CAN THE SPLIT-STEP CUTTING TECHNIQUE REDUCE LOADING AND MAINTAIN PERFORMANCE?

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INTRODUCTION: Cutting (evasive running) movements are integral to performance in many field- and court-based sports but have been associated with lower limb injuries. This injury risk is attributed to a combination of lower limb geometry and high forces acting together to stress anatomical structures, particularly at the ankle and knee joint. Alternative positioning of the stance foot and adjusted orientation of the lower limbs through changes to the cutting technique may reduce loading (e.g. Besier et al., 2001) but technique interventions for cutting have not been explicitly investigated in-depth. Therefore, the aim of this study was to compare the biomechanical characteristics of unplanned side-step (single foot contact) and split-step (double foot contact) cutting techniques, particularly relating to lower limb loading and ground reaction impulses generated during the primary cutting step. It was expected that the split-step would reduce joint loading and maintain performance requirements.
METHOD: Seven male subjects (age = 24.9 ± 4.6 years; mass = 79.4 ± 7.2 kg; height = 1.77 ± 0.07 m) performed a series of unplanned cutting movements of approximately 45° in a laboratory environment. Two cutting techniques were tested: side-step (single foot plant with subsequent movement in direction opposite to plant foot) and split-step (simultaneous double foot contact with push off in selected direction). Subjects were aware of the technique to be used prior to the trial but direction was determined by random visual stimuli presented just prior to the main cutting step. During the main steps of the cutting action, lower limb 3-D kinematics were obtained at 100 Hz (Optotrak 3020, Northern Digital) and ground reaction forces (GRFs) sampled at 1000 Hz from two force plates (Kistler Instruments). A 7-segment lower body model was created (pelvis, thighs, shanks, feet) in Visual 3D software, incorporating inertia data based on anthropometric measurements. Normalised peak knee joint moments were analysed over the first 50% of the support phase for the main cutting step and GRFs were used to calculate impulses generated during stance in the anterior-posterior and medio-lateral directions. Differences between conditions were assessed via two-way ANOVA (main factors: technique and limb).
RESULTS: Peak knee moments were not statistically different between techniques (side-step vs split-step, $p > 0.05$) although there was a main effect for limb, with the dominant limb exhibiting reduced peak adduction moment ($p = 0.018$). The split-step technique maintained lateral impulses (change in velocity) but increased braking impulses (side-step = -0.50 m/s; split-step = -1.0 m/s) and led to longer contact times in the primary cutting step.
DISCUSSION: Overall, a change in technique did not reduce peak knee joint loadings although some individual subjects demonstrated considerable reductions in peak knee moments when using the split-step. The double foot contact of the split-step permitted the necessary lateral change in velocity but also led to increased braking forces and longer contact times which are detrimental to evasive running performance.
CONCLUSION: Modification of cutting technique to the split-step did not lead to a global reduction in peak knee joint loading but responses were very individual and longer term familiarisation with the split-step may reduce loadings whilst maintaining performance levels.

REFERENCES:
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