

Fall Risk on Laboratory Instrumented Stairways

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The Challenge

A common parameter used to evaluate stairway fall risk is foot clearance. Foot Clearance measures the distance between one's foot and the edge of the step as one ascends/descends a stairway. A lower foot clearance is associated with an increased risk of unintentional stairway contact (i.e., tripping or stumbling), while a higher foot clearance has been associated with reduced fall risk when navigating stairs [1].



Figure 1. Illustration of foot clearance

Potential Solution

High-contrast vinyl placed on the tread edge of steps increases the perception of stairway step contrast [2]. By altering one's visual perception through contrast markings, we can effectively change one's gait pattern, leading to safer stair navigation and, in turn, fewer injuries.

Methodology

- 12 young, healthy adults with no musculoskeletal injuries, neurodegenerative conditions, or falls in the past year
- Outfitted with Vicon reflective markers (Figure 3A, 3B, 3C) and a Pupil Labs Neon headset
- In a randomized order, perform control, high-contrast vinyl, or reflective tape conditions
- Instructed to ascend and descend lab instrumented stairs as they would everyday stairs
- Foot clearances will be evaluated using motion capture

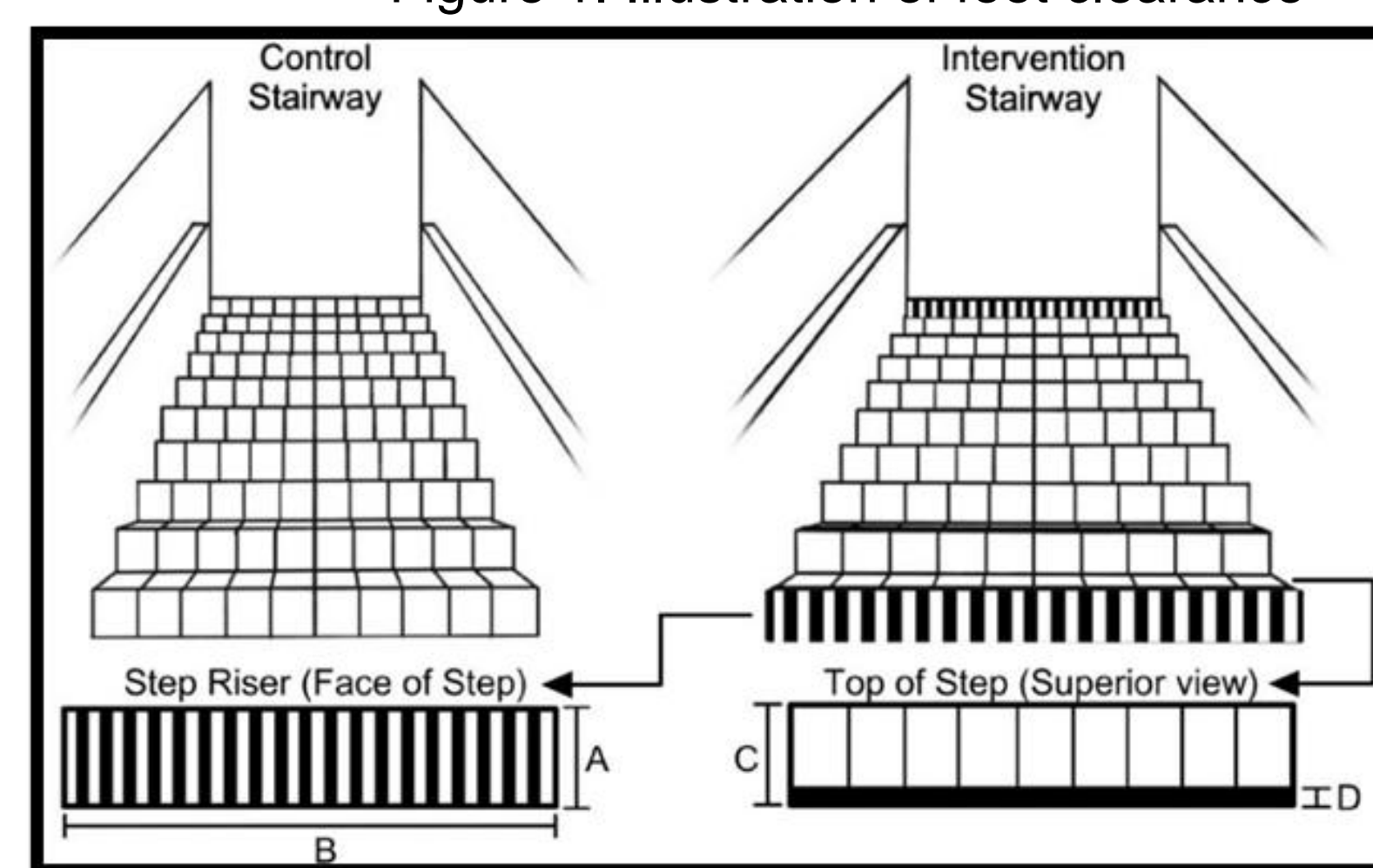


Figure 2. Illustration of control vs. stair high-contrast markings intervention stairway



Figure 4. Lab instrumented stairway

Implications

- Investigate the use of reflective tape as an alternative to high-contrast
- Determine if the conditions lead to a safer movement pattern when ambulating stairs

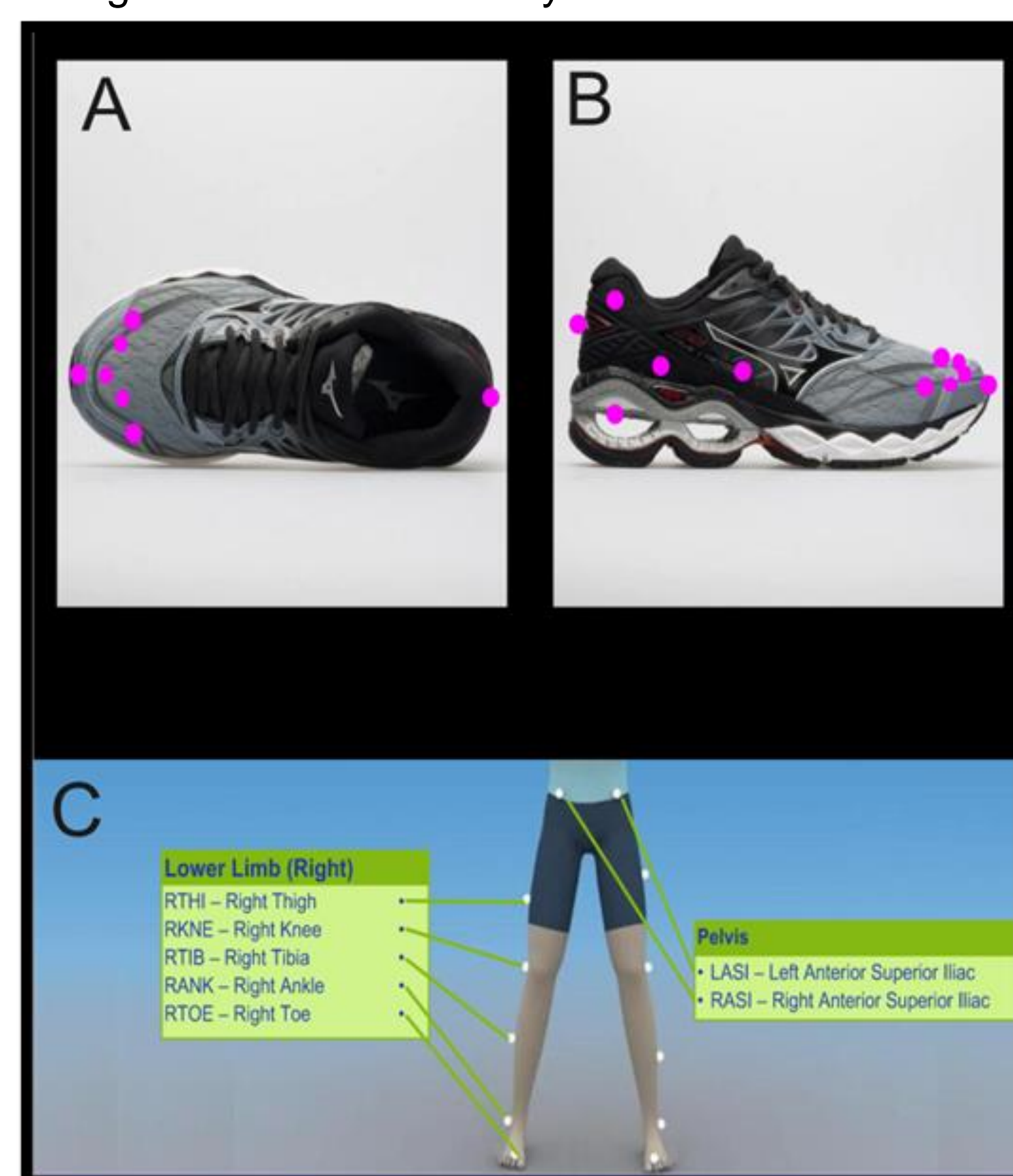


Figure 3. (A) Reflective marker placement on shoes, top down. (B) Reflective marker placement on shoes, side view. (C) Illustration of lower limb Plug-in Gait Model.

Project Status

This project has obtained IRB approval and is in the process of beginning recruitment. With limited time and space, visit one will take place in the CRABLAB, with the optional sub-study taking place in a lab space currently under renovation.

References

1. Ackermans, T. M. A., Francksen, N. C., Casana-Eslava, R. V., Lees, C., Baltzopoulos, V., Lisboa, P. J. G., Hollands, M. A., O'Brien, T. D., & Maganaris, C. N. (2019). A novel multivariate approach for biomechanical profiling of stair negotiation. *Experimental gerontology*, 124, 110646. <https://doi.org/10.1016/j.exger.2019.110646>
2. Bjelica, M., Levine, I. C., & Novak, A. C. (2021). Increasing the contrast of tread edge highlighters improves stair descent safety in older adults with simulated visual impairment. *Applied ergonomics*, 97, 103525. <https://doi.org/10.1016/j.apergo.2021.103525>

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