

Working

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Postural stability, body weight distribution, and foot typology of sportsmen



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ABSTRACT

The protocol describes guidelines and steps for taking repeated measurements of sportive population: postural stability, body weight distribution during quiet stance, and the foot type diagnostic. The parameters calculated from repeated measurements can be used for separate analyses: analysis of center of pressure displacement, represented by total travelled way parameter; analysis of body weight distribution and loading of the lower limbs; and foot typology. The guidelines are mostly based on recommendations of the literature, partly on our own research experiences. It is important to remain consistent during all of the measurements and follow the guidelines as they control important aspects of the measurements. Any changes of any aspects can significantly alter the final results.

EXTERNAL LINK

<https://doi.org/10.1371/journal.pone.0204578>

THIS PROTOCOL ACCOMPANIES THE FOLLOWING PUBLICATION

Marencakova J, Maly T, Sugimoto D, Gryc T, Zahalka F (2018) Foot typology, body weight distribution, and postural stability of adolescent elite soccer players: A 3-year longitudinal study. PLoS ONE 13(9): e0204578. doi: [10.1371/journal.pone.0204578](https://doi.org/10.1371/journal.pone.0204578)

PROTOCOL STATUS

Working

GUIDELINES

Postural stability - centre of pressure (COP) displacement measurements:

1) Narrow stance test - body weight distribution registration

Instruct the participant take a position of bipedal narrow stance in the middle of the tensometric platform.

Feet are close as possible without touching each other, neither ankles, knees or any part of leg.

Place the feet parallel with the heels aligned in a line and faced forward.

Maintain both lower limbs in full knee extension and arms resting along the body sides.

The exact foot placement should be maintained during the trials and visually controlled since its changes could affect the measured parameters.

Instruct the participant to watch the point on the wall placed at the eyes level 2 m far from the participant (to be sure the head and cervical spine is in a correct position during the test).

Say to the participant when the test starts and then wait 5-10 s to start the capturing the test to be sure the participants is already in steady state.

Record 30 s of calm standing (Kapteyn, Bles, Nijokiktjen, Kodde, Massen, Mol, 1983).

During the narrow stance test, register the body weight distribution from software measurements.

After the test finishes, let the participant rest for 60 s - just relaxed position or a short walk.

2) One-leg stance - total travelled way (TTW) of COP

Instruct the participant take a position of bipedal stance in the middle of the tensometric platform.

Feet are parallel, facing forward and the distance in between them is equal to a pelvis width.

Arms are resting along the body sides.

Instruct the participants to choose leg which he want to start with and to stand on it. The second leg is bending backward with 90

degrees of knee flexion and neutral position of the hip.

Chosen leg should stay extended all the testing time.

Instruct the participant to watch the point on the wall and be motionless as possible and after 5-10 s start the capturing.

After the test finishes, let the participant rest for 60 s - just relaxed position or a short walk.

Repeat the test 3 times.

Generally, maintain the exact conditions under each trial of all subjects.

3) Foot type analysis – Chippaux-Smirak Index (CSI)




Use the footprint from one-leg stance test and open it in 2D video analysis software.

Make a middle foot line and calibrate the measure by adding the foot length of the actual participant.

Draw a tangent to the lateral border of the foot. Then, draw 2 perpendicular lines: one in the most widest part of forefoot, and second in the most narrow part in the midfoot.

Measure and write down the length of these lines and add them to the equation for CSI which is a ratio of the minimum width of the midfoot to the maximum width of the forefoot multiply by 100 to get a percentage (Queen, Mall, Hardaker & Nunley, 2007).

MATERIALS

NAME	CATALOG #	VENDOR
 RS Footscan Balance tensometric plate		Contributed by users
 2D motion analysis software		Contributed by users
 Electronic spreadsheet software for storing, organizing and calculating data		Contributed by users

SAFETY WARNINGS

It is not intended for people suffered any acute or chronic pain of musculoskeletal system, and with any neurologic and psychologic health problems in the time of the measurements.

It is strictly prohibited to underwent the measurements under a drug or other substance affecting perception, concentration, mood, or behavior.

Researcher should avoid any unsafe objects from at least 3 m around the tensometric platform and carefully inform the participants prefer their safety and avoid the injury.

BEFORE STARTING

Set the pleasant temperature in the lab and avoid any noise occurrence during the testing.

Register related health problems history (injury, visual, musculoskeletal, neurologic, psychologic problems and diseases).

Take basic anthropometric data of the participants - body weight, body height, and foot size and length.

Ensure the participant is healthy, in a good physical and psychological state, and able to stand on one leg without problem.

Inform the participant about the whole measurement process and main goal: to be as motionless as possible during the testing.

Postural stability - centre of pressure displacement measurements (COP)

1 Perform measuring process by following the **Guidelines**:

- 1) 30 s of narrow stance
- 2) 60 s of one-leg stance
- 3) 60 s of one-leg stance - the second leg

2 Repeat each of the test 3 times and let the participant rest for 60 s in a relaxed position after every test.

- 3 Register:
 - 1) percentage of body weight distribution from narrow stance test.
 - 2) total travelled way of COP during one-leg stance test for both legs.

- 4 Save footprints from one-leg stance test for both legs.

Foot type analysis

- 5 Use 2D analysis software for Chippaux-Smirak Index calculation from saved footprints following the **Guidelines**.



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