Prosthodontics

Denture plaque distribution and the effectiveness of a perborate-containing denture cleanser

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Abstract

Formation of plaque on the surfaces of dentures is a common problem among denture wearers. A study was conducted to determine the distribution of plaque on dentures. The plaque material was disclosed with a dye solution and measured with a modified Quigley-Hein scale. A photographic method was used to determine the distribution of plaque on the dentures of a group of complete-denture wearers. The effectiveness of a perborate soak-type cleanser was also measured by studying the precleaned and postcleaned states of the denture. Denture plaque was more evident on the fitting surfaces of the dentures than on areas of the flange, teeth, and palate. The use of the soak-type cleanser alone may not be completely effective for the control of heavy plaque. (Quintessence Int 1996;27:341-345.)

Clinical relevance

More plaque tends to accumulate on the fitting surfaces of dentures; therefore, patients should direct brushing at these areas, because soak-type cleansers alone may not control heavy plaque.

Introduction

Denture plaque is formed on the surfaces of the dentures by the oral flora and the accumulation of food debris. The acrylic resin-mucosa interface forms an ideal environment for the formation of denture plaque, which is also facilitated by the irregularities of the acrylic resin and the temperature of the mouth at approximately 37°C. Studies by Budtz-Jorgensen et al.1 and Nater2 have shown that plaque deposited on the acrylic resin allows the action of microorganisms on the adjacent mucosa to cause varying grades of denture stomatitis. The condition is characterized by general redness located within the boundaries of the denture border. It is more often observed in the palate.

An increase in denture plaque bacteria found in patients with denture stomatitis suggests a possible role of plaque microorganisms.3,4 A significant relationship between poor denture cleanliness and denture stomatitis was first described by Budtz-Jorgensen and Bertram5 in 1970. Bergendal6 in 1982 also observed that patients with persistent denture stomatitis had greater amounts of maxillary denture plaque than did those with healthy mouths. Continuous night-and-day wearing of dentures is often associated with an increase in the frequency and density of Candida albicans on the fitting surfaces of the maxillary dentures.5

Because denture plaque is an important factor in stomatitis in patients who wear dentures, cleaning of dentures and the removal of the plaque are important steps in the maintenance of good oral health. Various commercial cleansers are available in the market for patients' use. These can be divided into groups, according to their main components: alkaline peroxides, alkaline hypochlorites, acids, disinfectants, and enzymes.7 The most commonly available cleansers are those based on the alkaline peroxides. Two methods are routinely used for cleaning removable prostheses.
They are the mechanical methods, which involve the use of brushes or ultrasonic agitation, and chemical methods, which utilize soak-type cleaners, disinfectants, and enzymes.

Various techniques have been used to determine plaque control levels in patients who wear dentures. These include plaque scoring, spectrofluorometric protein assay, the scanning electron microscope, and photographic methods. To assess the presence or absence of plaque deposits, Manderson and Brown used the staining of dentures and a photographic technique to determine the effects of a denture cleanser on the plaque.

Denture hygiene instructions to patients should describe both control of denture plaque and methods of cleaning dentures. The distribution of plaque on the various sites of the denture surface may vary. It would therefore be beneficial for patients to know the common locations in which denture plaque tends to accumulate. Therefore, the aim of the present study was to determine the distribution of denture plaque in a given sample of complete-denture wearers and the efficacy of a commonly used soak-type perborate denture cleanser.

Method and materials

The sample consisted of 42 units of complete dentures from 21 patients who attended the university clinic for replacement dentures. The patients were randomly selected for the study and had no prior knowledge that an experiment was to be conducted on their present dentures. This criteria helped to ensure that a mixed group of denture wearers in terms of denture hygiene status was obtained. Their regular denture cleaning habits were rinsing in tap water, brushing with mild soap, and, in some instances, a combination of those methods and soaking with denture cleansers.

The soiled precleaned dentures were first stained with a dye disclosing solution (Red-cote, Butler) and subsequently rinsed in tap water to remove any unbound dye. The plaque present could then be visualized. This precleaned denture was then photographed, under standardized conditions at a fixed object-film distance with standard exposure time, with a Medical Nikon camera (120-mm lens with built-in flash, 1:2.5 magnification ratio; ASA 100,135–36 Fujichrome color film). Slides were taken from five positions: palatal, fitting surface, anterior labial, and right and left buccal side views.

The manufacturer's recommendations for Polident cleanser (Block Drug) were followed. The denture, with disclosed plaque, was soaked in a denture bath containing 200 mL of tap water to which a Polident tablet was freshly added. The denture was exposed to the cleaning bath for 20 minutes, as recommended. Cleaning solutions were used only once, and fresh materials were utilized for each new cleaning cycle.

The postcleaned denture was then photographed in the postcleaned state in the same manner as described earlier.

For the location of the plaque distribution, the denture was divided into four areas: teeth, palate, flange, and fitting surface. These areas were considered because they represented the main areas of the denture surface and could be easily identified. Under the area designated as teeth, the buccal and palatal or lingual surfaces of the denture teeth, including the gingival margins, were taken into account. The palate represented the maxillary palatal polished area bounded by the palatal gingival margins.

For classification of the plaque coverage, a modified Quigley-Hein scale was used. In this scale, only whole numbers were recorded, as follows:

- 0 = no visible plaque;
- 1 = light plaque (0% to 25%);
- 2 = moderate plaque (26% to 50%);
- 3 = heavy plaque (56% to 75%); and
- 4 = very heavy plaque (76% to 100%) of the denture area covered.

All surfaces of the dentures were evaluated for the disclosed dye material.

For estimation of the plaque coverage, the color slides of all the dentures were evaluated by both investigators to confirm location and level of plaque. For consistency of evaluation in the study, the investigators had to agree to a score given for a particular location, and the results were recorded accordingly.

To assess the ability of the Polident denture cleanser to remove plaque, the scores of all the surfaces of maxillary and mandibular dentures were combined to give the total precleaned and postcleaned plaque scores of the denture units. All denture surfaces were included in the evaluation to allow assessment of the total cleaning ability of the cleanser and not the efficacy at any specific site.

Results

The mean age of the patients in the studied sample was 62.3 ± 9.8 years, and the present dentures had been in use for a mean of 5.5 ± 4.8 years. The plaque scores and their distribution are given in Table 1, which out-
Table 1  Baseline denture plaque levels (mean ± SD)*

<table>
<thead>
<tr>
<th>Location</th>
<th>Maxillary denture</th>
<th>Mandibular denture</th>
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<tbody>
<tr>
<td>Tissue</td>
<td>2.14 ± 0.96</td>
<td>2.38 ± 0.92</td>
</tr>
<tr>
<td>Flange</td>
<td>1.57 ± 0.68</td>
<td>1.76 ± 0.83</td>
</tr>
<tr>
<td>Teeth</td>
<td>1.28 ± 0.72</td>
<td>1.05 ± 0.67</td>
</tr>
<tr>
<td>Palate</td>
<td>1.38 ± 0.81</td>
<td>-</td>
</tr>
</tbody>
</table>

* Modified Quigley-Hein scale.

lines the plaque scores of the four large areas designated for the maxillary and mandibular dentures. There were significant differences between the baseline plaque scores of the maxillary tissue-fitting surface and those of the flange, teeth, and palate ($P < .001; t = 3.87$; $t = 4.31$, and $t = 4.54$, respectively). Similarly, there were significant differences between the baseline scores of the mandibular tissue-fitting surfaces and those of the flange and teeth ($P < .001; t = 4.24$ and $t = 8.37$, respectively). There were no statistically significant differences in plaque levels between the flanges and the teeth ($P < .001; t = 4.56$). More plaque was evident on the flanges of the mandibular dentures.

The mean total plaque score was reduced from $5.78 ± 2.44$ to $3.81 ± 1.53$ after cleaning ($P < .001; t = 9.51$). The results of the difference between the total precleaned and postcleaned plaque scores were calculated to give a reduction of plaque of approximately $34\%$ after 20 minutes’ exposure to the perborate cleanser. This percentage was derived by subtracting the value of the postcleaned plaque score from the value of the precleaned plaque score and dividing the result by the precleaned plaque score.

Typical locations of baseline plaque found on the mandibular and maxillary dentures can be observed in Figs 1 and 2. Many of the dentures in this study also demonstrated greater plaque accumulation in areas where there were significant stagnation and pooling of saliva on the fitting and polished surfaces. Marked staining of deposits was also observed along the gingival margins and gingival third of the tooth surfaces (Fig 2).

An example of the plaque on the fitting surface of the denture base and the effects of the soak-cleansing cycle on that plaque can be observed in Figs 3a and 3b. Notice the density and location of the plaque on the maxillary fitting surface and the subsequent reduction of plaque coverage and staining after cleaning.

Discussion

There is abundant documented evidence showing the relationship between good oral health and denture cleanliness. In view of this, various methods have been advocated for the management of patients with denture-induced inflammation. Current conservative methods of treatment of denture stomatitis include (1) prescription of an antifungal agent; (2) refinement of remaking of a denture to reduce trauma; and (3) provision of a sanitary denture. Besides correction of denture faults, proper plaque removal procedures are important aspects in the management and treatment of denture stomatitis. Recent work by Lal et al demonstrated that patients with denture stomatitis are prone to reinfection if the plaque containing Candida albicans on the fitting surfaces of the denture is not controlled or eliminated. Using an agar replica technique and a chlorhexidine rinse treatment, they also demonstrated that the pretreatment and posttreatment locations of Candida albicans on the denture were strikingly similar. Their findings highlight the importance of knowing the areas of the denture that may be more prone to plaque accumulation.

The findings of the present study showed that plaque levels are significantly higher on the fitting surfaces of the maxillary and mandibular dentures than at sites on the polished surfaces and teeth. This could be due to stagnation, pooling of saliva, and the absence of contact with the tongue on the fitting surfaces. Denture plaque was also observed to accumulate in greater amounts in the gingival margins, undercut zones, and rugae areas of the maxillary denture. Increased plaque deposits were also noted on the sublingual zones of the polished surfaces of the mandibular dentures in addition to the inner fitting surface. It would therefore be helpful to patients who require complete-denture service to be told of the importance of directing their brushing to these specific areas, if the manual method is advocated.

Numerous studies have been conducted on the effects of different cleaning methods on dentures as they relate to plaque control. Abelson compared the ultrasonic denture-cleaning technique to two types of soak-cleansing tablets by using the dye staining technique on the complete dentures of 18 patients. The
Fig 1  Typical disclosed plaque distribution on mandibular denture teeth, gingival margins, and flange.

Fig 2  Disclosed plaque distribution on a maxillary denture. Plaque is more apparent on the buccal and interdental surfaces of the posterior teeth and flange.

Fig 3a  Precleaned denture with heavy plaque (score 3) on the fitting surface. Disclosed dye is evident in the anterior rugae and buccal and posterior palatal regions.

Fig 3b  Postcleaned fitting surface of the denture. The amount of disclosure material has been reduced, revealing light plaque (score 1) after soak cleaning.

The ultrasonic method removed 2.5 times more plaque than did either of the soak-type cleansers tested. Furthermore, from the tissue surface scores, plaque reductions of 33% to 38% were calculated for the Efferdent and Polident soak cleansers.

In the present study, 42 heavily stained denture units that were soaked clean in Polident solution demonstrated a plaque reduction of approximately 34%. Because the technique of plaque scoring used was carried out with a photographic and visualization process, the plaque removal results can, at most, be an estimate. That soak cleansers by themselves cannot adequately remove heavy plaque deposits was also demonstrated in a study by Tarbet et al in 1984, who used similar plaque-scoring techniques. They found that the relative plaque removal score from polished and unpolished denture surfaces was approximately 30% in a group of 25 subjects.

It is apparent from these studies that soak cleansers alone may not adequately remove accumulated plaque deposits, especially if the deposits are heavy. Alkaline peroxide cleansers, such as Polident, contain sodium perborate, potassium monopersulfate, proteolytic enzymes, detergents, and an effervescent base. It is the agitation of the soaking solution caused by the dissolving tablet that does most of the cleaning activity.

Enzyme-containing denture cleansers have been studied in a group of 13 patients by Ordman in 1992. He reported that when soaking was used in combination with brushing, the denture became significantly cleaner. In an earlier study by Budtz-Jorgensen et al, plaque was measured from color slides (photographs...
taken with a standard camera setup and color film at fixed object-film distance) of a group of 17 subjects. Their findings were that the use of an enzyme, Alcalase, in adequate concentrations in a 150-mL solution is as effective as brushing. It was also noted that the use of a combination of the enzyme cleanser and a brushing method results in the lowest plaque scores. They concluded their study by indicating that the enzyme-solution cleanser would only be a significant adjunct to denture brushing.

Besides denture plaque, closely fitting denture bases and continuous wearing of dentures, night and day, have been implicated as factors in the prevalence of denture stomatitis. In view of this, dentures should be removed at night whenever possible to reduce the effects of plaque on the mucosa-bearing surfaces of the denture. This habit, together with proper hygiene procedures, would help improve oral health in these patients. Additionally, it is still unclear whether incomplete, versus complete, cleaning of dentures in and of itself has a significant impact on stomatitis, other things being equal.

Summary

The findings from the study showed that plaque tends to accumulate on the fitting surfaces of dentures more readily than on the polished surfaces. Cleaning might be more effective if denture hygiene procedures were directed at these specific areas. Clinical and technical procedures in denture treatment should also aim at producing dentures with smooth surfaces to facilitate denture cleaning.

The use of soak-type cleansers alone may not be completely effective for the control of heavy plaque. In the study, only about 34% of plaque was removed by this method of cleaning. The findings seem to support results of similar studies conducted on soak-type cleansers. To control plaque, and thus the possibility of denture stomatitis, patients should supplement the use of soak-type cleansers with brushing whenever possible, either by following careful instructions or by having their dentures professionally cleaned.

Patients should be encouraged not to wear their dentures at night if possible. Dentists should be mindful of the possibility of a reinfection in cases of denture stomatitis. Regular recalls for denture-wearing patients and follow-up denture sanitization procedures should be maintained. The recall visit may be especially useful for elderly patients, who may have difficulty in controlling the brushing of their prosthesis.

References