Effects of different jaw relations on postural stability in human subjects

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Abstract

Authors investigated the effects of different jaws relations on body posture in a sample of 95 subjects. All subjects underwent a posturometric and stabilometric analysis using a computerized footboard. Tests were performed in three mandibular positions: centric occlusion, rest position and myocentric position, respectively determined by teeth engagement, joints position, and muscles contraction. All subjects showed variations of body posture in the different mandibular positions. Statistical analysis (analysis of variance for repeated measures) confirmed that postural variations in different jaws relations were significant: in particular, the SKN multiple comparison test showed that myocentric position improved postural balance on frontal plane with respect to the other jaw positions considered.
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In the last years, a number of researches investigated the various determinants that may influence body posture. Respiration, head and neck position, mood states have been assessed to have effects on posture [1,11,12,18].

Among those determinants, recent studies seem to demonstrate a role of trigeminal afferences and dental occlusion on proprioception, visual and postural stabilization [2,6,7,13].

Moreover, the possibility that there could be a relation between stomatognathic pathologies, such as temporomandibular joint disorders, and postural disorders has been investigated [3,4,15,16].

The aim of the present paper was to verify if different jaws relations modify posture in a sample of human subjects.

The sample for the study was constituted of 95 subjects (23 males, 72 females), average age 29 ± 10 (range 18–52).

All subjects were asymptomatic volunteers without information on the aim of the study. They were preventively investigated in order to exclude signs and/or symptoms of temporomandibular disorders and of physiatric disorders.

Posture was analyzed in three different mandibular positions: centric occlusion (or intercuspid position): it is the most closed, static position which the mandible assumes determined by the full interdigitation of opposing teeth [17]: it is a position referred to the teeth, obtained asking the patient to close the mouth and get the teeth together in his habitual position.

Rest position: it is the habitual postural position of the mandible when at rest, with the condyles in a neutral, unstrained position in the glenoid fossa [17]. It is a position referred to the temporomandibular joints, obtained positioning two cotton rolls (8 mm thick) between the dental arches, asking the patient to swallow several times and stay at rest.

Myocentric position: it is a position established along the neuromuscular trajectory, most commonly between 1 and 2 mm of vertical closure from physiologic rest position. The neuromuscular trajectory is an induced isotonic closure path of the mandible from physiologic rest position, that occurs when postural and masticatory muscles are simultaneously at their resting length and in balanced tonus with respect to one another, to a selected terminal contact therapeutic position (myocentric occlusion). It is a position referred to the muscles, obtained by the transcutaneous electric neural stimulation (TENS) technique, according to Jankelson [8–10]. TENS was provided and monitored by means of a computerized mandibular scan CMS (mandibular kinesiograph K6-I) and the Myo-monitor J3 (both Myotronics Inc., Tukwila, WA). The kinesiograph is able to record mandibular position in three dimensions of space and simultaneously record the bilateral

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electromyographical activity of the masseter, anterior temporalis, sternocleidomastoideus and upper trapezius muscles. Myo-monitor supplies low frequency, low amplitude TENS stimulation to the muscles innervated by the mandibular division of the trigeminal nerve, causing muscles to contract once every 1.5 s.

Each subject underwent the TENS stimulation for at least 45′: when a stable mandibular position and a good muscular balance (EMG controlled) were reached, the myocentric position was recorded by an intraoral bite registration acrylic resin material, later used for the fabrication of an orthosis [9].

Subjects posture was evaluated by a computerized posturographic and stabilometric footboard (Moebius Alpha by Ergomed srl, Cremona, Italy).

A PC computer calculates the information and provides responses as load graph (load, expressed in kilograms and perceptual, on each feet supporting point) and stability graph (center of foot pressure, assumed to be body barycenter, and its swinging during time). The center of foot pressure is considered as the real body barycenter, and it is compared to the theoretical barycenter, which occurs when, ideally, the body weight is uniformly distributed on the feet supporting points.

For each subject, three different registrations on the footboard were taken: the first in centric occlusion (maximum intercuspidation, ICP); the second with the cotton rolls (rest position, REST); and the third with the orthosis (myocentric position, MYO).

The three tests were recorded consecutively, without moving the subject on the footboard: tests were recorded with open and closed eyes. Closed eyes results were considered in this research.

Both posturometric and stabilometric data were considered: from the load graph, the percent difference of load on right and left lower limbs was calculated. The obtained value was assumed as 'asymmetry index' of weight distribution. Ideally, the global weight has to be distributed 50% on each lower limb, that means asymmetry index is 0.

From the stability graph, it was considered the distance from the real to the theoretical barycenter, calculated on X (right/left direction) and Y (posterior/anterior direction) axes. Ideally X and Y distances are close to 0 [5,14].

The analysis of variance for repeated measures (ANOVA) test with the Student-Newman–Keuls Multiple Comparisons post test were performed in order to verify weather eventual postural variations in the different mandibular positions were statistically significant. The statistical analysis was made using a speciphic software (GraphPad Instat Ver 3.01 Graphpad Software Inc. San Diego, CA, USA) The hypothesis is that there is not any difference: if $P < 0.05$, eventual differences are significant. The test was repeated for the three measures considered (asymmetry index, x distance, y distance). The post test was then used for relating the average values two by two, to verify which mandibular position eventually corresponded to a significant different posture.

The posturographic examination showed that out of 95 subjects, an asymmetry index closer to 0 was found in 26 cases in centric occlusion, in 20 cases in rest position, in 45 cases in myocentric position. In four cases there was no difference about weight distribution in the three mandibular positions.

The average asymmetry index value was 6.7 ± 5.5 for the centric occlusion tests, 6.3 ± 4.8 for the rest positions tests, 5.3 ± 4.5 for the myocentric positions tests (Table 1).

The stabilometric examination showed that on the x axis (right/left axis) the distance between the real barycenter (center of foot pressure) and the theoretical barycenter was lower in 20 subjects in centric occlusion, in 28 subjects in rest position and in 44 subjects in myocentric position. In three subjects there was no variation of distance.

The average x distance value for the centric occlusion tests was 6.7 ± 5.3 mm, for the rest position tests it was 5.9 ± 4.6 mm, for the myocentric position tests was 5.3 ± 4.2 mm (Table 1).

On the y axis (anterior/posterior axis) the lower distance between the two barycenters was found in 42 subjects in centric occlusion, in 19 subjects in rest position and in 34 subjects in myocentric position. All subjects showed differences in the distance between the barycenters on y axis.

The average y distance value for the centric occlusion tests was -15.1 ± 15.2 mm, for the rest position tests it was -16.9 ± 14.8 mm, for the myocentric position tests it was -16.2 ± 15.0 mm (Table 1).

The ANOVA test performed on the asymmetry index results showed that there was a statistically significant

Table 1
Average values and SD of the posturometric and stabilometric parameters, ANOVA for repeated measures and Student-Newman–Keuls Post test results

| | ICP | | REST | | MYO | | F | P | SNK Post test |
	Mean	SD	Mean	SD	Mean	SD			
Asymm. Index	6.688	5.554	6.300	4.875	5.325	4.551	4.639	0.0108 (*)	MYO/ICP*, MYO/REST*
X distance	6.694	5.312	5.911	4.607	5.347	4.204	5.753	0.0038 (**)	MYO/ICP**
Y distance	−15.109	15.21	−16.927	14.832	−16.188	15.045	3.284	0.0396 (*)	REST/ICP*

The mean values of the sample of 95 subjects in the three mandibular position (ICP is centric occlusion; REST is rest position; MYO is myocentric position). The analysis of variance values (*F* values) of the three mandibular positions for each posturometric and stabilometric parameter, if $P < 0.05$ there is a significant postural difference of posture. For each posturometric and stabilometric parameter the Post test results are reported. If $P < 0.05$, postural difference between two mandibular position is statistically significant.

difference of the postural values in the three mandibular difference, for $F = 4.639$ and therefore $P = 0.0108$. The Post test evidenced that this significant difference was between centric occlusion and myocentric position, and between rest position and myocentric position, but not between centric occlusion and rest position (Table 1).

The ANOVA test performed on the x distance results was also significant for $F = 5.753$ and therefore $P = 0.0038$. The Post test evidenced that the difference was significant between centric occlusion and myocentric position, but not between rest position and myocentric position and centric occlusion and rest position (Table 1).

Also about y distance, the ANOVA test was significant for $F = 3.284$ and therefore $P = 0.039$. In this case the Post test confirmed a significant difference only between centric occlusion and rest position (Table 1).

The results seem to support the observation that different jaws relations imply differences in body posture. In fact, there was a strong relation between mandibular position and body posture: 91 out of 95 (95.8%) subjects showed variations in load distribution closing mouth either in centric occlusion or in centric relation or in myocentric position. Furthermore, 92 out of 95 (97.9%) subjects showed changes also in the distance between theoretical and real barycenter on x axis, and 95 cases out of 95 (100%) showed changes on y axis. Similar results were observed by the authors in previous experiences [2].

Statistical analysis showed these variations were significantly relevant.

Temporo-mandibular disorders are principally a pathologic condition of masticatory muscles and head and neck postural muscles or, at least, a combined pathologic condition of muscles and temporo-mandibular joints. Altering trigeminal afferences and proprioception, those disorders can provoke, with a descending action, an unbalance of the whole postural muscles chains and finally posture alterations. Since an occlusal therapy could induce a re-equilibrium of masticatory muscles, this re-equilibrium could influence, with a descending action, the whole body postural muscles, resulting in an improved posture.

Considering tests performed in centric occlusion, that is an habitual position, as a control group, the sample showed that myocentric position (which is a right-left muscular equilibrium position) seemed to improve postural balance on the frontal plane in about a half of the subjects with respect to other jaws relations considered: in 45 out of 95 subjects myocentric position improved the asymmetry index and in 44 out of 95 subjects it reduced the x distance. Statistical analysis showed that posture on the frontal plane was significantly different in myocentric position with respect to centric occlusion and rest position.

A good balance of masticatory and head and neck muscles seems to be an important factor of postural stability.

On the sagittal plane, neither myocentric position nor rest position improved posture with respect to centric occlusion.

It must be said that the methodic presents some limitations: stabilometry reduces all human posture to a single point, the center of foot pressure, which is assumed to be the gravity center [5]. There is not information about all districts that contribute to the maintenance of posture: only the final effect of the interaction of all districts could be observed.

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