

THOMAS J. BLOEM, DDS, MS; MICHAEL E. RAZZOOG, DDS, MPH;
BARBARA B. CHAMBERLAIN, DDS, MS; and BRIEN LANG, DDS, MS

Efficacy of tissue brushing as measured by the prosthodontic tissue index

GERIATRIC DENTISTRY

The management of abused tissues is the shared responsibility of dentist and patient.

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COMPLETE dentures are designed to replace lost teeth and restore comfort, function, and natural appearance. Unfortunately, the stomatognathic system does not always respond favorably to these oral substitutes.

Acute and chronic inflammatory changes of the oral mucosa beneath complete dentures are common, and the cause of these changes has been the subject of many reports. Even with the control of these etiologic variables, localized inflammatory response of the oral mucosa may continue. The management of the abused tissues is the shared responsibility of dentist and patient. Although soft bristle brushing has been considered valuable in reducing oral tissue inflammation, direct clinical evaluation of this method has lacked controlled objectivity. This study was initiated to determine the efficacy of brushing the oral mucosa of the edentulous mouth as a method of reducing soft tissue inflammation. A qualitative means of clinical evaluation, the Prosthodontic Tissue Index (PTI), was used.¹⁻³

REVIEW OF THE LITERATURE

Reports of the adverse reactions of the supporting mucous membrane to complete dentures have appeared in the literature under many titles and terms. One of the early writers to describe these phenomena was Cahn,⁴ who, in 1936, referred to the condition as "denture sore mouth." Detailed clinical explanations of the changes in the mucosa have been reported under corresponding titles, like papillary hyperplasia^{5,6} or papillomatosis.^{7,8} Others have avoided an exact diagnosis by writing about chronic irritation or inflammation associated with den-

tures.⁹⁻¹⁶ However, the term most often used to describe the "denture sore mouth" has been denture stomatitis.¹⁷⁻²³

Reports about the occurrence of changes in the oral mucosa under dentures vary. The incidence of some form of stomatitis diagnosed in the supporting oral mucosa of edentulous patients has ranged from a low of 25%, reported by Nyquist,¹⁷ to a high of 97.2%, observed and measured by Bloem and Razzoog.^{1,3} These differences may be caused by the criteria used in classifying the disease process.

Many conditions have been related to the occurrence of denture stomatitis. The main reported causes are: mechanical trauma,^{9,14,23-25} microbial infection,^{24,26-31} poor oral hygiene,^{18-27,32-35} continuous wearing of dentures,^{6,20,36} allergic reactions of the oral mucosa,^{25,36} and systemic disease resulting in depressed tissue resistance.^{9,10,12,16,36,37-42}

Treatment of denture stomatitis has been related to the classification of the disease process (simple localized, simple diffuse, or papillary hyperplasia) and the apparent causes. Regardless of the classification or the etiologic factor, treatment success is not simple nor are the results always spectacular. In general, most advocated treatment is directed at the apparent cause of denture stomatitis and is, therefore, of a local^{11,35,44,45} or systemic⁴⁶ nature.

Routine oral hygiene practice remains the prime preventive program for control of mucosal inflammation. Cleaning of dentures with an appropriate cleanser and scrubbing with a denture brush is good home care practice.³⁵ Brushing of the oral mucosa has been advocated by several authors as an effective treatment and preventive program.^{11,35,44,45} According to Kroon and others,⁴⁶ toothbrushing

stimulates a temperature rise in gingival and alveolar mucosa. This reaction may be caused by dilatation of the microvasculature and an increased blood flow, both of which are essential for removal of waste materials. The reactive hyperemia may partially explain why tissue brushing has an effect in reducing inflammation.

Subjective and objective methods of assessing the treatment of basal seat tissue inflammation were mentioned by Bloem² in 1978. The focus of that work was the development of a formalized method for clinical evaluation, the Prosthodontic Tissue Index. However, the study was limited because the index criteria relied heavily on subjective evaluation. In subsequent studies, Bloem and Razzoog^{1,3} modified the index. In its new form, the PTI is based on the color differentiation as the measurement of inflammation. Examiners were calibrated by means of standardized photographic descriptions and written criteria noting gradations in tissue health. Training sessions were held with clinical patients until an interexaminer reliability of more than 80% was obtained in several sessions. In each segment of the edentulous arch, oral health status was scored on the basis of color change. A normal, or zero, tissue surface was pink, had normal vascularity, and a matte appearance. An area with an inflammatory status of "1" was reddened or had solitary hyperemic foci and, generally, a matte appearance. A rating of "2" applied to reddened areas with multiple hyperemic foci, and a generally glossy appearance. When the tissue was distinctly red or red-to-blue, with or without hyperemic foci, and glossy, the area was rated as a "3."

The practice of tissue brushing the oral mucosa of the edentulous patient has been considered valuable in reducing inflammation. Clinicians have recommended tissue brushing as a method of preserving the health of the denture base-supporting mucosa.^{11,35,44,45}

Although mechanical removal of plaque can have a significant role in the prevention and control of dental disease,⁴⁷ the effectiveness of toothbrushing instruction has been a controversial subject. Gjeramo⁴⁸ observed that an audiovisual presentation in combination with individual oral hygiene instruction was effective in reducing plaque and debris on a short-term basis. Several other investigators have confirmed that a single session of motivational activity does not alter long-term oral hygiene performance.⁴⁹⁻⁵² Adams and Stanmeyer reported a continuous improvement in oral hygiene during a one-year educational program as a result of continuous efforts in patient motivation and reinstruction in oral hygiene skills.⁵³ The positive value of reinforcement has been reported by several investigators,^{54,55} and the use of models to demonstrate procedures has proved effective in teaching oral hygiene regimens.⁵⁴ The reports of these and other researchers provide evidence of the desirability of incorporating these concepts into a plaque-control and tissue brushing program.

METHODS AND MATERIALS

Phase 1: the initial appointment

For this study, the chosen level of significance was 95%, and a sample size of 60 patients separated into two groups was considered acceptable.^{56,57} Patients were selected from a group of 100 patients at the University of Michigan School of Dentistry. The initial criterion used in patient selection was that observable clinical signs of inflammation were present in the denture-bearing mucosa. The experimental population selected were 61.6% female and 38.4% male. Availability of fewer men (23 of the 60 patient experimental population) is not unique. In an earlier study, Olsson and Bergman found denture stomatitis and mucosal inflammation are more frequent in women than men in a ratio of 3:1.²¹ All patients completed the School of Dentistry Medical Health Questionnaire, obtained a panoramic radiograph, and received a thorough oral examination before acceptance in the study.

Intraoral photographs and PTI

To complete the initial data gathering for the first phase, photographs were obtained and the PTI was applied. Each of the 60 patients was examined by three calibrated examiners. The PTI was assessed for the maxilla and mandible and the scores recorded.

Group assignment: control and brush

Common methods for grouping patients include single groups, matched pairs, correlated samples, two or more independent samples, and modifications of the correlated and independent samples.⁵⁶⁻⁵⁹ This latter method makes use of two groups running concurrently for specified periods. For example, one group would use a tissue brush to massage oral mucosa, while the other group would use customary home care procedures for the first test period. At the end of this first test, the group initially using the brush would be asked to return to customary methods and the second group would start tissue brushing for the second test period. Thus, the values of the independent sample and a correlated sample are compounded. Because each group is balanced to the other by either randomization or allocation, investigators can be reasonably certain that any extraneous variations in one group, inherent or caused by the passage of time, are complemented by a corresponding variation in the other group. The technique of alternating the two test conditions enhances the elimination of extraneous variables because each group is subjected to both types of home care. Each group is a correlated sample and permits more than one measurement of the same experimental subjects, thereby reducing the possibility of experiment distortion caused by individual subject variation. Furthermore, the groups are isolated at visits to minimize transference of information between groups and subsequent distortion.

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During the initial appointment of phase 1, the 60 subjects were divided into groups. An attempt was made to balance each group in terms of the characteristics that influence the variable studied (brushing). At no time was denture care discussed or directed. Patients were encouraged to maintain their usual practices of prosthesis care so that mucosal brushing would remain the variable under study. Gender, age, and the amount of inflammation were considered when the subjects were separated into the two groups. Because women experience mucosal inflammation at a ratio of 3:1, the initial grouping was modified to include an equal number of men in each group. Therefore, the "Brush Group—Phase 1" consisted of 13 women and 12 men. The "Control Group—Phase 1" consisted of 11 men and 24 women.

Brushing regimen instructions

Each patient assigned to the "Brush Group—Phase 1" received a soft toothbrush for use during the study. The circular scrub method of brushing was demonstrated on resilient models of the maxillary and mandibular residual ridges by a registered dental hygienist. The instructors asked the patients to demonstrate the brushing technique on the models and, with the aid of a hand mirror, the patients repeated the same technique in their own mouths. A question and answer period followed to assure that the patient completely understood what was expected. Patients were instructed to brush the tissues twice daily for 2½ minutes during each brushing session. If the tissues were inflamed, the patients were informed to expect minor bleeding but to continue brushing with a light touch. The patients were reappointed to return in 30 days for brushing reinstruction.

Phase 1

At the one-month recall appointment, the dental hygienist questioned the patients about the brushing program, and answered patient questions about the technique. A second brush was dispensed and again the patients were requested to demonstrate brushing first on the models, and then in their own mouths. When the patients again demonstrated the technique to the satisfaction of the instructor, they were reappointed to return in 30 days for evaluation.

Phase 2

At the 60-day appointment, the procedures outlined in the "group assignment" section were accomplished. Intraoral photographs were obtained and the PTI scores were recorded for all 60 patients by the three examiners. The group reassignments (control and brush) were completed and the new "Brush Group—Phase 2" received instructions on tissue brushing. The new phase 2 control group was told to resume previous, usual oral hygiene habits, and the second 60-day experiment was initiated.

After 30 days, those patients assigned to the

"Brush Group—Phase 2" returned for brushing instruction reinforcement.

Phase 3

After completion of the second 60 days of the experiment, the patients returned for evaluation. Intraoral photographs were obtained, and the 60 patients were evaluated by the three examiners using the PTI.

MANAGEMENT OF DATA

A mean PTI score by examiner was obtained for each patient at each visit by totaling the scores at all tissue sites and dividing the sum by the total number of sites in both arches. Correlation coefficients were computed using the mean PTI scores, comparing them with each examiner for the same patient at the same visit to determine interexaminer reliability. Once it was determined that there existed an acceptable statistically significant correlation between examiner scores, a new PTI mean was created for each patient for each visit by summing the three examiner mean scores for all mouth sites and dividing the figure by three. These new mean scores, reflecting the tissue evaluation of the three examiners for all mouth sites, were finally subjected to the Median and Wilcoxon statistical tests used in the data analysis.

The Median Test gives information about the likelihood of two independent groups (not necessarily of the same size) drawn from the same population. In the null hypothesis the two groups are from populations with the same median; in the alternative hypothesis, the median of one group may be different. The test may be used whenever the scores for the two groups are in an ordinal scale.

The Wilcoxon Matched-Pairs Signed-Ranks Test uses information about the direction of the differences within pairs. If the relative magnitude and the direction of the differences are considered, the power of the test is increased. The Wilcoxon test gives more weight to a pair that shows a large difference between the two conditions than to a pair that shows a small difference.

RESULTS

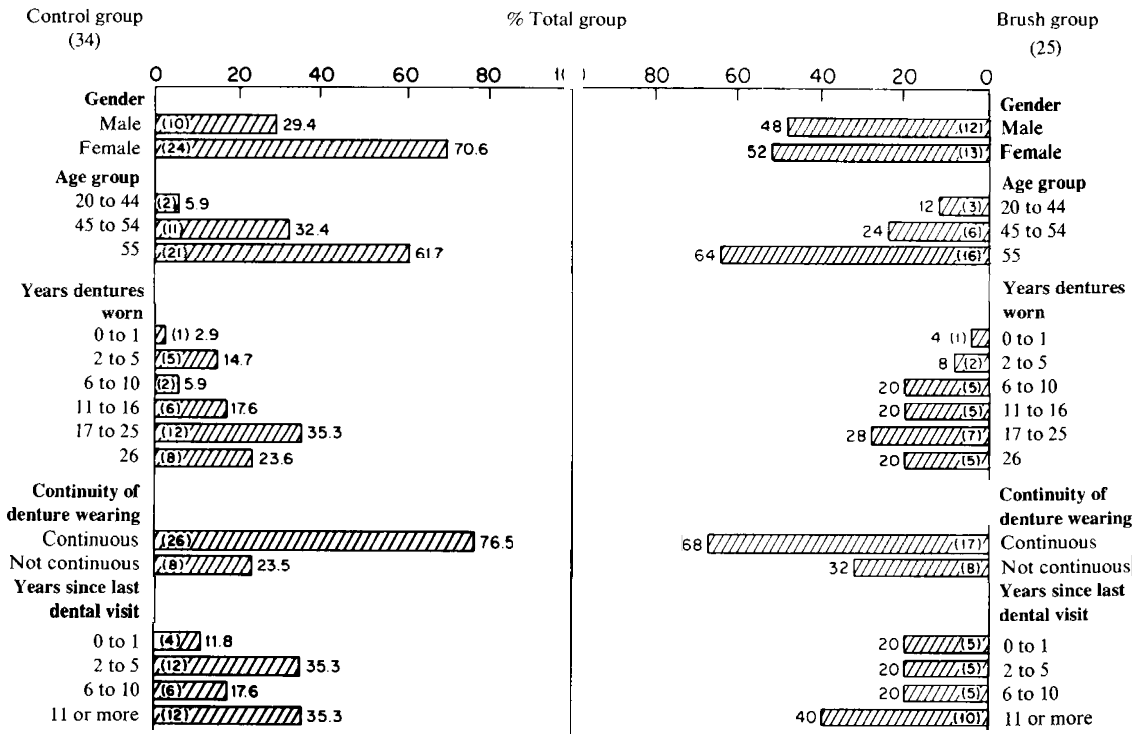
The objective of this study was to measure the reduction of inflammation in the supporting mucosa of edentulous patients as a result of tissue brushing.

Control of the experiment

The demographic characteristics of the edentulous patients assembled for this study are presented in Table 1. Age, gender, years dentures have been worn, whether the patient wears the dentures continually, and the years since the last dental visit are reported for the total population and the brush and control groupings. Examination of these variables shows that a reasonably representative patient sample with the factors commonly associated with denture stomatitis was used.

Clinical signs of inflammation were present on the denture-bearing oral mucosa of the 60 patients chosen to participate in this study.

Table 1. Demographic data.



To determine that the brush and control groups used in the study were from the same original population with regard to the extent of oral mucosa inflammation, the initial or Phase 1 mean PTI scores were subjected to the Median Test and the Wilcoxon Matched Pairs Signed-Ranks statistical test.

Initial group differences

The mean PTI scores for the brush and control groups (1.22 vs 1.23) at the initiation of the study are presented in Table 2. After being subjected to the Median Test and the Wilcoxon Test, no statistically significant difference was found.

Mean prosthodontic tissue index scores

The results presented in Tables 3 and 4 represent the mean PTI scores for the brush and control groups. These means were statistically tested and the correlation significance reported. Significant differences in PTI scores are reported for the brush group between the first and second phases, (1.22 vs 1.03), and between the first and third phases, (1.22 vs .94), at the 95% confidence level (Table 3). However, the differences in PTI scores between the second and third phases for this same patient group were not significant. The mean PTI scores for the control group, presented in Table 4, show the significant differences reported for all three phases.

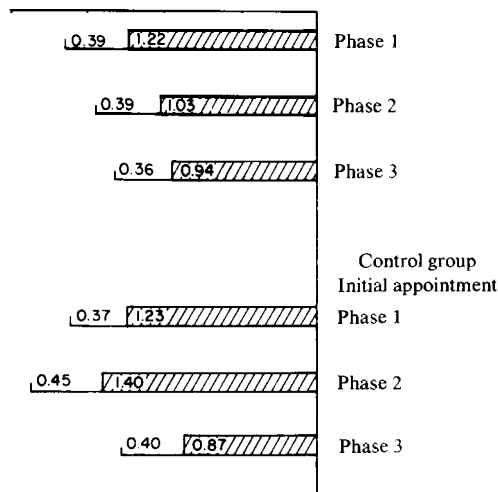
DISCUSSION

The practice of tissue brushing the oral mucosa sup-

porting complete dentures has been considered valuable in reducing inflammation in these oral tissues. However, clinical data to support this premise has been lacking. A controlled study was needed to provide scientific documentation supporting visual assessment of the efficacy of tissue brushing as a method for reducing or eliminating inflammation. The experimental design of this study required the investigators to assemble a denture population with

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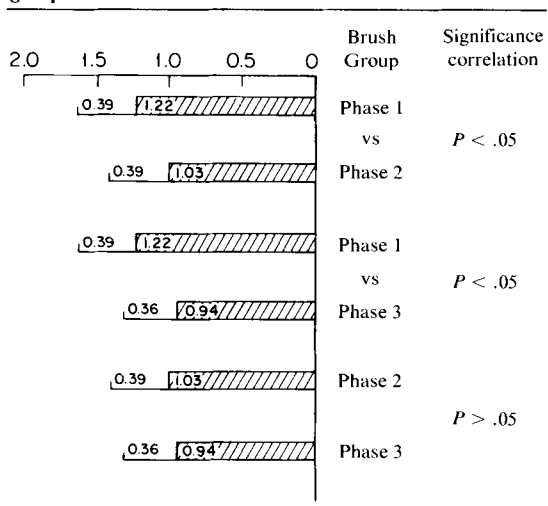
Table 2. Mean prosthodontic tissue index scores (PTI),* start of study.



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*Total mouth site scores and three examiner mean PTI scores.

Table 3. Mean prosthodontic tissue index scores (PTI),* brush group.



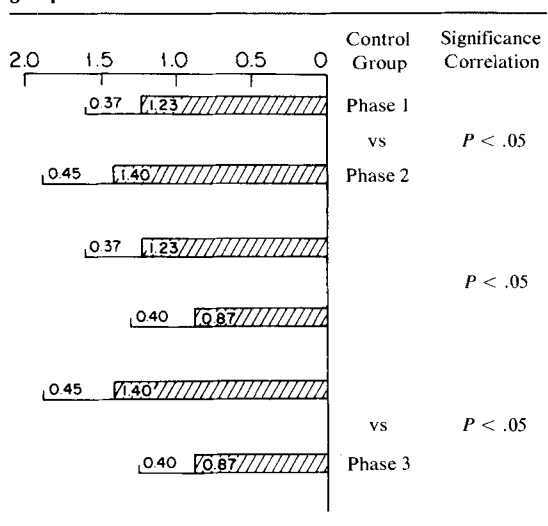
*Total mouth site scores and three examiner mean PTI scores.

inflamed tissue beneath complete dentures. This patient group needed to demonstrate a denture health profile that included those variables implicated as causative factors in oral mucosa inflammation. Years and continuity of denture use, denture age, frequency of dental visits, patient age and gender, and oral hygiene habits were considered. Before the study began, it was necessary to determine the status of these variables for each patient so that the assignment to either the control or brush group at the initial appointment provided a balance to each group and thus, more reliable comparisons during the study.

Inflammation reduction

The PTI scores for each patient were compared at the beginning and the end of each phase of the investigation to provide scientific documentation support-

Table 4. Mean prosthodontic tissue index scores (PTI),* control group.



*Total mouth site scores and three examiner mean PTI scores.

ing the efficacy of tissue brushing as a method for eliminating or reducing inflammation. Table 3 shows the mean PTI scores for the total mouth and all three examiners for those patients initially assigned to brushing. The significant difference in PTI scores between Phase 1 and Phase 2 ($P = < .05$) indicates that the treatment activity of brushing had reduced the oral mucosal inflammation. When these same patients were asked to return to their usual methods of home care at the start of Phase 2 and to continue this activity for the next 60 days, the index scores continued to decrease. The lower scores at Phase 3 however, were not significantly different from those at the beginning of Phase 3 ($P = > .05$). Apparently brushing had a latent effect in these patients. Also, because some patients reported improved oral comfort with brushing, we suspect these individuals continued tissue brushing to some extent.

The overall effects of brushing can be seen by comparing the scores at Phase 1 with Phase 3, which show significant, favorable difference ($P = < .05$).

The results for those patients initially assigned to the control group are shown in Table 4. Although significant difference ($P = < .05$) exists between Phase 1 and Phase 2 PTI scores for this group, the tissue changes were not favorable. At the beginning of Phase 2, the initial control group began brushing and at Phase 3 the mean PTI scores reflected a significant difference. The higher index scores at Phase 2 might be regarded as the factor that created the large difference at Phase 3. However, when the scores at Phase 1 are compared with those at Phase 3, a significant difference ($P = < .05$) is again noted. Apparently the oral condition of patients monitored for the first 60 days using their usual home care either remained unchanged or declined. This control group phenomenon is regarded as confirmation that separation of the initial control and brush groups at the phased intervals prevented any transference of effect between groups. When these same patients began brushing in Phase 2, the tissue responded favorably and the inflammation was substantially reduced.

SUMMARY

This study was conducted to determine the efficacy of brushing the oral mucosa supporting complete dentures with a soft brush to see if this treatment would reduce inflammation.

The oral mucosa health status of 60 patients was monitored for 120 days using the PTI to measure inflammation. For comparison the patients were divided into two groups, and every effort was made to balance the groups for those variables that may effect inflammation. The patients were also compared with themselves. The experiment consisted of three phases; Phase 1 established baseline data, and Phases 2 and 3 were information-gathering sessions. Each patient received brushing instructions at the start of the brushing test period and additional brushing instruction during a reinforcement session after

30 days. Tissue brushing did reduce the inflammation index of the oral mucosa examined.

CONCLUSIONS

Within the constraints of this study, the following conclusions can be made: a statistically significant improvement was observed in the oral mucosa of completely edentulous patients who followed a home care regimen of tissue brushing for 60 days, as measured by the PTI. The confidence level was $P = .05$. The Prosthodontic Tissue Index was determined to be valid and reliable, with significant interexaminer correlation coefficients.

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Dr. Bloem is assistant professor, complete denture department and department of hospital dentistry; Dr. Razzoog is associate professor, complete denture department and department of community dentistry; Dr. Chamberlain is assistant professor, complete denture department and department of hospital dentistry; and Dr. Lang is professor and chairman, complete denture department, the University of Michigan, School of Dentistry, Ann Arbor, 48109. Requests for reprints should be addressed to Dr. Bloem.

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Participants in the study were divided into two groups and were encouraged to maintain their usual practices of prosthesis care.

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ACCESS PROGRAMS MOVE TOWARD COMPREHENSIVE CARE

According to the *1983 Access Programs Survey*, from the ADA Council on Dental Health and Health Planning, since 1981 dental societies have moved toward comprehensive care access programs instead of limiting programs to denture care.

With all 53 constituent dental societies responding to the survey, the Council determined that 30 constituent society programs provided a full range of dental care services; of the 311 component societies that responded to the survey, 48 had programs that provide a full range of services. These figures represent an approximate 40% increase over the 1981 survey findings.

The 1983 results also show that almost every state has established either a constituent or a component access program. According to Kris Warren, the Council's assistant secretary, dentists in the seven states that did not develop formal access programs have acted on an individual basis to provide access to care to underserved populations.

Although most programs are geared toward the elderly, 12 constituent and 23 component programs were identified as directed to persons with handicapping conditions, those who are living in institutions, or patients living in remote areas. In 1981, only eight component programs were established to care for these special populations.

The most common method of increasing access (43 constituent and 52 component programs) is to offer fee reductions. Seven constituent and 16 component programs offer transportation assistance. Three constituent and nine component society programs use portable dental equipment.

Although the private practice office is the most common location for delivery of care, in 1983, 12 constituent programs reported long-term care facilities as an additional site for care delivery. Thirteen percent of the component societies identified hospital settings are part of their programs.