain in maxillary complete dentures: A preliminary report. Int J Prosthodont 2011;24:273–276.
3. Takahashi T, Gonda T, Maeda Y. Influence of reinforcing materials on strain of maxillary complete denture. Acta Odontol Scand 2013;71:307–311.
4. Watanabe T. Study of masticatory forces of complete denture wearers. Kokubyo Gakkai Zasshi 1990;57:16–31.
5. Wada J, Hideshima M, Inukai S, Ando T, Igarashi Y, Matsuura H. Influence of the major connector in a maxillary denture on phonetic function. J Prosthodont Res 2011;55:234–242.