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Posturalbert - An Innovative System for Posture Evaluation.

Laura Stalteri[1], Marco Giovagnoli[2], Giovanni Bertinelli[3]

[1]Odontologist - Città di Castello, Perugia.
[2]Physiotherapist - osteopath – Perugia.
[3]Inventor and technician for postural evaluation – Perugia.

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ABSTRACT

Background: A good posture is the state of muscular and skeletal balance that protects the body's supporting structures from injury or progressive deformity, regardless of the position (upright, lying down, crouched or bowed) in which these structures are, in tension or at rest. There is an urgent need of posture evaluationt based on the use of objective measures of both static and dynamic function, in order to obtain more reliable and valid information on patients and their responses to therapeutic interventions. **Methods**: *Posturalbert*'s postural evaluation instrument was used to assess postural stability in 110 individuals enrolled from June 2015 to December 2017. The instrument allows to measure the relationship between the stomatognathic system and the rest of the body in the search for possible high postural anomalies. **Results**: Almost all the individuals showed a symptomatology connected to postural instability, in particular, the main prevalences were referable to headache / neck pain (n = 31, 28.2%), upper back pain (n = 45, 40.9%), low back pain / sciatica (n = 16, 14.5%). Common comorbidities were bruxism (13.6%), tooth serration (19.1%) and dental malocclusion (10.9%). In most cases there was a significant (tilt) alteration of the mandibular plane and of the shoulders (89.1%). Almost all the individuals had at least one alteration in the three planes. **Conclusions**: The instrument presents considerable interest in the identification of postural alterations in relation to different symptoms prior to clinically evident pathologies occurring.

Keywords: Postural instability; stomatognathic system.

INTRODUCTION

Posture is usually defined as the relative arrangement of parts of the body. A good posture is the state of muscular and skeletal balance that protects the body's supporting structures from injury or progressive deformity, regardless of the position (upright, lying down, crouched or bowed) in which these structures are, in tension or at rest. In such conditions, the muscles work efficiently and the thoracic and abdominal organs are in optimal position. There is poor posture when there is an incorrect relationship between the various parts of the body, which produces an increase in tension of the supporting structures and when the balance of the body on its base of support is less efficient. Posture is the result of a dynamic adaptation of musculoskeletal structures to the surrounding environment. This adaptation takes place from birth onwards, and the problems resulting from bad adaptation can already be found at an early age and then concentrate into old age.

Name & Address of Corresponding Author
Giovanni Bertinelli,
Inventor and technician for postural evaluation
Perugia.

The muscular system, as a complex system, may undergo primary shortenings (inherent in the system) or secondary shortages (caused by the malfunctioning of other structures). In both cases a postural problem will occur over time.

For example, a stomatological problem (due to asymmetry or excess intensity) has an abnormal effect on the masticatory muscles, involving other muscular districts at a distance (neck-back- limbs).

The available evidence indicates that the jaw represents a sort of outrigger, capable of influencing posture, but also be influenced by posture itself. The postural problem involves the individual in his/her entirety. Because of muscular interconnection mechanisms, we could find anomalies in which a muscular imbalance, coming from other areas of the body, determines occlusal problems that will generate condilo – meniscus - temporal conflicts, and vice versa.

Therefore, patient assessment focused on the use of objective measures of both static and dynamic function, in order to obtain more reliable and valid information on patients and their responses to therapeutic interventions.

An area that has historically been fundamental for many therapeutic interventions in various medical fields is the postural evaluation that, to date, has made use of numerous postural assessment systems (static and dynamic) both clinical and instrumental, also in relation to various pathologies.

MATERIALS AND METHODS

Description and function of the measurement instrument "Posturalbert"

Posturalbert's postural evaluation instrument (invention patented as Italian Patent n. 0001408290 http://www.uibm.gov.it/uibm/dati/tmview.aspx?load=info&id=1985353&table=Invention) is new and original as, in the current state of the art, no postural assessment instrument exists that allows the horizontal measurement of the inclination of the jaw with respect to the shoulders.

In fact, postural measurement devices currently used have the function of detecting postural anomalies in the lower part of the body, not allowing to perform evaluations on the horizontal plane of the inclination of the lower jaw with respect to the shoulders.

The aim of the invention is to allow the collection and processing of data relating to the horizontal axis of the jaw with respect to the shoulders, in order to identify manually or remotely with the aid of specific software, any postural abnormalities of the upper body, with the aim to arrive at a specific analysis of the posture of the patient's upper body part, otherwise not possible on the basis of currently existing instruments, identifying the cause of any anomaly, also to complete a general postural analysis carried out in the medical and physiotherapeutic fields.

The instrument in question is therefore capable of conducting a postural analysis through collection of data related to the position of the jaw in relation to the axis of the patient's shoulders, using detection systems placed at the apex of the instrument. This ensures control and analysis, both manually and through remote data processing, of all possible postural abnormalities due to problems related to the jaw and its morphology and/or possible congenital or traumatic abnormalities. The PosturalBert instrument is compatible with a stabilometric platform and can also be used with a specific software program in order to collect and process remotely the information deriving from measurements (such as the inclinations evaluated at angular degrees converted to centimetres) to then allow patient's monitoring and constant monitoring of the information.

Data communication between the device and the PC can be made by connecting the device via cable or wirelessly, also providing an extensive plurality of integrated protocols for dialogue with different units, such as: control systems, printers, displays and more.

The instrument [Fig. 1] consists of a fixed platform to which two vertical rods are hooked, one of which is fixed and one adjustable in height from the motor below the platform. At the top of the adjustable rod, a device is applied, inserted with a screw to the movable rod. The two rods of the device (lower and upper) are fixed with two screws to a vertically adjustable vertical axis, which is in turn applied to the main vertical shaft regulated by the motor positioned on the base.

The lower part consists of two cross-shaped rods. The lower one is a horizontal rod, adjustable in width, with a movable central pin that guarantees tilting.

At both ends of said rod, two length-adjustable tubulars branch off at a right angle and they will rest at the highest point of the shoulders [Fig. 2] or at the anterior-superior iliac spine [Fig. 3]. At the level of the central pivot there is a graduated half-moon for the manual measurement of the inclination of the two shoulders.

The upper part is composed of two rods, also adjustable in width, in the form of a facial arch with central pivot for tilting. On its ends, two ogival extensions are inserted, which will be positioned on the mandibular bone edge. A rectangular graduated plate is inserted on the pivoting joint for the manual measurement of the inclination of the hemimandibles [Fig. 4].

Measurements can also be shown through photographic reproduction, through a micro-camera, where the result of the measurement made with the instrument is shown in the same image.

The measurement of the relationship between the different planes (i.e.: jaw vs shoulders and jaw vs pelvis) is obtained by collecting data remotely through a specific software.

In summary, the instrument allows to measure the relationship between the stomatognathic system and the rest of the body in the search for possible high postural anomalies. It can also be used to complete a general postural analysis conducted in the medical and physiotherapeutic fields. Measurement results can also be shown with photographic reproduction; through the image shows the degree of inclination between the horizontal mandibular and the horizontal clavicular plane.

The instrument measures any misalignment of the jaw, shoulders and pelvis with respect to the horizontal plane.

Measurement Modalities

Mandibular plane

The rods (arched) are positioned on the lower edge of the left and right jaw. The inclination of the rods on the horizontal plane, detected by the precision sensor through the computerized system, measures

the exact reciprocal position of the hemimandibles (in degrees) meaning the angle with respect to the horizontal plane itself. An inclination greater than 0.5° corresponds to a significant discrepancy between the left and right hemisomas.

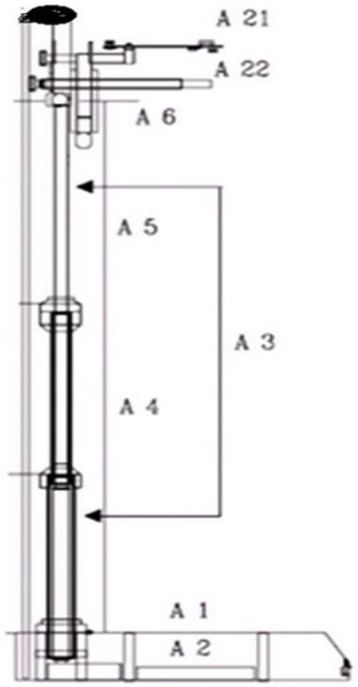

Fig. 1

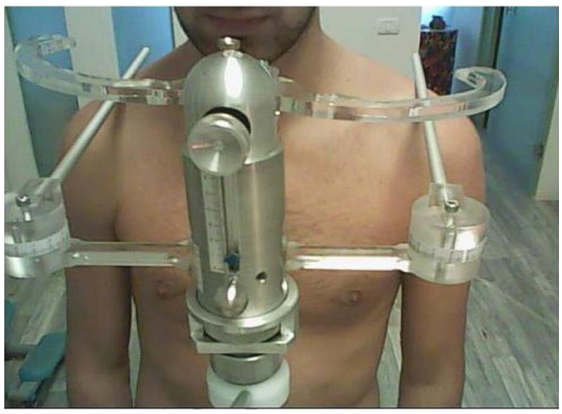

Fig. 2

Fig. 3

Shoulders plane

The tubulars, adjustable in length, are placed on the acromial end of the left and right collarbone at the level of the insertion of the trapezius muscle. The inclination of the tubulars on the horizontal plane, detected by the precision sensor through the computerized system, measures the exact position of the shoulders (in degrees) meaning the angle relative to the horizontal plane itself. An inclination greater than 1° corresponds to a significant discrepancy between the left and right hemisomas.

Pelvis plane

The tubulars, adjustable in length, are placed on the left anterior and upper iliac spine. The inclination of the tubulars on the horizontal plane, detected by the precision sensor through the computerized system, measures the exact reciprocal position of the emipelves (in degrees) meaning the angle with respect to the horizontal plane itself. An inclination greater than 1° corresponds to a significant discrepancy between the left and right hemisomas.

Fig. 4

RESULTS

From June 2015 to December 2017, 110 individuals were evaluated through postural assessment, divided by age group and pathological condition [Tab. 1]. 50 were males (54.5%) and the average age was 36. Almost all the individuals showed a symptomatology connected to postural instability [Tab. 2], in particular the main prevalences were referable to headache / neck pain (n = 31, 28.2%), upper back pain (n = 45, 40.9%), low back pain / sciatica (n = 16, 14.5%).

Among the most common comorbidities [Tab. 3], bruxism (n = 15, 13.6%), tooth serration (n = 21, 19.1%) and dental malocclusion (n = 12, 10.9%).

In most cases there was a significant (tilt) alteration of the mandibular plane (n = 74, 67.3%) and of the shoulders (n = 98, 89.1%) [Tab. 4].

Almost all the individuals had at least one alteration in the three planes (n = 104, 94.6%).

Table 1: Patients examined divided by gender and age.

Gender	N	%
M	50	45.5
F	60	54.5
Age (years)		
≤20	25	22.7
21-40	41	37.3
41-60	33	33.0
≥61	11	10.0

Table 2: Symptoms reported by patients

Symptoms	n	%
None	2	1,8
Headache / neck pain	31	28.2
TMJ* pains with / without mandibular click	7	6.3
Upper back pain	45	40.9
Knee pain	3	2.7
Low back pain / sciatica	16	14.5
Groin pain	1	0.9
Stiffness and functional deficits lower / upper limbs	5	4.5

*TMJ = Temporo-Mandibular Joint

Table 3: Comorbidities found in patients

Comorbidity	n	%
Arthritis	1	0.9
Scoliotic attitude	3	2.7
Bruxism	15	13.6
Coxarthrosis with hip prosthesis	2	1.8
Inf. Partial edentulia	7	6.4
Sup. Partial edentulia	3	2.7
Sup. Total edentulia	1	0.9
Fibromyalgia	1	0.9
Dental malocclusion	12	10.9
Scoliosis	1	0.9
Tooth serration	21	19.1
Not detected	43	39.1

Table 4: Measurement of the inclination of the mandibular plane, of the shoulders and of the pelvis done with the Posturalbert instrument.

Mandible	n	%	Average in ° (min-max)
Altered	74	67.3	1.4 (0.5 – 6.0)
Normal	36	36.7	0.2 (0.0 – 0.49)
Shoulders			
Altered	98	89.1	3.67 (1.50 – 10.8)
Normal	12	10.9	0.86 (0.60 – 0.91)
Pelvis			
Altered	38	34.6	1.88 (1.00 – 3.60)
Normal	72	65.4	0.64 (0.00 – 0.94)

DISCUSSION

The analysis of the data concerning the patients examined with the Posturalbert instrument indicates the presence of disparate symptoms related to the osteo-muscular-articular apparatus, often due to the failure to detect a well-defined pathology. Up to 39.1% of patients show no comorbidity. Despite this situation, most patients show alterations, documented with the instrument, of the shoulder and mandibular plane in 90% and 67%, respectively, of cases corresponding to pathological dysmetries between left and right hemisomas.

CONCLUSIONS

The instrument presents considerable interest in the identification of postural alterations in relation to different symptoms prior to clinically evident pathologies occurring. Clinical application can be foreseen both for the prevention of disabling diseases of the locomotor apparatus and for the monitoring of already established treatments, in particular in the orthopaedic and orthodontic fields.

Implications for research

In order to confirm the diagnostic and monitoring potential of treatment results in different pathological conditions where a postural evaluation is required, and therefore its extensive use in clinical practice, further comparative research is needed to quantify the level of accuracy and reliability of the Posturalbert instrument.

Authorship

All the authors have substantially contributed to: the conception of the work; the acquisition, analysis, and interpretation of data; the drafting of the paper and its revision until the final approval.

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