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# DYNAMIC ANALYSIS OF THE BODY'S BALANCE WITH THE AID OF PODATA PLATFORM IN PATIENTS WITH VESTIBULAR DISORDERS AND MALOCCLUSIONS

Miroslav Stoykov<sup>1</sup>, Mario Milkov<sup>1</sup>, Hristina Arnautska<sup>2</sup>

<sup>1</sup>*Department of Dental Material Science and Prosthetic Dental Medicine,  
Faculty of Dental Medicine, Medical University of Varna*

<sup>2</sup>*Department of Orthodontics, Faculty of Dental Medicine, Medical University of Varna*

## ABSTRACT

**Introduction:** Human posture is linked to a certain stable anatomic position between head, body, and upper and lower limbs. Posturology is the science for the human posture. The connections between the vestibular, ocular, stomatognathic, postural, and proprioceptive systems are studied due to their muscular chains interconnections.

**Aim:** The present research aims to study the characteristics of the body's balance in patients with vestibular disorders and orthodontic malocclusions, utilizing the PODATA platform.

**Materials and Methods:** A total of 83 patients in the time period November–July 2022 were included. All patients filled out written informed consent forms in order to participate. The study received approval by the Medical University of Varna's Ethics Committee. Patients were also provided with questionnaires in order to assess their symptoms. An ENT specialist and a dentist examined all patients. Patients were divided into several diagnostic groups.

**Results:** When examined on the platform, patients shifted the center of gravity (CoG) of the body more often backwards and to the right side. Most patients with a shift of CoG backwards and to the right had a temporomandibular disorder (TMD) on the left side. Female patients were more affected than male ones. In patients who also had a vestibular disorder, CoG of the body was more often shifted backwards and to the right. Thirty-one had a malocclusion. Patients with a change of the middle line and deep bite were the most prevalent and they shifted CoG backward and to the right or only backwards.

**Conclusion:** The presented study confirmed that there is a connection between the postural, stomatognathic and vestibular systems. Disorders in either of the systems results in consecutive changes in the others.

**Keywords:** *dynamic posturography, balance, malocclusions, vestibular and temporomandibular disorders*

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### Address for correspondence:

Miroslav Stoykov  
Faculty of Dental Medicine  
Medical University of Varna  
84 Tzar Osvoboditel Blvd  
9002 Varna  
e-mail: miroslav.stoikov93@gmail.com

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## INTRODUCTION

According to the confirmed definition, human posture is linked to a certain stable anatomic position between head, body and upper and lower limbs, where a minimal amount of energy is needed for support (1). Everyday static and dynamic movements are performed thanks to a number of systems, one of which is the postural system (2).

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Posturology is the science for human posture. It studies the characteristics of posture in health and when there is a disorder. The history of the stated science dates back to the 1950s (2,3). Nowadays, it is paid special attention. Society is being acquainted with the postural disorders and their connections with vestibular, ocular, stomatognathic, and proprioceptive systems thanks to the large amounts of information in the scientific journals, popular science websites, mass media (4–6). The age at which these disorders (postural, dental malocclusions, ocular, vestibular—tinnitus, vertigo, dizziness, sleep problems, obstructive sleep apnea) occur tends to become lower (4–10). There are studied connections between the systems mentioned, due to their muscular chains interconnections. According to some authors, there are relationships between the posture system, the stomatognathic system, the audiovestibular system, and the ocular system. Other clinicians disagree. All agree that disorders in the stated systems diminish the quality of life of the patients. A change (shift) of the center of gravity (CoG) of the body is a sign of a postural and/or vestibular disorder (10–15).

### AIM

The present study aims to study the characteristics of the body's balance in patients with vestibular disorders and orthodontic malocclusions, utilizing the PODATA platform.

### MATERIALS AND METHODS

A total of 83 (52 females and 31 males, minimum age = 8, maximum age = 86, mean age = 41.398) patients who have passed through the Audiovestibular and Sleep Laboratory of the University Medical and Dental Center at the Faculty of Dental Medicine, Medical University of Varna in the time period November–July 2022 were included in the presented study. All patients filled out written informed consent forms in order to participate. They were explained all the details regarding the prepared examinations and tests and the expected outcomes. The study received approval by the Medical University of Varna's Ethics Committee (KENI, MU-Varna). Patients were also provided with questionnaires in order to assess their symptoms from the audiovestibular and stomatognathic systems. An ENT specialist and a

dentist examined all patients in order to determine if the symptoms were due to a disorder in the vestibular or in the stomatognathic system (occlusion), or it was a case of a mixed etiology. The dynamic stabilometric PODATA platform (part of the Global Postural System Leonardo PL0800, Chinesport, Italy) was implemented to perform dynamic posturography on all patients and to assess their body's balance. Clinicians studied the shift of patients' center of gravity under three different modalities—with eyes open/closed, teeth clenched/relaxed, head tilted left and right, for fixed amount of time—20 sec, as well as the occlusion, marking whether or not there were any disorders with teeth positions and temporomandibular joints. Each patient stood still in an upright position on the posturographic platform, which possesses the feature to take high definition pictures (HD video camera and a mirror supplied) of their feet and measure a number of indicators, e.g., the shift of the body's CoG, the shift of the body's mass to either foot, confidence ellipse area, curve length, and others. In order to fulfil the aim of the study, patients were assessed according to the presence of a temporomandibular disorder (TMD) and a shift of CoG, the presence of a vestibular disorder and a shift of CoG, a presence of a malocclusion and a shift of CoG. Twenty-eight patients were diagnosed with a TMD.

### RESULTS

When examined on the platform, patients shifted the CoG of the body more often backwards and to the right side (especially if the TMD was bilateral). Most patients with a shift of CoG backwards and to the right had a TMD on the left side. On Fig. 1 the number of patients and the direction of displacement of their bodies' CoG is seen. Female patients were more affected than male ones. More of the body's mass was shifted to the right foot and backwards. The TMD patients who did not change their CoG were only 2.

In patients who also had a vestibular disorder (dizziness, vertigo, change of the gait)—a total of 40, half of the patients examined, the CoG of the body was more often shifted backwards and to the right, as visible on Fig. 2.

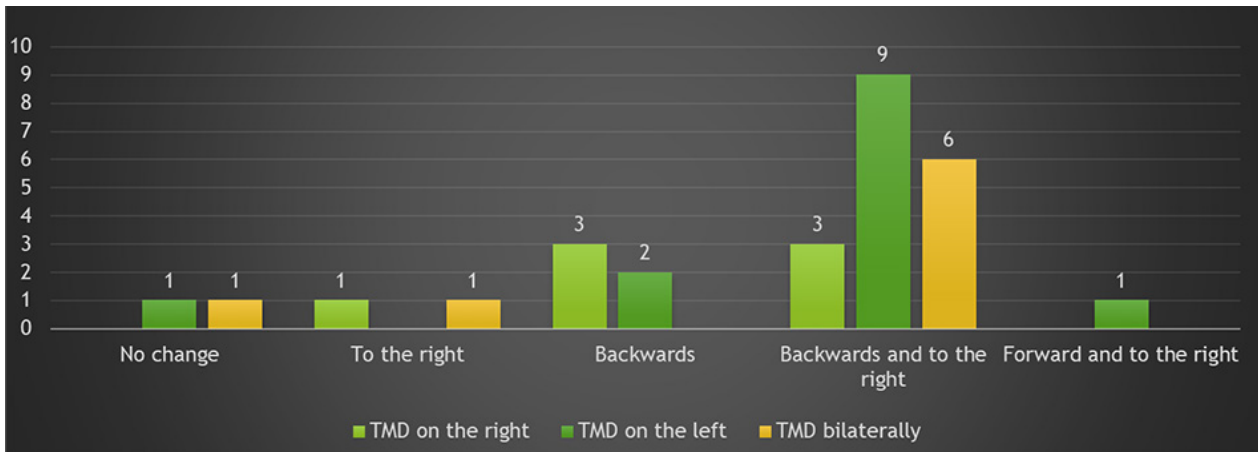


Fig. 1. Patients with a TMD who displace the CoG of their bodies and the direction of displacement.

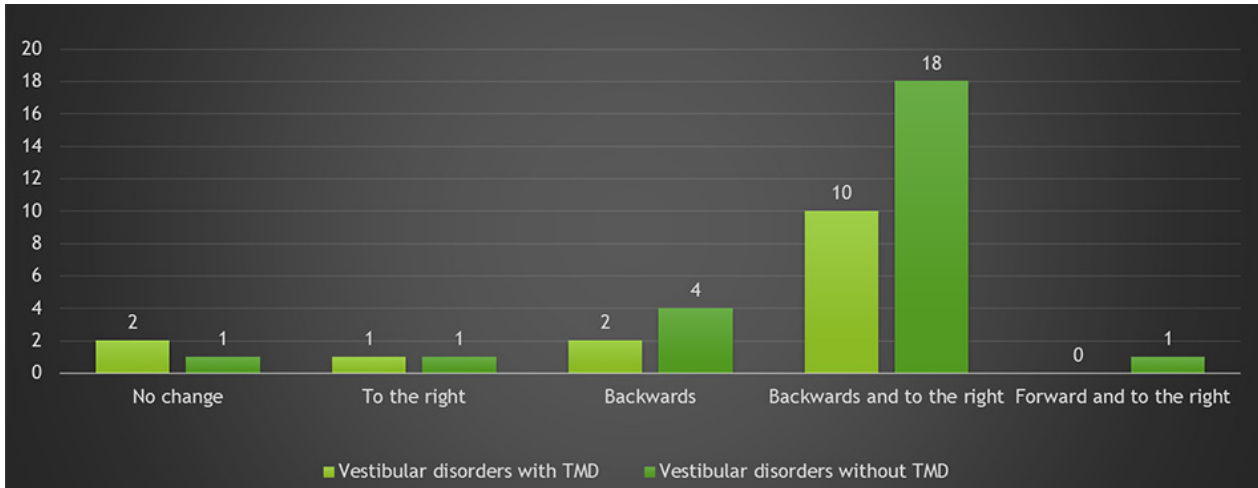


Fig. 2. Patients with a vestibular disorder in regard to the presence of a TMD and direction of displacement of the CoG

Of the 83 tested patients, 31 had a malocclusion. With the implementation of intraoral dental examinations, patients with Angle class II (distal bite), Angle class III, crossbite in the lateral area, laterognathia, changed middle line, open bite, deep bite, deep overlap, edge-to-edge occlusion, were diagnosed. Patients with a change of the middle line and deep bite were the most prevalent and they shifted CoG backward and to the right or only backwards (Fig. 3)

A popular patients' question was if the posturographic platform was a source of ionizing radiation. Thanks to the system, combining HD

camera, LED diodes and a mirror, the answer provided was negative.

## DISCUSSION

Postural disorders worsen existing symptoms and the quality of life of the patients. Older patients tend to displace CoG more than younger patients, consistent with the results of other studies. Connections between the stomatognathic, vestibular, and postural system have been proven, as it was done in other studies. Scientific literature does not contain enough evidence in support of the shift of the body's mass being a factor when the patient suffers from one disorder or a combination of two or more (1, 16–20).

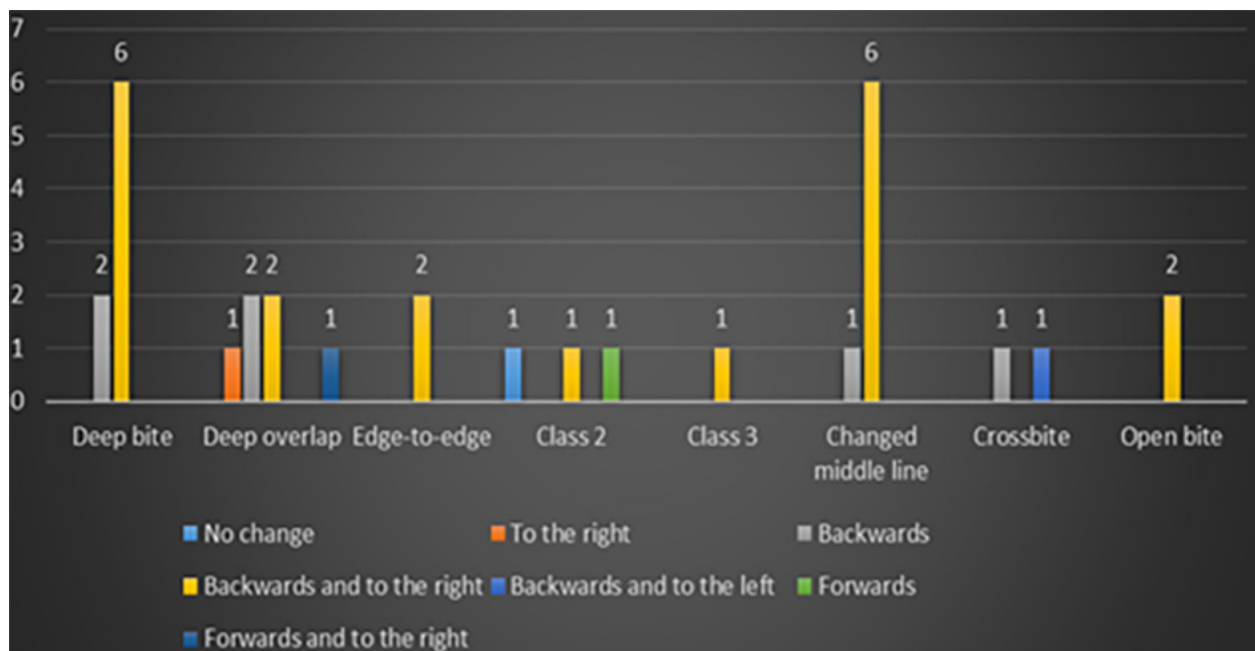


Fig. 3. Direction of displacement of the CoG of patients with different malocclusions

## CONCLUSION

The presented study confirmed that there is a connection between the postural, stomatognathic, and vestibular systems. Disorders in either of the systems result in consecutive changes in the others. Clinicians who are a part of interdisciplinary diagnostic teams are the present and the future of the clinical medicine.

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