Treatment of Sleep Apnea with Herbst Mandibular Advancement Splints

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Abstract
Sleep apnea and obstructive sleep disorders represent a danger for the cardiovascular system and metabolism. They also give rise to somnolence, which can cause accidents at work or road accidents. Along with positive pressure ventilation, oral mandibular advancement devices are today regarded as reliable forms of treatment. Unfortunately, not all patients adhere fully to the treatment, particularly over time. Some even abandon it entirely. The reasons generally put forward to explain this poor compliance are discomfort, pain, occlusal problems and poor psychological disposition (Figure 1). Orthesis over three years showing the high levels during the first months of treatment.

Keywords: Obstructive sleep apnea; Mandibular advancement device; Compliance; Manufacture

Analysis of Publications 2004-2011
Twenty-three referenced articles concerning the efficacy of the Herbst appliance for the treatment of obstructive sleep apnea have been studied. Table 1 lists a selection of articles on the Herbst appliance, presented methodologically [1-25]. Also listed are three doctoral theses presented in two French medical schools (Table 2) [26-28]. Table 3 lists 23 articles presented in terms of efficacy of treatment of respiratory disorders. A summary report on the subject of sleep presented to the French Ministry for Health and Solidarity in December 2006 (Appendix Ch. 2.2.3.), concluded in these terms: “Currently only made-to-measure orthesis have proved their efficacy in controlled trials. Herbst mandibular advancement splints, used in orthodontics since 1980, remain the most widely-studied systems.”

This review of the literature is illustrated by the captions accompanying figures derived from these articles (Figures 2-12); adverse and parasitic effects: the discomfort caused by the Herbst advancement splint is no different from that described with other types of oral orthesis or with ventilators. But, unlike other models [29], they remain well positioned on the teeth.

While TMJ pain is only temporary, tooth pain persists if it is linked to the initial state of the mouth or to movements caused by the orthesis. Pain in the facial muscles is more often the result of poor adjustment of the amplitude of propulsion. As for breakages, they are due to faulty manufacturing methods (Table 4).

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Prescriptions and Contra-Indications
The economic filter
Patient selection represents a radical approach to the reduction of failures of compliance. The difficulty is to find an infallible method to avoid excluding patients with a favourable profile. In France, the conditions for reimbursement of costs are laid down by law: patients can only benefit if the treatment by orthesis:
- is second-line treatment (after refusal of CPAP);
- is first-line treatment for an index of between 15 and 30,
- without excessive somnolence or severe cardiovascular comorbidity;
- and is prescribed by a sleep specialist. However, no provision is made for the reimbursement of dental and stomatological procedures and consultations!

The Initial Dental State
Today, too many orthoses are still prescribed despite the presence of periodontal disease, dislocation, desmodontitis, ankylosis of the temporal-maxillary joints, multiple missing teeth, broken or carious teeth, etc. According to Petit et al. [30], 50% of patients requiring an orthesis have periodontal abnormalities, 31% have more than 10 missing teeth and 20% have bridges that complicate the insertion of an orthesis. More than 50% of patients present with malocclusions that expose some of them to a risk of irreversible occlusal modification caused by the side effects of the orthesis: subjects in Class I, Class III and with overbite are more at risk than those in Class II without overbite.

Since more than 50% of the population suffers from occlusal asymmetry, and since some cases of hyperdivergence can easily be worsened, the widespread use of advancement devices is not without certain consequences. After being worn for some time, mandibular

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advancement orthoses modify occlusion, according to Almeida et al. Doff et al. [32], the most visible man-infestation of these changes is the advancement of the lower teeth. While these movements may be beneficial for some subjects who are initially in Class II, for the others (44.3%) they cause permanent discomfort. Over a period of 5 years this is alleged to be the main cause of abandonment of treatment by mandibular advancement splints. Pancherz and Hansen [33] sought to reduce these parasitic movements by changing the support, but without success. Wescelar and Pancherz [34] noted that whether they were cast or banded, splints always induced this movement (11.8” W 3.7” for the 107 latter).

Psychological Acceptance

The articles in this selection concern samples of patients who were previously treated with CPAP ventilation. It is not surprising that this category of patients, emerging from a situation of treatment failure, should be more inclined to abandon this new treatment too. And yet it is this population that is given priority by the law in France for treatment of obstructive sleep apnea, Poulet et al. [35] identified two predictive variables that would make it possible to avoid 85.7% of cases of discontinuation of treatment. These are patients’ perception of their state of health, and their mental state (depression test) [36-40].

Prevention of Discomfort and Device Fragility

Complaints

Surveys of apnea sufferers treated with splints highlight the following complaints:

- Transient complaints: TMJ pain, pain in masticatory muscles, poor stability of the device, discomfort caused by lower pivots, hypersialiosis;
- Long-term complaints: dry mouth, tooth pain, occlusal problems, mobility of teeth.

Standing grievances:

- Dry mouth
- Toothache
- Occlusal genes
- Tooth mobility

The information obligation: Considered as “knowing”, the practitioner is legally obliged to inform the patient of the disadvantages and ways to address them. The marketing of any laboratory does not absolve the practitioner’s professional responsibility [41-43].
**Conclusions**

<table>
<thead>
<tr>
<th>SL No.</th>
<th>Author</th>
<th>Effectiveness in decreasing confirmed HAI; Side effects: dry mouth, dental and musculo-facial pain, dental displacements (10th of mm).</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Pauron</td>
<td>Effectiveness in decreasing confirmed HAI; Side effects: dry mouth, dental and musculo-facial pain, dental displacements (10th of mm).</td>
</tr>
<tr>
<td>2</td>
<td>Roussel</td>
<td>Effectiveness in decreasing confirmed HAI; Side effects: dry mouth, dental and musculo-facial pain, dental displacements (10th of mm).</td>
</tr>
<tr>
<td>3</td>
<td>Lavis</td>
<td>Decreased IAH by -5.6 ± 10.2, (for 44% of the sample), advancement of the palate, increased pharyngeal space. No break was observed</td>
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</tbody>
</table>

**Table 3:** Data similar to those of Table 2 presented according to respiratory efficacy.

**Figure 2:** This representation taken from the first study already shows individual variations in response to therapeutic mandibular advancement. AHI: apnea-hypopnea index (events/hour), RHA with Herbst splint. Note here that patients starting with a high index finally achieve an index close to that of patients with low initial levels of apnea. Study by Eveloff et al. [3].

**Figure 3:** Same response variability as in (figure 2). Note the high degree of variability in response, with some patients achieving a 100% reduction in their apnea (case 18). Note that only three cases do not reach normal levels. Johal and Battagel [15].
Technical support

Patient comfort must be sought carefully at the first appointment. To eliminate the pains of ATM and musculature, nothing is more effective than activating the propulsion gradually. Thus, the masticatory muscles and the back-meniscal ligaments have time to become accustomed without painful reaction [44]. Postherpetic expressed in many articles (Bloch, Evenoff, Clark) could be prevented by reducing the magnitude of the propulsion from the start of treatment. Also in those first moments, the practitioner should be concerned about the retention of the orthosis: too maintained, it will require grinding; too loose, it will require a reline. A special care should be given to the adaptation of the lower lip opposite the pivots. With some forms of arches and adjacent tissues, it will not hesitate to change the location of these pins:

The manufacturing process: Breakage, lack of retention or unexpected discomfort always originally a development error. The meta-analysis of 36 Ahrens 2010 (of 1475 references) joined our opinion, “The success and subjective input depend on a variety of factors including the type of material, technical or manufacturing model devices individualized to determine the propulsion.”
Also remember a manufacturing protocol bringing more unreliability:

- To secure the inclusion of son and pivots, the molding technique can be used using two plates: a first formed on the model is 0.5 mm thick and a second 1.5 mm thick.

- This way allows to include completely metal and resin filling between the two thermoformed sheets. In addition, it eliminates contact between the lining and metal for comfort.

- The titration is done by reducing the length of tube or by setting calettes crimped on the axis.

Note, finally, that all the authors propose to add vertical elastic rods on the gutters to force the patient to close the mouth.

### Implementation and Monitoring Treatment

The Church of study 38 concludes by noting that one-day training for a general is sufficient to control it. (Success rate 48%). Any pain, any discomfort may result in discontinuation of treatment, especially in the absence of motivation by a practitioner. A decreased range of propulsion as the grinding sound associated with a few words of comfort can go a tour status to failure.

### Conclusion

If Herbst updated on gutter device is a generic method for reliable and proven mandibular propulsion. Also, the main failure of treatment with orthoses Herbst is not medical but behavioural, by

*Table 4: Presentation according to complaints expressed by patients.*
patient membership loss. It is on this crucial point that the expertise and knowledge provide the practitioner, came to the fore. Without controls, parasites tooth movement can occur and develop. How to eliminate injuries, pain and discomfort without careful control? How to avoid the abandonment, without encouragement and information from the practitioner? How to conduct suitable treatment with a faulty initial dental condition? How not to expose themselves to major failures without following a reliable and rigorous manufacturing process?

References


44. Health authority, Medical devices and associated services for the treatment of respiratory insufficiency and sleep apnea. Framing Note March 30, 2011.