

Removable Partial Denture with Bar or Plate: How should We Decide?

Marta Radnai, Rajiv Saini, Istvan Gorzo

ABSTRACT

Aim: Although there is evidence that covering teeth by parts of a denture may damage teeth and the periodontium, the lingual plate is still common in clinical practice in many countries. The aim of this study was to compare the lingual plate and lingual bar type major connectors in the lower jaw as reflected in the literature.

Materials and methods: A literature search was carried out in PubMed for articles focusing on the possible effects of lingual plate major connector on the oral environment. Case and technical reports were excluded.

Results: The lingual plate which covers the soft tissues of the periodontium and the hard tissues of teeth results in increased plaque accumulation, development of caries and gingivitis, which in turn results in periodontal breakdown. The lingual plate functions as a barrier to saliva circulation, decreasing self-cleaning of teeth on the covered surfaces. Wearing a linguo-plate denture increases the likelihood of halitosis, corrosion and metallic taste. Patients have to wear a large volume of metal, which may cause difficulties in speech and may impair touch and form perception. The lingual plate may not satisfy the patient's esthetic expectations either. These issues are uncharacteristic for the use of lingual bar connector for removable partial denture.

Conclusion: A lingual bar should always be used in the lower removable partial denture, thus providing a hygienic denture design, comfort and esthetic appearance.

Keywords: Denture design, Lingual bar, Lingual plate, Plaque, Removable partial denture, Saliva.

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INTRODUCTION

The aim of prosthetic treatment was formulated very concisely by De Van¹ many years ago and it did not lose its relevance up to the present day 'Our objective should be the perpetual preservation of what remains rather than the meticulous restoration of what is missing'. When planning a prosthetic appliance the dentist must envisage the finished work and its immediate and long term effect on the hard and soft tissues, and the condition of the patient's mouth in 10 or 20 years time. The potential changes in the oral environment caused by the denture must be considered during planning and processing.

Fitting of a clasp retained removable partial denture (RPD) is still a common practice for patients with missing teeth. The cobalt-chromium metal framework was introduced in dentistry in the early 1930s.² It has many advantages compared to the acrylic base plate. The main advantages are the possibility of dental support and leaving the periodontal and dental tissues free from coverage to a great extent.

In the case of a Kennedy class I or II, a lingual plate or a lingual bar can be used as a major connector in the mandible. The major connector has to fulfil not only mechanical but also prophylactic requirements. The prevention of caries, gingivitis, periodontal damage and bone loss has to be kept in mind. The connection of the saddles must not cause a limitation in oral hygiene or any discomfort. The major connector may be a lingual plate or a lingual bar. A linguo-plate type major connector covers the oral surface of the teeth and the periodontium, a lingual bar type leaves the teeth and the periodontium free (Figs 1 and 2).



Fig. 1: A lingual plate major connector



Fig. 2: A lingual bar major connector

The aim of this survey was to collect and discuss the harmful effects of the lingual plate in the oral cavity. Main problems wearing a lingual plate are the increased risk of caries, gingivitis and periodontal disease, but patients and dentists have to face other disadvantages as well.

MATERIALS AND METHODS

A literature search was carried out in PubMed for articles focusing on the possible effects of lingual plate major connector on the oral environment. A preliminary search was run for 'removable partial denture' and 1088 articles in English matched the criteria. After restricting the search to documents that contain both the expressions of 'removable partial denture' and 'lingual plate' only five publications were found. One further article came up after searching for the term 'linguoplate'. To be able to compare the effects of lingual plate and lingual bar another search was carried out for publications containing 'removable partial denture' and 'lingual bar' as well. Ten articles were found including the studies focusing on the impact of lingual plate on the oral tissues. Case and technical reports, studies focusing on clasp design, were excluded from the search. As only a few relevant studies could be located, further publications on this topic were used to collect the relevant evidence of the disadvantages of the lingual plate.

RESULTS AND DISCUSSION

Increased Plaque Retentive Surface Area

The size of the surfaces on which plaque may accumulate largely determines the risk of caries and periodontitis, as plaque and microorganisms are the main etiologic factors for both diseases. When comparing the size of the linguoplate and the bar type major connector it can be easily seen from a calculation that there is a great difference. Using an example of a patient with the front teeth in the mandible, the average size of a plate can reach about 5 mm^2 ($3.5 \text{ mm} \times 1.5 \text{ mm} = 5.25 \text{ mm}^2$). After adding the covered tooth and gingiva surface of the same size, it becomes apparent that the area on which plaque may accumulate is about 10 mm^2 bigger in the case of a lingual plate connector than in the case of a bar.

Plaque forms on the entire surface of the mouth soon after tooth brushing, especially on rough surfaces. The oral surface of the linguoplate and the whole surface of the lingual bar is highly polished, while the tissue surface of the plate is electropolished, thus the surface roughness of the plate is different on its two sides. The surface roughness of the highly polished metal sublingual bar reaches³ $0.133 \mu\text{m}$ which is below the clinically acceptable surface roughness of $0.2 \mu\text{m}$ where the accumulation of plaque is

minimal.⁴ The only electropolished tissue surface of the plate is not as smooth as a highly polished surface; this accelerates the development of bacterial biofilm.

On examining titanium abutments Quirynen et al⁵ concluded that: 'rough surfaces harbored 25 times more bacteria' and 'supragingivally, rough abutments harbored significantly fewer coccoid microorganisms (64 vs 81%), which is indicative of a more mature plaque.' This shows that greater surface roughness facilitates biofilm formation. Significantly greater plaque accumulation was found by Akaltan et al⁶ in a 30-month follow-up study on tooth surfaces under the lingual plate in spite of periodic recalls.

The number of pathogen bacteria on the teeth and in the periodontal sulcus increases with the surface size of the linguoplate, and may cause other serious diseases, especially in case of elderly and more susceptible persons.⁷ Oral and periodontopathogenic bacteria may have a significant role in bacterial endocarditis, aspiration pneumonia, gastrointestinal infection and chronic obstructive pulmonary disease.⁸ Denture surfaces should be considered a reservoir for microorganisms.⁹ Therefore, in addition to oral hygiene, the size of these surfaces is relevant and should be kept to a minimum.

Saliva circulation and self-cleaning of the teeth is inhibited by the lingual plate, as it works as a barrier in the mouth.

Saliva has important functions in the prevention of caries through its antibacterial, buffering, remineralizing and hygienic action. Saliva flowing around the tooth surfaces clears and removes food particles. The food debris is loosened and washed away by the stream of saliva. During this process the concentration of acids decreases and the saliva works as a buffer against acids due to its bicarbonate content.

Additionally saliva contains antibodies, which play a role in the prevention of bacterial colonization, enhancing phagocytosis. Its peroxidase system and lysozyme have an antibacterial effect as well. The inhibition of caries is also due to the fluoride, calcium and phosphate ion content of the saliva, which plays a role in the remineralization of the demineralized tooth surfaces. The saliva develops its prophylactic effect in many ways, but only if it can reach the tooth surfaces directly.¹⁰

The lingual plate works as a barrier between the saliva flow and the teeth; the plate prevents the flow of the saliva to the tooth surface and into the interdental area and inhibits all the neutralizing, antibacterial and remineralizing effects. The presence of a denture in the mouth decreased the oral carbohydrate clearance in case of elderly people. This indicated that the flow of saliva was hindered by the prosthesis.¹¹

It can be perceived that by blocking the saliva circulation around the teeth an iatrogenic xerostomia develops under the area covered by the plate. Furthermore, in case of the elderly, due to the decreased function of salivary glands, and/or side effects of medication, xerostomia is quite common.¹² If xerostomia is left untreated, dental caries will soon appear,¹³ similarly to the risk of caries under the plate increases.¹⁴

Increased Caries Risk

There is more evidence for increased caries risk on surfaces covered by partial dentures. Mainly the adverse effect of acrylic dentures on the teeth was published¹⁵ but the risk of caries is rather due to the fact that the teeth are covered¹⁶ and less to the material of the denture. However, as regards surface roughness, there is a difference between acrylic and metal base plate. In case of a lingual plate the caries is caused by limited self cleaning, increased plaque accumulation and the mechanical damage of the denture produced by its small, but frequent movements on the teeth. In a distally extended denture—even if it has a dental support—the resilience of the mucosa results in small movements toward the edentulous ridge during function due to the chewing load. These movements occur in apical and occlusal direction on the lingual surface of the teeth in contact with the lingual plate. The development of abrasion and caries on these surfaces is only a question of time.

Jepson et al¹⁴ in a cross-sectional study reported 51 new or recurrent carious lesions and three fractures of 156 available teeth in the denture group, compared with 11 new carious lesions and one tooth fracture of 165 remaining natural teeth in the bridge group ($p < 0.01$) after 2 years of wearing RPDs in one group and bridges in the second group. Twenty-six of the 30 lower RPDs had plate connectors. The relative risk of new caries was nearly four times greater in the group of patients whose teeth were covered by the denture.

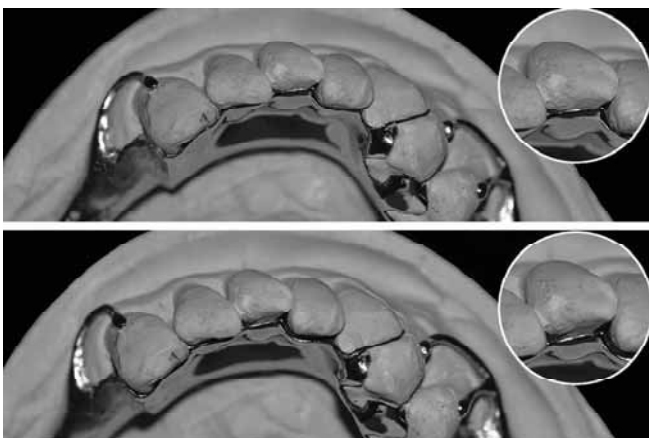


Fig. 3: Loading on the saddle results in moving the lingual plate off the teeth

When a distal extension partial denture accepts load on the saddles there is a slight rotation and the plate moves away from the teeth. Meanwhile (when the patient is eating) food particles may lodge in the gap between the plate and the teeth, increasing plaque accumulation, which may result in caries and gingivitis¹⁷ (Fig. 3).

Gingival Inflammation and Periodontal Breakdown

A consequence of the coverage of the marginal gingiva is gingivitis and later on periodontitis.¹⁸ The severity depends on the oral hygiene, the surface roughness of the denture touching the tissues, the host response to plaque and the duration of the coverage.

A clinical study using the experimental gingivitis model was performed to evaluate the effect of the mandibular major connector design on the marginal gingiva. Researchers examined the changes in the health of gingival tissues using the linguoplate and cingulum bar major connectors. Clinical parameters were measured at 7-day intervals for 21 days. The patients did not wear the framework when they were eating. Results showed a greater increase in gingival inflammation when a linguoplate was used than when a bar connector was applied, suggesting that the ‘cingulum bar has fewer detrimental effects on gingival tissues than the linguoplate major connector.’¹⁹

In a recent study of Zlatarić et al²⁰ the oral health of RPD wearers was assessed. A total of 205 patients with RPDs participated in the study. According to their results the highest plaque index, calculus index, gingival recession, probing depth were registered in linguoplate mandibular RPDs. Chandler and Brudivik²¹ found also increased levels of gingival inflammation in regions covered by the RPD after examining patients after an 8- to 9-year period.

Load on Teeth produced by the Lingual Plate

The rigidity of different types of mandibular major connectors was examined in an *in vitro* experiment. The result showed that the lingual bar dissolved the energy through vibration faster than the lingual plate, therefore the potential harmful effects on the teeth and periodontium were smaller in case of a bar.²²

According to H. Spiekermann, a lingual plate should not be used because it displaces the incisors in a labial direction and results in periodontal damage of these teeth.²³ It does not fulfil the task of an indirect retainer, as the lower incisors have short roots and in partially edentulous and older patients the resistance of the periodontium is in many cases not resistant enough.

Halitosis/Odor

Odor causes discomfort and is regarded as unwelcome in the social life of the patients and their surroundings. The reasons for bad breath can be found mainly in the oral cavity. Pratibha et al²⁴ found that oral causes, such as poor oral hygiene, periodontal disease, tongue coating, food impaction, unclean dentures, faulty restorations and dry mouth, are far more common than nonoral causes of malodor. The bigger the surface area of the denture the greater is the possibility of plaque retention on the denture and on the teeth with the consequence of malodor. Until today only a few articles have been published on malodor associated with removable dentures, but clinicians encounter it regularly. The denture material provides a surface for the plaque biofilm, which contains a range of odor-producing bacteria species, causing the unpleasant halitosis.²⁵

The plate closes the interdental space on the lingual side of the front teeth causing food impaction, which causes bad breath⁶ as well. Food trap is more common when the interdental papillae are short or not present and there is a recession of marginal gingiva. Furthermore, in case of the periodontal disease an oral malodor may develop, supporting evidence was found already.²⁶

Impaired Phonetics, Restricted Space for the Tongue

There are consonants (θ , δ) that create contact between the tongue and the lower teeth during phonation. If the lingual surface of the lower teeth is covered, the space for the tongue will be smaller and the shape of the area where the tongue is supported will be changed as well. It may influence the phonation. Of course people accommodate to the new situation, but it may be uncomfortable for a longer period of time.

Poor Esthetics

Nowadays esthetic appearance has become very important to patients.²⁷ They request restorations made of tooth-colored material. In case of elderly patients the muscle tone is weaker and therefore the lower teeth are more visible. The metal lingual plate covering a large surface of the lower incisors may be visible during speaking or laughing from the labial view and from above, especially when the patient has diastemata between the teeth.²⁸ On the contrary the lingual bar is not visible during normal function. The patient who cannot afford a more sophisticated restoration (implant, RPD with precision attachment) may still opt for an esthetic solution.

Metallic Taste, Corrosion

Patients may complain about a metallic taste if they have amalgam fillings, metal crowns, bridges and RPD with a plate. The release of metal ions was shown in more studies.^{29,30} The degree of corrosion is probably higher in the case of a large, uncovered metal surface. Corrosion can result in a metallic taste, burning mouth and/or oral pain.³¹ Baričević et al found that metal ions released by Co-Cr-Mo alloy might be responsible for DNA damage of oral mucosa cells.³²

Patient Satisfaction is Questionable

After a 1-month long trial of RPD with lingual plate or lingual bar patients adapted better and preferred the lingual bar type denture where the coverage of tissues was smaller.³³ Patient satisfaction depends greatly on esthetics; the lingual plate cannot be regarded as an esthetic restoration.³⁴

Oral Hygiene Improvement is often Questionable after Insertion of a Denture

Caries and periodontal disease are the main reasons for tooth loss.³⁵ When a patient seeks treatment for partial edentulousness, the dentist has to consider the patient related factor of tooth loss. In the etiology of caries and periodontitis the most important factor is plaque accumulation. Consequently, the probability of poor oral hygiene in partial edentulous patients is quite high. Wearing a plate connector only makes matters worse. The presence of a removable denture in the mouth increases the surface area where plaque may be attached. Is it a realistic expectation that oral hygiene will improve after fitting a denture in the patients? Even after oral hygienic instruction and motivation, many times the improvement is only temporary. Bassi et al³⁶ showed in a cross-sectional study of patients wearing RPD for 6 to 12 years that, without regular recall, only 10.5% of the patients had maintained optimal oral hygiene.

According to Jacobson:³⁷ 'Although some patients can maintain meticulous levels of home care..., dentures should be fabricated along guidelines that benefit the majority of the patients, including those who demonstrate less than ideal levels of plaque control.' When planning the denture connector the difficulty of improving oral hygiene habits has to be considered as well and therefore a bar connector that does not inhibit self-cleaning of the teeth should be favored. Of course regular checkups and tooth cleaning sessions help to maintain good oral hygiene³⁸ as a high level

of oral hygiene regimen is necessary for patients with RPD.³⁹ Plaque formation under the plate on the teeth starts early on, especially if the patients are not highly motivated to keep meticulous oral hygiene and change their existing (or missing) oral hygiene methods.⁴⁰

Loss of Stereognostic Ability

During our lives we all get accustomed to the shape of our teeth. After the placement of food into the mouth, we gain information about the shape and texture of the food in relation to that of our teeth. If there is a plate between the teeth and the tongue, this will affect the information gathering function of the tongue, at least temporarily. In an experiment, when the whole palate was covered with a plate the masticatory efficiency was less favorable.⁴¹

CONCLUSION

After dental implants were introduced, the indication for RPD is greatly restricted in the industrialised countries. It is mainly used as a treatment option when economic factors dominate the decision,⁴² but according to epidemiologic studies removable dentures are and will be widely provided all over the world.⁴³

Although, the adverse effects of covering the teeth with a lingual plate were described already in the last decades, it is still a common major connector type in many dental practices.^{44,45} According to the above described disadvantages the use of a lingual plate does not improve oral health. On the contrary, it has several adverse effects and it can be regarded as a treatment failure. In 2002, a consensus report was published by experts in prosthetic dentistry.⁴⁶ It came to the conclusion that the hygienic and preventive aspects of RPD design are important requirements in the prognosis of treatment. Consequently the application of the lingual bar is highly recommended instead of a plate connector.

The elements of the partial denture should be far from the marginal gingiva, whenever possible, as there is plenty of evidence of gingival and periodontal damage when the periodontium is covered by the denture.³⁹ The aspects of framework design include not only static-dynamic, but also biologic, esthetic and comfort considerations for the best interest of the patient and the long term success of the treatment.⁴⁷ The brief statement of Marxkors⁴⁸ provides the best guideline: 'If the base elements of the RPD do not contact either teeth or periodontium, it cannot cause any injuries to these tissues.' Based on the enumerated evidence and opinions the lingual plate should belong to the past.⁴⁹ This is particularly true in the case of elderly patients whose dexterity may decline and who may not be able to clean their teeth and denture efficiently. Fortunately recent trends

show increase in the usage of the lingual bar^{50,51} in some countries at least and hopefully such trends will become common all over the world.

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