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Title: Lower-Limb Biomechanical Characteristics Associated with Unplanned Gait Termination Under Different Walking Speeds

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Author Questionnaire

1. **Microscopy**: Does your protocol require the use of a dissecting or stereomicroscope for performing a complex dissection, microinjection technique, or something similar? **No**

2. **Software:** Does the part of your protocol being filmed include step-by-step descriptions of software usage? **Yes**

3. **Interview statements:** Considering the COVID-19-imposed mask-wearing and social distancing recommendations, which interview statement filming option is the most appropriate for your group? **Please select one**.

   ☒ Interviewees wear masks until videographer steps away (≥6 ft/2 m) and begins filming, then the interviewee removes the mask for line delivery only. When take is captured, the interviewee puts the mask back on. Statements can be filmed outside if weather permits.

4. **Filming location:** Will the filming need to take place in multiple locations? **No**

Current Protocol Length

Number of Steps: 11
Number of Shots: 26

Introduction

1. Introductory Interview Statements

REQUIRED:

1.1. **Xuanzhen Cen:** This method can be used to investigate key question in lower-limb biomechanical changes that occur during unplanned gait termination under different walking speeds.

1.1.1. INTERVIEW: Named talent says the statement above in an interview-style shot, looking slightly off-camera.

1.2. **Xuanzhen Cen:** The main advantage of this technique is that it can provide some specific details for exploring potential injury risks associated with gait termination.

1.2.1. INTERVIEW: Named talent says the statement above in an interview-style shot, looking slightly off-camera.

Ethics Title Card

1.3. Procedures involving human subjects have been approved by the Human Ethics Committee of Ningbo University.

Protocol

2. Participant Preparation

2.1. Before the test, interview all subjects and provide them with a simple explanation about the experimental goals and procedures **[1]**. Obtain written informed consent from subjects who meet the key inclusion criteria **[2]**.

2.1.1. WIDE: Establishing shot of talent and subject discussing the experiment.

2.1.2. Subject signing consent form.

2.2. Include subjects who are physically active male adults, have the right leg as dominant, do not have any hearing disorder, do not have lower-limb disorders, and have not incurred injuries in the last six months **[1]**.

2.2.1. Ideal subject for the experiment.

2.3. Instruct all subjects to fill out a survey with questions such as "Have you had a history of running or other physical activities?", "How often do you do physical activities in a week?", "Do you have any professional athletic training?", and "Have you suffered any lower-limb disorders and injuries in the last six months?" **[1]**.

2.3.1. Subject filling out a questionnaire.

2.4. Ensure that all subjects wear identical t-shirts and tight-fitting pants **[1]**. Measure subjects' standing height and body weight **[2]**, lower limb length **[3]**, knee width **[4]**, and ankle width of both left and right leg using a Vernier caliper or a small anthropometer **[5]**. *Videographer: This step is important!*

2.4.1. Subject wearing the appropriate clothes.

2.4.2. Talent measuring the height of the subject.

2.4.3. Talent measuring the lower limb length.

2.4.4. Talent measuring the knee width.

2.4.5. Talent measuring the ankle.

2.5. Shave off body hair where appropriate **[1]** and remove excess sweat using alcohol wipes **[2]** to prepare skin areas of anatomical bony landmarks for marker placement on joints and segments. Identify 16 anatomical landmarks and attach passive retro-reflective markers with double-sided adhesive tapes **[3]**. *Videographer: This step is important!*

2.5.1. Subject or talent shaving off the hair.

2.5.2. Talent wiping the subject with alcohol wipes.

2.5.3. Talent placing the retro-reflective markers.

2.6. Give each subject 5 minutes to adapt to the test environment and warm up with light running and stretching **[1]**. *Videographer: This step is important!*

2.6.1. Subject warming up.

3. Dynamic Trials

3.1. Once the subject is at the starting position **[1]**, open the Kinematics Motion capture system, select the "**Go Live**" button in the "**Resources**" pane, and click "**Capture**" in the right toolbar. Find "**Trial Type**" and "**Session**" and edit the Trial description **[2]**.

3.1.1. Subject at the start position.

3.1.2. SCREEN: video 1.mp4. 0:00 – 0:06. *Video Editor: Emphasize the Trial Type and Session at the top right between 0:04 – 0:06.*

3.2. Ask subjects to walk along a walkway at their normal walking speed **[1]** and instruct them to use the dominant and non-dominant leg to pass areas A and B, respectively, and then to stop at area D on the pressure platform **[2]**. *Videographer: This step is important!*

3.2.1. Talent instructing the subject and the subject walking.

3.2.2. Talent instructing subject to pass area A and B and then stop at D, pointing out the areas.

3.3. Let the subject know that when the termination signal is provided, they need to quickly stop at B **[1]**. Randomly provide the termination signal **[2]** as the heel touches area A, ensuring that the unexpected gait termination, or UGT, is executed **[3]**. After finishing the UGT test, click **Stop** to end the data collection trial **[4]**. *Videographer: This step is difficult and important!*

3.3.1. Talent instructing the subject to stop at the termination signal.

3.3.2. Talent providing the termination signal.

3.3.3. Subject's heel touching A and then subject executing UGT.

3.3.4. SCREEN: video 1.mp4. 0:10 – end.

3.4. Capture at least five successive UGT trials with 2-minute rest intervals between trials **[1]**. Calculate each subject's walking speed using the pressure platform software. Then, calculate the fast walking speed as 125% of the normal walking speed **[2]**.

3.4.1. Subject repeating trial from beginning to end.

3.4.2. Talent at the computer, calculating walking speed.

3.5. To calculate plantar pressure, select the **Measure** button before starting the UGT trials **[1]**. After finishing the UGT test, click **Save Measurement** button to save the data **[2]**. Repeat the test at fast walking speed to capture at least 5 successive trials **[3]**.

3.5.1. SCREEN: video 2.mp4. 0:00 – 0:09.

3.5.2. SCREEN: video 2.mp4. 0:09 – end.

3.5.3. Subject performing UGT at FWS.

Results

4. Results: ROMs and Plantar Pressure during UGT

4.1. This protocol was used to compare the biomechanical characteristics of the lower extremity during unplanned gait termination under different walking speeds. Data was collected from 15 subjects. Mean normal and fast walking speeds of the subjects were 1.33 and 1.62 meters per second, respectively **[1]**.

4.1.1. LAB MEDIA: Figure 3.

4.2. The mean range of motion of the hip, knee, and ankle joints in the sagittal plane during unplanned gait termination at normal and fast walking speeds is shown here **[1]**. Compared with normal walking speed, the range of motion of three joints increased significantly at fast walking speed **[2]**.

4.2.1. LAB MEDIA: Figure 3.

4.2.2. LAB MEDIA: Figure 3. *Video Editor: Emphasize the fast speed bars.*

4.3. The plantar pressure data, including maximum pressure **[1]**, maximum force **[2]**, and contact area **[3]**, during unplanned gait termination is shown here. Compared with normal walking speed, the maximum pressure in BT, M1, M2, M3, MH and LH regions increased significantly at fast walking speed **[4]**.

4.3.1. LAB MEDIA: Figure 4. *Video Editor: Emphasize A.*

4.3.2. LAB MEDIA: Figure 4. *Video Editor: Emphasize B.*

4.3.3. LAB MEDIA: Figure 4. *Video Editor: Emphasize C.*

4.3.4. LAB MEDIA: Figure 4 A. *Video Editor: Emphasize the BT, M1, M2, M3, MH and LH bars.*

4.4. Similarly, the maximum force increased significantly in BT, M1, M2, M3, MH and LH at fast walking speed **[1]**. Differences in contact area occurred in the heel region, MH and LH, both increasing at fast walking speed **[2]**. No significant difference occurred in any parameters for the OT, M4, M5 and MF regions **[3]**.

4.4.1. LAB MEDIA: Figure 4 B. *Video Editor: Emphasize the BT, M1, M2, M3, MH and LH bars.*

4.4.2. LAB MEDIA: Figure 4 C. *Video Editor: Emphasize the MH and LH bars.*

4.4.3. LAB MEDIA: Figure 4. *Video Editor: Emphasize the OT, M4, M5 and MF bars in A, B, and C.*

Conclusion

5. Conclusion Interview Statements

5.1. **Xuanzhen Cen:** Following this procedure, the effects of different speeds with different strike patterns on muscle activities and joint moments during gait termination can be researched.

5.1.1. INTERVIEW: Named talent says the statement above in an interview-style shot, looking slightly off-camera.

5.2. **Xuanzhen Cen:** Gait termination trials could be used as an effective tool for diagnosis of clinical biomechanical performance and assessment of rehabilitation treatment.

5.2.1. INTERVIEW: Named talent says the statement above in an interview-style shot, looking slightly off-camera.

