

The effect of denture adhesive on bite force until denture dislodgement using a gnathometer

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Purpose: Denture adhesives are used to improve denture retention, stability and function. The purpose of this study was to determine the effect of a cream-type denture adhesive on bite force until denture dislodgement (BFDD) using an improved gnathometer.

Materials and Methods: Twelve denture-wearing patients (six females and six males, mean age: 69 years) were involved in the study. The maximum BFDD of two groups (“no biting pain” and “biting pain”) was measured using a disposable gnathometer before and after denture adhesive application. The standard curve of the gnathometer measurements was produced using a constant load compression testing machine from 10 N to 80 N.

Results: A significant difference was found between the no biting pain group and the biting pain group before the application of denture adhesive ($p < 0.0001$). A notable improvement was observed in BFDD of the biting pain patients after denture adhesive was applied ($p < 0.0001$). No significant difference in BFDD was found in the no biting pain subjects following the application of denture adhesive.

Conclusion: The following conclusions were drawn: 1) Denture adhesive is effective for improving the BFDD of complete denture wearers with biting pain; 2) The gnathometer is useful for measuring the BFDD of complete denture wearers. (Int Chin J Dent 2010; 10: 41-45.)

Key Words: bite force, complete denture, denture adhesive, gnathometer

Introduction

Denture adhesive has been extensively used by denture wearers with well-fitting and ill-fitting dentures as a means to enhance denture retention, stability and function.¹⁻⁶ The American Dental Association first reported the use of denture adhesive in 1935.⁷ The first patent for denture adhesive was issued in 1913 in the US, with other patents following in the 1920s and 1930s.⁸ Clinical opinion about denture adhesive has been negative,⁹⁻¹² and dentists have been slow to accept denture adhesive. Reported reasons for trying denture adhesive are to improve fit, comfort, chewing ability, and also to improve patient confidence in wearing dentures.^{5,13} In the US in 1980, 15% of denture wearers used denture adhesives.^{14,15} Wilson et al.¹⁶ reported in 1990 that 30% of denture wearers used, or had used, denture adhesive. However, Coates¹⁷ reported that a significant number of subjects in his study did not know that denture adhesives existed. However, denture adhesives still hold a legitimate and indispensable place in prosthetic dental treatment.

The mechanical properties and cytotoxicity of denture adhesives have been widely investigated using a variety of testing methods.¹⁸⁻²² Boos²³ demonstrated the use of a gnathometer to measure intermaxillary biting force in 1940. In 2004 and 2005, Psillakis et al.²⁴ and Özcan et al.²⁵ used a gnathometer to examine the effect of denture adhesives on bite force until denture dislodgement (BFDD).

Patients using denture adhesive need to know how denture adhesive affects denture stability. The gnathometer is a useful tool to measure the BFDD of complete denture wearing patients. It is therefore important that this device is easy for patients to use.

The purpose of this study was to examine the properties of the improved gnathometer using a calibration test. In addition, the effect of denture adhesive on BFDD of complete denture wearing patients was examined using the improved gnathometer.

Materials and Methods

Twelve patients fitted with complete mandibular and maxillary dentures (six females and 6 males) were involved in the study. Patients' ages ranged from 52 to 82 years with a mean age of 69 years. The patients were divided into the following two groups: those who did not experience pain in the alveolar mucosa on biting (the no biting pain group; seven patients: three females and four males); and those who experienced pain in the alveolar mucosa on biting (the biting pain group; five patients: three females and two males). All patients were in good health with no medical problems that would contraindicate their participation in the study. The patients were informed about the aim of the study, and informed consent was supplied for the patients according to the Ethical Commission of the University.

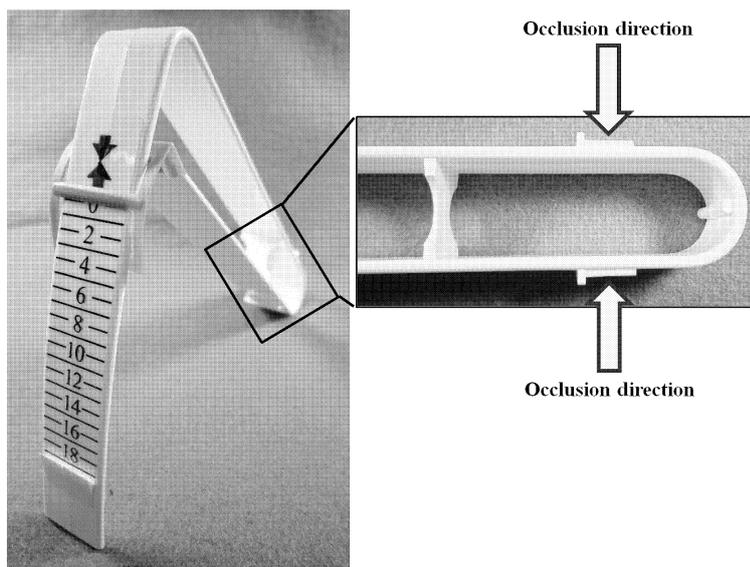


Fig. 1. Disposable gnathometer

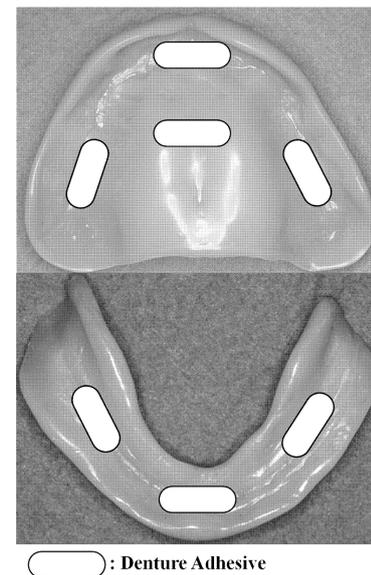


Fig. 2. Denture adhesive application space

A baseline maximum BFDD was measured using a disposable gnathometer (GlaxoSmithKline K.K., Tokyo, Japan; Fig. 1) before denture adhesive application. Measurements were taken of the bite force a patient could apply to the right first molar (R), central incisor (F) and left first molar (L) before dislodgement of the denture occurred at the palatal seal. The denture was then removed, cleaned and dried. A cream-type denture adhesive (New Poligrip S, GlaxoSmithKline K.K.) was applied to the mandibular denture as 3x2 cm long strips, and to the maxillary denture as 4x2 cm long strips (Fig. 2). BFDD was measured 30 minutes following the application of the denture adhesive.

We measured the correlation between the gnathometer scale and the load using a constant load compression testing machine (A-001, Japan Mecc Co. Ltd., Tokyo, Japan) from 10 N to 80 N (10, 15, 20, 25, 30, 35, 40, 50, 70, and 80 N), and produced a standard curve using regression analysis (SPSS 16.0, SPSS Co., Tokyo, Japan). Three gnathometers were used for measurement, and each gnathometer was measured five times at each load. The data were analyzed using ANOVA and Student's t-test at a 0.05 level of significance (SPSS 16.0, SPSS Co.).

Results

Figure 3 shows the standard curve of the gnathometer measurements. The regression was $y=5.0007x+5.6205$.

R^2 is 0.9855 and high correlation was accepted. A significant difference was found between the no biting pain group and the biting pain group before the application of the denture adhesive ($p < 0.0001$) (Fig. 4). A notable improvement from the baseline was observed in the BFDD of the biting pain group ($p < 0.0001$) when denture adhesive was used (R: 23.82 N, F: 26.12 N, L: 25.62 N). All patients in the biting pain group reported that pain in the alveolar mucosa diminished with the use of denture adhesive. In the no biting pain group, BFDD was observed to rise from the baseline when denture adhesive was used (R: from 82.06 N to 86.71 N, F: from 93.14 N to 94.57 N, L: from 89.92 N to 93.85 N); however, no significant difference was found ($p > 0.05$). No significant differences were found among the three biting sites for all groups ($p > 0.05$).

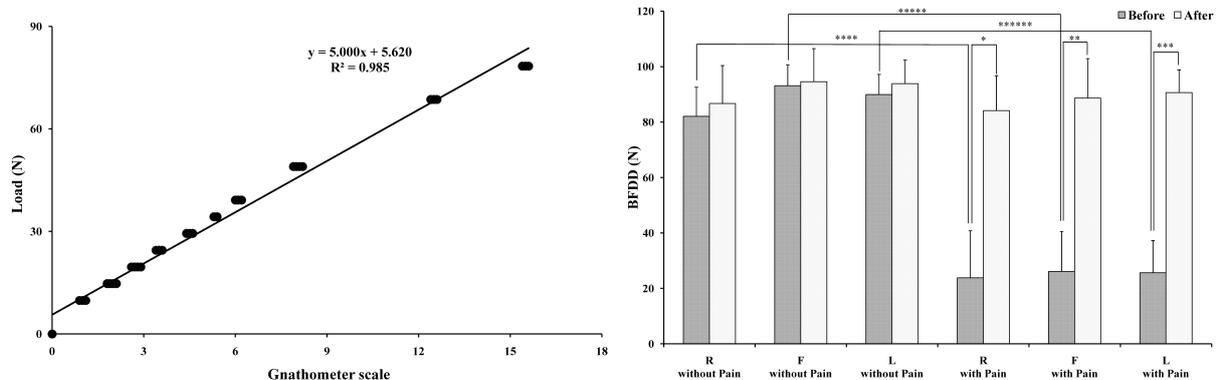


Fig. 3. Standard curve of gnathometer (left)

Fig. 4. Mean BFDD with standard deviation before and after denture adhesive application (right)

R: right first molar; F: central incisor; L: left first molar. *: BFDD of R between before and after denture adhesive application for biting pain group ($p < 0.0001$). **: BFDD of F between before and after denture adhesive application for biting pain group ($p < 0.0001$). ***: BFDD of L between before and after denture adhesive application for biting pain group ($p < 0.0001$). ****: BFDD of R between no biting pain group and biting pain group before denture adhesive application ($p < 0.0001$). *****: BFDD of F between no biting pain group and biting pain group before denture adhesive application ($p < 0.0001$). *****: BFDD of L between no biting pain group and biting pain group before denture adhesive application ($p < 0.0001$).

Discussion

Denture cleansers are widely used by denture wearers to remove plaque, stain and calculus from the surface of dentures.¹⁻⁵ In the clinic, patients would benefit greatly from a dentist's guidance in the use of denture cleansers. This study was designed to survey the knowledge, understanding and level of education about denture cleansers among Japanese, Chinese, and Indonesian dentists.

More than 76% of Chinese dentists and more than 62% of dentists in Indonesia said that they had heard only a little about denture cleansers and that they knew only a little of the function of denture cleansers. Furthermore, more than 76% of dentists in China and more than 61% of Indonesian dentists answered that they did not know of any disadvantages of denture cleansers. It is important for dentists to be familiar with the disadvantages of denture cleansers; in particular, the risk of deterioration of the physical and mechanical properties of denture base materials and oral mucosal injury caused by inappropriate use of denture cleansers.¹⁵ Professional education about denture cleansers is therefore necessary. Almost none of the dentists in China and Indonesia knew of any domestic brands of denture cleanser. In China and Indonesia, there are practically no domestic manufacturers of denture cleansers, and denture cleansers are mainly imported. This may be why so many dentists in China and Indonesia did not know of any domestic brands.

Over 61% of dentists in China and Indonesia responded that they had never been taught about denture

cleansers, and between 80% and 100% of Chinese dentists had never encountered denture cleansers in books, lecture meetings or on television. Information about denture cleansers often comes from textbooks and lectures, but dentists often encounter this information only in technical journals and specialty books. In China and Indonesia, there have been few reports about problems caused by denture cleansers. Therefore, problems arising from the improper use of denture cleansers, such as deterioration of the physical and mechanical properties of denture base materials and oral mucosal injury, may be prevented by raising dental professionals' awareness and knowledge of denture cleansers. We suggest that it is particularly important to teach dentists about the advantages and disadvantages of denture cleansers in professional continuing education and training.

Over 69% of the dentists in Chinese and over 54% of the Indonesian dentists stated that they had never seen denture cleansers in the clinic. There are various environmental differences among the three countries. These differences could affect dental treatment, and could affect the use of denture cleansers.

Some limitations can be identified in this study. Firstly, indirect translation of the questionnaire from Japanese to Chinese and Indonesian might have influenced the results. Secondly, the sample sizes were small. Thirdly, there were significant differences in age among the three groups of subjects. It is unknown whether the results can be generalized to other samples; therefore, it is necessary to conduct future research over more diverse samples. Although caution should be exercised in making generalizations based on the results of this study, the questionnaire is a starting point for investigating the awareness and knowledge of dentists in Japan, China, and Indonesia about denture cleansers. These methods may be useful for comparing awareness of denture cleansers among other groups, and may further contribute to the evaluation of denture cleansers.

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