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ORIGINAL RESEARCH REPORT

Lower-Extremity Electromyography Measures During Walking With Ankle-Destabilization Devices

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Context: Ankle-destabilization devices are rehabilitation tools that may improve neuromuscular control by increasing lower-extremity muscle activation. Their effects should be tested in healthy individuals before being implemented in rehabilitation programs. ***Objective:*** To compare EMG activation of lower-extremity muscles during walking while wearing 2 different ankle-destabilization devices. ***Design:*** Crossover. ***Setting:*** Laboratory. ***Participants:*** 15 healthy young adults (5 men, 10 women). ***Intervention:*** Surface EMG activity was recorded from the anterior tibialis, peroneus longus, lateral gastrocnemius, rectus femoris, biceps femoris, and gluteus medius as subjects walked on a treadmill shod, with an ankle-destabilization boot (ADB), and an ankle-destabilization sandal (ADS). ***Main Outcome Measures:*** Normalized amplitudes 100 ms before and 200 ms after initial heel contact, time of onset activation relative to initial contact, and percent of activation time across the stride cycle were calculated for each muscle in each condition. ***Results:*** The precontact amplitudes of the peroneus longus and lateral gastrocnemius and the postcontact amplitudes of the lateral gastrocnemius were significantly greater in the ADB and ADS conditions. In the ADB condition, the rectus femoris and biceps femoris postcontact amplitudes were significantly greater than shod. The peroneus longus and lateral gastrocnemius were activated significantly earlier, and the anterior tibialis, lateral gastrocnemius, and rectus femoris were activated significantly longer across the stride cycle in the ADB and the ADS conditions. In addition, the peroneus longus was activated significantly longer in the ADB condition when compared with shod. ***Conclusions:*** Both ankle-destabilization devices caused an alteration in muscle activity during walking, which may be favorable to an injured patient. Therefore, implementing these devices in rehabilitation programs may be beneficial to improving neuromuscular control.

Keywords: chronic ankle instability, gait, rehabilitation

Lateral ankle sprains are among the most common musculoskeletal injury seen in sports[1,2] and in people who are recreationally active.[3] It is estimated that approximately 47% to 74% of people who suffer a lateral ankle sprain will go on to have recurrent sprains 6 to 18 months after their first ankle sprain.[4–6] Furthermore, it is estimated that about 30% of people who suffer an ankle sprain will go on to develop chronic ankle instability (CAI).[5,7] CAI is a pathology characterized by residual symptoms of ankle instability and recurrent feelings of the ankle "giving way" that lasts longer than 1 year after the initial sprain.[8,9] Although the cause of CAI remains unclear, multiple characteristics have been identified to be different in groups with CAI compared with those who do not. These characteristics include, but are not limited to, impaired proprioception,[10–14] decreased neuromuscular control,[15–19] decreased range of motion,[20–22] decreased strength,[10,15,23] and altered gait.[24–28] Multiple studies have shown patients with CAI to have decreased dorsiflexion[20,27] and increased inversion during the late phases of swing.[24,25,28,29] Finally, multiple studies found neuromuscular deficits in patients after acute ankle sprains and in those with CAI in more proximal muscles such as the hip,[30,31] quadriceps, and hamstring musculature.[32,33] It is thought that a combination of these characteristics leads to repetitive bouts of instability.[34]

CAI is commonly treated conservatively.[35] Rehabilitation programs often consist of exercises to improve range of motion, increase strength, and improve proprioception and neuromuscular control. In addition to therapeutic exercises, clinicians often implement devices designed to improve various aspects associated with CAI. These devices, such as the biomechanical ankle platform system (BAPS), DynaDisc, foam padding, and wobble boards, allow for multiplanar motion at the ankle and have been shown to improve postural control in patients with CAI.[17,36–38] The unstable nature of these rehabilitation devices most likely enhances muscle activation by placing increased external demands on the sensorimotor system. Even though these devices cause improvements in postural control, they are limited to relatively nonfunctional rehabilitation exercises and have not been shown to alter gait patterns of patients with CAI. A recent case

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