

REMOVABLE PROSTHODONTICS

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Clinical comparison of two mandibular major connector designs: The sublingual bar and the lingual plate

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The design of a mandibular removable partial denture major connector is a subject of ongoing interest because of anatomic restraints and limitations in design options.¹⁻⁵

DESIGN OPTIONS

Lingual bar

The traditional approach is to use a lingual bar major connector when anatomically possible (Fig. 1). An essential requirement for the lingual bar is the presence of at least 7 mm distance from the gingival margin of the mandibular teeth to the functional depth of the alveolar lingual sulcus. The occlusogingival height of a chromium-cobalt lingual bar should be a minimum of 4 mm to achieve adequate rigidity. In addition, a distance of at least 3 mm is essential between the superior border of the lingual bar and the gingival margins.^{4,5} If the superior border of the lingual bar is closer than 3 mm to the marginal gingivae, there is an increased likelihood that the bar will traumatize these tissues or that food may wedge between the major connector and delicate gingival tissues creating a periodontal breakdown or insult. The total of the two distances accounts for the 7 mm minimal requirement (Fig. 2).

Lingual plate

If there is insufficient distance to use a lingual bar as the major connector, an alternate design is the lingual plate (Fig. 3). The lingual plate covers the marginal gingival tissues. Some dentists believe that covering these tissues may not be conducive to long-term gingival health because the stimulating effect of food and saliva will be reduced.^{5,6} Campbell¹ found that patients adapt best to major connectors that cover the least amount of soft tissue. Esthetics may sometimes be a factor in avoiding a lingual plate design since diastemata between the mandibular anterior teeth will result in a display of metal.

The opinions or assertions contained herein are not to be construed as official or as necessarily reflecting the views of the Department of the Army or the Department of Defense.

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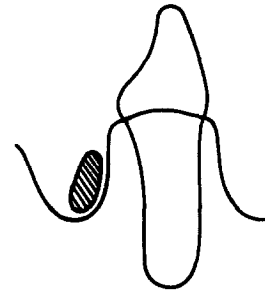


Fig. 1. Lingual bar major connector. Inferior border located at base of alveolar lingual sulcus in its functional position.

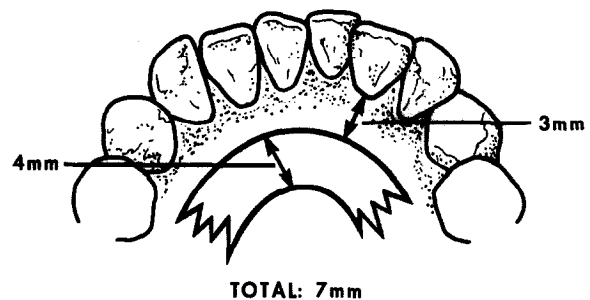


Fig. 2. Lingual bar. Superior border must be at least 3 mm from gingival margin of mandibular teeth to maintain health of gingival tissues.

Sublingual bar

A mandibular major connector design originally described by Brantenburg and Tryde⁷ offers an alternative to the lingual plate design. They called this design the sublingual bar based on its location in the alveolar lingual sulcus and position under the tongue (Fig. 4). The rationale for using the sublingual bar is to provide a major connector that permits exposure of the lingual surfaces of the anterior teeth and contiguous structures and still achieves maximum rigidity. Placing the sublingual bar within the functional form of the alveolar lingual sulcus is reported to prevent irritation to the tip of the tongue because the bar is in an unobtrusive position.⁸

In accordance with the cross-sectional outline of the alveolar lingual sulcus, the sublingual bar resembles the

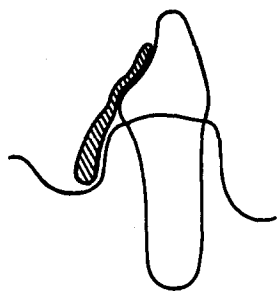


Fig. 3. Lingual plate major connector. Inferior border positioned at base of alveolar lingual sulcus in its functional position.

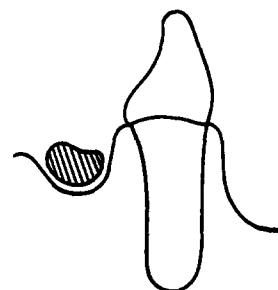


Fig. 4. Sublingual bar major connector. Cast to form of alveolar lingual sulcus in its functional position.

Table I. Patient data and design evaluation

	Patient No.									
	1	2	3	4	5	6	7	8	9	10
Sex	F	M	M	M	M	M	M	F	F	F
Kennedy classification for mandibular RPD	III	II	III	I	I	III	III	I	I	II
Disposition of opposing arch	ND	CD	ND	CD	RPD	ND	RPD	RPD	CD	RPD
Distance from gingival margin to floor of mouth (mm)	5.0	4.5	4.0	4.5	4.0	5.0	6.5	5.0	4.0	4.0
Major connector placed first	LP	SLB	SLB	LP	LP	LP	LP	SLB	SLB	SLB
Subject preference	SLB	LP	LP	LP	LP	LP	LP	LP	equal	LP
Designs found satisfactory	SLB	both	both	both	both	both	both	both	both	both

ND = Natural dentition; CD = complete denture; RPD = removable partial denture; LP = lingual plate; SLB = sublingual bar.

shape of a tear drop. The base of the tear drop is toward the base of the tongue. Krol² describes the sublingual bar as a lingual bar turned on its side. The degree of rotation of the sublingual bar varies according to the shape of the alveolar lingual sulcus it fills and is often considerably less than 90 degrees from the vertical. The greatest bulk of metal lies in the horizontal plane; therefore, the sublingual bar provides exceptional rigidity as a major connector.

The purpose of this study was to evaluate patient acceptance of the sublingual bar when compared with the lingual plate major connector and to determine the preferred design.

MATERIAL AND METHODS

Six men and four women patients requiring a mandibular removable partial denture were selected for this study. The following criteria were used for selecting the patients.

1. The presence of 4 to 6.5 mm between the lingual gingival margins of the mandibular anterior teeth and the alveolar lingual sulcus in its functional position

2. Controlled plaque formation and the absence of dental disease

3. The absence of excessive undercuts of the gingival tissues lingual to the mandibular anterior teeth that would compromise optimum placement of a major connector

4. A mandibular lingual frenum, if present, that did not obviate normal alveolar lingual sulcus form

5. The absence of mandibular lingual tori

Table I shows data for the patients regarding sex, status of each dental arch, and measurements from the gingival margins of the mandibular anterior teeth to the floor of the alveolar lingual sulcus in its functional position.

Two mandibular removable partial dentures were fabricated for each patient. One prosthesis had a lingual plate and the other a sublingual bar.

Preliminary impressions were made and diagnostic casts poured. The mandibular cast was blocked out with Playdoh (Kenner Corp., Cincinnati, Ohio) over the teeth and in other undercut areas. Casting wax (28 gauge) was placed over the distal-extension ridges to provide spacing. The casting wax was covered with 0.001-inch tinfoil to prevent contamination of the tray material by the wax (Fig. 5). Using acrylic resin repair material, a custom tray was constructed on this cast with suitable

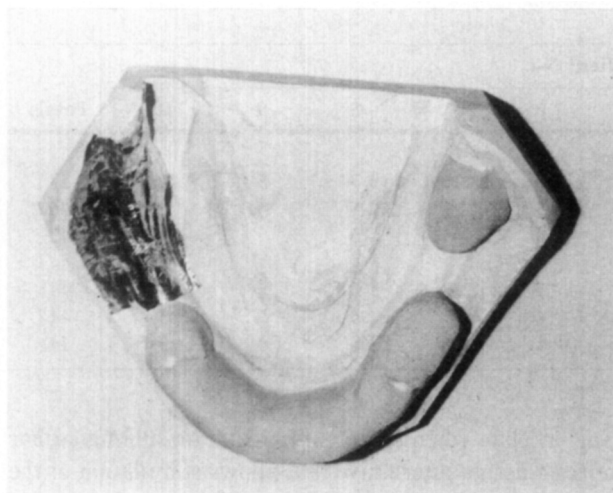


Fig. 5. Mandibular preliminary cast is blocked out. Relief is provided over distal-extension ridge area.

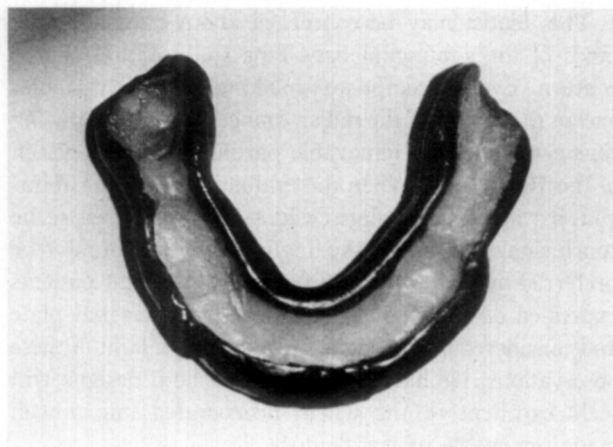


Fig. 6. Custom tray is border molded with modeling plastic. Alveolar lingual sulcus form is captured in its functional position.

stops on the natural teeth. After polymerization, the tray was cleaned and trimmed short of the movable mucosa. The periphery of the custom tray was border molded with green modeling plastic in the same manner as that for a complete mandibular denture impression (Fig. 6). Special care was taken to capture the form of the alveolar lingual sulcus in the functional position as described by Ceconi.⁹ The tray was painted with a suitable adhesive and left to dry for an appropriate time. The final impression was made with light-bodied mercaptan rubber-base impression material (Permlastic, Kerr/Sybron, Romulus, Mich.) (Fig. 7). The impression was immediately boxed and poured (Fig. 8).

Two laboratory work authorizations were written for each patient. One prescribed a lingual plate and the other a sublingual bar major connector. The designs for the other components of the frameworks were identical. The frameworks were cast in a chromium-cobalt alloy (Vitallium II, Howmedica, Inc., Chicago, Ill.). The



Fig. 7. Final rubber-base impression gives accurate detail and extension.

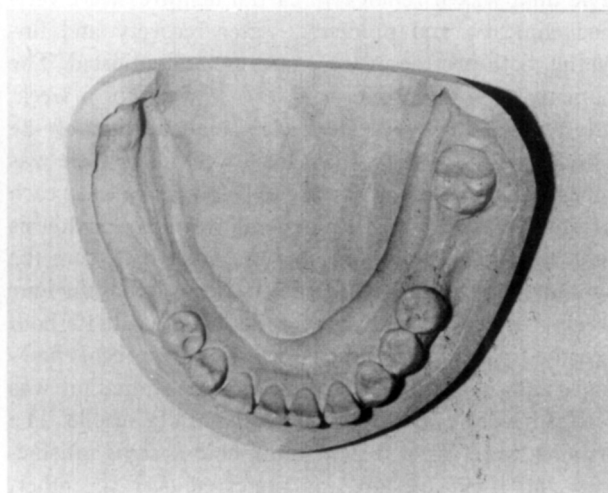


Fig. 8. Final cast with border roll preserved. This is particularly important in anterior lingual area.

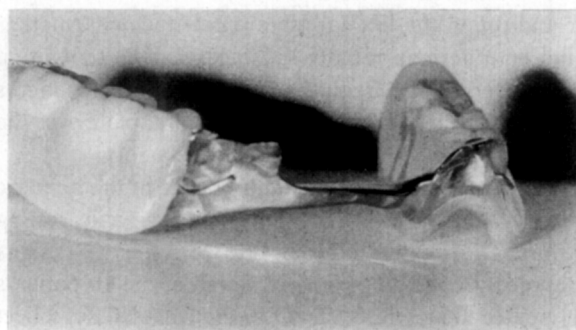


Fig. 9. Mandibular removable partial denture with sublingual bar major connector.

master cast was duplicated to permit fabrication of the resin bases for the second prosthesis.

The metal frameworks were adjusted to the subjects' mandibular teeth with chloroform and rouge to eliminate binding.¹⁰ The occlusion was adjusted, and a centric

Table II. Patient numeric evaluation of design

	Patient No.										Totals
	1	2	3	4	5	6	7	8	9	10	
Sublingual bar											
Speech	4	4	2	4	5	3	5	3	5	2	37
Chewing	2	4	2	5	5	3	4	5	4	2	36
Resting comfort	5	5	2	3	5	4	3	5	5	5	42
Lingual plate											
Speech	3	4	5	4	5	5	5	5	5	3	44
Chewing	2	5	5	5	5	4	5	5	5	3	44
Resting comfort	2	5	5	4	5	4	5	5	4	5	44

jaw relationship record was made to relate each framework and cast to the opposing arch. An altered-cast procedure was not used because the accuracy of the mandibular rubber base final impression was accepted. The final waxed removable partial dentures were verified clinically and processed. After recovery and finishing, both prostheses were inserted and adjusted. The patients were given one prosthesis to wear for a week, after which they were to return for insertion of the second prosthesis to be worn for a week. The cycle was repeated so the patient had the opportunity to wear each prosthesis twice. Half the patients wore the prosthesis with the lingual plate first and the other half wore the sublingual bar prosthesis (Fig. 9). At the end of the four weekly trials, the patients were asked to evaluate both prostheses as related to interferences with speech, chewing comfort, and resting comfort. The evaluation was made on a scale of 1 to 5, with 5 the most favorable. The patients were asked if they found both designs satisfactory and if one design was preferred over the other. Table II contains data from these evaluations.

RESULTS

One patient indicated a preference for the sublingual bar and found the lingual plate unsatisfactory. Another found both designs equally satisfactory. The remaining eight preferred the lingual plate. These eight patients stated that while they preferred the lingual plate over the sublingual bar, both designs were satisfactory.

The lingual plate scored slightly better in the numeric evaluation for chewing comfort, speech, and resting comfort. The greatest difference between the two designs was noted for chewing comfort. Seven of the 10 patients commented that while chewing, food tended to collect under the sublingual bar.

DISCUSSION

The limited space that often exists between the functional level of the floor of the mouth and the free gingival margins of the mandibular anterior teeth reduces the design options for a mandibular major connector. The dentist is usually forced to prescribe a

lingual plate when space is limited. The sublingual bar offers a design alternative that allows stimulation of the lingual tissue by contact with the tongue, movement of food, and the flow of saliva while maintaining 3 mm of space between the major connector and the marginal gingivae.

The dentist may be concerned about patient acceptance of the sublingual bar. This study addressed the concern. Every attempt was made to keep all variables except the design of the major connector constant during construction of two removable partial dentures for each of the 10 patients. When the evaluations for the sublingual bar and lingual plate designs were compared at the conclusion of the study, the lingual plate was found to be preferred by eight of the 10 patients. The eight patients expressed only a slight preference for the lingual plate and considered both designs satisfactory. In light of these observations, we have concluded that both designs will yield excellent results when incorporated into a well made removable partial denture.

The main advantage of the sublingual bar is that the lingual surfaces of the mandibular anterior teeth and contiguous structures are not covered by metal. There is also some esthetic advantage in keeping the major connector away from the lingual surfaces of the anterior teeth. The primary disadvantage of the sublingual bar design is the expenditure of time required to adequately develop the mandibular final impression so that the functional form of the alveolar lingual sulcus is accurately recorded. In addition, the sublingual bar design complicates the subsequent addition of mandibular anterior teeth to the prosthesis in the event that any of the natural teeth are lost. Many patients also have observed that food is more prone to collect under the horizontally oriented sublingual bar.

SUMMARY

Two mandibular removable partial dentures, one with a sublingual bar and one with a lingual plate as the major connector, were constructed for 10 patients. Both were made using the same impression and were identical except for the design of the major connector. The two

major connector designs were evaluated by the patients at the conclusion of the study. Eight of the 10 patients preferred the lingual plate and nine of the 10 found both designs satisfactory. One patient indicated a strong preference for the sublingual bar over the lingual plate and another found both designs equally acceptable. We have concluded from the final data that the sublingual bar compares favorably with the lingual plate in patient acceptance and should be considered as a viable design alternative when a lingual plate is not indicated.

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REFERENCES

1. Campbell LD: Subjective reactions to major connector designs for removable partial dentures. *J PROSTHET DENT* 37:507, 1977.
2. Krol AJ: Removable Partial Denture Design, Outline Syllabus, ed 3. San Francisco, 1981, University of the Pacific Bookstore, p 40.
3. Henderson D: Major connectors—United it stands. *Dent Clin North Am* 17:661, 1973.

4. Rudd KD, Morrow RM, Eissmann HF: Dental Laboratory Procedures. Removable Partial Dentures, ed 1. St. Louis, 1981, The CV Mosby Co, vol 3, p 144.
5. Lavere AM, Krol AJ: Selection of a major connector for the distal extension-base removable partial denture. *J PROSTHET DENT* 30:102, 1973.
6. Potter RB, Appleby RC, Adam CD: Removable partial denture design: A review and a challenge. *J PROSTHET DENT* 17:63, 1967.
7. Brantenburg RM, Tryde G: Connectors for mandibular partial dentures: Use of the sublingual bar. *J Oral Rehabil* 4:389, 1977.
8. Derry A, Bertram U: A clinical survey of removable partial dentures after 2 years usage. *Acta Odontol Scand* 28:583, 1970.
9. Cecconi BT: Lingual bar design. *J PROSTHET DENT* 29:635, 1977.
10. Leupold RJ, Kratochvil FJ: An altered-cast procedure to improve tissue support for removable partial dentures. *J PROSTHET DENT* 15:672, 1965.

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Diagnosing functional complete denture fractures

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Complete dentures often fracture during normal masticatory function. However, an edentulous patient can only exert occlusal forces of 15 to 25% that of dentate patients.¹ Theoretically, therefore, an edentulous patient could not fracture a denture base that possesses a tensile strength of 7000 to 9000 psi, a compressive strength of 11,000 psi, and an elastic modulus of 550,000 psi. This article describes many of the causes of maxillary and mandibular complete denture fracture, and discusses methods to help prevent their recurrence.

MAXILLARY COMPLETE DENTURE

A common problem is the recurrent midline fracture of a maxillary complete denture opposing natural dentition or dentition that is restored with fixed partial dentures.² Frequently, the opposing arches are restored

at different times by different dentists with little or no consideration to the final occlusal plane.

Uneven or defective occlusal contacts will deform the denture base and create lines of fatigue that result in complete denture base fracture. Many authors emphasize the importance of properly restoring the occlusal plane.³⁻⁷ They agree that recontouring the natural dentition will provide a more favorable occlusal plane and facilitate the development of balanced occlusion for the maxillary complete denture, which will more evenly distribute the forces of mastication to the denture base and help prevent fracture.

The occlusal plane can best be evaluated on accurate, mounted diagnostic casts. The proper plane can be determined using several methods that include retromolar pads, esthetics and phonetics, a curved occlusal template, or the Broderick occlusal plane analyzer (Figs. 1 and 2).

An acceptable occlusal plane can occasionally be

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