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POSTUROSTABILOMETRIC EVALUATION OF PLANTAR VARIATIONS IN PATIENTS WITH TEMPORO-MANDIBULAR DYSFUNCTION: A CASE-CONTROL STUDY

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The aim of this experimental study was to find out if temporo-mandibular dysfunctions (TMD) can influence two of the parameters defining body posture, intersolar distance and plantar lay. Test group (TG) was made of 52 subjects (14 males and 38 females aging from 12 to 64 years, average 34.25 ± 12.96.) all affected by temporo-mandibular dysfunctions. Control Group (CG) was made of 52 subjects (21 males and 31 females aging from 16 to 56 years average 34.19 ± 13.40) completely negative for temporo-mandibular or occlusal dysfunctions. The posturo-stabilometric measurements were made using a stabilometric platform and the following conditions were investigated: mandibular rest position (rest) and intercuspidal position (icp) with both eyes open/closed. For both conditions the following parameters were recorded: sway area, sway velocity, sway length, sway velocity variation, weight distribution, right foot angle, left foot angle, the sum of feet angles, bar torsion angle and intersolar distance. The results of our study show that there is a detectable difference between Test and Control group in intercuspal position.

Human posture is the resulting of the position and orientation of body and limbs in order to maintain equilibrium against the force of gravity.

Postural adjustments, consisting of slight swaying movements, comprehend visual, vestibular and somatosensorial inputs integrated by a complex regulation system (1).

Many studies have underlined that respiration, head and neck position, mood and in a particular anxiety, can influence body posture (2, 3).

Dentistry literature, yet, reports many observations respect the influence of body and head posture on the mandibular rest position, on the range of its movements and on the final intercuspidal position (4). The masticatory muscles activity seems to be correlated with the trunk and neck ones, in fact, alterations of muscular body equilibrium can influence mandibular position (5, 6) and facial morphology.

Human body can compensate postural alterations, in healthy subjects better than in patients with occlusal dysfunctions (5).

Recent studies evidence a potential role of dental occlusion(7-10) and trigeminal afferences in the determination of postural control, as the afferences from the periodontal system, from the masticatory muscles and from the Temporo-mandibular Joint (TMJ) converge in the trigeminal nuclei. Recent neuroanatomical studies has evidenced a projection of the trigeminal neurons to the vestibular nuclei(11) and trigeminocerebellar links, although the functions of these remain to be defined (12). However, they are of interest since these anatomical areas are involved in body posture (12). Moreover, several studies seem to indicate that different mandibular positions induce variations in body posture (10, 13, 14). Other studies suggest that dental occlusion may influence head posture (15), spine curvatures (e.g., scoliosis and lordosis) (8, 16, 17) and even leg length (18). According to these findings, previous investigations using posturography described correlations between body posture and dental occlusion (10), postural sways

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stabilisation (7) and diminishing of trigeminal afferences through unilateral anaesthesia (12). In contrast, an earlier study published about 12 years ago did not support a similar correlation (19).

The results of an experimental study published in 2005 do not support the correlation between dental occlusion and body posture. Actually, the findings of this study are considered not valid because the test group examined were totally healthy patients and did not present any dental occlusion alteration (20). Also other studies asses that there is no detectable correlation between posture and temporo-mandibular dysfunctions or occlusal alteration (21, 22).

A huge literature review published some years ago, settled that there is no scientific evidence that justifies occlusal therapy for the treatment of postural disorders and vice versa (23).

In accord with the hypothesis that dental occlusion may influence body posture (10, 19) dysfunctions, such as chewing and swallowing of the masticatory muscles can be transmitted to distal musculature along the so-called "muscle chains" (18).

Only one article in literature, based on an experimental study on rats, settles that vertebral spine alignment seems to be influenced by an alteration of occlusion caused by a monolateral molar pad (16).

In spite all, the influence of occlusal factors in body posture is yet to be established.

For these reasons we designed a study aiming to find out if patients showing Temporo-mandibular Dysfunction (TMDs) present also a variation of the distance between the two foot centres (intersolar distance) and, consequently, of the foot lay.

MATERIALS AND METHODS

Test group (TG) included 52 subjects,14 males and 38 females (ages 12 to 64 years mean age 34,25 ± 12.96) signing an informed consent form and satisfying the following inclusion criteria:

(i) good general health according to medical history and clinical judgement; (ii) negative history of vertigo through central nervous disease; (iii) no previous orthodontic or gnathologic treatement; (iv) absence of any particular episode of psychosocial and psychological stress profile in the last year; (v) no vestibular apparatus alteration; (vi) positive to gnathologic examination for Temporo-Mandibular Dysfunctions.

Control Group was made of 52 subjects, 21 males and 31 females (ages 16 to 56 years, mean age 34.19 ± 13.40) signing an informed consent form and satisfying following inclusion criteria:

(i) good general health according to medical history and clinical judgement; (ii) negative history of vertigo through central nervous disease; (iii) no previous orthodontic or gnathologic treatement; (iv) absence of any particular episode of psychosocial and psychological stress profile in the last year; (v) no vestibular apparatus alteration; (vi) completely negative for temporo-mandibular dysfunctions.

Posturography recordings were performed by using a 10 Hz sampling frequency vertical force platform (Lizard, Lemax s.r.l.Como, Italy) and elaborated by using the Lizard v 3.0 software (Lizard, Lemax s.r.l.Como, Italy). The platform transforms signals received by its load cells into outputs elaborated by the software and transformed in repeatable parameters like sway area, sway velocity, sway length, sway velocity variation and weight distribution. Besides, there are other parameters not directly provided by the software but that are easily detectable and in a repeatable way by making simple arithmetical operations based on data that the software provides. These parameters include: right foot angle, left foot angle, bar torsion angle and intersolar distance. For example, by making a simple addition/subtraction operation between the distance of each foot pressure centre from the central axis (data provided by the software) we obtained the distance between the two feet pressure centres and its' variation. (data detected indirectly).

All records were taken in a quiet room by the same expert operator. Patients were asked to remain as stable as possible, but relaxed, with their arms hanging free beside their body, facing the wall and gazing a point in the wall placed in correspondence with the central axis of the platfrom (80 cm away). Moreover they were asked to avoid physical stress, alcohol, coffee and exiting substances during the 24 hours before the recording.

The position of the patient on the platform is matter of argument in literature because of the hardly repeatable position of lateral malleulus in the oblique line of the platform. In order to avoid this error we created a tool which gives an exact projection of the centre of the lateral malleulus on the platform so we eliminated, or highly reduced, subjectivity in positioning the patient on the platform.

Two conditions, mandibular rest position (rest) and intercuspidal position without clenching (icp), were investigated with both open and closed eyes. The recording lasted 51.2 sec.

For both conditions the following parameters were recorded: sway area (sa), sway velocity (sv), sway length (sl), sway velocity variation (Δv), weight distribution (wd), right foot angle (rfa), left foot angle (lfa), the sum of feet angles (suman), bar torsion angle (bta) and intersolar distance (isd).

Data treatment

A non parametric results test (Wilcoxon Signed Rank Test) was used for the statistic treatment. Parametric results statistic tests were not considered valid because the sample did not satisfy the normality and homogeneity criteria.

Longitudinal statistic analysis rest *vs.* icp were made for Test and Control group.

Moreover was made a transversal test with the following criteria:

1. rest position, test group vs control group.
2. icp position, test group vs control group.

DISCUSSION

Recent Studies assess that does not exist any

Table I. *REST vs ICP IN TEST GROUP.*

REST VS ICP IN TEST GROUP	p value	significative
SA REST TEST *vs.* SA ICP TEST	p = 0,518	NO
SV REST TEST *vs.* SV ICP TEST	p = 0,925	NO
SL REST TEST *vs.* SL ICP TEST	p = 0,899	NO
DELTA V REST TEST *vs.* DELTA V ICP TEST	p = 0,764	NO
WD REST TEST *vs.* WD ICP TEST	p = 0,764	NO
RFA REST TEST *vs.* RFA ICP TEST	p = 0,005	YES
LFA REST TEST *vs.* LFA ICP TEST	p = 0,497	NO
SUMAN REST TEST *vs.* SUMAN ICP TEST	p = 0,001	YES
BTA REST TEST *vs.* BTA ICP TEST	p = 0,935	NO
SR REST TEST *vs.* SR ICP TEST	p= 0,444	NO
ISD REST TEST *vs.* ISD ICP TEST	p = 0,629	NO

Table II. *TEST GROUP vs. CONTROL GROUP IN REST POSITION.*

TEST GROUP vs. CONTROL GROUP IN REST POSITION	p value	significative
SA REST TEST vs. SA REST CONT	p = 0,078	NO
SV REST TEST vs. SV REST CONT	p = 0,087	NO
SL REST TEST vs. SL REST CONT	p = 0,129	NO
DELTA V REST TEST vs. DELTA V REST CONT	p = 0,135	NO
WD REST TEST vs.WD REST CONT	p = 0,588	NO
RFA REST TEST vs. RFA REST CONT	p = 0,845	NO
LFA REST TEST vs. LFA REST CONT	p = 0,616	NO
SUMAN REST TEST vs. SUMAN REST CONT	p = 0,760	NO
BTA REST TEST vs. BTA REST CONT	p = 0,873	NO
SR REST TEST vs. SR REST CONT	p = 0,426	NO
ISD REST TEST vs. ISD REST CONT	p = 0,054	NO

detectable correlation between occlusion and posture (20-23). Three of these studies (20, 22, 23) investigated parameters such as sway area (sa), sway velocity (sv), sway length (sl), sway velocity variation (Δv), weight distribution (wd) or sway shape variation in different conditions (rest, icp, open/closed eyes). All these parameters evaluate sway, which is indisputably influenced by visual inputs. So, in our opinion, all of these parameters are to be considered unspecific, as they do not investigate all other postural variations but sway. Moreover, in one of the two studies, examined patients do not show any orthodontic or gnathologic dysfunction, thus the study is to be considered unfounded. In the third study (21) a visual measurement method is used, which does not consider possible compensation mechanisms involved during different conditions (icp or rest). Moreover, there is no normalisation of all other parameters involved in human body posture.

For these reasons we considered other, more specific, parameters such as plantar lay (feet angles) and intersolar distance and investigated their variations in icp and rest position.

In Table I is evidenced that no significant differences occur between the two conditions in Control group, that is to say that in healthy patients there are no significant changes in rest or intercuspidal position. So their

Table III. TEST GROUP *vs.* CONTROL GROUP IN ICP POSITION

TEST GROUP *vs.* CONTROL GROUP IN ICP POSITION	p value	significative
SA ICP TEST *vs.* SA ICP CONT	p = 0,100	NO
SV ICP TEST *vs.* SV ICP CONT	p = 0,161	NO
SL ICP TEST *vs.* SL ICP CONT	p = 0,099	NO
DELTA V ICP TEST *vs.* DELTA V ICP CONT	p = 0,090	NO
WD ICP TEST *vs.* WD ICP CONT	p = 0,261	NO
RFA ICP TEST *vs.* RFA ICP CONT	p = 0,740	NO
LFA ICP TEST *vs.* LFA ICP CONT	p = 0,594	NO
SUMAN ICP TEST *vs.* SUMAN ICP CONT	p = 0,781	NO
BTA ICP TEST *vs.* BTA ICP CONT	p = 0,636	NO
SR ICP TEST *vs.* BTA ICP CONT	p = 0,888	NO
ISD ICP TEST *vs.* ISD ICP CONT	p = 0,027	YES

Table IV. *TEST GROUP vs. CONTROL GROUP IN ICP POSITION*

TEST GROUP vs. CONTROL GROUP IN ICP POSITION	P value	significative
SA ICP TEST vs. SA ICP CONT	P = 0,100	NO
SV ICP TEST vs. SV ICP CONT	P = 0,161	NO
SL ICP TEST vs. SL ICP CONT	P = 0,099	NO
DELTA V ICP TEST vs. DELTA V ICP CONT	P = 0,090	NO
WD ICP TEST vs. WD ICP CONT	P = 0,261	NO
RFA ICP TEST vs. RFA ICP CONT	P = 0,740	NO
LFA ICP TEST vs. LFA ICP CONT	P = 0,594	NO
SUMAN ICP TEST V vs. S SUMAN ICP CONT	P = 0,781	NO
BTA ICP TEST vs. BTA ICP CONT	P = 0,636	NO
SR ICP TEST vs. BTA ICP CONT	P = 0,888	NO
ISD ICP TEST vs. ISD ICP CONT	P = 0,027	YES

occlusion does not influence the posture of the rest of their body. Besides, differences are evidenced between the two conditions in Test group (suman and rfa) (Table II). This means that, in patients with TMJ dysfunctions, occlusion influences the whole body posture. Moreover, there are no differences between the two samples in rest position, condition in which occlusal influences are eliminated (Table III). Besides the intersolar distance changes between TG and CG in intercuspidal position, in which occlusion and TMJ dysfunctions play an important role (Table IV).

Physiatric studies assess that TMJ axis, scapolo-omeral joint axis, coxo-femoral joint axis and tibial-astragalus joint axis have to be perfectly parallel in order to guarantee a correct equilibrium of the body. Compensations are possible in order to maintain parallelism of the axis as these junctions have 6 degrees of range.

TMJ dysfunctions, especially condylo-diskal displacements, or even pre-contacts like cross-bites can modify TMJ bicondylar axis. According to physiatric studies we can suppose that a modification of TMJ axis leads to a compensation of the other joints which induces a modification of the plantar lay and intersolar distance.

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