

# Implant Rehabilitation Planning Protocol for the Edentulous Patient According to Denture Space, Lip Support, and Smile Line

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## Keywords

Prosthodontic rehabilitation; planning; profile; lip support; smile line; denture space.

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## Abstract

Rehabilitation with implants is a challenge. Having previous evaluation criteria is key to establishing the best treatment for the patient. In addition to clinical and radiological aspects, the prosthetic parameters must be taken into account in the initial workup, since they allow discrimination between fixed and removable rehabilitation. We present a study protocol that analyzes three basic prosthetic aspects. First, denture space defines the need to replace teeth, tissue, or both. Second, lip support focuses on whether or not to include a flange. Third, the smile line warns of potential risks in esthetic rehabilitation. Combining these parameters allows us to make a decision as to the most suitable type of prosthesis. The proposed protocol is useful for assessing the prosthetic parameters that influence decision making as to the best-suited type of restoration. From this point of view, we think it is appropriate for the initial approach to the patient. In any case, other considerations of study may amend the proposal.

In an edentulous patient, rehabilitation has two main goals: to restore oral function and facial shape.<sup>1</sup> Loss of the natural dentition involves resorption of the residual ridge that entails, on the one hand, changes in the maxillomandibular relationship and, on the other hand, changes in facial musculature and morphology.<sup>2</sup> Proper treatment planning involves knowing the progressive atrophy of both jaws, that is, bone resorption and the consequent loss of soft and hard tissues, because the treatment is much more complex in situations in which it is necessary to replace both.<sup>1</sup> Patient evaluation means analyzing several factors: bone availability, general state of the mucosa, hygiene concerns, economic costs, and specific prosthetic factors such as the emergence profile of the artificial teeth, degree of residual ridge resorption, facial support, and smile line.<sup>3,4</sup> All these parameters influence selection of the appropriate treatment plan. In edentulous patients, the therapeutic possibilities are basically overdenture, implant-supported fixed prostheses, and hybrid.

There is a strong belief that fixed-implant prostheses have better patient acceptance, although there are no differences between fixed and removable prostheses when patient preferences are studied.<sup>3</sup> In many cases, the choice of restoration is based solely on bone availability and the number of possible implants. This approach is not appropriate, since the key lies

in the degree of atrophy of both soft and hard tissues. This will be the determining factor in the choice of three types of implant prosthesis that can be used. Thus, in patients with moderate tissue loss, the fixed prosthesis may be appropriate. As the degree of atrophy increases, the patient becomes a candidate for a hybrid or overdenture. In this context, other criteria that allow us to determine the type of prosthesis that provides the best functional and esthetic result for the patient is needed. Various planning protocols have been proposed as aids in making therapeutic decisions.<sup>4-9</sup> Most plans are directed exclusively to the rehabilitation of the maxilla and cover some, but not all, prosthetic factors necessary for choosing a fixed or removable restoration. This article presents a planning protocol for designing a more appropriate prosthesis, analyzing three criteria: the denture space, lip support, and the smile line.

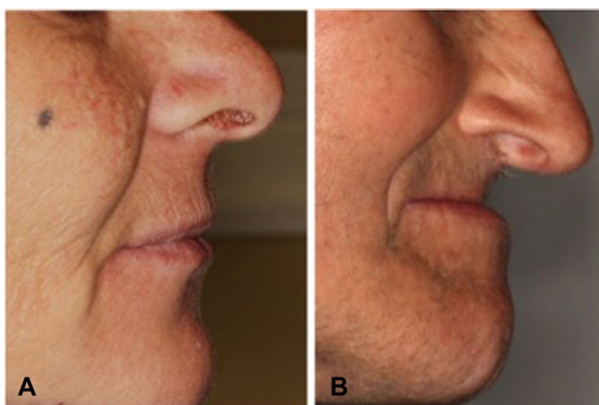
## Materials and methods

### Denture space

In this first criterion, the degree of vertical resorption is evaluated (Fig 1). The patient may present with various types of atrophy: first, intact volume of alveolar bone and tooth loss that occurs in patients with recent extractions and, second, bone resorption and consequent loss of hard and soft tissues



**Figure 1** A comparison between increased denture space (A) vs. conserved denture space (B).



**Figure 2** An example of conserved lip support (A) vs. lost lip support (B).

in addition to the teeth. Quantifying the degree of tissue loss is a key point, since tissue resorption can occur vertically, horizontally, or both, being difficult to recognize. Therefore, the first step should be to make and mount models in an articulator to assess the denture space. An idealized prosthetic set-up is the essential tool in this first criterion. In some patients, the space available allows only the placement of teeth, the fixed prosthesis being the most appropriate treatment. In other cases, the residual space between the crest and the opposing arch will be increased, indicating the need for a prosthesis to replace hard and soft tissues as well as teeth.

### Lip support

The degree of resorption is analyzed horizontally by making two baseplates, with and without a flange, to evaluate the degree of lip support necessary. This procedure is done for proper lip support and to prevent the improper angulation of implants that could interfere with oral hygiene (Fig 2). If the patient does not need lip support, a fixed prosthesis is indicated; however, if lip support is necessary, an overdenture is the best option.

### Smile line

The degree of exposure or visibility of the residual ridge is valued at the moment of maximum smile without any retractor. If the patient has a low smile line that does not allow visibility of the ridge, the transition from prosthesis to the residual soft

tissue does not imply esthetic risk. If, however, the smile line is high and the residual ridge visible, the esthetic compromise will be high. In this situation, a hybrid prosthesis could be a challenge if the smile line is too high. In cases where the smile line is higher an overdenture or fixed prosthesis can avoid the problem (Fig 3).

## Results

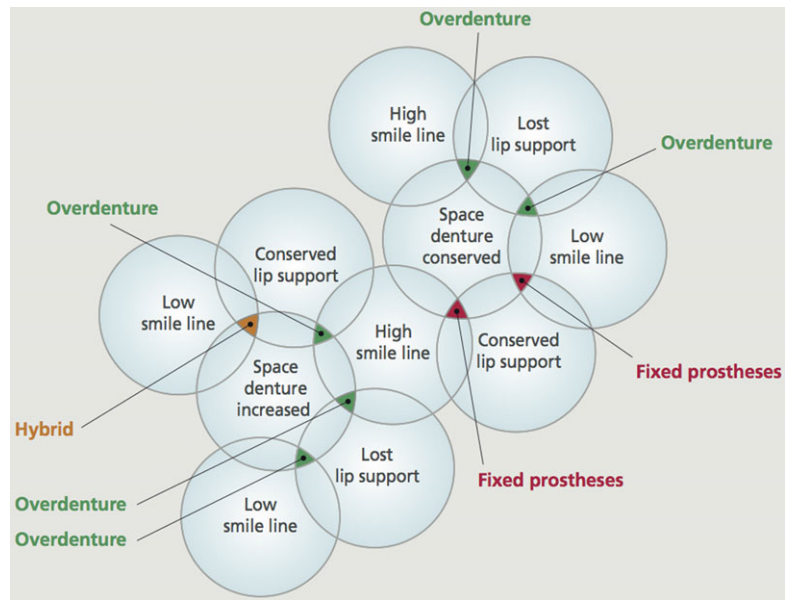
Combining one or more of these three parameters will determine the best treatment option based on patient characteristics (Fig 4). For example, if the denture space and lip support are lost, replacing hard and soft tissue is necessary, whereas if the smile line is high, an overdenture would be best (Fig 5). If, however, there is more denture space, a conserved lip support, and a low smile line, a hybrid prosthesis would be the treatment of choice (Fig 5). Finally, if the denture space and lip support have been preserved independently of the smile line, the more favorable therapeutic alternative would be a fixed prosthesis (Fig 5). After this analysis, an initial diagnosis is made, because then other parameters such as bone availability, socioeconomic status, and general health, will need to be studied.

## Discussion

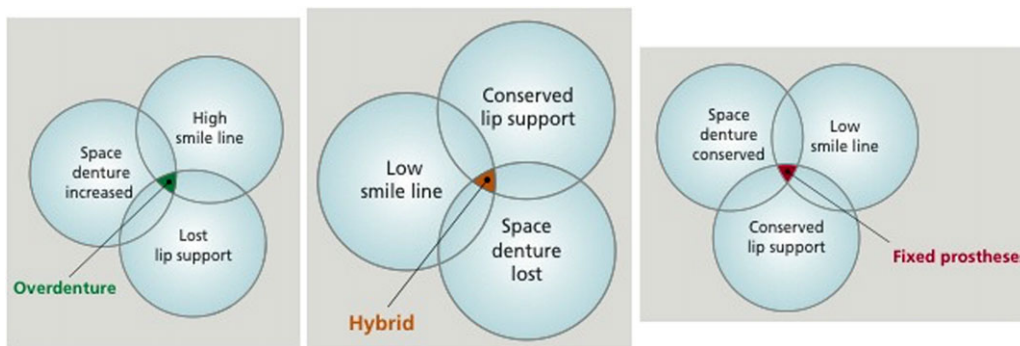
The aim of this work is to establish a basic diagnostic protocol to determine the most appropriate treatment option. Several protocols have been described as an aid in therapeutic decision making. Bedrossian *et al*<sup>6</sup> established a method of pretreatment assessment based on the study of three factors: whether there is a compound defect, visibility of the residual crest, and quantity of bone available. Using these diagnostic criteria enables the clinician to make an early restorative choice of three implant designs, but as the authors reported, a limitation of this protocol is the inability to measure the width of the residual ridge. It also does not consider whether there is lip support, a key factor in differentiating between a fixed prosthesis and overdenture. Moreover, Avrampou *et al*<sup>5</sup> determined anatomical and prosthetic landmarks on patients using computerized tomography (CT) and analyzed prosthetic parameters in the anterior edentulous maxilla by means of a computerized virtual implant planning guide. They proposed a classification and virtual planning process that simplifies decision making regarding the type of prosthesis, improving the predictability of results. Although its classification for decision making is



**Figure 3** Differences between high smile line (A) and low smile line (B).



**Figure 4** Combining three prosthetic parameters shows all possibilities.



**Figure 5** Criteria selection for three different treatments: overdenture (left), hybrid (center), and fixed prosthesis (right).

simple and has great clinical utility, it does not take into account the smile line. In addition, the need for a CT scan is highlighted. Bidra and Agar<sup>10,11</sup> presented a 3D plan for the edentulous maxilla based on esthetic concepts. The plan is classified into four categories useful only for implant-supported fixed prostheses. Malo et al<sup>7</sup> reported a planning protocol that emphasizes the angulation between implants and prosthesis without compro-

misg the lip movement during smile. Similarly, Calvani et al<sup>9</sup> showed a study of soft tissue defects in the philtrum of the upper lip in patients treated with dental implant-supported fixed prostheses. Other protocols focus only on the emergency profile of the artificial gum without studying other parameters to help set the partial.<sup>12-14</sup> In any case, an idealized prosthetic set-up is the key to the study of an edentulous patient. As Avrampou et al<sup>5</sup>

reported, in most cases the space between the crown and the implant platform should be filled with prosthetic materials, not just teeth. Because of moderate or advanced atrophy, very few patients are candidates for an implant-supported fixed prosthesis.

## Conclusion

The proposed protocol is useful for assessing the prosthetic parameters that influence decision making as to the best-suited type of restoration. It considers three factors based on an initial therapeutic diagnosis, which requires only articulator-mounted models and diagnostic wax on a plate. It is easy to perform and not expensive. Clearly, this schedule does not, in many cases, provide a final diagnosis regarding the type of rehabilitation, but it does allow for a reliable initial diagnosis that avoids serious errors and for an assessment of the esthetic value of the definitive prosthesis. From this point of view, the authors think it is appropriate for the initial approach to the patient. In any case, other considerations of study may amend the proposal.

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