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ORIGINAL ARTICLE

Bilateral differences in knee and ankle loading of the support limb during maximal instep soccer kicking

Contraintes appliquées au niveau du genou et de la cheville lors de tirs au but avec le membre dominant, ou non dominant

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Summary
Objective. — Kicking actions have been implicated in the aetiology of soccer injuries and the unilateral nature of kicking may influence this. The biomechanics of the support limb are distinct between the dominant and non-dominant during instep kicking, although little is known about how these alterations in mechanics may be associated with the risk of injury. This study aimed to examine vertical ground reaction forces as well as knee/ankle loads when performing maximal kicks with the dominant and non-dominant limbs.
Material and methods. — Twenty male academy soccer players performed maximal kicks with their dominant and non-dominant limbs striking a force platform with their support limb. Vertical ground reaction forces and knee/ankle joint kinetics were obtained from each limb and then contrasted using paired *t*-tests.
Results. — Significant increases in knee extensor and abduction moment were found when using the non-dominant limb. It was also shown that patellofemoral contact force was significantly higher in the non-dominant kicking condition.
Conclusions. — The findings from the current investigation have clinical significance and support the notion that kicking with the non-dominant limb may be associated with and increased injury aetiology.

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MOTS CLÉS
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Football

Résumé
Objectif. — L'étiologie des blessures du football démontre l'importance de la phase de tir. Le caractère unilatéral de ce geste peut avoir une influence sur le type de blessure et leur localisation. La biomécanique du membre inférieur est différente entre le membre dominant et le membre non dominant lors du coup de pied. Toutefois, on en sait peu sur la façon dont ces modifications mécaniques peuvent être associés avec le risque de blessure. Cette étude vise à examiner les forces de réaction au sol verticales ainsi que des chargements au sein du genou et de la cheville lors de l'exécution de tirs avec la jambe dominante et avec la jambe non dominante.
Matériel et méthodes. — Vingt joueurs de football ont effectué des tirs à vitesse maximale avec leur jambe dominante et non dominante au dessus d'une plate-forme de force placée sous la jambe d'appui. Les forces de réaction au sol et ainsi que les chargements au sein du genou et de la cheville ont été obtenues pour chaque membre puis les différences significatives ont été analysées à l'aide de *t*-tests appariés.
Résultats. — Des augmentations significatives du moment de flexion et d'abduction sur le genou ont été retrouvées lors de l'utilisation du membre non dominant. De même la force de contact fémoro-patellaire était significativement supérieure lors de l'utilisation de la jambe non dominante.
Conclusions. — Les résultats de cette étude ont une signification clinique et renforcent l'hypothèse que les tirs avec la jambe non dominante peuvent être associés à une augmentation et à l'étiologie des blessures du membre inférieur.

1. Introduction

Kicking is a fundamental motor skill in soccer [1] and the instep kick is the most frequently analysed action in soccer research [2,3].

Whilst there is a considerable body of scientific research that has examined biomechanics of the kicking leg [4,5], the support limb has received a paucity of interest in soccer literature [1]. In comparison to other sports soccer has a high injury frequency which ranges from 3.7—29.1 injuries per 1000 hours of game and training activity [7]. Aetiological analyses have documented that 60—80% of injuries are experienced by the lower extremities, most commonly at the knee or ankle [7,8].

Non-contact injuries sustained as a function of soccer may occur during dribbling, cutting or change of direction movements [9,10] and thus knee and ankle biomechanics have been examined extensively during these motions [11]. Whilst these movements are common, the primary movement in soccer is the kick [12]. Kicking actions have been implicated in the aetiology of soccer injuries, Rahnama et al. [13] showed that kicking accounts for 51% of potential actions linked to the generation of injuries. Analysis of game dynamics shows that during a 90 minute match, soccer players will have 51 ball contacts, 26 of which are with the foot [14]. This indicates that the support limb will be loaded 26 times during a game of soccer.

Soccer players are typically encouraged to develop proficiency in kicking with both limbs [15]. However, despite the advocacy of bilateral kick training, soccer players habitually exhibit dominance in kicking ability [16]. The unilateral nature of kicking may have implications regarding the aetiology of injury [15]. Whilst there is some evidence to support the notion that the biomechanics of the support limb are distinct between the dominant and non-dominant during instep kicking [17], very little is known about how these alterations in mechanics may be associated with the risk of injury. Brophy et al. [18] demonstrated that soccer players were most likely to suffer an injury to their dominant support limb, although it should be noted that this study was retrospective in nature and thus does not provide insight into the aetiology of lower extremity injuries. Clagg et al. [17] showed that soccer players were associated with increases in knee extension, abduction, and external moments in the non-dominant support limb which they suggested may predispose this limb to a greater risk for injury; although they did not resolve their joint kinetics further to investigate the loads experienced by specific joint structures.

These inconsistencies pose a question regarding the susceptibility of the dominant or non-dominant support limbs to injury during instep kicking. The aim of the current investigation was therefore to determine whether soccer players exhibit bilateral differences in support limb vertical ground reaction forces as well as knee and ankle load that may provide insight into the aetiology of injury.

2. Methods

Twenty male soccer players (age = 24.1 ± 1.1 years; height = 1.77 ± 0.2 m; body mass = 73.2 ± 6.1 kg) were examined whilst kicking a stationary soccer ball as hard as possible into a regulation goal with their right (dominant) and left (non-dominant) foot. The dominant support leg was defined as the limb most often in contact with the ground during kicking; this was the left limb in all participants involved in the current investigation. Five trials were recorded for both the dominant and non-dominant sides. Participants were academy players contracted to a professional club in England. All players were free from injury at the time of data collection and provided written informed consent in accordance with the procedures outlined in the