Collision avoidance between two walkers: Reduced avoidance behavior in previously concussed athletes

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PURPOSE
To investigate collision avoidance strategies when avoiding another walker between previously concussed athletes and healthy athletes using the metric MPD

HYPOTHESIS
Previously concussed athletes will demonstrate altered trajectory adaptation and individual contribution to collision avoidance compared to healthy athletes

IMPLICATIONS
Athletes with previous concussion demonstrate decreased collision avoidance behavior, which results in a higher risk of a collision occurring. This may indicate a persistent deficit in perceptual abilities following concussion

INTRODUCTION
• Athletes with previous concussion exhibit persistent visuomotor deficits during static balance and visuomotor tasks such as collision avoidance1
• Less is known of visuomotor strategies used in dynamic scenarios such as person-person interaction2
• When avoiding another walker approaching at 90°, individuals adjust their path and/or velocity to mitigate the risk of collision2
• Minimal Predicted Distance (MPD) is a proposed metric predicting the future distance between participants if no trajectory adaptations are made3
• Will MPD variables reflect persistent visuomotor and perceptual deficits in previously concussed individuals during avoidance of an individual?

METHODOLOGY
Participants:
• 8 previously concussed athletes (4 female; 22.3±2.6 years) and 8 healthy control athletes (4 female; 23.3±3 years)

Experimental Protocol:
• 3D kinematic data were recorded using 24 Vicon cameras (120Hz)
• Two at a time, athletes walked along a 90° trajectory to each other to induce a possible collision2, while avoidance behaviours were recorded
• Four types of interactions completed (healthy-healthy; concussed-healthy; healthy-concussed; concussed-concussed) for a total of 80 trials

Data & Statistical Analysis:
• MPD calculated using statistical parametric mapping analysis
• General linear models were used to determine differences in MPD; pairwise t-tests to assess changes in contribution to collision avoidance
• Significant contributions to collision avoidance described as a percentage of the trial where contributions were significantly different (Fig 2)

RESULTS

DISCUSSION & CONCLUSION
• Previously concussed athletes demonstrated reduced contributions to the avoidance of a collision, especially when passing as the second walker, indicating a persistent deficit in perceptual abilities following return-to-play1
• Athletes with previous concussion remain at elevated risk of collision and possible injury following recovery
• Visuomotor and perceptual impairments persist following return-to-play in previously concussed athletes
• Using the metric MPD to assess collision avoidance may assist in the assessment and rehabilitation of visuomotor processes that are affected following a concussion
• Future research: develop a protocol to be used in sideline assessment to guide treatment following RTP

Figure 1: A) Mean MPD(t) evolution over time for each group and B) MPD(t) time derivative for each group. Both figures are presented without inversion trials. Shaded areas represent subject variability within each group. No significant differences found.

Figure 2: Contributions (mean ± SD) to MPD between first and second walker for each interaction type. Significance: HH:20-100%; CH:28-100%; HC:0-14%; CC:8-100%.

References:
1Baker C., & Cinelli M. E. (2014). Psychological Reports. 2(72)

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