Contribution of the Ankle, Knee, and Hip to Total Lower Extremity Internal/External Rotation

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ABSTRACT

The nature of the ankle, knee, and hip interaction can profoundly impact the movement patterns of the lower extremities. The ability to internally and externally rotate the lower extremity is essential in order to effectively absorb and apply force. In previous studies, most measurements have been conducted in 2D using a protractor, while mainly evaluating the hip. Dysfunction in any joint throughout the kinetic chain can lead to inefficient movement patterns that can compromise performance and potentially lead to injury. Appreciating the complexity of the lower extremity brings to attention the importance of any segments that are compromised. **PURPOSE**: To investigate the contribution of the ankle, knee, and hip to the total lower extremity internal rotation (IR) and external rotation (ER) range of motion (ROM) using a 3D camera system. **METHODS**: Fifteen college students participated in the study (21.2±1.9 years, 72.2±12.8 kg, 170.5±8.7 cm), eight males (21.1±1.2 years, 80.7±11.4 kg, 176.2±6.3 cm) and seven females (21.3±2.5 years, 62.5±5.0 kg, 163.8±6.0 cm). Lower extremity IR and ER ROM for each side were captured using 3D camera system, at 240 Hz. Each participant was instructed to perform maximal IR and ER in standing position, using sliding disk. Participants performed three trial of each rotation. Test-retest reliability identified good to excellent reliability, ICC 3,1 .797-.959. Based on this findings highest IR and ER ROM were further analyzed. Repeated measure ANOVAs were performed to determine differences between the three joints for each rotation and each side, followed by Bonferroni post-hoc analyses, were granted, $p<.05$. One-way ANOVAs were used to compare IR and ER ROM between gender and sides at each joint, $p<.05$. **RESULTS**: Significant main effect was found for IR of the right leg, $p=.001$ (hip 14.2°±5.5°, knee 12.0°±4.0°, and ankle 24.4°±9.9°). Post-hoc analyses revealed that ankle IR was significantly larger than hip IR ($p=.022$) and knee IR ($p=.001$). Significant main effect was found for IR of the left leg, $p=.005$ (hip 13.2°±3.4°, knee 12.2°± 5.6°, and ankle 23.6°±10.6°). Post-hoc analyses revealed that ankle IR was significantly larger than hip IR ($p=.019$) and knee IR ($p=.003$). Significant main effect was found for ER of the right leg, $p=.001$ (hip 17.1°±5.2°, knee 16.6°±3.1°, and ankle 26.8°±7.5°). Post-hoc analyses revealed that ankle ER was significantly larger than hip ER ($p=.002$) and knee ER ($p=.001$). No significant main effect was found for ER of the left leg, $p=.138$ (hip 18.7°±10.0°, knee 16.8°±5.9°, ankle 23.6°±7.3°). One-way ANOVAs Comparing between gender and side did not find any significant differences, $p>.05$. **CONCLUSION**: The findings suggest that the ankle joint is contributing the most for IR and ER ROM. On average, ankle contributes 42%±9% to the lower extremity ROM during ER and 47%±13% during IR. The knee contributes 29%±9% to the lower extremity ROM during ER and 24%±8% during IR. The hip contributes 29%±10% to the lower extremity ROM during ER and 29%±12% during IR. Practitioners need to be caution when interpreting lower extremity or hip IR and ER ROM. Future studies need to further investigate the influence of each of the three joints IR and ER ROM on performance and injury.