Postural Analysis: Description of a Dedicated System

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Method Article

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Abstract

Postural analysis is a fundamental tool for evaluating the neuromusculoskeletal structure of a subject. Although it is an important tool, a unique formal analysis process has not yet been determined.

The aim of this work is to propose a postural analysis protocol that can be used for both initial investigations and ongoing monitoring of the effects of therapeutic treatment in the field.

A second aim of this work, equally important in the opinion of the author, is to promote discussion with other practitioners so as to make continuous improvements in the proposed protocol to provide a tool that can serve the needs of specialists even more efficiently.

The proposed system consists of four subsystems: medical history data, photographic references, overall observations, and tests.

Even though the initial results are encouraging, additional use of the described analysis system is considered essential to improve the technique and the skills of the operator.

In this light, specific requests and observations from other professionals are essential, and obtaining these requests and observations is one of the purposes of the present article, as initially declared.

The proposed postural analysis system represents a good balance of various, often opposing needs, being easily completed and reasonably fast and repeatable, making it possible to compare time series data.

Introduction

Postural analysis is a fundamental tool for evaluating the neuromusculoskeletal structure of a subject and can provide useful indications about the presence and possible origins of imbalances that may occur using symptoms and signs, often with little or no relationship, as indicated in many related studies [1–5].

Although it is an important tool, a unique formal analysis process has not yet been determined, and the several tests involved, which are available in the literature, can be broadly and variously combined and integrated with the many different measuring systems available on the market.

The aim of this work is to propose a postural analysis protocol for (1) initial investigations, wherein the essential characteristics are the broad viewing spectrum, as a guarantee of accuracy, and short analysis time, as a guarantee of exclusion of biases being attributable to the negligible interference of the observed measuring system; and for (2) ongoing monitoring of the effects of therapeutic treatment in the field, wherein the main characteristic is the capacity to guarantee comparability among analyses of the same subject conducted at different times, so that observed differences, or the absence thereof, that could be related to errors introduced by the measuring system can be reasonably excluded.

A second aim of this work, equally important in the opinion of the author, is to encourage debate with other practitioners so that the proposed protocol can be continuously improved and serve the needs of specialists even more efficiently.

Materials And Methods

The proposed system consists of four subsystems, each of which has a precise goal that complements the goals of the other subsystems, resulting in a complete postural analysis of the subject under examination. Each of the subsystems will now be described in detail.

MEDICAL HISTORY DATA

To frame, in a suitable way, the values and results that are obtained from the postural analysis, it is fundamental that current data and medical histories be collected for each subject. The list of items considered essential is shown in Fig. 1.

It is important to highlight that postural analysis is not exclusively performed by physicians as well as is used to aid physicians in decision-making processes; thus, the collection of medical history data should not be considered as an attempt to search for a condition or its diagnosis or to develop a rehabilitation plan. Indeed, the purpose is to acknowledge existing behaviours and conditions that could influence the posture of the subject.

None of the items listed in Fig. 1 need explanations since they are inherently clear and easy to understand. However, relating to "*scar description*", it is believed that some clarification may be useful.

Since "*each scar is a possible disturbance*", as reported by Caiazzo in 2007 [6], it is always very useful to consider not only the exterior aspect but also the viable activity using the vascular autonomic signal (VAS) test, also known as Rèflexe Arteriel de Nogier (RAN). Further, it should be understood that the same test can also be used to investigate parts of the same scar to understand whether the produced activity is linked to specific segments thereof.

PHOTOGRAPHIC REFERENCES [7–13]

Experience and observation, free of prejudice and judgment, are essential and fundamental tools in postural analysis and specific contributions of the operator. In this light, a set of photographic references enables precise postprocessing without the need for the patient to be present and concretizing of personal observations using simple graphic tools (the author generally uses GIMP).

The proposed photographic set consists of three parts, each of which has a particular purpose.

The first part concerns the whole structure of a person and consists of five pictures in an orthostatic position, from antero-posterior, postero-anterior, left lateral, right lateral and top view, after positioning the markers on the subject. Markers positioning requires the subject once supine and after being prone, to arrange markers on the front and lateral sides and subsequently on the back side. The position and the number of markers are reported in Fig. 2, differentiated according to sex. The letters indicate the distances between two markers. These distances are used to verify the conversion from pixels to millimetres, achieved using markers with known lengths that are positioned to the front, back and sides (on both the right and left sides) on a surface as flat and orthogonal to the floor as possible (e.g., the thigh).

The anterior superior iliac spine (ASIS) and posterior superior iliac spine (PSIS) are manually highlighted, i.e., without the use of markers, for better precision using a simple cosmetic make-up pencil. The equipment, built to obtain the described photographic references, is visible in Fig. 3, while in Fig. 4 and Fig. 5, the obtained results are displayed. As highlighted in Fig. 4, in the antero-posterior view, only the horizontal laser is used, centred on the interASIS line to create a fixed reference for future analyses; vertical laser off is a further safety for patient. In the other views, the lasers, horizontal and vertical, are both activated: the first one is still centred on the interASIS line in the antero-posterior view, while the second one is centred according to Barre's vertical in both the postero-anterior and latero-lateral views.

Three pictures are added to what is described above; they are used in postprocessing to objectify rotations of the pelvic girdle in the coronal and sagittal planes.

To obtain a picture enabling quantification of rotation in the coronal plane, it is necessary to centre one horizontal laser on the right ASIS and one horizontal laser on the left ASIS and to take a picture of both traces with the patient in orthostasis in the antero-posterior view. The measurement of rotation is then indicated by the gap, on the order of millimetres, between the two traces.

To obtain a picture enabling quantification of rotation in the sagittal plane, it is necessary to centre one horizontal laser on the right ASIS (in the antero-posterior view) and one horizontal laser on the right PSIS (in the postero-anterior view) and to take a picture of both traces with the patient in orthostasis in the right lateral view. In this picture, the laser trace centred on ASIS crosses the anterior body profile at a specific point (A). Analogously, the laser trace centred on PSIS crosses the posterior body profile at a specific point (P). The measurement of rotation is the angle between the horizontal line and the line joining A and P. The procedure is repeated in the same manner on the left side.

The second part concerns the stomatognathic apparatus and the acquisition of five pictures that describe the reciprocal layout of the dental arches in the antero-posterior, latero-lateral, left oblique, and right oblique views and at the largest buccal opening with the tongue on the palatal spot; this enables detection of the position of the upper canine and first upper molar teeth respect to the lower arch, as well as of the ability of the tongue to reach the palatal spot. Figure 6 shows them schematically and directly. Additionally, a video in the latero-lateral view is included in this group of pictures and highlights atypical movements observed during swallowing. In the case of atypical swallowing movements, it is more useful to perform at least three-four consecutive swallowing actions, possibly interrupted by a rest break.

Finally, the third part concerns the feet during standing and includes pictures of the feet during single- and double-leg standing in the postero-anterior view; the pictures may be supplemented by or replaced with a video that captures all of these aspects. The addition of a picture of the feet during double-leg standing in the cranial-caudal view is useful for highlighting deformities in the 1st radius (e.g., hallux valgus). In summary, with the system reported in Fig. 7, pictures can be acquired of the feet during standing with eyes both open and closed and with the dental arches separated and in contact.

OVERALL OBSERVATION [6]

Figure 8 shows the list of the item used in the analysis to describe how the person holds himself in the space in a general manner.

The organization of the analysis follows a directional logic in a cranial-caudal sense, starting from the temporomandibular joint (TMJ) and ending with the feet during standing as documented by the photographic references.

The overall observation is not meant to be an exhaustive evaluation but rather to be an examination of a wide spectrum of possible receptor influences on posture within a limited amount of time to avoid disturbing the postural system of the patient examined. In other words, an attempt was made to acknowledge the possibility that each receptor system that influences posture could be a source of postural disturbance without interference of the measuring system on the observed system. Thus, if some findings are suggestive of disharmonies, it is possible beneficial to consider having a specialist in the field (ophthalmologist, odontostomatologist, otolaryngologist, orthopaedic, physiatrist or podiatrist) conduct a more detailed evaluation based on what was objectively found, as measuring system disturbances have been avoided.

TEST [6, 14–15]

Figure 9 shows the list of selected tests.

The first five tests must be performed initially, and their main purpose is to identify the presence of a possible *disharmonic syndrome*, as described by Caiazzo in 2007 [7].

It should be observed that, as is common in posturology, it is not the result of a single test that indicates the presence of disharmony, but congruent results from multiple tests to indicate its probable presence.

All tests are widely described in the literature and do not need further explanation. However, for the "*visceral*" test, additional details can be useful. This test examines the possible influences of the visceral apparatus on postural disturbance, and after it is performed, the previously described items must be re-evaluated, especially if abnormal results have been found.

The two final tests aim to analyse the mobility of the vertebral column, in particular the possibility of shifts in the coronal plane, and the layers of torso-lumbar region musculature.

Results

In comparison with prior versions, the described postural analysis system exhibited improvements in data collection and the possibility of more extensive and objective postprocessing, enabling inclusion of more detailed and comparable reports for a given subject at different times and improved usability for specialists of other professions.

Discussion

Although the initial results are encouraging, further use of the described analysis system is considered essential for improving the techniques and the practice of operators.

In this light, specific requests and observations from other professionals are essential, and one of the purposes of the present article, as initially declared, is to obtain this input.

Conclusions

The proposed postural analysis system represents a good balance of various, often opposing needs, being easily accomplished, addressing the main contributors to postural control; reasonably fast, due its overarching approach; and reasonably repeatable, making it possible to compare time series data.

Further confirmations will be derived from systematic use of this system over time, which will also lead to the possibility of further improvements.

Declarations

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DECLARATIONS

Conflicts of interest

The author declares that he has no conflicts of interest.

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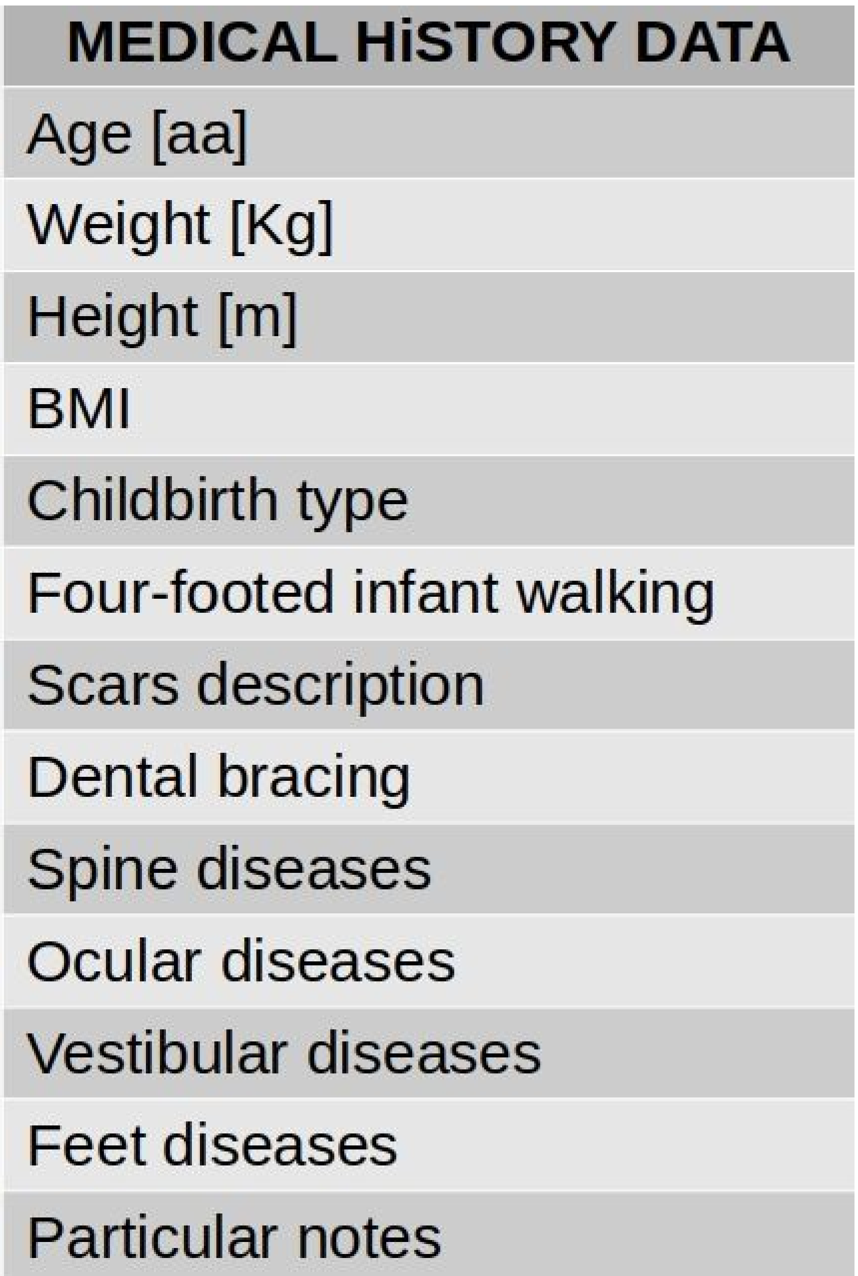
Figures



MEDICAL HiSTORY DATA
Age [aa]
Weight [Kg]
Height [m]
BMI
Childbirth type
Four-footed infant walking
Scars description
Dental bracing
Spine diseases
Ocular diseases
Vestibular diseases
Feet diseases
Particular notes

Fig. 1 Medical history data

Figure 1

Medical history data

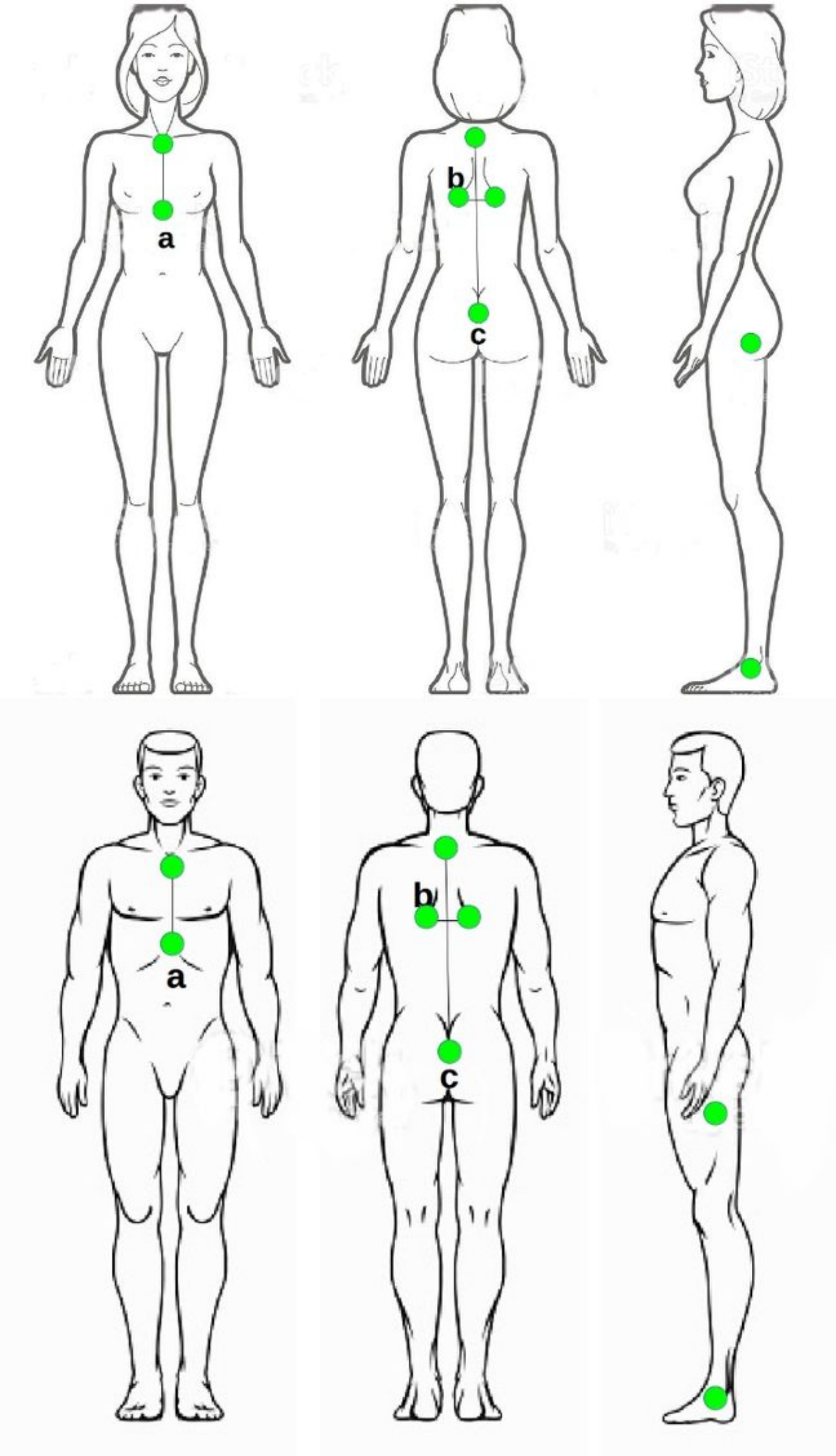


Fig.2 Marker positions

Figure 2

Marker positions

Fig.3 Details and aggregates of equipment used

Figure 3

Details and aggregates of equipment used

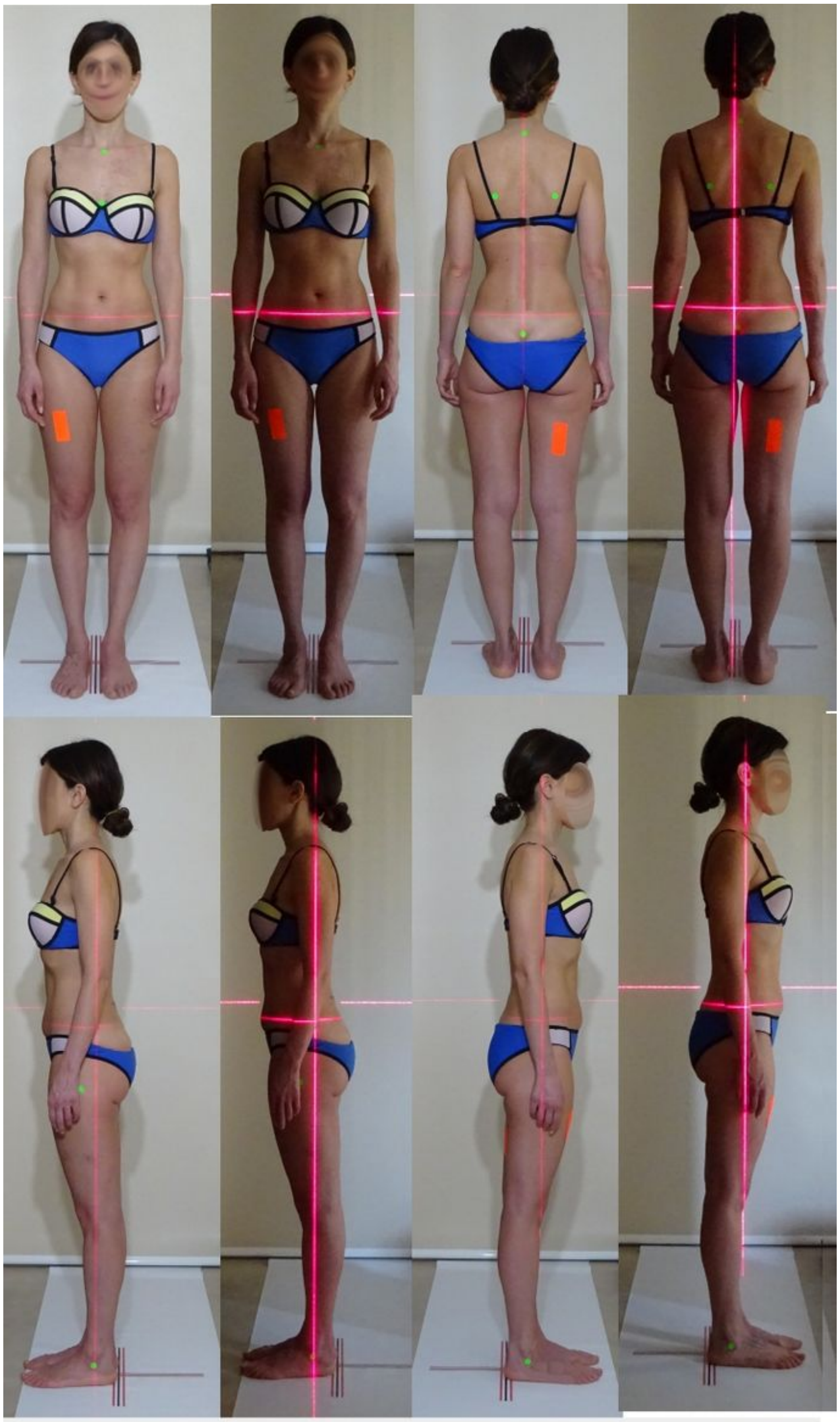


Fig.4 Pictures on main planes and related laser traces

Figure 4

Pictures of the main planes and related laser traces

Fig.5 ASIS and PSIS markers, related laser traces and top view

Figure 5

ASIS and PSIS markers, related laser traces and top view

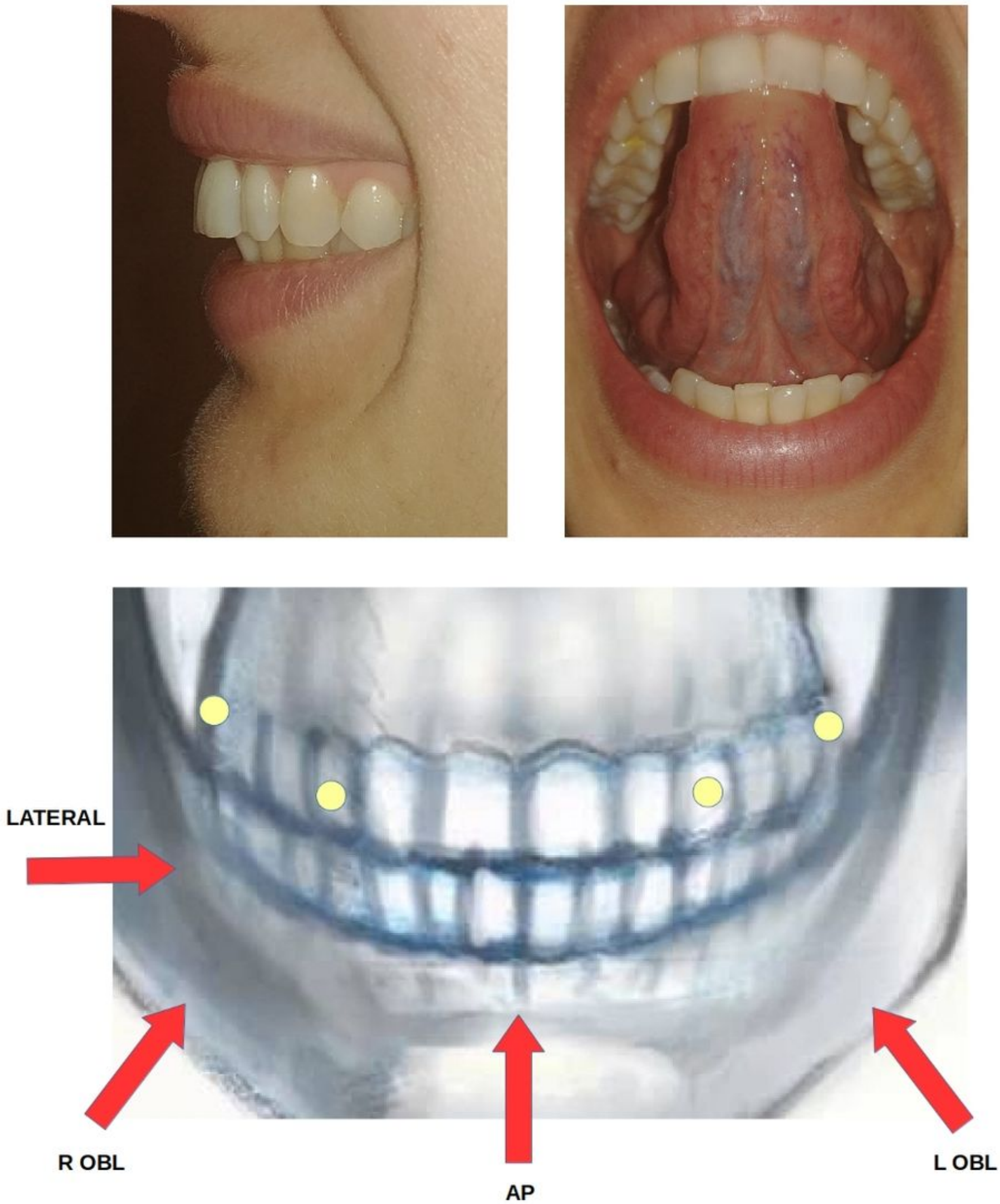


Fig.6 Descriptive views for dental arches and tongue relative to the palatal spot

Figure 6

Descriptive views for dental arches and tongue relative to the palatal spot

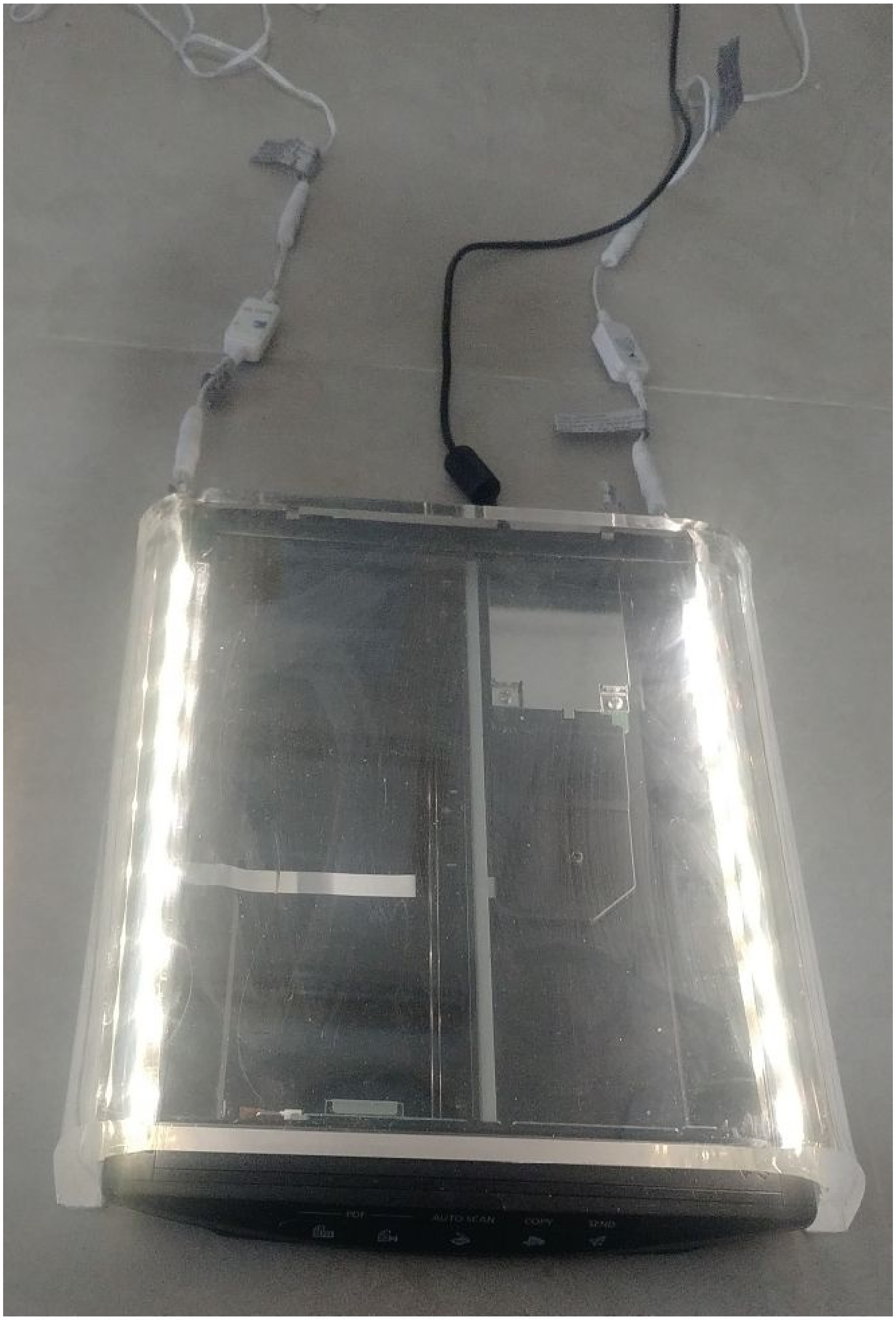


Fig.7 System for detection of feet during standing

Figure 7

System for detection of feet during standing

OVERALL OBSERVATION
TMJ
dental implications (Meersseman)
dominance
CPP
Pursuit
Cover Test
head rotation (AX)
scapulo-humeral girdle rotation (AX – COR)
pelvic rotation (AX – COR – SAG)
femuro-tibial joint
feet stand

Fig.8 Analyses executed in the overall observation

Figure 8

Analyses executed in the overall observation

TEST
postural cone
Autet
Bassani
De Cyon
Fukuda
visceral
Adams
taperulè

Fig.9 List of proposed tests

Figure 9

List of proposed tests