

Unilateral Load Carriage in Golf Increases Frontal Plane Moment Demand at the Knee

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ABSTRACT

Golf equipment transportation (GET) is a regular task in the sport of golf, a popular activity with more than 66 million participants globally. Unilateral GET is commonly practiced by junior and collegiate golfers, and professional caddies, who incur large walking distances daily, especially during competition. Therefore, the influence of GET on knee mechanics during gait has important implications for performance and injury risks. Furthermore, frontal-plane lower extremity (LE) demands including knee abductor moment during activities may alter knee mechanics and contribute to pain and progression of osteoarthritis (OA). **PURPOSE:** To compare the frontal-plane knee moments of two different GET methods to each other and unloaded walking. **METHODS:** 20 experienced young golfers (11M/9F, Age: 26.4±4.5yrs) participated in 3D motion capture of 3 walking tasks: 1) unloaded walking (UW), 2) unilateral carrying on the right shoulder (SS), and 3) carrying the golf bag across both shoulders (DS); using an 11kg bag. For each condition, one stride was taken from each of the 3 successful trials for analysis. Kinematic and Kinetic data were collected at 60Hz and 1000Hz, respectively, and filtered with a 6Hz lowpass filter. Frontal-plane kinematics and kinetics were calculated in Visual 3D. Post-processing and statistical analysis were done in R and MATLAB. One-way ANOVA was used to compare across conditions. Hedge's g effect sizes (ES) were calculated. **RESULTS:** The left knee demonstrated higher peak knee abductor moment (PKAM; SS: 0.63 ± 0.08; DS: 0.48 ± 0.09; UW: 0.44 ± 0.07 Nm/kg) during SS compared to DS ($p < 0.001$, ES = 2.02) and UW ($P < 0.001$, ES = 2.4). The right knee demonstrated lower PKAM during SS (0.3 ± 0.15 Nm/kg) compared to DS (0.51 ± 0.11 Nm/kg, $p < 0.001$, ES = 1.51) and UW (0.42 ± 0.11, $P = 0.014$, ES = 1.24). PKAM did not differ between DS and UW (left: $P = 1$; right: $P = 0.243$). **CONCLUSION:** PKAM increased on the contralateral knee and decreased on the ipsilateral side during unilateral GET with large effects. Higher PKAM is associated with knee disorders including pain and OA, and could also contribute to localized fatigue. While decreased PKAM on the ipsilateral knee may seem beneficial, bone-on-bone forces could be altered and redistributed. Future studies should investigate moment impulse and bone-on-bone forces associated with GET.