The digitized biometrics technician

The Biometrics Technician (TB) is a healthcare provider able to make his scientific and technological knowledge available and apply it in the field of biometric measurements, such as a biometrics and digitalised clinical posturology laboratory, an analysis laboratory of the movement.

The basic knowledge concerns:
• Anatomy
• Morphometry
•Computer technology
•Biomechanics
•Mathematics
•Physics
•Other

How the biometrics technician is trained
In addition to the knowledge learned during the conventional study cycles in a related field (Three-year Rehabilitation Degrees, Master's Degree in Medicine and Surgery and Specializations, Degree in Physical Education, Degree in Bioengineering etc.), in order to acquire the appropriate skills it is appropriate to undertake specific vocational and training courses as I and II Level Masters, as well as clinical experiences with professionals able to perform and report biometric exams.
The TB must be able to record and subsequently correctly document the data obtained, therefore organizational and communication skills are fundamental.
It must be able to guarantee updates on procedures, new technologies and professional certification through constant improvement courses, to manage continuous technical and scientific progress.

Patient evaluation
Starting from the assumption that in the clinical field it is considered the most reliable patient, TB must adopt the following criteria:

• no examination is carried out without a clinical evaluation first
• the choice of the type of exam is based on a diagnostic hypothesis, after an accurate history and objective examination by the clinician, according to the therapeutic approach, [1]

Laboratory opening

The TB takes care of all the preliminary operations at the opening of the examination sessions.
He must therefore open the room at least 30 'before the arrival of the first patient, in order to:

1. provide proper lighting (around 300-350 lumens)
2. start the applications and check for updates and / or problems concerning the acquisition software
3. make sure that the sound interferences are at an adequate level (about 30 dB)
4. evaluate through an inclinometer that the acquisition platforms are not sloping
5. evaluate the positioning, the switching on and eventually the calibration of the various cameras
6. insert in the archiving programs the personal and statistical data of the sessions (date, name and surname, type and quantity of examinations, type of pathology etc.).

Patient management

This figure has the important task of welcoming the patient to the biometrics laboratory.
For this to happen in the best way it is a good thing that in addition to using a formal and professional tone, to put people at ease, following a standard protocol that includes:

1. to have the referral from the attending physician or specialist doctor taken over, so as to define the sending setting, checking the veracity of the corresponding personal data, the payment of the ticket or the number of exemption indicated, the type of service requested and corresponding tariff number
2. to accommodate the patient alone (or accompanied if a minor or with reduced cognitive abilities)
3. turn off mobile phones or any possible source of disturbance
4. make sure that the shoes coming from the external environment do not contaminate the delicate instruments, providing for them to be removed as soon as possible, after ensuring adequate decontamination by cleaning a special sleeper located at the entrance
5. the patient's stockings must be replaced with a clean pair (information usually given when the biometric examination is being performed)
6. arrange the patient and complete the software folder and interface with the anthropometric data collected at the time (age, height, weight, number of shoes) and the pathology for which the examination is carried out
7. administer an SEA: visual-analogue scale for pain / balance
8. formulate the preliminary questions for a biometric exam (history of hypertension, diabetes, osteoporosis, use of antidepressants, important eye operations, relief surgical operations, etc.)
9. mark the temperature and humidity level present at the time of acquisition in the folder;
10. have any items removed from the pockets (wallet, keys, mobile phones, etc.) and make sure the clothing does not restrict movement
11. make sure that the patient can keep the standing station static for at least 30 seconds with both eyes open (OA) and eyes closed (OC) for the stabilometric examination and that he can perform an evaluable gait for the dynamic baropodometric examination (at least 6 steps); if these two conditions cannot be reached at all, it is not possible to proceed with the examinations.

Procedures and methods
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Untenberger test

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Used to bring out any imbalances or postural abnormalities of the spine. Recognizes three phases:

1. sets the patient in the center of the "star"

2. invites him to start walking on the spot for about 1 min, raising his lower limbs (maintaining a rhythm that is not too fast), to OA;

3. repeat the OC test.

Stabilometry

For this examination it is important to take into account that there are aspects in common for all the stabilometries:

• the reference is always given by the Cartesian axes (x, y)

• the instrument used is a dynamometric platform (force meter)

• for the study of the upright station it can consist of a single module or several modules (linear dimensions on which is recorded: 40 cm)
• for the study of the sitting position it is always and only a single module placed at a height of about 45 cm from the ground;
• postural indicators are divided into kinetics (quantitative, functional) such as trace length, subtended area, frequency domain (in mm or cm, provide information on the function) and kinematics (qualitative, structural) such as statokinesigrams and stabilograms (concerning the aspects graphs / geometries and provide information on structures) [2];
• the task of the TB is to record the motor behavior on the platform, signaling ankle, knee, hip and / or compensation strategies such as enlargement of the upper limbs, of the support base, opening of the eyes in the OC phase or widening of the "vu "Femoral and upper limbs with the compensation given by the widening of the support base constituted by the two feet and by the support with the forearms (in a sitting position).

Study of the upright static station with bipodalic support

We have the following applications:

a) Classical clinical stability in standing
b) Clinical stability with retroflexed head tests
c) Static Postural Stabilometry at 51.2 according to Gagey
d) Postural Static Pathology with film analysis
e) Calibrated rate

Patient positioning

To obtain the maximum repeatability of the examination over time it is useful that the TB uses a retractor / spacer (usually supplied by the manufacturer of the instrumentation) able to keep the patient's heels parallel and distant between them 2 cm and the tips of feet spread at 30 ° (position of the plumb line).

Fig.

Before removing the garrison the TB asks the patient to:

• place the upper limbs at your sides
• focus on a point in front of you (gaze at infinity)
• do not talk, laugh or move the upper limbs for the duration of the exam
• follow the instructions provided

a) Classical clinical stability in standing

It is used in neurological, otorhinolaryngological, orthopedic, dis-metabolic and internalist pathologies consisting of a 30-second test at OA and 3 sec. to OC, therefore lasts a total of 1 minute.
b) Clinical stability with retroflexed head tests
It is used in suspicions of vertigo of cervical origin.
The TB asks the patient to turn his gaze, rear-flexing his neck, towards the ceiling, first at 30 seconds at OA, then at 30 sec. to OC. **

** In the event of positivity to cervical interference, it is possible to proceed with classical clinical Stabilometry in a sitting position with sequential static-dynamic head-neck tests.

The tests are divided into static:

• rotation of the head, chin on the right shoulder and hyperextension of the head for 5 "at OA and 5" at OC;
• head rotation, chin on the left shoulder and hyperextension of the head for 5 "at OA and 5" at OC;

- rotation of the head to the right for 5 "to OA and 5" to OC;
- head rotation left for 5 "at OA and 5" at OC;
- inclination of the head on the right for 5 "to OA and 5" for OC;
- inclination of the head to the left for 5 "to OA and 5" to OC;

Esso retroflexed head for 5 "at OA and 5" OC;

- head in neutral position (look at infinity) for 5 "at OA and 5" at OC;

The dynamic tests consist of:

- active head-neck rotation on the right and left continuously for 5 "at OA and 5" at OC;
- active head-neck inclination on the right and left continuously for 5 "at OA and 5" at OC;

Esso active head-neck flexion extension to the right and left continuously for 5 "at OA and 5" at OC [6]

c) Postural Static Pathology according to Gagey

Used for the evaluation of ascending-descending disorders, it facilitates the distinction between disorder at the level of the fine postural system or of the paravertebral rachis musculature.
It differs from the classic version for the duration: 51.2 seconds, at OA.
It can also be performed in its three variants:

• with or without an orthodontic appliance (for downward interference)
• with or without tampons for the Messerman test (for ATM interference)
• with or without tongue to the Ferrante spot (for lingual interference)

d) Postural Static Pathology with film analysis

It is used to understand which muscle chains intervene normally or are improperly activated in maintaining the upright position.
The duration is always 51.2 seconds.
Very useful for the evaluation of a shoe or an arch support or to evaluate a specific rehabilitation treatment. [3].

e) Calibrated rate

It is performed in the evaluations of the hetero-hypometries (to understand the tolerance or not by the patient of a possible rise), for the study of scoliosis and paramorphisms.
Its duration is 30 seconds per test, normally using 4-5 raises [4].
TB must be able to record the major criteria (the perceived one, ie the sensation experienced by the patient) and the minor criteria (Center of Pressure or CoP, trace length and load analysis) [5].

Static heritage station and monopodalic support

It is carried out for the distortive results of the tibio-tarsal articulation and serves to graphically and numerically evaluate the degree of breech stability deficit.

The TB asks the patient to maintain a support on a limb only (the acquisition usually takes place in 5-10 seconds at OA per limb) and then supports the contralateral limb.

The comparison of the parameters (speed, statokinesigram and track length) occurs between healthy and pathological limb.

Study of sitting position

f) Standard clinical status in a sitting position
g) Calibrated clinical stability in a sitting position

Patient positioning

The TB invites the patient to stand on the dynamometric platform and position himself with:

- 30 ° split femurs (open femoral VU) and 90 ° shins (plumb line test)
- support of the upper limbs on the thighs;
- head in neutral position;
- look at infinity;
- trunk as upright as possible.

f) Standard clinical status in a sitting position
Performed in patients with central or peripheral balance disorders (strokes cerebri, polyneuropathies, movement disorders).

The TB positions the patient in 3 different ways, with the first two that make up the static tests and the 3rd which consists of dynamic tests:

1. plumb line test;
→ the duration of each test is 15 "at OA and 15" at OC
2. Pronation test (PP) with the upper limbs raised to 90 °, adducts, parallel and with the palms of the hands facing upwards;
→ the duration of each test is 15 "at OA and 15" at OC
3. perturbation tests (P.P)

→ the TB invites the patient to rest his hands on his thighs, after which he gives a push from behind (on the shoulder blades), from the front (on the bald spot), from the left (deltoid muscle), from the right (deltoid muscle).

The duration of each test is 25 seconds at OA and 25 seconds at OC.

Static Tests	VFA a 30° A.AA.SUP OA	15sec.
	VFA a 30° A.AA.SUP OC	15sec.
	VFA a 30° PP OA	15sec.
	VFA a 30° PP OC	15sec.
Dinamic Tests (perturbation)	VFA a 30° A.AA.SUP OA P.P	25sec.
	VFA a 30° A.AA.SUP OC P.P	25sec.

VFA = "open femoral vu"; A.AA.SUP. = support for upper limbs on the thighs;
PP = proof of pronation; P.P perturbation test
The indicators, as previously stated, are the same as those of upright stabilometry, but the perturbation tests can provide subsequent information on the supraspinal kinetic labyrinthine reflexes (derived from the parachute reflex responses that allow protection from falls) [7].

g) Calibrated clinical stability in a sitting position

It is used in the study of pelvic asynchisms in association with alterations of the vertebral column, paramorphisms, hypo-hypercyphoses which can be corrected by raisings of varying thickness to the buttocks in a sitting position.
The TB after placing the 16 physical markers (see fig.) On the back of the trunk invites the patient to simply position himself on the platform.
At this point the right or left hemibacine is raised by the software.
The extent of the upside is usually defined a priori, but can be changed on the spot, depending on the needs.
It is therefore necessary to take note of the changes in the positions of the markers (especially on the posterior iliac spines) and to verify them by recording the indicators on the platform.

The indicators are:
qualitative
- Analysis of loads in Kg
- Positioning of the pressure center or Cps with respect to the X / Y axes

quantitative
- Path length
- Amplitude of the subtended area (sway area)

The exam lasts 30 seconds and is carried out at OA [8].

Baropodometry

We have the following applications:

h) Static baropodometry
i) Dynamic baropodometry
j) Tandem Gait Test (OA / OC)

This clinical examination is used:
- in foot pathologies (hollow foot, flat foot, hemicavism, strength deficit)
- in developmental age pathologies
- in pathologies of adult age of various etiology and variously treated (with no orthosis; surgical therapy, medical) [9]

Patient positioning and exam execution

h) The TB invites the patient to take a position as for carrying out the stabilometric examination (position of the plumb line).

Depending on the diagnostic question, surveys can be performed:
1. with and without footwear
2. with and without orthotics
3. with orthotics and footwear

The choice of indicators depends on the type of application in use and the patient's level of disability.
Among these we have *quantitative parameters*:

1. Dist.CoF-Battuta Pressure centers (CoF aligned / not aligned)
2. Dist.CoF-CoP equidistant / not equidistant
3. Dist. CoF-breech axis
4. Dist.CoP-C.Geom.C.Geom. coincident / non-coindident with the CoP
5. CoP position
6. Podalico Axis
7. Foot angle
8. Foot surface

qualitative parameters:
1. Point analysis
2. High resolution analysis
3. Numerical analysis
4. Analysis in 3D
5. Position of the average CoP, right and left
6. Position of point M (maximum pressure)

The exam, for each test, usually lasts 5 seconds, exclusively for OA [10].

i) The TB asks the patient to position himself just before the margin of the first sensorized module, so that walking, as in literature, begins with an entire podogram.

It is always advisable to have a couple of walking exercises (recorded) not so much to accustom the patient to the platform, but to have in any case parameters to be analyzed. In the clinical field it often happens that the patient cannot perform more than two steps (due to physical limits).

Registration lasts 60 seconds, during which talking or leaving the walkway is not allowed.

The TB manages the start and end of the test with simple voice commands ("VIA"; "STOP") and must ensure that the patient does not stop on the part of the platform with sensors.

The indicators analyzed, again according to literature, are

quantitative:

1. Length of the half-pass (Lsp)

→ distance between the right heel support and the left heel support;

2. Average speed (V.media)

→ contextualized speed of the patient himself;

3. Cadence (steps / minute)

→ number of podograms on a passing platform;

4. Distance of the interphase (Dip)

→ distance of opening between the two feet during walking;

5. Support time (T.app.)

→ single foot support time;

6. Double support time (T.d.app.)

→ support time of the two feet simultaneously [11]

quality:

1. Average resultants (Mass Center or CoM)

2. Trend of the centers of gravity

3. Partial results

4. Variation of the angles of the results of the pressure centers

5. Position of point M

6.

j) Through this examination we study the line of the step in those patients in which we want to unbalance the disturbance of the balance of central or peripheral origin and who are borderline to the other tests (stabilometry, objective examination), quantifying and graphing the deficit according to the HOBarber scale (v. literature).

It represents a valid tool for the study of patient simulators or functional patients.

TB invites the patient to:

- go up barefoot on the platform,
- memorize a red central line (or a color in any case that creates a contrast with the covering of the platform)
- first follow it to OA and then to OC, for 1.20 m and for a single passage.

For the study of the indicators, the reference is to the table of the Tandem Gait Test by H.O. Barber.

Baropodographic Treadmill

This type of exam is used in:

- all movement disorders of various origins (eg M. of Parkinson),
- problems related to walking or running (
- pathologies of the foot.

Patient positioning and exam execution

Depending on the diagnostic need, the measurement can be performed with / without footwear and with / without orthosis (orthotics, Codivilla spring, etc.).

The TB asks the patient to settle on this special treadmill in correspondence of the handrail, in order to have the security of a support in case of need.

On this instrumentation the speed, which starts at about 1 km / h, is regulated by the examiner (TB), who must be able to adapt it to the patient's clinical characteristics and / or disability.

A practical example is given by the walking of the Parkinsonian, where its execution becomes less difficult, slightly increasing the speed (about 1.2-1.4 km / h).

The patient is asked to simulate a march on the spot waiting for the platform to be activated, after which an acquisition time of about 10 seconds is sufficient, at the end of which the TB interrupts (progressive in about 3-5 seconds) the functioning of the rotating platform.

The indicators are divided into:

functional
- Development of Mass Centers (CoM);
- Partial results of right and left foot

structural
- Oria Point pressure analysis
- Isobaric analysis
- Analysis in 3D [12]

Three-dimensional spine reconstruction: Body Analisis Capture (BAK)

With this examination, without the use of ionizing radiation, we study:
- scoliosis
- the paramorphisms,
- the dorsal and lumbar hyper-hypocytes
- the hetero-hypometries of the lower limbs

Camera arrangement

The provision of the cameras where to carry out the BAK exam is different depending on whether you have one, two or four cameras.

The following indications refer to a 4-camera acquisition, able to eliminate the problems of patient rotation (inevitably present in a 1, 2 or 3 system). The distance separating the camera lens from the ground must be about 1m.

The cameras, arranged frontally two by two, frame the patient in a way dedicated to the Frontal planes, and the other couple to the Sagittal planes.

1 T1 Front Front Plan
2 T2 Posterior Frontal Plan
3 T3 Right Sagittal Plane
4 T4 Left Sagittal Plane

The task of the TB is also to provide for the calibration of the cameras, which must take place whenever it is planned to perform examinations. This operation must also be carried out if one of the cameras has been moved, rotated or tilted.

Patient positioning and exam execution

The patient is invited to undress, remaining in briefs.
In the case of a female patient, bra maintenance is also permitted.
At this point the TB provides for the positioning of adhesive cutaneous markers on points established by literature (trunk, column, pelvis, upper and lower limbs).
The patient is then invited to position himself at a predetermined point on the platform, in frontal front view.
The indicators that are studied for the column deviations in the frontal and sagittal planes are:
1. measurement of Cobb grades
2. angles of the cervico-dorsal and dorso-lumbar curves
3. linear distances between various landmarks

How does a TB laboratory session end?

At the end of each session it is the task of the TB:

- proceed with the backup of the exams carried out on special archives (to lighten the software and not leave you sensitive data);
- turn off all the equipment (not forgetting those not used) and check the closing processes;
- sanitize the surfaces of the various instruments with the special products

-soak a soft crossbar with simple alcohol,
- always start from the PVC moving from the center to the periphery both longitudinally and transversely,
- only afterwards proceed to clean the first and second stops of the walkway module,
- once every 30 days carefully remove the PVC.
Tilt it and clean it on the inner surface.
Then carefully remove the cloth cover.
Moving it, and more than 1 meter away from the sensors, slam it 2-3 times,
- only afterwards, with a clean cloth / cross soaked in alcohol, clean the sensors always starting from the middle of the platform,
- replace in sequence: cauciù, PVC
- put back the posters bearing the various prohibitions

- switch off heating / cooling systems if used.
- turn off the lighting and lock the Laboratory

General tricks

- At the end of each exam, the test is immediately saved.
- The patient must be informed by the TB about the type of exam that is carried out, without any condition in the execution of the same (he must not accurately describe the examination or anticipate the contents, it will be the task of the referring specialist to answer any questions about it)).
- When the data is saved and written to a folder, if the patient has finished the exam / exams and has no other tests to perform on other equipment, he is asked to put his shoes back on and / or get dressed if a 3D reconstruction of the vertebral column (during which one remains only in panties and bra) and to leave the room, so as to wait outside the Laboratory for written reports addressed to the treating physician and / or specialist doctor. The latter is delivered in a sealed envelope (possibly with a label with an identification code).

N.B. If technical acquisition difficulties occur, the patient must not be alarmed or any doubts regarding the correct functioning of the equipment must be raised. Any kind of misunderstanding needs to be addressed with the patient not present, so if this occurs, the TB must ensure that the situation can be restored without other people in the room.

Cleaning: general rules

Premise: the cleaning of the room must be carried out daily starting from some criteria previously established and assigned to the staff:

- it is not possible to refurbish, if this operation is granted, the water must not touch or touch the footboards
- all instruments must be moved only by laboratory operators

Accurata Accurate cleaning must be done carefully around all the footboards

- at least once a month must be sanitized: keyboards, video terminals, printers, towers, cameras

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