Ankle and Lower Leg Proprioception in Injury and Performance.

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Abstract

The evolution of bipedal gait in humans required the concurrent development of the ability to stabilise the entire bodyweight through a single ankle and foot during ambulant activity. Stability is maintained by a complex interaction between bony anatomy, ligamentous integrity and sensorimotor control that consists of sensory reception, central nervous system (CNS) integration of sensory information, and muscular action. Proprioception from sensory reception is defined as the afferent stimuli perceived by the CNS from reception at peripheral and internal sensory receptors.

Studies of proprioception around the ankle have shown links between chronic ankle instability (CAI) and proprioceptive deficits. However, systematic review and meta-analysis of ankle characteristics within this body of research has shown an inconsistency in the findings of the relationship between ankle proprioception and injury risk. This suggests that the ecological validity of current proprioceptive testing methodologies is not appropriate for comparison to normal functional activities.

The programme of research reported here has used the Active Movement Extent Discrimination Apparatus (AMEDA) to assess joint position sense (JPS) around the ankle. The original methodology for the AMEDA positions the participant in full weight-bearing in standing (AMEDA-stand), and uses active movement of the test apparatus footplate, in order to increase the ecological validity of testing. An extension of this methodology, to enable testing of JPS while stepping onto and across the AMEDA footplate (AMEDA-step), was developed within this research programme. The addition of walking movement to the test renders the test more ecologically valid, although at the expense of specificity of testing around the ankle joint.

The studies conducted with the AMEDA-stand have shown that individuals with ligamentous laxity in the anterior drawer test carry deficits in JPS, hopping distance in a straight-line single leg hop, and hopping agility in a hexagon-hop test. A further study shows that all participants improve their score for JPS during repeated testing on the AMEDA-stand, but that those with CAI learn more slowly than those with healthy ankles. Using the AMEDA-step, it has been shown that all individuals score a higher JPS score on the AMEDA-stand than the AMEDA-step, but those with CAI experience a learning effect on retesting, while those with healthy ankles immediately establish a stable performance level and do not change on retesting. Vision has also been shown to contribute to contribute significantly to performance on the AMEDA-step, with focal vision enabling better JPS than peripheral vision.

These findings contribute to knowledge of proprioceptive deficits in CAI, whether mechanical laxity or self-reported functional instability. Individuals with CAI show differences in proprioceptive learning ability, which indicates changes in CNS integration of proprioceptive information. The AMEDA-step has been shown to be a valid additional testing methodology for JPS testing within walking. These findings provide direction for further research into CNS engagement with ankle function associated with CAI, particularly with regard to proprioception.

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Publications and Presentations.

Papers published/in press.

Witchalls, J., P. Blanch, G. Waddington and R. Adams (2012). "Intrinsic functional deficits associated with increased risk of ankle injuries: a systematic review with meta-analysis." Br J Sports Med 46(7): 515-523.

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APA ACT Branch Research Symposium 2011. (Most discussion-provoking paper.)

SMA-ACT Branch State Conference – South East Regional Conference of Science & Medicine in Sport 2012.

Canberra Health, Annual Research Meeting 2012. (14th – 17th August 2012.)

Presentations pending.

SMA National Conference, Sydney. (Oct 31st – Nov 3rd 2012.)

Awards.

UC 3-minute Thesis Competition 2010. (Finalist.)

APA ACT Branch Research symposium 2010. (Best student paper.)

SMA-ACT Branch: 2011 ACT Sports Research Award; (Best New Investigator.)

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