CAN RISK FACTORS FOR KNEE INJURY DURING LANDING BE REDUCED BY SIMPLE VERBAL INSTRUCTION?

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INTRODUCTION

Knee injuries are very common during sports activities, particularly those which involve jumping and landing. Anterior cruciate ligament (ACL) tears are a particular cause for concern, and the majority of these occur via non-contact mechanisms [1]. In recent years, several preventative programs have been developed in an attempt to address this issue and reduce the number of ACL tears occurring during landing from a jump. It has been suggested that future research in this area should focus on identifying which components of these programs are contributing directly to modifying the biomechanics of jump landings [2]. Proposed biomechanical risk factors for ACL injury include: increased frontal plane knee abduction motion; reduced knee flexion, high peak ground reaction force, and interlimb asymmetry [3].

Therefore, the aim of this study was to determine whether simple verbal instructions altered landing performance in female recreational athletes. In particular, frontal and sagittal plane knee mechanics, peak vertical ground reaction force, and interlimb symmetry were compared among control (CTRL), soft landing (SOFT), knees over toes (KOT), and equal weight (EQWT) conditions.

METHODS

Twelve young, healthy female recreational athletes aged between 18 and 35 years were recruited into the study (mass 57.3 ± 9.5kg; height 1.62 ± 0.05m; age 25.6 ± 2.0y). All subjects provided informed consent to participate. Lower extremity position and force data were recorded using an optoelectronic motion capture system and synchronized force platforms. Participants performed maximal effort countermovement jumps following simple verbal instructions in a control condition and three counterbalanced intervention conditions. Standardized instructional statements were used in all conditions. Practice trials were used to familiarize the participants with each condition, and five good trials were recorded.

The following variables were calculated for the dominant limb from ground contact to peak knee flexion: peak vertical ground reaction force; peak knee flexion angle; peak knee abduction angle; knee abduction excursion (from initial contact to peak abduction). Symmetry index of peak vertical ground reaction force was calculated using both limbs. One way repeated measures MANOVA and post-hoc tests were used to compare biomechanical variables in the dominant limb among the four conditions. One way repeated measures ANOVA and post-hoc tests were used to compare SI among conditions ($p \leq 0.05$).

RESULTS AND DISCUSSION

Peak vertical ground reaction force was different across groups ($p = 0.013$). In particular, it was reduced in the SOFT condition compared to all three other conditions, as expected (Table 1). It was similar among the other three conditions. Significant differences were also found in peak knee flexion angle across conditions ($p = 0.001$). In particular, more knee flexion

was observed in the SOFT and KOT condition compared to the CTRL condition. Increased knee flexion in the SOFT condition compared to the CTRL was expected, since knee flexion is the major shock absorbing mechanism in the lower extremity. This ties in with the lower peak vertical ground reaction force observed in the SOFT condition. Similar reductions in ground reaction force and increases in knee flexion have been reported previously with other instructional protocols [e.g. 4,5]

Greater peak knee flexion was found in KOT compared to all three other conditions. Additionally, both peak knee valgus ($p = 0.724$) and knee valgus excursion ($p = 0.346$) were similar across conditions. These results were unexpected and may be related to the participants' interpretation of the instruction given (land with knees over toes). If this was interpreted in the sagittal rather than the frontal plane, it may have resulted in increased knee flexion to place the knee vertically above the toes. Including a demonstration of the desired technique has been successful in reducing knee valgus [5], and should be included in future studies.

As expected, participants were more symmetrical (lower SI) in the EQWT condition compared to the other conditions ($p = 0.045$). Notably, peak vertical ground reaction force was similar in the dominant limb in the EQWT condition compared to the CTRL condition. Therefore, the improvement in symmetry in the EQWT condition was achieved without an increase in peak force.

The benefit of these verbal instructions is that they are simple and do not require specialized equipment, such as video, for incorporation into an activity program. Further work is required to determine whether these performance changes can be retained over the longer term.

SUMMARY

Two simple verbal instructions were successful in reducing biomechanical risk factors for ACL injury during a single session: 'land softly' reduced peak ground reaction force and increased peak knee flexion; 'equal weight on both feet' improved interlimb symmetry of peak vertical ground reaction force. The 'knees over toes' instruction had no effect on frontal plane knee kinematics (although peak knee flexion angle was increased).

REFERENCES

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Table 1: Knee angles and ground reaction force in different instruction conditions, mean (sd)

	Peak vertical GRF (BW)	Peak knee flexion (°)	Peak knee abduction (°)	Knee abduction excursion (°)	Symmetry Index
CTRL	1.989 (0.651)	87.1 (19.9)	-10.5 (4.1)	7.7 (3.4)	21.1 (18.4)
SOFT	1.509 (0.214)	94.6 (17.2)	-9.9 (3.9)	8.5 (3.2)	16.5 (10.6)
KOT	1.792 (0.400)	101.4 (18.9)	-10.4 (6.26)	9.0 (4.1)	19.9 (13.5)
EQWT	1.899 (0.584)	91.7 (22.3)	-10.7 (4.2)	8.7 (3.5)	10.6 (7.8)