Effect of cognitive tasks on forward lunge performance: a biomechanical analysis

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Introduction

The forward lunge develops unilateral strength and stability to maximise performance and reduce the risk of injuries [1]. In day-to-day life, as well as sport, motor-cognitive dual tasking is often required for successful task performance. Dual-tasking can cause performance decrements in one or both tasks, which can result in injuries [2].

By 'return to activity/sport' in rehabilitation evidence of dual-tasking ability is important, thus rehabilitation must incorporate this. It is unknown how different types of cognitive tasks can be used in rehabilitation. Virtual reality (VR) could create a diverse, challenging, and controllable environment, representative of real-world situations for dual-task training.

Research Question

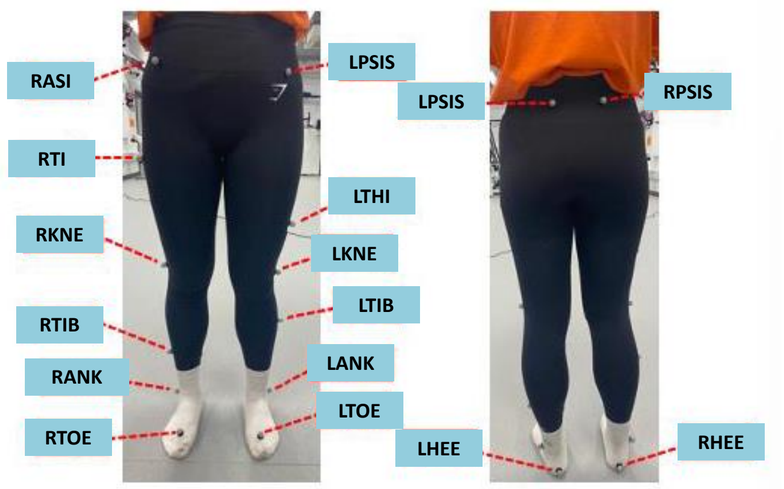
Does performing a cognitive task while lunging affects an individual's lunge performance?

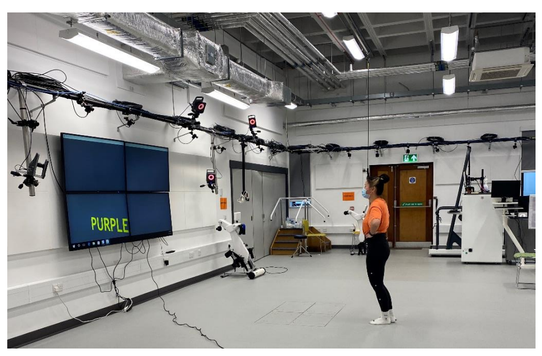
Method

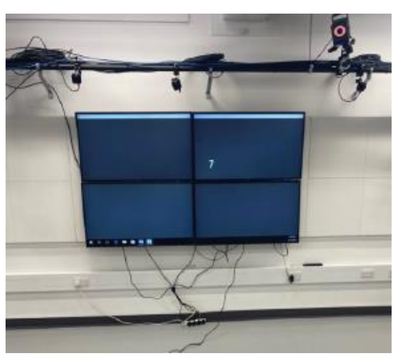
Six able-bodied participants (3 males, 3 females; age 23.7±2.3 years) performed forward lunges under 4 conditions (Table 1). The Stroop and mental arithmetic tasks were displayed on a large TV screen and created and controlled by D-Flow software. The Plug-In-Gait lower limb model was applied to all participants to track movement using Vicon Nexus. Three-dimensional kinematic data were analysed (Fig 1). Statistical testing was performed using SPSS software (p<0.05).

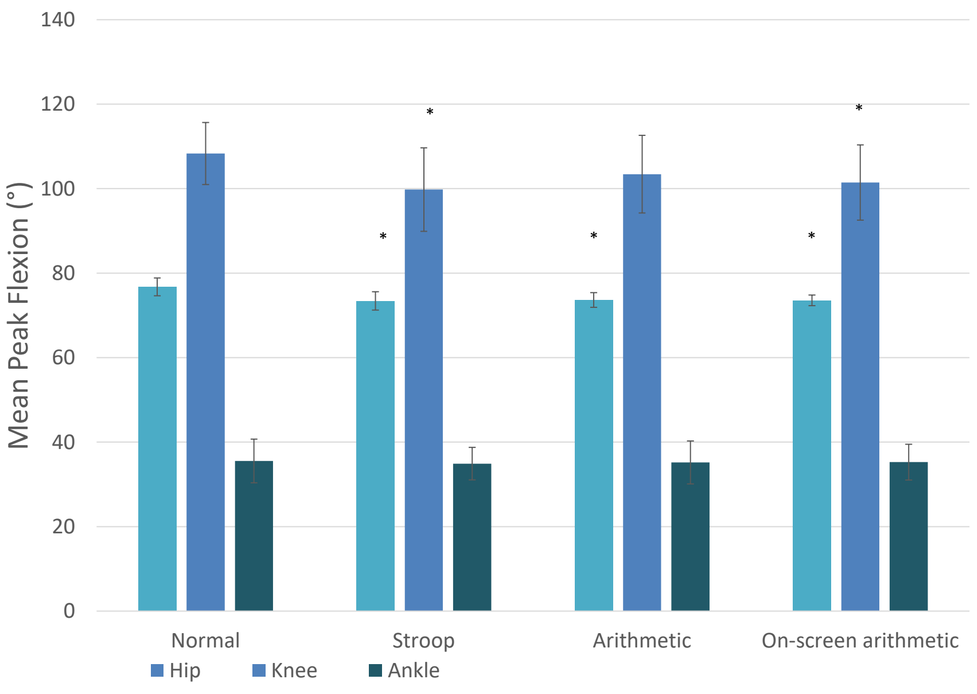
Table 1. Motor-cognitive conditions performed.

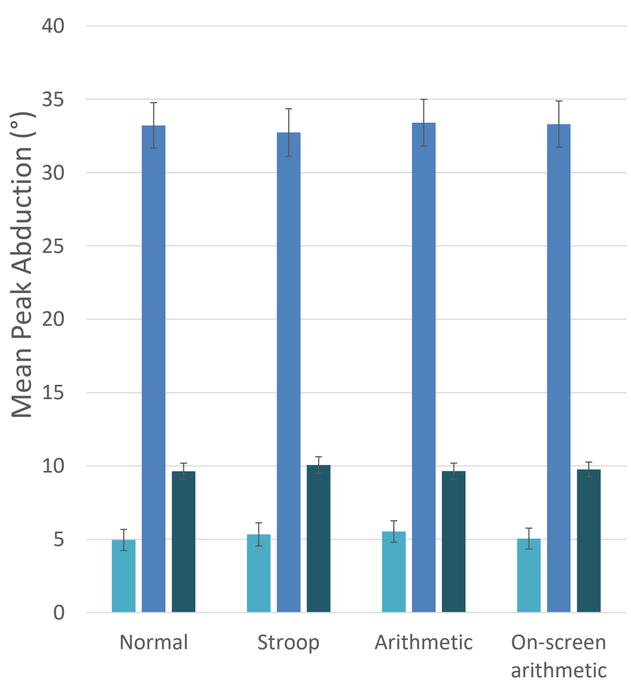
Task	Description
Normal lunges	Perform forward lunges.
Lunges with Stroop Test	Perform forward lunges whilst completing a Stroop test displayed on screen.
Lunges with Arithmetic Task	Perform forward lunges whilst counting down in 3s from 100.
Lunges with On-screen Arithmetic Task	Perform forward lunges whilst subtracting numbers that appear on screen from 100.











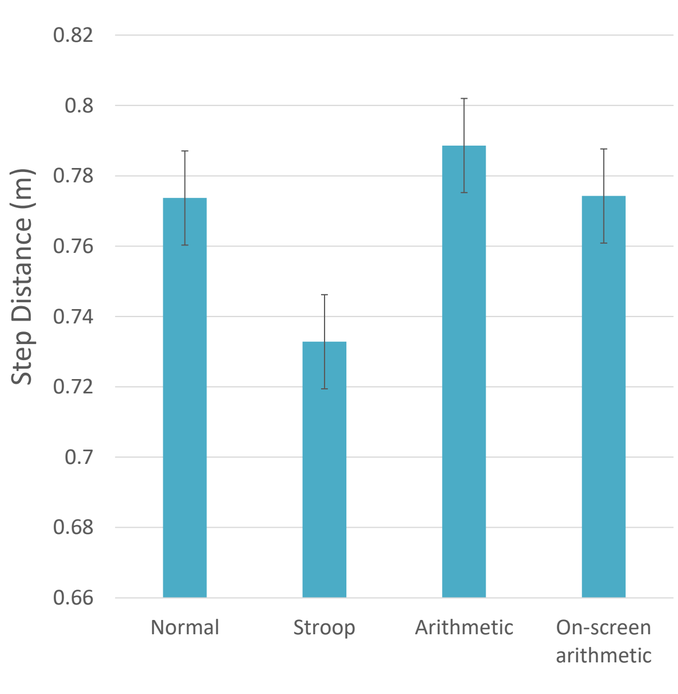


Figure 1. Participant preparation, lunge assessment, and peak flexion for all joints and gender, and step length results. * p<0.05.

Results

Under all dual-task conditions, participants exhibited decreased mean peak hip flexion (p<0.05) (Fig 1). For tasks using the screen (Stroop and Arithmetic), peak mean knee flexion was also reduced (p<0.05).

Conclusion

Motor-cognitive tasks appear to affect lunge performance, particularly in the sagittal plane. Reduced lunge depth could lead to inadequate loading of tissues in training, or to greater loads on structures such as the anterior-cruciate ligament due to less absorption. This may lead to injury [3].

VR tasks (using the screen) may be able to better identify those at risk of injury, and create more challenging rehabilitation programmes due to greater unpredictability of these tasks or provide augmented feedback to maximise technique efficiency. VR has also been shown to have motivational qualities in rehabilitation [4].

References

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