Journal of Electromyography and Kinesiology 37 (2017) 21–24

Contents lists available at ScienceDirect

Journal of Electromyography and Kinesiology

journal homepage: www.elsevier.com/locate/jelekin

Postural stability in subjects with temporomandibular disorders and healthy controls: A comparative assessment

Alessandro Nota[a,b,*], Simona Tecco[a,*], Shideh Ehsani[a], Johnny Padulo[b,c], Alberto Baldini[a,b]

[a] Dental School, Vita-Salute San Raffaele University, Milan, Italy
[b] Faculty of Kinesiology, University of Split, Croatia
[c] University eCampus, Novedrate, Italy

ARTICLE INFO

Keywords:
Posture
Postural balance
Temporomandibular joint disorders
Mandible
Masticatory muscles

ABSTRACT

Purpose of the study: The influence of the stomatognathic apparatus on body posture is a continuously discussed topic with contrasting results. The aim of this study is to analyze differences in postural stability between subjects with and without myogenous TMD.

Methods: 25 subjects affected by myogenous TMD according with DC/TMD (6 males, 19 females; mean age 31.75 ± 6.68 years) and a healthy control group of 19 subjects (4 Males, 15 Females; mean age 27.26 ± 3.85 years) were enrolled in the study.

Both groups underwent a posturo-stabilometric force platform exam under different mandibular and visual conditions. Sway area and sway velocity of the COP (Center Of foot Pressure) posturo-stabilometric parameters were evaluated and compared applying Mann-U-Whitney statistical test.

Results: The sway area and sway velocity parameters resulted statistically significantly higher in the TMD group (sway area $p < 0.01$; sway velocity $p < 0.05$) in mandibular maximum intercuspation and rest positions with eyes open.

Conclusions: This study demonstrates a significant difference in body postural stability between subjects with myogenous TMD and healthy controls. In particular, sway area and sway velocity postural parameters are increased in these subjects.

1. Introduction

The human posture is the result of positioning and orientation of the body and limbs in equilibrium with motion and gravitation. Postural adjustments, consisting in slight sways, include visual, vestibular and somatosensory inputs integrated in a complex regulatory system (Baldini et al., 2016; Ries and Bérzin, 2008). During the last years, various authors, discussed about the influence of stomatognathic apparatus on body posture with contrasting results (Baldini et al., 2013c, 2013b; Perinetti, 2007).

Temporomandibular disorders (TMD) is a collective term which includes a group of clinical conditions affecting the stomatognathic system, in particular the muscles of mastication and the Temporomandibular joints (TMJ) (Baldini et al., 2015b; Rocha et al., 2017).

No unequivocal definition of the disease exists and 2 classification schemes are used. The DC/TMD classification divides TMD into 2 syndromes: (i) muscle-related TMD (myogenous TMD), sometimes called TMD secondary to myofascial pain; and (ii) dysfunction Joint-related TMD (arthrogenous TMD), or TMD secondary to true articular disease. Myogenous TMD is more common. In its pure form, it lacks apparent destructive changes of the TMJ on radiograph and can be caused by multiple etiologies such as bruxism and daytime jaw clenching (Jerjes et al., 2008).

Arthrogenous TMD can be further specified as disk displacement disorder, chronic recurrent dislocations, degenerative joint disorders, systemic arthritic conditions, ankylosis, infections, and neoplasia, and present destructive changes of the TMJ on radiograph.

A literature review (Chaves et al., 2014), concluded that there is a correlation between TMD and cervical posture and furthermore, subjects with TMD showed limited cervical spine mobility (Grondin et al., 2015; Grondin and Hall, 2017; Walczyńska-Dragon et al., 2014) thus, it should be considered that TMD can have an influence on body posture. Nowadays the current literature background on this topic is overall of low quality and for this reason Chaves et al. (2014) concluded that there is no evidence of absence of correlation between TMD and global body posture.

A recent study by Rocha et al. (2017) showed the absence of

* Corresponding authors at: Via Olgettina, 58 Milan (MI) 20132, Italy.
E-mail address: dr.alessandro.nota@gmail.com (A. Nota).

http://dx.doi.org/10.1016/j.jelekin.2017.08.006
Received 6 July 2017; Received in revised form 11 August 2017; Accepted 21 August 2017

differences in body posture between subjects with and without unilateral disk displacement in the TMJ. Furthermore, they interestingly state that the available literature on this topic focused on subjects with TMD pain, while such approach is likely not the most appropriate strategy to assess the phenomenon, since the presence of pain may provoke a demand for postural adaptation, viz., postural changes potentially being the effects and not the cause of the symptoms (Rocha et al., 2017; Manfredini et al., 2012).

Thus, the aim of this study is to analyze the postural stability (the sway area and the sway velocity of the body Center of posture) of patients affected by myogenous TMD (i.e. pain at manual palpation of masseter and/or temporalis muscles and absence of spontaneous pain), and compare the data with control healthy subjects.

2. Methods

2.1. Subjects

After a proper oral and anamnestic examination and TMJ screening of the subjects performed by an expert operator to seek out dental occlusion abnormalities or TMD, 25 subjects examined for oral health at the dental clinic of the institute and diagnosed as affected by myogenous TMD according with DC/TMD (6 males, 19 females; mean age 31.75 ± 6.68 years; mean weight 61.04 ± 8.69 kg; mean height 169.68 ± 6.51 cm) were enrolled in the study. The ethical committee of the institute approved the protocol where all the subjects signed an informed consent form prior to their participation.

All the subjects had to meet the following inclusion criteria: diagnosis of myogenous TMD according to local myalgia described in DC/TMD, absence of spontaneous pain (myogenous pain at rest or without specific causes), absence of pain during the postural exam, good general health according to medical history, absence of trauma or surgery which could influence posture, absence of visual or vestibular problems, absence of any other disorder able to influence posture, absence of evident postural problems, presence of not less than 28 teeth, absence of crossbite, dental overjet between 1 and 4 mm, absence of cast restorations and extensive occlusal restoration (less than 3 teeth with onlay restorations), absence of previous orthognathic surgery, absence of ongoing orthodontic treatment or previous orthodontic treatment during the last 3 years.

Then, a control group of 19 subjects (4 Males, 15 Females; mean age 27.26 ± 3.85 years; mean weight 61.31 ± 11.91 kg; mean height 170.32 ± 9.59 cm) was also enrolled following the previous inclusion criteria but free from TMD signs and symptoms.

All subjects were blinded to the aim and design of the study. In both groups there were no semi-professional of professional athletes or obese subjects.

2.2. Test procedure

Both groups underwent a posturo-stabilometric force platform exam (Postural Health Station, DL Medica S.p.A. Milano, Italy) under the following conditions in random order: mandibular rest position (REST) obtained asking the subject to maintain an habitual relaxed condition of the masticatory muscles without any contact between the dental arches, maximum intercuspation (MAX INT) obtained asking the subject to close the mouth achieving and maintaining an habitual and stable contact between the dental arches and mandibular position with cotton rolls (ROLLS) achieved positioning cotton rolls 8 mm thick and 37 mm long between the dental arches distal to the canines. Each recording lasted 51.2 s and the test was repeated with both eyes open (EO) and closed (EC).

The force platform was placed in order to position subjects perpendicularly faced to the wall at 150 cm. Quiet conditions were maintained during the exam, without any disturbing element that could affect the posture. The subjects were asked to remain as stable as possible, relaxed, with their arms hanging free beside their trunk, and facing the wall without concentrating on a precise point on it. Alcohol, sport and conservative dental therapies had to be avoided during the 24 h before the clinical recordings.

The subjects were positioned on the force platform according to the following rules: feet angle of 30°, calcaneal tendon positioned in correspondence of the length of the foot expressed in French points marked on the surface of the platform, malleolus positioned in correspondence of the angled line marked on the surface of the platform, second toe root projection correspondent to the principal line marked on the surface of the platform, foot outline correspondent to the areas drawn on the surface of the platform.

This protocol was previously tested for reliability achieving excellent intrasession and good intersession results (Baldini et al., 2013a; Bauer et al., 2010; Lafond et al., 2004).

2.3. Data analysis

An a priori power analysis was performed, on the basis of a preliminary pilot study conducted on a part of the final sample of the present study, in order to determine the necessary sample size for achieving a minimum 80% power with an alpha error probability of 5% on the sway area parameter considered as primary outcome; thus it was established to reach a minimum of 16 subjects per group.

Sway area and sway velocity of the COP (Center Of foot Pressure) posturo-stabilometric parameters were evaluated and summarised as means and SDs, according to the test condition. Because Kolmogorov-Smirnov test showed a non normal distribution of the data, Mann-U-Whitney test was used to verify the differences in parameters between the two groups.

The significance was set at $p < 0.05$.

The method error, determined according to Dahlberg's formula applied on two repeated recordings on a sample of 20 subjects, was equal to 0.29 mm/s for the sway velocity parameter and 10.98 mmq for the sway area parameter.

3. Results

Sway area and sway velocity resulted higher in the TMD group compared with the control group as confirmed by the significance of the differences between the two groups (Table 1).

In particular, the sway area parameter resulted statistically significantly ($p < 0.01$) higher in the TMD group in REST EO (61% higher than the control group), in MAX INT EO (151%) and in MAX INT EC (193%) conditions.

The sway velocity parameter resulted statistically significantly ($p < 0.05$) higher in the TMD group in REST EO (18%) and MAX INT EO (48%) conditions.

4. Discussion

This study was performed to assess the differences in body postural stability between subjects with spontaneous-pain-free myogenous TMD and a healthy control group.

The method error analysis showed a good reproducibility, applied on two repeated recordings on a sample of 20 subjects (it was equal to 0.29 mm/s for the sway velocity parameter and 10.98 mmq for the sway area parameter). This is also confirmed by recent literature COP displacements are well reproducible within-day, but had significant between-days variations, and thus should be performed in the same session (Lovecchio et al., 2017).

In the present study, subjects affected by arthrogenous TMD were excluded because of the clinical, biological and etiological relevant differences between myogenous and arthrogenous TMD, which could have compromised the correct interpretation of data. Furthermore, a recent study (Rocha et al., 2017) showed a well-preserved postural