Knee Kinematics and Kinetics in Single Leg Drop Jumps Between a Healthy Athlete and an Athlete 3 years Post-ACL Reconstruction

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Background: Anterior Cruciate Ligament (ACL) tears are one of the most common injuries seen in the athletic population. Physical therapists are instrumental during the rehabilitation process in order to help restore strength, flexibility, and neuromuscular control of the affected leg. During the return to sport stages of rehabilitation, an in-depth focus is placed on landing mechanics - particularly prevention of dynamic valgus collapse. It is crucial to train all athletes in the prevention of valgus collapse during any plyometric activity in hopes to decrease the risk of injury - specifically ACL injuries[1]. For this reason, landing mechanics becomes a large focus in the later stages of rehabilitation following ACL reconstruction. However, due to the neuromuscular changes facilitated in rehabilitation, as well as neural plastic changes in the brain[2], many of these athletes alter their mechanics to land much stiffer and with more force[3]. Due to the prevalence of ACL re-injuries occurring within the first 2 years post injury[4], it is important to dissect all components of landing mechanics training in order to eliminate potential risk factors that increase the chances of injury or re-injury. The literature is currently unclear as to the risk or benefit a stiffer landing may have on one's chances of re-injury.

Purpose In this experiment, we seek to determine the kinetic and kinematic differences in landing mechanics of a single leg drop jump between an athlete with no history of ACL injury and an athlete who had an ACL reconstruction surgery.

Methods: Our case-control study included an athlete (age 24) who had ACL reconstruction surgery completed on the knee joint three years ago, and an athlete (age 23) with an intact ACL. Leg length (cm) and leg girth (cm) at the knee and ankle were measured (cm). The two athletes were instructed to perform a 32cm drop jump from a stable surface and execute a single leg landing. Sagittal and frontal plane analysis of knee kinematics were recorded using a 3D motion capture picture. Vertical ground reaction forces of these athletes were also collected and recorded through force plates the two subjects landed on.

Results: The athlete with a history of ACL reconstruction presented with decreased range of motion at the hip, knee, and ankle in the sagittal and frontal plane while performing a single leg drop jump. These differences between the two athletes are found to be clinically significant. The largest differences occurred between the hips and knees. An increased vertical GRF was seen in the athlete post ACL reconstruction. The Table 1 and Figures 1-2 below depict the kinetic and kinematic variables of each athletes drop jump landing.

Table 1: Sagittal and Frontal Plane Kinematics of Single Leg Drop Jump

Peak ROM	Subject 1 (Non-ACL)	Subject 2 (ACL)
Ankle PF + / DF – Ev + / Inv -	-11.6 to 27.9 3.3 to 7.4	-21.4 to 12.9 -1.3 to 1.2
Knee flex + Add + / Abd -	20.4 to 76.0 4.3 to 15.2	8.4 to 44.5 -0.5 to 1.2
Hip flex + Add + / Abd -	23.4 to 53.9 -2.0 to 4.4	17.3 to 30.5 -2.9 to -7.8

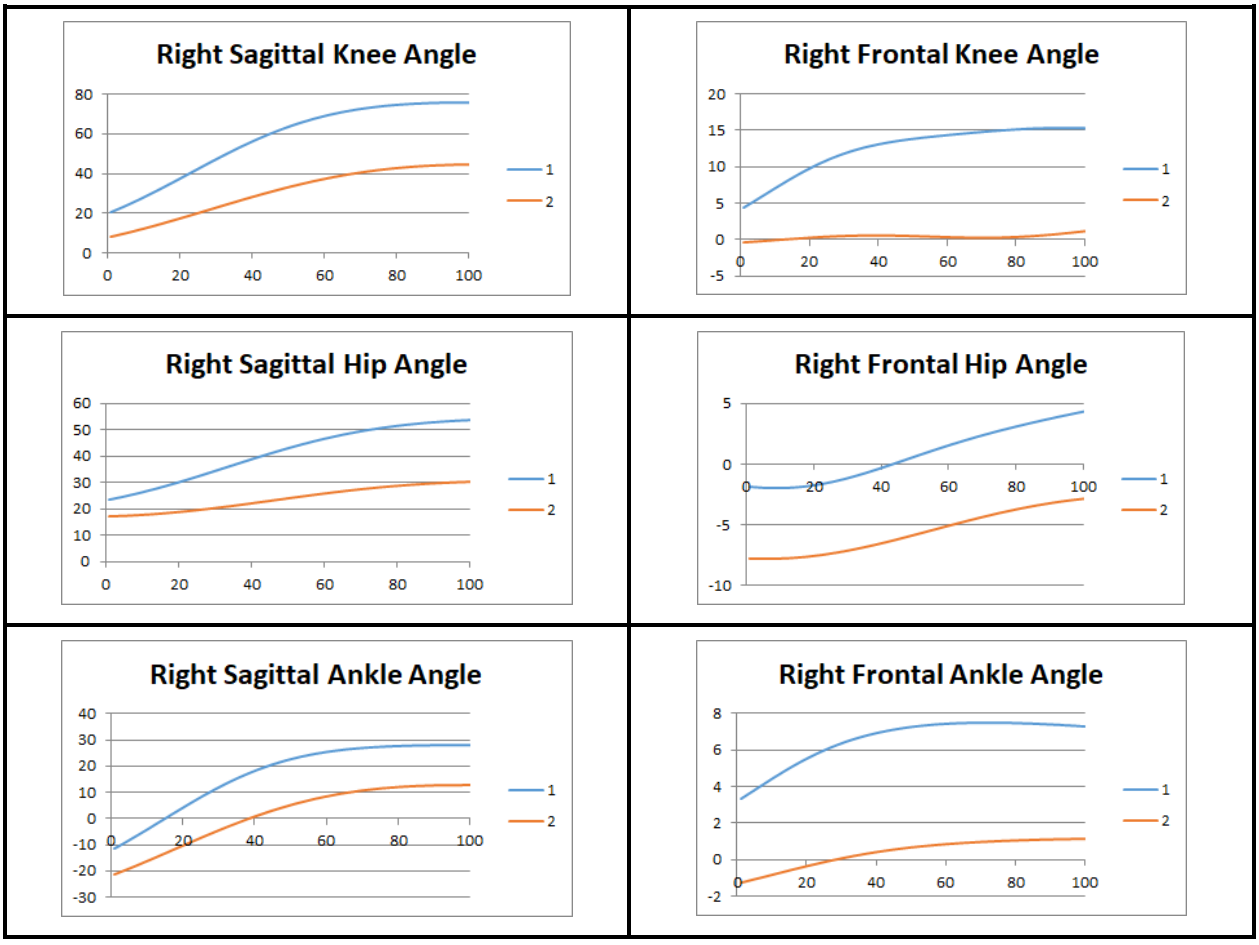

Figure 1: Sagittal and Frontal Plane Kinematic Graphs

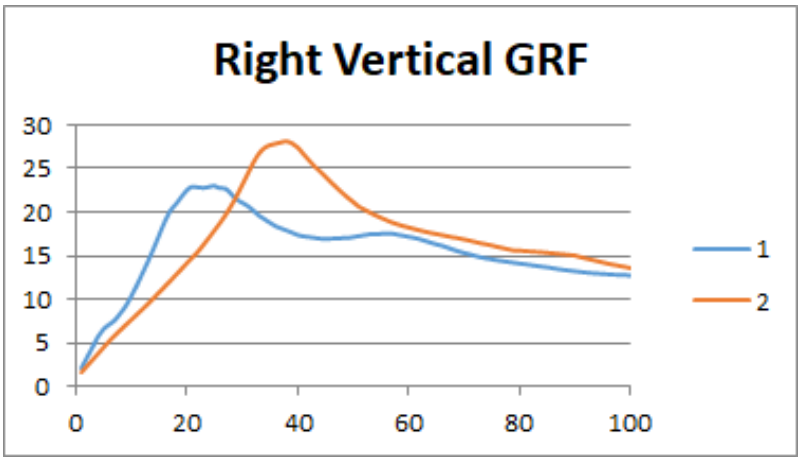

Figure 2: Vertical GRF Forces of Single Leg Drop Jump Landing

Conclusions: The results of this study are consistent with our hypothesis. The athlete with a history of ACL reconstruction had higher ground reaction forces and decreased overall knee range of motion during a drop jump onto a single leg when compared to the athlete with a healthy, non-surgical knee. These findings further provide evidence to the claim that athletes with a history of ACL reconstruction have stiffer landings. This mechanical trend may put them at a higher risk for re-injury[1]. The exact mechanism for these findings are still poorly understood and further research is warranted.

Discussion: Altering one's landing mechanics derives from several components of the individual including: psychological, neuromuscular control, strength, flexibility, and quality of rehabilitation. It is important to analyze and acknowledge alteration in landing mechanics as they often are indicators that place athletes at risk for injuries. The findings of this experiment add to the body of literature that individuals post ACL reconstruction exert greater forces and demonstrate less range of motion (ROM) during plyometric landing activities. These kinetic and kinematic variables need to be analyzed during rehabilitation and addressed appropriately through neuromuscular re-education and strength training. Eccentric and plyometric exercises help to address these deficits and are crucial to a comprehensive rehab program for individuals post ACL reconstruction. More research is required in order to definitively correlate decreased ROM and greater GRF to increased risk of injury. However, clinicians and rehab experts should consider examining these components of a single leg drop jump landing in order to better facilitate a comprehensive rehabilitation program for their athletes' s/p ACL reconstruction.

References:

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