An Evidence Based Technical Framework for Mitigating Knee Joint Loads in Cutting Tasks

Thomas Anthony Donelon

Section of Sport and Exercise Sciences, Canterbury Christ Church University, Canterbury, United Kingdom

Abstract

Cutting actions are associated with non-contact ACL injuries in multidirectional sports due to the propensity to generate large multiplanar knee joint loads (KJLs) that have the capacity to increase ACL loading and strain. Numerous studies have investigated the biomechanical determinants of KJLs in cutting tasks. The aim of this systematic review was to comprehensively review the literature regarding biomechanical determinants of KJLs during cutting, in order to develop a cutting technical framework alongside training recommendations for practitioners regarding KJL mitigation. Databases (SPORTDiscus, Web of Science and PubMed) were systematically searched using a combination of the following terms: "Biomechanical determinants", or "Knee abduction moment", or "Technical determinants", or "Knee loading", or "Knee loads", or "Mechanical determinants", or "ACL strain", or "Knee adduction moment", or "Anterior tibial shear", or "Knee internal rotation moment", or "Knee valgus moment" AND "Change of direction", or "Cutting manoeuvre", or "Run and cut", or "Run-and-cut", or "Sidestepping", or "Side-stepping", or "Shuttle run". Inclusion criteria were as follows: studies examining a cutting task < 110° with a preceding approach run that examined biomechanical determinants of KJLs using three-dimensional motion analysis. The search returned 6404 possibly eligible articles, and 6 identified through other sources. Following duplicate removal, 4421 titles and abstracts were screened, leaving 246 full texts to be screened for inclusion. Twenty-three full texts were deemed eligible for inclusion and identified numerous determinants of KJLs; 11 trunk, 11 hip, 7 knee, 3 multiplanar KJLs, 5 foot/ankle and 7 identifying ground reaction forces (GRFs) as determinants of KJLs. Using the framework developed from the results, cutting KJLs can be mitigated through the following: reducing lateral foot-plant distances, thus lowering hip abduction and orientating the foot closer to neutral with a mid-foot or forefoot placement strategy; minimising knee valgus and hip internal rotation angles and motion at initial contact (IC) and weight acceptance (WA); avoiding and limiting lateral trunk flexion and attempt to maintain an upright trunk position or trunk lean into the intended direction; and finally, reducing GRF magnitude during WA, potentially by attenuation through increased knee flexion and emphasising a greater proportion of braking during the penultimate foot contact (PFC).

Biography

Thomas Donelon is a University Instructor and PhD candidate in Sports Biomechanics and Strength and Conditioning at Canterbury Christ Church University. Tom completed his BSc in Sport Science (Advanced Strength and Conditioning) at The University of Salford in 2016, attaining a first-class degree with honours. During this time he developed a deep interest in biomechanics, predominantly the biomechanics of Strength and Conditioning, and injury incidence and prevention. Previous posts have involved the testing of team GB triple jumpers, 3D motion analysis of elite endurance runners and other athletic populations, alongside a research assistance post in clinical gait analysis. Tom graduated with an MSc in Strength and Conditioning with Distinction from the University of Salford in 2018. Tom acts in a consultancy capacity with numerous sports clubs. Current research interests are aligned to the biomechanics involved in change of direction tasks, their application to performance and injury and if using strength and conditioning protocols can mitigate knee joint loads and improve performance in these tasks.