Maximizing Mandibular Denture Retention in the Sublingual Space

Jia-Jin Chang, DDS, MDS^a/Jen-Hao Chen, DDS, MDS^b/Huey-Er Lee, DMD, PhD^c/Hong-Po Chang, DMD, PhD^d/ Hong-Sen Chen, DDS, MDS, PhD^e/Yi-Hsin Yang, MS, PhD^e/Tsau-Mau Chou, DMD, MScD, DScD^f

> Purpose: This study was designed to investigate potential discrepancies between the depth and width of the mandibular denture anterior lingual flange and the alveolingual sulcus and to measure the changes in retention when flange lengths were modified to optimal dimensions in a sample population of elderly edentulous subjects. Materials and Methods: The anterior lingual flange and alveolingual sulcus were measured in 66 randomly selected elderly Taiwanese denture patients. The length and width of corresponding regions of the anterior lingual flange and alveolingual sulcus were compared. Mandibular denture retention was recorded and compared prior to and following modification of the anterior lingual flange with border molding. **Results:** A significant statistical difference existed between the mean anatomical dimensions of the alveolingual sulcus and the corresponding denture flanges. Following functional border molding, the mean retention of the mandibular denture increased in a statistically significant manner. Conclusion: The discrepancies between the anterior lingual denture flange and alveolingual sulcus dimensions appeared to significantly diminish mandibular denture retention and reinforce the value of proper flange extensions in the sublingual region. Int J Prosthodont 2011;24:460-464.

Complete denture retention is widely regarded as contributing significantly to a patient's adaptive prosthesis-wearing experience.¹ One determinant of such a clinical result is optimal border molding of the denture's periphery, which leads to a seal created by closely adapting the denture to its surrounding tissues. This prevents air from entering the fluid interface at the peripheral border seal. Mandibular complete dentures have less denture-supporting area than maxillary complete dentures. In addition, retention is influenced by the mobile base of the tongue and the floor of the mouth, which provide a portion of the desired overall border seal. The correct dimensions of the denture border are regarded as more easily determined in the labial and buccal regions, whereas the precise extensions of the lingual border are far more challenging. Miller et al² reported that the sublingual region, from canine to canine, is a critical area for retention of the mandibular denture. Since the tongue is a highly mobile organ, the sublingual space is actually dynamic, displaying a dimensional range that can be quite large. Extreme tongue movements are difficult to accommodate and often result in underextension and loss of border seal. Consequently, mandibular dentures frequently lack retention when compared with maxillary dentures, especially in patients with severely resorbed ridges.

The dental literature fails to provide research that establishes the quantitative influence that properly extended anterior lingual flanges have on denture retention. Consequently, the purpose of this preliminary study was to determine whether a difference existed between the anatomical

^aSenior Graduate Student in Prosthodontics, Graduate Institute of Dental Sciences, Kaohsiung Medical University, Kaohsiung, Taiwan.

^bLecturer, Department of Prosthodontics, Kaohsiung Medical University Hospital and Faculty of Dentistry, College of Dental Medicine, Kaohsiung Medical University, Kaohsiung, Taiwan. ^cProfessor, Department of Prosthodontics, Kaohsiung Medical University Hospital and Faculty of Dentistry, College of Dental Medicine, Kaohsiung Medical University, Kaohsiung, Taiwan. ^dProfessor, Graduate Institute of Dental Sciences, Kaohsiung Medical University, Kaohsiung, Taiwan.

^eAssociate Professor, Graduate Institute of Dental Sciences, Kaohsiung Medical University, Kaohsiung, Taiwan.

^fAssociate Professor Emeritus, School of Dentistry, University of Missouri-Kansas City, Kansas City, Missouri, USA; Professor, Department of Prosthodontics, Kaohsiung Medical University Hospital and Faculty of Dentistry, College of Dental Medicine, Kaohsiung Medical University, Kaohsiung, Taiwan.

Correspondence to: Dr Tsau-Mau Chou, Department of Prosthodontics, College of Dental Medicine, Kaohsiung Medical University, 100 Shih-Chuan 1st Road, Kaohsiung 80708, Taiwan. Fax: 886-7-3210637/3221510. Email: pro11sth@ kmu.edu.tw

Fig 1 Measurement of the anterior lingual flange of a mandibular denture.





Fig 2 Postadjustment measurements. (*left*) Postfunctional border molding with soft compound; (*center*) retention force measurement; (*right*) length measurement using a periodontal probe.

dimensions of the alveolingual sulcus and the corresponding flange extensions of mandibular dentures worn successfully in a sample population. In addition, the study sought to correlate the magnitude of nonfunctional change in mandibular denture retention after anterior lingual flange extensions were modified via border molding so as to fit the alveolingual sulcus in an optimal manner.

Materials and Methods

In 1999, a new welfare and public health policy was initiated in Kaohsiung City, Taiwan, that provided a new set of complete dentures, free of charge, to edentulous citizens 65 years of age or older. Over the following 8 years, more than 25,000 elderly citizens received new dentures as beneficiaries of this program. Denture fabrication was performed by licensed dentists in the 11 districts of Kaohsiung City. From among the denture recipients, 66 edentulous patients (38 men, 28 women) were randomly selected to participate in this study. The subjects were free from oral pathology and compromising medical conditions and had worn complete dentures for at least 12 years. The existing dentures were at least 1 year old, and patient satisfaction with their dentures was not determined.

Five locations on the crest of the edentulous ridge were marked with an indelible pencil for each subject

(M, R1, R2, L1, L2). The locations of these points were: M point, near the labial/lingual frenum; L1, 5 mm left of M point; L2, 10 mm left of M point; R1, 5 mm right of M point; and R2, 10 mm right of M point. The indelible markings were then transferred to the existing denture, and the depths of the alveolingual sulcus and corresponding anterior lingual flange were measured from the crest of the residual ridge to the floor of the mouth at each location using a periodontal probe (Hu-Friedy) (Fig 1). The width of the anterior lingual flange of the existing denture was measured using a Boley gauge.

With the denture in place, each patient was instructed to open his or her mouth slightly and relax the tongue. Preadjustment resistance to lifting force at the midline of the denture was measured using an electronic dynamometer (UWE HS-3000, serial no. HS0013840). Warm green stick compound was added on the lingual flange from canine to canine, the denture was inserted, and each subject was asked to elevate the tongue, lightly touch the lower lip from side to side with the tip of the tongue, and then relax the tongue.³ During the process, the mandibular denture was not to be displaced. If displacement occurred, excess compound was removed and the procedure was repeated two more times. Following border molding, postadjustment retentive forces and the depth and width of the anterior lingual flange were measured (Fig 2).

© 2011 BY QUINTESSENCE PUBLISHING CO, INC. PRINTING OF THIS DOCUMENT IS RESTRICTED TO PERSONAL USE ONLY.. NO PART OF MAY BE REPRODUCED OR TRANSMITTED IN ANY FORM WITHOUT WRITTEN PERMISSION FROM THE PUBLISHER

	Alveolingual		Differen		
	sulcus (mean ± SD)	Preadjustment (mean ± SD)	Mean ± SD	%	Р
Μ	8.6 ± 2.3	6.6 ± 1.6	-1.9 ± 2.0	23.0	< .0001
L1	9.9 ± 2.6	7.3 ± 2.0	-2.5 ± 2.3	26.0	< .0001
L2	10.7 ± 2.5	7.9 ± 2.1	-2.7 ± 2.3	26.0	< .0001
R1	9.8 ± 2.4	7.4 ± 1.8	-2.3 ± 2.2	24.0	< .0001
R2	10.6 ± 2.5	7.9 ± 2.0	-2.6 ± 2.3	25.0	< .0001
Mean	9.9 ± 2.4	7.4 ± 1.8	-2.4 ± 2.1	24.8	

 Table 1
 Mean Depth of Alveolingual Sulcus and Preadjustment

 Anterior Lingual Flange According to Site*

SD = standard deviation.

*Depth measurements were made using a periodontal probe.

	Alveolingual		Difference		
	sulcus (mean ± SD)	Postadjustment (mean ± SD)	Mean ± SD	%	Р
Μ	8.6 ± 2.3	9.2 ± 2.1	0.6 ± 1.5	6.0	< .0001
L1	9.9 ± 2.6	10.8 ± 2.4	0.9 ± 1.9	9.0	< .0001
L2	10.7 ± 2.5	11.7 ± 2.3	1.0 ± 1.8	9.0	< .0001
R1	9.8 ± 2.4	10.4 ± 2.1	0.7 ± 1.6	6.0	< .0001
R2	10.5 ± 2.5	11.4 ± 2.2	0.9 ± 1.7	8.0	< .0001
Mean	9.9 ± 2.4	10.7 ± 2.2	0.8 ± 1.6	7.6	

Table 2Mean Depth of Alveolingual Sulcus and PostadjustmentAnterior Lingual Flange According to Site*

SD = standard deviation.

*Depth measurements were made using a periodontal probe.

Statistical Analysis

Paired *t* tests were used to analyze the pre- and postadjustment measurements. The significance level was set at P < .05, and the data were analyzed using statistical JMP 7.0 software (SAS Institute). To assess the reliability of the data, measurements were performed on 20 subjects in a pilot study. The correlation coefficient was approximately 0.8, indicating a high level of reproducibility between different examiners.

Results

The mean depth measurements of the alveolingual sulcus and corresponding pre- and postadjustment anterior lingual flange depths by site are shown in Tables 1 and 2. Table 1 shows that at each corresponding location, there was a statistically significant

difference in the depth between the alveolingual sulcus and the preadjustment anterior lingual flange (P < .0001). A statistical difference also existed between the depth of the alveolingual sulcus and the postadjustment depth (Table 2).

After remolding the anterior lingual flange, a significant difference was observed between the pre- and postadjustment depths and widths of the mandibular anterior lingual flange (P < .0001) (Tables 3 and 4). The mean difference in depth was approximately 2.5 mm at the M point (P < .0001, 38% difference) and 3.6 mm at the canine location (P < .0001, 45% difference) (Table 3). The mean difference in width (Table 4) was 1 mm at the M point (P < .0001, 48% difference) and 1.6 mm at the canine location (P < .0001, 68% difference). After remolding the anterior lingual flanges, a statistically significant increase in retention was observed (P < .0001). The mean preadjustment retention

	Preadjustment (mean ± SD)	Postadjustment (mean ± SD)	Difference (mean ± SD)	Increase (%)	Р
Μ	6.6 ± 1.6	9.2 ± 2.1	2.5 ± 1.8	38	< .0001
L1	7.3 ± 2.0	10.8 ± 2.4	3.4 ± 2.1	48	< .0001
L2	7.9 ± 2.0	11.7 ± 2.3	3.7 ± 2.3	48	< .0001
R1	7.4 ± 1.8	10.4 ± 2.1	3.7 ± 2.5	41	< .0001
R2	7.9 ± 2.0	11.4 ± 2.2	3.5 ± 2.1	45	< .0001
Mean	7.4 ± 1.8	10.7 ± 2.2	3.3 ± 1.9	44	

Table 3Mean Pre- and Postadjustment Depth of Anterior Lingual FlangeAccording to Site

SD = standard deviation.

 Table 4
 Width of Pre- and Postadjustment Anterior Lingual Flange

	Preadjustment (mean ± SD)	Postadjustment (mean ± SD)	Difference (mean ± SD)	Increase (%)	Р
Μ	2.1 ± 0.5	3.2 ± 0.5	1.0 ± 0.7	48.0	< .0001
L1	2.4 ± 0.7	3.9 ± 0.7	1.5 ± 1.0	64.0	< .0001
L2	2.6 ± 0.9	4.7 ± 0.6	2.0 ± 1.0	79.0	< .0001
R1	2.6 ± 1.4	4.0 ± 0.6	1.3 ± 1.6	51.0	< .0001
R2	2.6 ± 0.8	4.6 ± 0.6	1.9 ± 1.1	76.0	< .0001
Mean	2.5 ± 0.6	4.1 ± 0.5	1.6 ± 0.9	63.6	

SD = standard deviation.

Table 5Difference in Retentive Force Between Pre- and PostadjustmentMeasurements (gmw)

	Preadjustment (mean ± SD)	Postadjustment (mean ± SD)	Difference (mean ± SD)	Increase (%)	Р
Retention	76.8 ± 77.1	119.5 ± 89.9	42.6 ± 30.5	55.4	< .0001

SD = standard deviation.

was 76.9 gmw. After functional remolding, the mean retention of the mandibular dentures was 119.5 gmw. The difference was approximately 40 gmw, and the mean increase in retention was 55% (Table 5).

Discussion

The literature has historically stressed the relationship between the depth of the anterior lingual flange and the depth of the alveolingual sulcus to retention. When the anterior lingual flange does not extend to the fornix of the alveolingual sulcus, the retentive hydrostatic pressure gradient in the fluid layer between the intaglio and the soft tissue may be substantially reduced. Since mandibular dentures have less tissue contact area and more border areas to seal than maxillary dentures, managing the anterior lingual flange extensions is important for the clinician to consider.

The alveolingual sulcus is different from the maxillary and mandibular buccal vestibules in that the amount of soft tissue contact with the polished surfaces of the anterior lingual flange changes substantially when the tongue moves from a resting state to an actively functional state. In addition to the anatomical dimensions of the anterior alveolingual sulcus, functional considerations caused by the movement of the tongue substantially influence the tolerable width and depth limits of the anterior lingual flange. In this study, the differences in depth and length were significant and remarkable and suggested that methodologic errors in the denture fabrication process may have resulted in improper flange border extensions. The authors recognize that border molding with soft green stick compound may extend the depth of the alveolingual sulcus beyond its normal anatomical dimensions by distending the compressible soft tissue and glands in the floor of the mouth (Table 2). Under normal swallowing and functional movements, the tissue in the sublingual region moves mainly in a horizontal direction without any major uplifting of the sublingual gland.³ Since the sublingual gland is flexible and highly compressible and the floor of the mouth does not have firm muscular support, the literature suggests that slight distension may not create sore spots or instability of the denture and may improve retention.³ In this study, increases in retention (55%) were observed following functional border molding. However, the flange extensions created by functional border molding exceeded the dimensional depth of the anterior alveolingual sulcus by 8%. Since long-term functional analysis was not conducted in this study to determine if the subjects could tolerate the amount of dimensional changes created by compound remolding, the magnitude of change in retention remains tentative. The improvement in retention in this study needs to be considered preliminary and should be confirmed by further time-dependent assessments and patient-mediated input.

As a preliminary study, pre- and postadjustment assessment of the subject's appraisal of denture retention and the impact on personal well-being was not considered. Correlation between each subject's appraisal and an objective functional assessment of each denture was not assessed, and time-dependent functional analysis was not conducted following postadjustment border molding. In addition, accurate assessment of the alveolingual sulcus with a periodontal probe was problematic. Consequently, the dimensional measurements in the study should be treated as relative values rather than exact representations. Although the authors were able to demonstrate a high level of reproducibility between the two examiners, the intent of this study was not to offer specific mean vestibular dimensional standards. Instead, the goal was to determine if significant dimensional differences existed between the anatomical alveolingual sulcus and the preadjustment denture flanges and if potential improvements in mandibular retention might occur when border extensions of the mandibular anterior lingual flanges were remolded dimensionally congruent with the alveolingual sulcus.

Conclusion

This preliminary study revealed significant and substantial differences in the mean depth and width between the alveolingual sulcus and the anterior lingual flange dimensions of existing mandibular dentures in this pool of elderly complete denture subjects. Mean retention was increased by extending the anterior lingual flange depths and widths to functional border molding limits. However, long-term patient satisfaction and functional assessment were not considered.

References

- 1. Zarb GA, Bolender CL. Prosthodontic Treatment for Edentulous Patients, ed 12. St Louis: Mosby, 2004:84–85.
- Miller WP, Monteith B, Heath MR. The effect of variation of the lingual shape of mandibular complete dentures on lingual resistance to lifting forces. Gerodontology 1998;15:113–119.
- Azzam MK, Yurkstas AA, Kronman J. The sublingual crescent extension and its relation to the stability and retention of mandibular complete dentures. J Prosthet Dent 1992;67:205–210.

Literature Abstract

Oral Cancer Case Finding Program (OCCFP)

The purpose of this Oral Cancer Case Finding Program (OCCFP) study was to reduce the morbidity and mortality rates of oral cancer in Cuba. The OCCFP consists of health education for the entire population and examination of the oral complex by a stomatologist. The health education component consists of educating the public on signs and symptoms of oral cancer with an emphasis on self-examination and consultation with a stomatologist if a suspicious lesion was noted. Such education was done through radio, television, and other information media. A detailed oral and neck examination was performed for each patient attending every stomatologic care center in Cuba. Referrals to a maxillofacial specialist were made if a suspicious lesion was noted at these care centers. This specialist then performed further clinical examinations and possible biopsy to determine a definitive diagnosis. A referral form was then completed and initiation of treatment carried out. If necessary, the patient was sent to an oncology hospital. Relevant data collected at the National Direction of Statistics of the Ministry of Public Health, Cuba, was used in the analysis. The percentage of patients with various stages of oral cancer from 1983 to 1990, in 1982 (before OCCFP was initiated), as well as in 1990 was obtained from the National Registry of Cancer of Cuba. The results of this study showed that 10,167,999 patients were examined between 1983 and 1990. A total of 30,478 were referred and 8,259 had final diagnosis recorded. Of the patients with final diagnosis, 3,220 had precancerous and 708 had cancerous lesions. During the 6 years of the program, Stage I cases showed an increase from 22.8% in 1982 to 48.2% in 1988, with a corresponding reduction in the most advance stages (19.5% in 1982 to 17.1% in 1988).

Santana JC, Delgado L, Miranda J, Sánchez M. Oral Oncol 1997;33:10–12. References: 16. Reprints: Dr JC Santana, Instituto de Oncologia, 29 y Fl Vedado, Havana, Cuba—Alvin G. Wee, Omaha, NE

The International Journal of Prosthodontics

© 2011 BY QUINTESSENCE PUBLISHING CO, INC. PRINTING OF THIS DOCUMENT IS RESTRICTED TO PERSONAL USE ONLY.. NO PART OF MAY BE REPRODUCED OR TRANSMITTED IN ANY FORM WITHOUT WRITTEN PERMISSION FROM THE PUBLISHER Copyright of International Journal of Prosthodontics is the property of Quintessence Publishing Company Inc. and its content may not be copied or emailed to multiple sites or posted to a listserv without the copyright holder's express written permission. However, users may print, download, or email articles for individual use.