Clinical and Microbiologic Effects of Lingual Cervical Coverage by Removable Partial Dentures

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Purpose: The effect of gingival coverage by removable partial dentures (RPDs) on bacterial accumulation has not been sufficiently established. The aim of this study was to evaluate the periodontal and microbiologic reactions to mandibular major connectors. It was hypothesized that the use of a lingual plate increases the risk of periodontal disease. ***Materials and Methods:*** Fourteen subjects (mean age: 69.0 years) received oral hygiene instructions and ultrasonic debridement prior to examination. Each subject received an experimental RPD incorporating either a lingual bar or lingual plate for the first 8 weeks and was then switched to the other option for the next 8 weeks. Clinical parameters (Plaque Index, Gingival Index, probing depth, and tooth mobility) were recorded. Subgingival plaque samples were collected from the periodontal pocket in the test site to measure the colonization of periodontal pathogens after the use of each denture. ***Results:*** The mean probing depth was significantly greater after use of the lingual plate compared to the lingual bar ($P < .05$), whereas the type of connector did not affect the levels of any of the microbial species. All subjects that exhibited at least one bacterial species showed smaller numbers of microorganisms at the second examination than at the first. ***Conclusions:*** The lingual cervical coverage did not precipitate the accumulation of anaerobic microorganisms, although it could potentially induce gingival inflammation. The results suggest that a lingual plate can be used as safely as a lingual bar if oral and denture hygiene are carefully monitored. *Int J Prosthodont 2013;26:45–50. doi: 10.11607/ijp.3061*

The response of periodontal tissues to removable partial dentures (RPDs) has been a subject of significant controversy.[1] The influence of major connectors on parameters such as the Plaque Index,[2,3] gingival inflammation,[2–4] probing depth,[2–5] gingival recession,[3,5] attachment loss,[3,5] and tooth mobility[3,4] of the abutment teeth and/or remaining dentition has been investigated in previous studies. Decreased scores of these clinical parameters were mostly reported, especially at the dentogingival surfaces in close proximity to the connectors.[2] Other studies indicated moderate[6–8] or minimal[9] periodontal destruction as a result of broad areas of tissue contact with the dentures. Information regarding bacterial colonization in association with mandibular major connectors is lacking.

A lingual bar is primarily used in mandibular RPDs. The bar is usually positioned at least 3 mm from the free gingival margin because failure to provide sufficient space may lead to irritation of the adjacent soft tissues. Otherwise, the major connector should be carried onto the lingual surfaces of the teeth in the form of a lingual plate. In a previous study, more plaque accumulation was found with the lingual plate than with the lingual bar.[3] Covering the cervical gingival margin with a metal or acrylic resin lingual plate can lead to accumulation of food debris and bacteria, which are potentially detrimental to the periodontal

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health of the abutments and remaining dentition. However, the influence of lingual cervical coverage by RPDs on colonization of bacteria has not been investigated.

In this study, the number of anaerobic microorganisms was measured to evaluate the effect of major connector design on the risk of periodontal disease. A previous study[10] that employed the N-benzoyl-DL-arginine-2-naphthylamide (BANA) test[11] indicated that the prevalence of a trypsin-like enzyme unique to certain periodontal pathogens was greater at abutment teeth than at non-abutment teeth in RPD wearers. However, the BANA test was not capable of detecting specific aerobic and anaerobic bacterial species. The present study used the Invader assay (Hologic), a signal amplification system that allows for quantification of DNA and RNA targets[12] to assess the presence of anaerobic periodontal microorganisms in the remaining anterior teeth. The purpose of this within-subject study was to evaluate the periodontal and microbiologic effects of RPDs with connectors. It was hypothesized that the use of a lingual plate increases the risk of periodontal disease.

Materials and Methods

Subjects

Sixteen subjects with bilateral loss of mandibular posterior teeth were recruited from patients seeking prosthodontic treatment at the Tokyo Medical and Dental University Hospital, Tokyo, Japan. Inclusion criteria were a complete maxillary dentition and the retention of functionally normal mandibular incisors, canines, and first premolars. All subjects had been wearing RPDs but required new dentures because of poor fit or fracture. Patients exhibiting occlusal abnormality or complaining of any medical or oral condition were excluded. Normal food intake and dietary conditions were confirmed using a questionnaire on dairy food consumption. All experimental procedures were approved by the Ethical Committee of Tokyo Medical and Dental University (authorization no. 409). All subjects received written descriptions of the study and provided informed consent. Each subject was given routine oral hygiene instructions, including mechanical tooth cleaning using a toothbrush and an interdental brush after every meal and cleaning of the RPD using a denture brush every night. Preliminary measurements of the probing pocket depths were done by the first author using the walking-stroke method for all mandibular anterior teeth,[13] and the deepest pocket of all lingual sites was selected as the test site for that patient. Patients exhibiting deep pockets (probing depth > 4 mm) were excluded because the study was focused on partially edentulous patients who had received partial dentures without extensive periodontal therapy. All patients were randomly allocated to one of two groups: the bar-first group, in which the subjects used the lingual bar RPD first and then switched to an acrylic resin lingual plate RPD, or the plate-first group, in which the subjects used the lingual plate first and then switched to the lingual bar. Two subjects, both belonging to the plate-first group, dropped out for personal reasons before receiving the first denture. Therefore, 14 subjects (9 women, 5 men; mean age: 69.0 years; range: 53 to 81 years) were included in the study.

Experimental Denture Design

An experimental distal-extension RPD was constructed for each subject. Each cobalt-chromium framework incorporated a rigid lingual bar of 4 mm in width and 2 mm in maximum thickness, which was placed at least 3 mm away from the lingual cervical region of the anterior teeth. Wrought wire clasps were separately fabricated and welded to each framework.

For all subjects, the lingual plate portion was separately fabricated on a duplicate master cast with the lingual bar framework. The plate form was waxed up so that it covered the lingual cingulum of the incisors and canines. The lingual plate was relieved by 0.1 mm by placing dental plaster on the cast for all gingival margins. The wax plate was invested and processed using heat-polymerizing denture resin (Acron no. 9, GC). The wax denture with the lingual bar was processed to fabricate the RPD on the original master cast using the same heat-polymerizing denture resin. Polishing and finishing proecedures were then carried out following conventional laboratory procedures.

Insertion of the First RPD

Next, each patient received the first RPD (bar or plate). For the plate-first group, the separately prepared acrylic resin lingual plate was attached to the lingual bar RPD in the mouth. Prior to connection, the surface of the lingual bar was sandblasted with aluminum oxide, and a priming agent was applied (Metal Primer II, GC) to accelerate bonding. The plate was then connected to the RPD using self-cured acrylic resin (Unifast III, GC). All patients were instructed to wear their dentures during daytime (except while brushing and cleaning), but not during the night. Throughout the adaptation period (Fig 1), each patient received toothbrushing instructions accompanied by

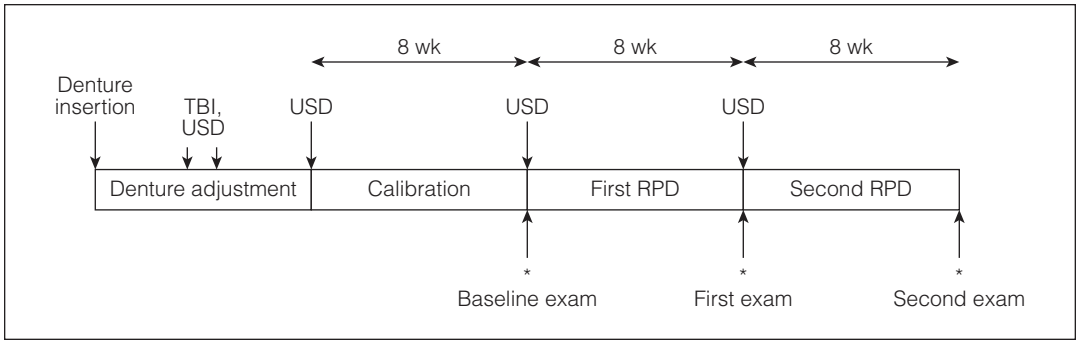

Fig 1 The study design. TBI = toothbrushing instruction; USD = ultrasonic debridement; * = clinical and microbiologic examinations.

full-mouth ultrasonic debridement (USD) using a piezoceramic ultrasonic device (EMS Piezon Master 600 with PS tips, EMS). The ultrasonic device was set to "perio-mode" with water coolant and a power level of 5.[14–16] The last USD was performed 8 weeks before the baseline examination. This calibration period was required to exclude the potential influence of incomplete denture maintenance by the subjects on the scores for the first dentures.

Baseline Examination

At baseline, each patient received another round of USD, followed by clinical and microbiologic examinations according to the following protocol.

Clinical examination. The clinical examination included assessment of *(1)* Plaque Index (PI) according to Silness and Loe,[17] *(2)* Gingival Index (GI) according to Loe and Silness,[18] *(3)* probing pocket depth (PD) of the test site using a Williams periodontal probe with a 0.5-mm-diameter tip and gentle pressure, and *(4)* tooth mobility (TM) using a Periotest instrument (Siemens).[19] Each patient was instructed to begin using the first denture after the baseline examination.

Microbiologic examination. Subgingival plaque samples were collected from the periodontal pocket of the test site for each subject. Prior to sampling, supragingival plaque around the test site was wiped away using sterilized cotton rolls, and saliva was gently dried with compressed air. A paper point (no. 40, Pierce) was inserted into the sulcus, left in place for approximately 30 seconds, and transferred to Nunc CryoTubes (Thermo Fisher Scientific). All samples were transported by express mail without temperature control to the testing facility (BML), where the numbers (copy/10 μL) of five main periodontal bacteria—*Aggregatibacter (Actinobacillus) actinomycetemcomitans, Porphyromonas gingivalis, Prevotella intermedia, Tannerella forsythia, Treponema denticola*—were measured using Invader assay.[12]

Examinations of the First and Second RPDs

Eight weeks after the baseline examination, the same clinical and microbiologic examinations were performed again for each patient. To minimize the effect of the first RPD, it was necessary to remove microbiota using another round of USD before insertion of the second RPD. The plate-first group was switched to the lingual bar by removing the lingual plate using dental cutting carbide burs. The bar-first group was switched to the second RPD by attaching the lingual plate to the lingual bar RPD. Eight weeks after receipt of the second RPD, each patient was recalled, and the same examinations were repeated.

Statistical Analysis

Multilevel analyses were performed using the Wilcoxon signed rank test for all variables for the clinical and microbiologic parameters. Both denture effects (bar vs plate) and period effects (first denture vs second denture) were investigated as potential sources of variation. For all tests, $P < .05$ was considered statistically significant.

Results

The mean clinical examination scores of all 14 subjects are shown in Fig 2. No statistically significant differences between the bar and plate were found regarding PI, GI, and TM. The mean scores of these parameters were all within the normal range for periodontally healthy adults. The statistical difference between the bar and plate was significant only for PD ($P = .02$); the mean PD of 3.4 mm after use of the plate was significantly higher than the PD of 2.9 mm after use of the bar. In all four clinical examinations, there was no significant difference in the mean scores between the bar and plate within each of the bar-first and plate-first groups (data not shown).

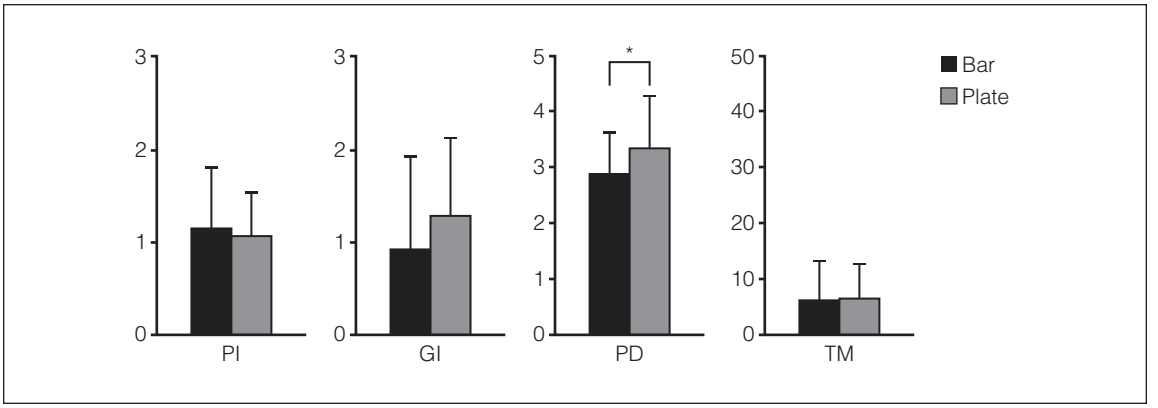

Fig 2 Mean (± standard deviation) Plaque Index (PI), Gingival Index (GI), probing depth (PD), and tooth mobility (TM) for the bar and plate RPDs. The differences between the bar and plate were not significant except for regarding PD. *P = .02.

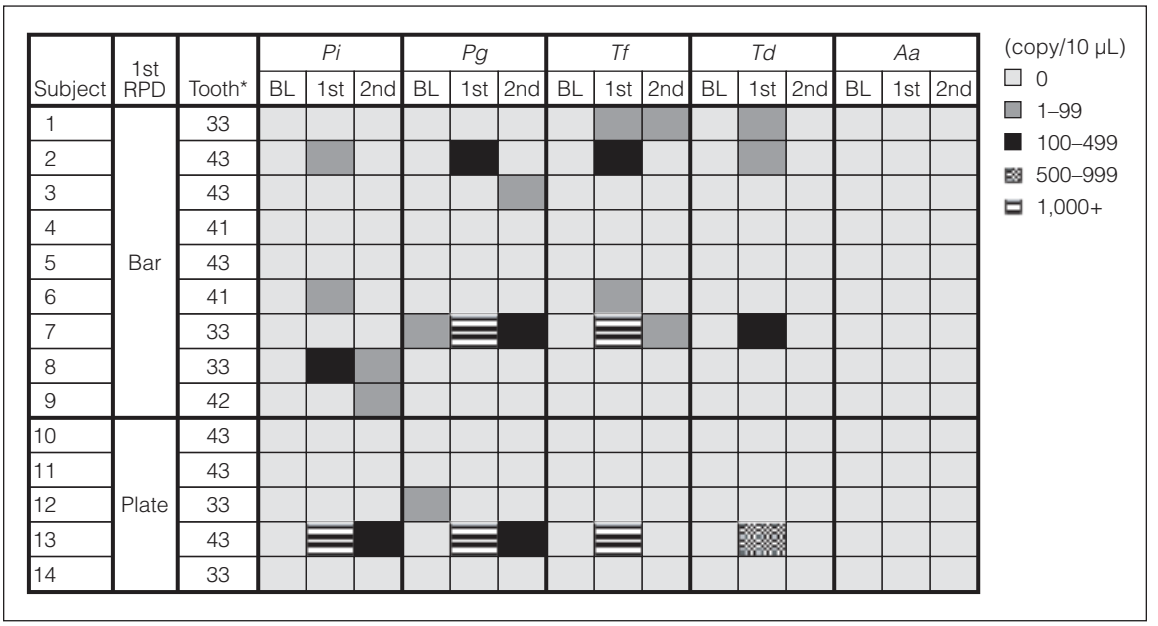

Fig 3 The numbers (copy/10 μL) of the five microbial species at baseline and at the first and second examinations. *Pi = P intermedia (P.i.); Pg = P gingivalis; Tf = T forsythia; Td = T denticola; Aa = A actinomycetemcomitans;* BL = baseline. *FDI tooth-numbering system.

The numbers of the five microbial species in all subjects at baseline and at the first and second examinations are shown in Fig 3. All baseline measurements revealed no bacterial colonization, except for relatively small numbers of *P gingivalis* in two subjects. One or more microbial species were detected in nine subjects, while three or more species were identified in three subjects. All three subjects (two from the bar-first group and one from the plate-first group) revealed decreased numbers at the second examination. Figure 4 shows box plots of the distribution by total microorganisms of the five species.

Discussion

The mean PD after use of the lingual plate was significantly greater than after use of the bar. This suggests that the lingual cervical coverage of the acrylic resin plate poses a higher risk of gingival inflammation of the remaining anterior dentition. The lingual plate covering the periodontal sulcus of the anterior teeth could mechanically stimulate the gingival tissues as well as promote bacterial colonization in the plaque adhered to the denture base.[20] However, there were no statistically significant differences between

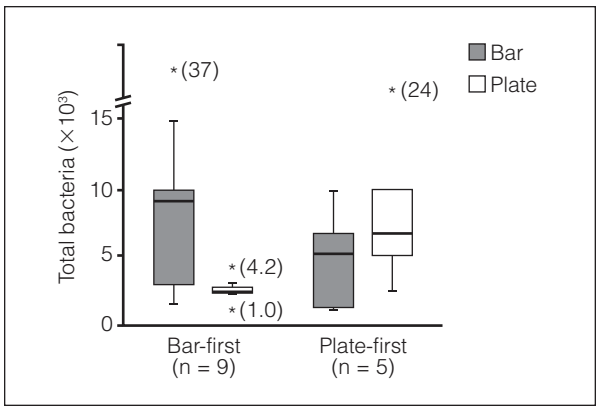

Fig 4 Box plots of the mean total bacterial numbers in the bar-first and plate-first groups. The upper and lower bases of each box represent the 25th and 75th percentiles, and the horizontal line in each box shows the median. The whiskers represent the 10th and 90th percentiles. Asterisks indicate an outlier.

the bar and plate in the other clinical parameters. The mean GI after use of the bar was insignificantly lower than after use of the plate (P = .19), supporting the potential detrimental effect of the plate on gingival inflammation. Akaltan and Kaynak[3] reported that the differences in PI and TM between the bar and plate were insignificant after 6 weeks of denture use but became statistically significant after 30 months. The results of the 8-week obsevation in the present study are in agreement with those 6-week results, suggesting that patients were able to maintain the periodontal health of anterior dentition equally well with the bar and plate for at least 8 weeks after receiving the last USD. An observation period of 8 weeks was used because the bacterial load usually reverts to its former level 8 weeks after professional plaque removal.[21] This duration was relatively short for evaluating the definitive influence of lingual cervical coverage on the periodontal conditions; further long-term studies are necessary to establish the appropriate recall period for denture wearers.

This study measured the levels of bacterial species *P gingivalis, T forsythia,* and *T denticola,* which are recognized as the main pathogens of periodontal disease[14,15] and are members of the red complex.[14,15] In addition, *P intermedia* and *A actinomycetemcomitans* were included because they are commonly detected in patients with periodontal disease and are associated with localized aggressive periodontitis.[14,16] Therefore, the risk of periodontal disease was reasonably estimated by the microbiologic analysis in this study.[12,22–24] The results indicated that there were no clear differences in the numbers of microorganisms between the bar and plate. All three subjects who revealed three or more bacterial species showed less bacteria at the second examination than at the first examination, regardless of whether they were in the plate-first or bar-first group. The insignificant difference between the bar and plate may be partially attributed to the effect of the oral hygiene care executed by each patient in addition to the professional care provided by the dentist. Meticulous oral hygiene could prevent the bacterial increase associated with both RPDs. Because debridement and hygiene instructions were repeated for all subjects at every recall, they were likely to have become more effective by the later examinations. Although the periodontal parameters indicated that coverage of the cervical gingival margin could increase the risk of gingival inflammation, the use of a lingual plate did not cause increased accumulation of anaerobic bacteria in the periodontal sulcus. Because of the small sample size and lack of external validity, the power of this study was too weak to detect the significant effect of major connectors on the risk of periodontal disease in general. Despite such limitations, the results may provide preliminary information for further investigation in this field.

An acrylic resin denture is used as an interim prosthesis in cases where one or more anterior teeth are periodontally involved and new artificial teeth may have to be added to the existing denture.[25] The acrylic resin lingual plate used in this study may be more prone to bacterial accumulation in the gingival margins than a cast lingual plate due to the relatively high water absorbing property of the acrylic resin.[26] Therefore, the experimental conditions of this study may have presented a worst-case scenario in terms of the hygienic environment. The findings indicate that the amount of bacterial colonization did not increase following cervical gingival coverage in denture wearers with acceptable oral hygiene. However, the probing depth, indicative of periodontitis, increased with use of the lingual plate. Therefore, the hypothesis that an acrylic resin lingual plate covering the gingival margins increases the risk of periodontal disease was partially supported.

Conclusion

The results suggest that RPDs featuring a lingual plate can be used as safely as those featuring a lingual bar if oral hygiene instructions and professional care are fully implemented before and after denture insertion.

Acknowledgments

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Literature Abstract

Public health surveillance of dental pain via Twitter

This study aimed to evaluate the content of Twitter posts that met a search criteria relating to dental pain. One thousand "tweets" were randomly selected from a representative sample collected using the search terms "toothache OR tooth ache OR dental pain OR tooth pain." Seven hundred seventy-two tweets were analyzed after the exclusion of ambiguous tweets, spam, and repeat users. The data analysis showed that 83% (n = 640) were general statements of dental pain, 22% (n = 170) regarded action taken or contemplated, and 15% (n = 112) were describing impact on daily activities. For the actions taken or contemplated, 44% of tweets (n = 74) reported seeing a dentist, 43% (n = 73) took medication (analgesic or antibiotic), and 14% (n = 24) actively sought advice from the Twitter community. This study showed that the Twitter community extensively shares health information relating to dental pain, which includes actions taken to relieve symptoms and the impact of pain on their daily activities. The authors concluded that this new medium may provide a new avenue for dental professionals to disseminate health information.

Heaivilin N, Gerbert B, Page JE, Gibbs JL. *J Dent Res* 2011;90:1047–1051. **References:** 21. **Reprints:** Asst Prof Jennifer L. Gibbs, Department of Endodontics, New York University College of Dentistry, 345 East 24th Street, New York, NY 10010, USA. Email: jlg15@nyu.edu—*Sapphire Gan, Singapore*