EFFECTS OF CLOTHING COLOR ON GAIT KINEMATICS WITH MARKERLESS MOTION CAPTURE

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Summary

Clothing conditions were evaluated within the same session in a group of 51 individuals walking at comfortable speeds. Randomized all black, all white, and self-selected clothing were worn. Waveform comparisons with SPM identified significant differences in each clothing comparison for sagittal, frontal, and transverse planes for the hip, knee, and ankle. However, the overall RMSE was low, ranging between 1.6 to 3.4 degrees.

Introduction

Markerless motion capture has continued to gain attention in the field. Studies have shown the data is repeatable, and clothing may not impact clinical interpretations [1,3]. Further research is still needed to understand the influence of specific types of clothing conditions. The purpose of this study was to determine the effect of clothing color on markerless motion capture kinematics during gait.

Methods

Fifty-one individuals (age 26.8±8.5 years, height 1.69±0.09 m, mass 73.2±16.5 kg) from a general population volunteered to participate in this study. Participants wore 3 randomized sets of clothing: self-selected (SS) and identical black (BLK) or white (WHT) clothing with footwear (Figure 1). Participants were instructed to walk at their comfortable gait speed on a 9-meter walkway.

Figure 1: Self-Selected (SS), White (WHT), and Black (BLK).

A markerless motion capture system (60Hz, Miqus Hybrid, Qualisys AB, Goteborg, Sweden) was used to measure kinematics. Three-dimensional pose estimations were conducted using Theia3D (2022_1_0_2309, Theia Markerless Inc., Kingston, ON). Right and left sides were averaged and hip, knee, and ankle angles across the gait cycle were compared with a two-tailed paired sample t-test correcting for multiple pairwise comparisons (<0.01) for each clothing combination (BLK vs WHT, BLK vs SS, WHT vs SS) using statistical parametric mapping (SPM) (Sift, HAS Motion, Kingston, Ontario). All SPM analyses were conducted from heel strike to the next heel strike for each full gait cycle. The percentage of frames significantly different during the gait cycle were reported. Root mean square error (RMSE) was also calculated across the comparisons.

Results and Discussion

Statistically significant differences were found for each clothing condition comparison within each of the joint angular rotation waveforms over time (Figure 2, p<0.01). The average gait cycle percentage difference across the BLK vs WHT condition for all rotations was 67%. The BLK vs SS condition exhibited an average difference of 53%. The WHT vs SS condition had an average difference of 52% of the gait cycle. The RMSE across comparisons had a range of 1.6 to 3.4 degrees. The largest RMSE for an individual participant curve comparison was 7.6 degrees.
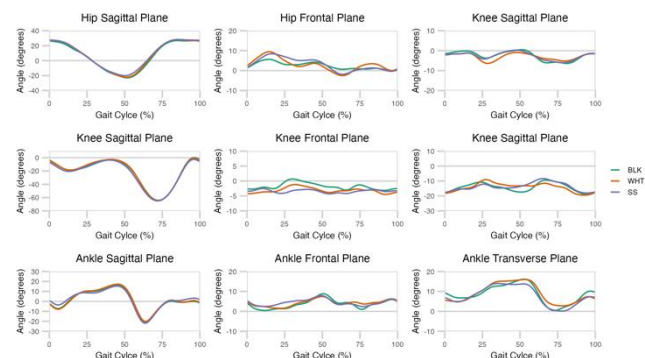

Figure 2: Mean angular joint motion for each clothing condition.

Conclusions

Clothing conditions influenced waveform comparisons during gait at comfortable walking speeds when evaluated with SPM. However, the overall error between clothing conditions was less than 4 degrees, with the maximum RMSE for one participant comparison just under 8 degrees.

References

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