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**Case report**

# Verification of the Effectiveness of Occlusal Treatment Using Postural Information: A Case Report

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## Abstract

Occlusal treatments can cause irreversible dental changes without guaranteeing clinical success. To avoid this, an initial, non-mutilating, phase of treatment using splint, for example, followed by an objective evaluation of the effectiveness is required before moving to next phase that permanently freezes the new mandibular position. As an example, a 74 years-old European female who consulted for tinnitus was referred, prior to any procedure, to a posturologist who established an initial postural assessment. A splint was made to increase the height between posterior teeth. 6 months after the tinnitus had disappeared, the patient was sent for postural assessment (made by the same posturologist and using the same tests). After an additional increase in posterior teeth height validated by an additional postural analysis, new fixed prostheses were placed taking into account the respective increases in height validated during this initial phase of treatment.
Monitoring the effectiveness of initial and reversible stage is important as in occlusodontology, the disappearance of clinical symptoms is not always synonymous with healing. Moreover this is an interesting way to improve the rigor of patient management.

***Keywords:*** ***occlusion; splint; tinnitus; posturology; case report***

## Introduction

The relationship between occlusion and posture is supported by the extensive statistical evidence from observations and experimental data [1,2,3] and temporomandibular joints (TMJ) could be an outer entrance of postural regulation [1,4] as are the eyes [5], feet, and even spatial hearing [6]. For example, a disruption of these balance sensors may be responsible for postural impairment syndrome, which is characterized by symptoms ranging from mobility restriction, dizziness, and tinnitus, and that may potentially be painful [7]. However, the mechanisms involved in this relationship are not known [8] but there are many theories attempting to explain the observations and infer from them treatments [9] that are not objectively evaluated and the success of which is limited [10]. Currently, clinicians rely on the reduction of symptoms in the absence of clinical signs but this is highly subjective and is influenced by the trust relationship developed with his/her patient. This is all the more important since such treatments can lead, after the interception and stabilization stage, to irreversible dental modifications, including modification of dental crowns by addition or subtraction, tooth movement, or even osteotomy using orthodontic or orthosurgical protocols [11,12].

## Method

Prior to any procedure, the patient has to be referred to different specialists to which the symptoms reported by the patient may be related (for example otoraryngologist for tinnitus). If these specialists do not detect any cause likely to explain the symptoms, an occluso-postural assessment may be considered. The patient can either consult the posturologist who will ask for a dental opinion to explore an occlusal cause or consult the dentist who will ask for a postural opinion if postural symptoms are suspected to be of occlusal origin. The posturologist establishes the initial postural assessment to state the diagnosis of occlusal disturbance causing a postural disorder, which is also used to follow the course of the initial and reversible part of the occlusal treatment. The postural assessment is as follows: after anamnesis, it begins by a stabilometric examination that consists of the recording of the moving projection of the patient's center of pressure (COP) under standard conditions, using a force platform. This device aims to

measure and observe the way the patient stands and aims to quantify his/her stability, following, the stabilometric standard protocol defined by the French Association of Posturology (AFP 85 standard) [13]. The posturologist completes the stabilometric examination using different tests (Barré's vertical test, Fukuda test, postural evaluation, imprint convergence test, Romberg test) and, if necessary, sends the patient to one or more specialists according to the identified cause(s) of postural disorder.

A summary sheet contains all these informations, the overlap of which makes it possible to establish a positive diagnosis and therefore a treatment plan. This treatment plan consists of two successive phases, of which only the first will be detailed in the present article. The first phase is reversible and must ensure the success of the treatment while not making changes to the teeth or prostheses present in the mouth; therefore, it uses a removable device consisting of a splint. The second phase must perpetuate the result obtained previously thanks to irreversible occlusal and/or anatomical modifications; it aims to maintain the mandibular repositioning allowed by the splint while eliminating related discomfort and aging of the material. The splint uses a Gelb design: two posterior sectors of hard transparent methacrylate resin over the teeth and an anterior metallic lingual bar. It allows the mandibular condyle to go lower inside the TMJ, and then create, secondarily, an inclination, symmetrical or not, centered at the level of the posterior teeth thanks to the anterior part remained free. To obtain muscles and TMJ physiological changes, the device must be worn all the time, but to avoid device fracture we advise patients not to wear it during meals. To artificially synchronize muscles contractions and occlusion, methacrylic resin material in plastic phase is placed on the top of the splint as the patient is asked to swallow while biting lightly. After polymerization, the resin is carefully removed to keep only contacts between mandibular fossae and maxillary cusps in a static occlusion. Special attention should be paid to remove the occlusal contacts on the non-working side since they may cause joint disorders. It can be noted that according the diagnosis, there is an initial discrepancy between the maximal intercuspal position and the synchronized contractions of temporal muscles which disappears thanks to the resin added to the splint. It is therefore normal that the patient, at the beginning of using the splint, feels an overbite on the side where the muscles contracted secondarily.

The splint and the synchronization between occlusion and muscle contractions, as well as the evolution of tinnitus have to be monitored every three weeks. At each visit, according to the muscular repositioning, the reworking of the initial occlusion and functions (such as phonation), which may be disturbed by the splint, methacrylic resin can be added to one side of the splint or removed from the other side depending on whether the height of the splint has physiologically to be increased or not. After the symptoms have disappeared, the rotation movement can be initiated by removing the anterior contacts between the teeth and the splint in a progressive way by finally maintaining only the posterior contacts. This modification allows the mandible to perform a rotation movement centered on the posterior teeth thanks to the splint design. The splint is subsequently monitored every three weeks and the new anterior occlusal contacts that appear during the rotating movement have to be removed at each visit. The end of this mandibular rotation movement is reached when occlusal contacts are spread over all teeth.

It is interesting to note that there should be a newly posterior space between the upper and lower posterior teeth, which can be different depending on the side, when swallowing without the splint, while the anterior teeth are in contact. Although many parameters (phonation, labial competence, and aesthetics) can be satisfactory in a context of disappearance of tinnitus, a postural end-of-treatment analysis, made by the same posturologist and using the same tests, is compared to the initial assessment. This indicates the extent to which the posture has changed and brought closer to statistical normality as defined by the AFP 85 standard and provides objective information as to the effectiveness of the initial treatment. Once the initial treatment has been validated, the space released on the posterior level during swallowing during light biting, is recorded using for occlusion impression material, such as silicone, methacrylic resin or wax. While the permanent prostheses are being made, temporary overlays of methacrylic resin are used.

## Case Presentation

A 74-year-old European female patient consulted for tinnitus more present on the right than on the left side. Tinnitus first appeared three weeks after the replacement of the right lower molars and the second premolar by prosthodontic fixed implants. Since etiological investigation of the inner ear by the otolaryngologist was not successful, the patient consulted to explore the potential dental cause. During a comprehensive examination at the dental office, in which no evidence of dysfunction was found in the occlusion and temporomandibular joint examination, the patient was asked to bite gently until first contact while biting gently during swallowing and then biting strongly in the same position; during light biting a contraction of the left temporalis muscle was observed while there was no contraction of the right temporalis muscle; during strong biting there was contraction of both the left and right temporalis muscles; the interpretation was that there was an offset between the position of maximal intercuspation and the symmetrical isometric contraction of the temporalis muscles. This led us to suspect that the implants were out of occlusion on the right side allowing the mandible to rise a little higher during swallowing on this side. The patient was then referred, prior to any procedure, to a posturologist who established an initial postural assessment and confirmed the diagnosis of occlusal disturbance causing a postural disorder (**Fig. 1**).

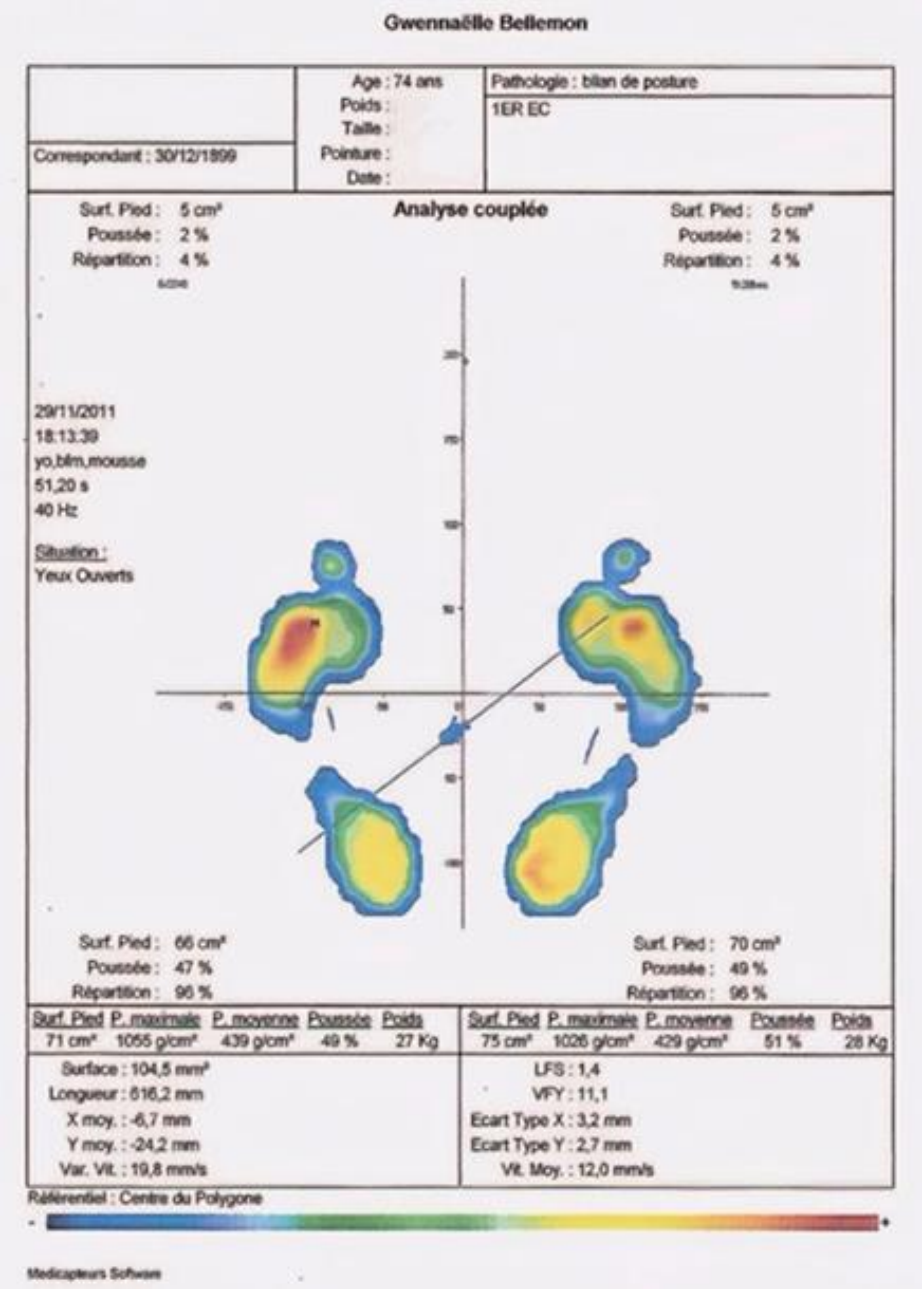


**Fig. 1: Datasheet of the stabilometric results using Fusyo®; Medicapteur™, (Médicapteurs France SAS, Balma, France) before treatment**

We therefore proposed a mandibular splint, as described above, to increase the height between the upper and lower posterior teeth especially on the right side. The first step was to place methacrylic resin material in plastic phase on the top of the splint and to ask the patient to swallow while biting lightly. After polymerization, the resin was carefully removed to keep only contacts between mandibular fossae and maxillary cusps in a static occlusion. The splint and the synchronization between occlusion and muscle contractions, as well as the change in tinnitus while the splint was placed in the mouth, was monitored every three weeks. At each visit, and according to the muscular repositioning and the phonation, methacrylic resin was added to the right side of the splint. After three months, the patient reported that the tinnitus had disappeared. At this point, the rotation movement was therefore started by removing the anterior contact of the splint in a progressive way by finally maintaining only the posterior contacts. The splint was then subsequently monitored every three weeks and the new anterior occlusal contacts, appeared during the rotating movement, were removed at each visit. The rotating movement, made mostly on the right side, was considered as complete 6 months after the tinnitus had disappeared because the occlusal contacts, using the splint, were spread over all the teeth. It is interesting to note that there was a newly posterior space between the upper and lower posterior teeth mostly on the right side, during swallowing without the splint, while the anterior teeth were in contact. Aesthetic and physiological parameters such as labial competence, speaking and chewing were satisfactory. The patient was then sent for postural assessment (made by the same posturologist and using the same tests); comparison to the initial assessment found a still significant asymmetry between the right and left sides, despite the disappearance of symptoms. However, the postural end-of-treatment analysis suggested an additional increase in posterior tooth height, mainly on the right side, which was applied over 6 months, after the patient has returned to consult, and validated by an additional postural analysis that assessed the end of the initial phase of treatment (**Fig. 2**).

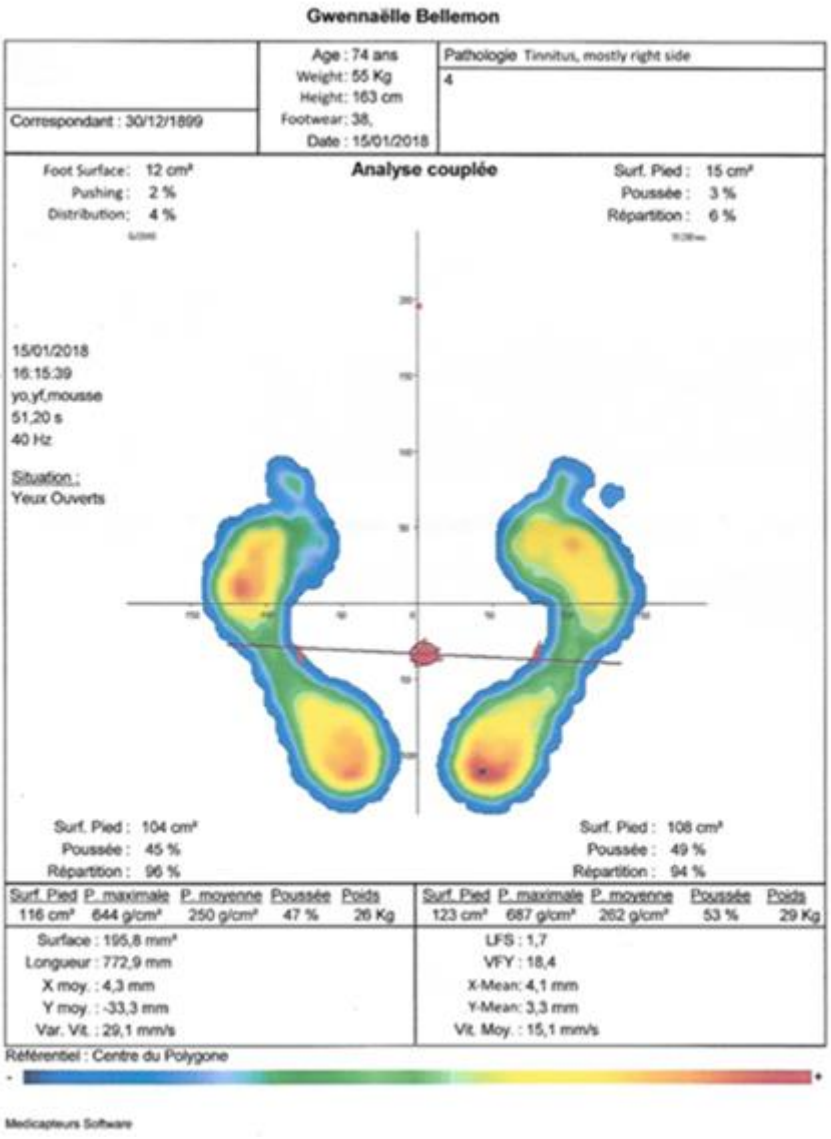


**Fig. 2: Datasheet of the stabilometric results at the end-of-treatment analysis**

The space released during swallowing, on the posterior level, was recorded using a silicone material made for occlusion (Occlufast rock™, Zhermack, Zhermack SpA, Badia Polesine, Italy) and in a temporary step, methacrylic resin overlays were clipped in the interdental spaces, to replace the splint (**Fig. 3**).

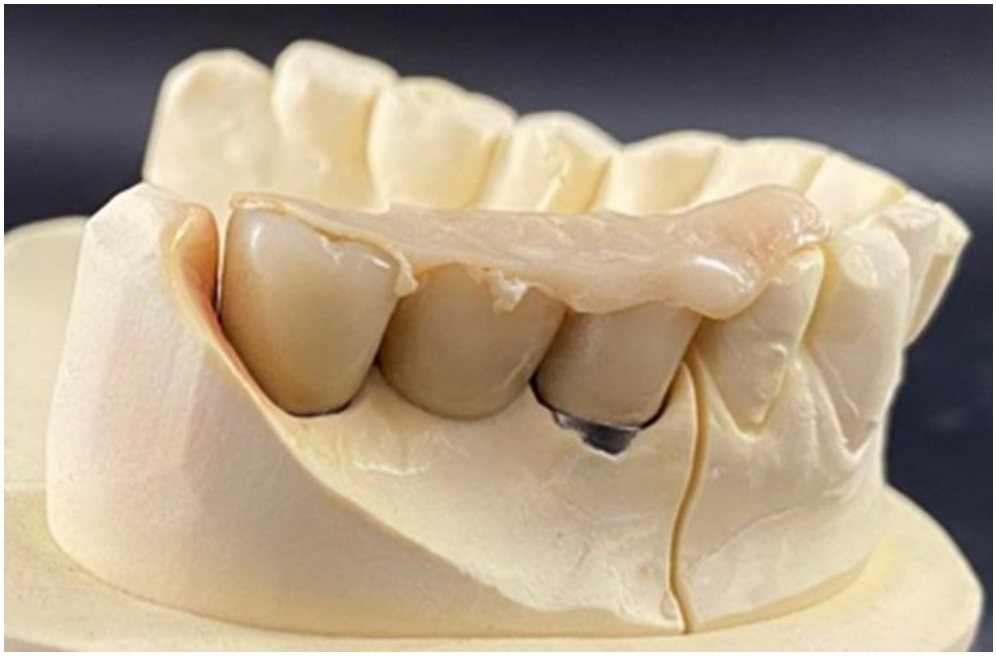

**Fig. 3: Methacrylic resin overlays on the old implant prostheses (mandibular right side)**

New prostheses were placed on teeth (maxillary left side) and on implants (mandibular right side), taking into account the respective increases in height (greater on the right side) validated during this initial phase of treatment. At the end of an eighteen-month monitoring period, no symptom reappeared, and the patient is doing well.

## Discussion

In the case presented, tinnitus was eliminated. This occurred during a phase of reversible treatment that was monitored by the posturologist using a splint designed by Gelb; once the symptoms disappeared and the postural end-of-treatment analysis validated, the replacement of the splint by dental and implant fixed prosthesis could be considered.

When an occlusal cause likely to explain tinnitus is found by the dentist, as is the case for posterior out of occlusion in the case presented, it is important to confirm the occlusal cause through a postural analysis if no objective cause explored by specialists has been found. This postural analysis will further be used to monitor the occlusal treatment because changes in mandibular position can be observed by different postural tests [14] particularly when compared to the initial situation. This is all the more important as in occlusodontology the disappearance of clinical symptoms is not always synonymous with healing [15]. Therefore, as in the case in other fields of medicine, where additional tests such as x-rays, audiograms or blood tests, can be used to confirm or exclude the diagnosis of healing, it seems relevant to have a way to observe the effects of the changes in the mandibular position, following occlusal treatment, using information other than those provided by the patient or observed by the dentist; in the present case of tinnitus, such information can only be considered as subjective [16]. However, the validity of posturology tests is debated because of potential biases induced by the repetition of measurements needed but also that the mechanisms involved in postural control are not scientifically supported [17]. Despite this, the overlapping data provided by these tests, combined with very strict implementation protocols, allow to define statistical parameters of normality. This is particularly the case for stabilometric data; for example, the Japanese reference database from which 2 201 Japanese individuals (1013 men and 1188 women) are used to define the postural normality criteria [18] and the French reference database used to define the postural normality criteria of the AFP 85 standard.

Changes in occlusion (by addition, such as new crown, splint or restoration; or by subtraction, such as carious material removal or loss of tooth structure related to pulpitis treatment, for example) can be very rapid, but, as for any biomechanical change, the occlusal balance takes more time and the impact of this change on the muscles requires many weeks [19]. This is why treatment in the case presented was re-evaluated every 3 weeks as progressives changes were made on the splint according to the synchronization of the temporalis muscles; it allows not only cellular changes inside muscles (3 to 7 days) necessary to move the muscle insertions, but also more complex changes (muscles, fascia, ligaments) involved in postural reshuffle [19].

At the end of the reversible treatment, temporary overlays using a clipping system were preferred over bonding to allow easy disassembly and repositioning during the prosthodontic reconstruction phase. This mechanical repositioning limits occlusal errors and preserves the result of the initial treatment. These temporary overlays also allow us a final simulation, especially during chewing, before making permanent prosthodontics.

In addition, although symptoms with an occlusal origin and causing a postural disorder can be very debilitating (pain, tinnitus, vertigo, etc.), their origin must absolutely be corroborated by the orofacial and dental examination and by the postural analysis after elimination of other causes. If so, the practionners (dentist, podiatrist, orthoptist, …) involved in the treatment plan must have relevant discussions about the patient, in order to manage the physiological interactions (the most disruptive sensory sensor is treated first) and to optimize the treatment.

If all these conditions are not fulfilled, no treatment should be undertaken. Furthermore, if the patient has a postural disorder that is confirmed by an orofacial examination, but if that disorder is not symptomatic, we strongly suggest to only monitor the evolution over time of this imbalance as recommended by the scientific societies of occlusodontology [20].

## Conclusions

Verification of the effectiveness of occlusal treatment through postural measures is a way to improve the rigor and the quality of patient management particularly if it occurs in the initial and reversible phase of treatment.

## Ethics approval and consent to participate

Although the case report has been anonymized, the patient provided informed consent for a publication.

## Data Availability

Not concerned

## Conflicts of interest

The author(s) declare(s) that there is no conflict of interest regarding the publication of this paper.

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## Authors' contributions

Christophe Jeannin and Gwenaelle Bellemon directed together this clinical case. Christophe Jeannin wrote the manuscript. Mathieu Moreno and Sarah Gebeile-Chauty reviewed and modified it. All authors read and approved the final manuscript.

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