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Protocol Normative Gait Data ZHAW Movement Laboratory

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Bettina Sommer[1], Christoph Bauer[1], Carole Pauli[1], Michelle Haas[1], Eveline Graf[2]

[1]Zurich University of Applied Sciences; [2]ZHAW Zurich University of Applied Sciences

Eveline Graf
ZHAW Zurich University of Applied Sciences

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We use this protocol and it's working

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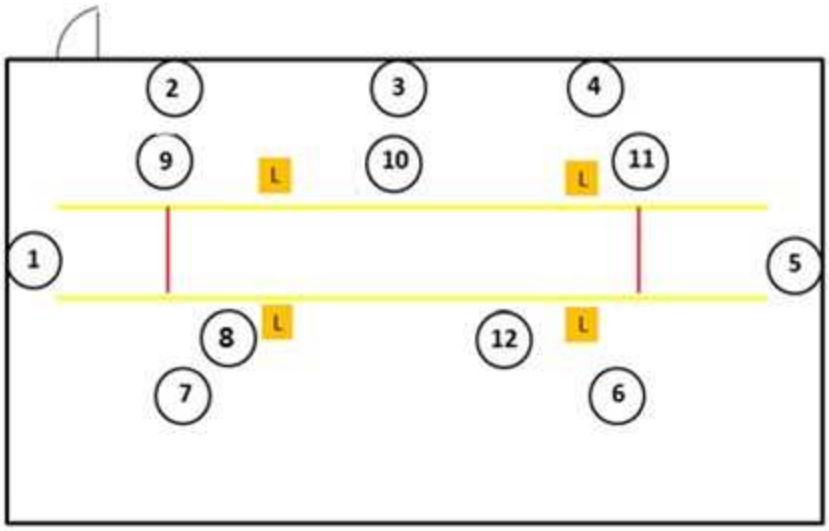
Abstract

This protocol describes the detailed study procedures for the collection of normative gait data for walking at the ZHAW movement laboratory.

Laboratory Preparation

1 Cameras

A total of 12 Vicon Vantage cameras were used for data collection.
Cameras need to be turned on for warming up at least 30 minutes before system calibration



Position of cameras and photocells (indicated with "L") in the movement laboratory.
Cameras 1-8 were wall-mounted, 9-12 were mounted on tripods on the ground.

2 Photocells

The photocells are placed in the room as shown in the figure above, with a distance of 360 cm between them. Switch on the light barriers before calibrating. A marker is placed on the light barrier to measure the exact distance in the Vicon. This information is used to track the walking speed.

3 System Calibration

The camera system needs to be calibrated according to the manufacturer's guidelines. For the Vicon system, guidelines can be found here:
https://help.vicon.com/space/Nexus216/11606902/Calibrate+a+Vicon+system

Participant Preparation

4 Information and informed consent

Upon arrival of the participant, they will be informed about the study procedures. After signing informed written consent, the detailed inclusion and exclusion criteria will be checked and the final inclusion decision will be made by the investigator. After inclusion, the participant will be

asked to change into shorts, male participants will be shirtless, female participants will be asked to wear a (sports)bra.

Inclusion criteria:

- signed informed written consent
- age between 18 and 70 years
- body mass index between 18 and 28 kg/m^2

Exclusion criteria:

- acute or chronic musculoskeletal diseases
- acute or chronic neurological diseases
- acute or chronic cardiopulmonal diseases
- amputation
- diagnosed scoliosis
- pregnancy

5 Collection of anthropometric data

Height (in mm) and mass (in kg) will be recorded with the participant barefoot.

6 Palpation of anatomical landmarks

Specific markers need to be placed on anatomical landmarks which can be identified with the following instructions:

	anatomical landmarks	instruction for palpation
	anterior spina iliaca	Palpate from distal, medial protrusion.
	lateral & medial femoral epicondyle	Palpate from proximal along the leg to the bony structure, outermost point. Check during flexion/extension movement whether the center of rotation is correct.
	lateral & medial malleolus	Highest point of the malleolus.
	Posterior spina iliaca	Palpate from distal.

7 Marker placement

Retroreflective markers will be attached to the skin of the participant using double-sided tape on the following locations:

	Segment	Marker Name	Marker Position
	Rearfoot	L/R HeeMeDia	Left / Right heel medial
		L/R HeeLaTer	Left / Right heel lateral

	Segment	Marker Name	Marker Position
		L/R HeePoPro	Left / Right heel posterior proximal (along Calcaneus)
		L/R HeePoDis	Left / Right heel posterior distal (along Calcaneus)
	Shank	L/R AnkMeMal	Left / Right ankle medial malleolus (on the most prominent part)
		L/R AnkLaMal	Left / Right ankle lateral malleolus (on the most prominent part)
		L/R ShaLoLat	Left / Right shank lower lateral
		L/R ShaLoMed	Left / Right shank lower medial (preferably on the shin)
		L/R ShaUpLat	Left / Right shank upper lateral
		L/R ShaUpMed	Left / Right shank upper medial (preferably on the shin)
	Thigh	L/R KneLaEpi	Left / Right knee lateral epicondyle
		L/R KneMeEpi	Left / Right knee medial epicondyle
		L/R ThiLoMed	Left / Right thigh lower medial (above the patella)
		L/R ThiLoLat	Left / Right thigh lower lateral
		L/R ThiUpMed	Left / Right thigh upper medial
		L/R ThiUpLat	Left / Right thigh upper lateral (below the fingers, when arms are hold beside the body)
	Pelvis	L/R ASI	Placed directly over the left / right anterior superior iliac spine
		L/R PSI	Placed directly over the left / right posterior superior iliac spine
		L/R IC	Placed directly over the left / right iliac crest

Data Collection

8 Static Trial

For the static trial, place feet parallel. Place the right foot on the line on the floor, with the heel and 2nd toe on the line.

After the static trial, the markers are labeled to check that all markers are present.

9 Functional Calibration

The functional calibration of the hip and knee joint will be performed according to **List et al. (2013)**

The following verbal instruction will be provided:

Knee joint

"Stand upright. Lift your left/right leg off the floor and move your lower leg back and up to your thigh and back again three times. You can hold on to the chair to help you keep your balance."

Hip joint

"Stand upright. Lift your left/right leg off the floor and circle your outstretched leg around your hip three times. The circle should be as large as possible. You can hold on to the chair to help you keep your balance."

10 Dynamic Trails

The following verbal instruction will be provided for the walking trials at the specific speeds

Self-selected speed

"Walk at your usual speed."

Slow speed

"Walk at the specified slow speed."

Normal speed

"Walk at the specified normal speed."

Fast speed

"Walk at the specified fast speed."

To determine the self selected speed, 10 gait tests are carried out. The time of each test is measured and recorded. The mean value is then calculated and the number of trials within ± 5% is determined. The remaining number of attempts is then recorded.

To determine the specified speeds, perform gait trials and give feedback if the target speed has been reached. Keep practicing until the target speed has been reached at least twice in succession and the force plate has been hit. In order to hit the force plate, move the starting point that is indicated with a wooden block.

11 End of data collection

After all data have been collected, the markers are removed from the participant who is then free to change and leave.

Data Processing

12 Labelling of marker trajectories

The marker trajectories are labelled in the Vicon Nexus Software (Vicon Motion System, UK). The raw data files of each trial are then imported into Matlab (R2019a, Mathworks, USA) where data are processed and joint angles and gait parameters are calculated based on published formulas.

Protocol references

http://10.0.5.239/JSC.0b013e3182736034