

ORIGINAL ARTICLE

EXERCISE PHYSIOLOGY AND BIOMECHANICS

Gender differences in instep soccer kicking biomechanics, investigated through a 3D human motion tracker system

Bruno RUSCELLO ^{1, 2, 3, 4 *}, Mario ESPOSITO ¹, Gianmarco SILIGATO ¹, Laura LUNETTA ^{1, 3}, Lorenzo MARCELLI ¹, Laura PANTANELLA ¹, Paolo R. GABRIELLI ^{1, 4}, Stefano D'OTTAVIO ^{1, 4, 5}¹School of Sport Sciences and Exercise, Faculty of Medicine and Surgery, Tor Vergata University, Rome, Italy; ²School of Sports and Exercise Sciences, San Raffaele University, Rome, Italy; ³Department of Industrial Engineering, Faculty of Engineering, Tor Vergata University, Rome, Italy; ⁴LUISS SportLab, LUISS University, Rome, Italy; ⁵Department of Clinical Science and Translational Medicine, Faculty of Medicine and Surgery, Tor Vergata University, Rome, Italy*Corresponding author: Bruno Ruscello, School of Sport Sciences and Exercise, Faculty of Medicine and Surgery, Tor Vergata University, via Montpellier 1, 00133 Rome, Italy. E-mail: bruno.ruscello@uniroma2.it

ABSTRACT

BACKGROUND: This study aims at describing and comparing each other male and female soccer players kicking instep a stationary ball. The different measures we collected by the 3D motion capture system Movit G1 and the High-Speed Camera (240 fps) were considered as dependent variables, whereas the gender was considered as the independent one.**METHODS:** Twenty soccer well trained non-professional players: 10 men (age: 25.3±6.5 yrs; height 1.80±0.07 m; body mass 76.9±13.2 kg) and 10 women (age: 19±3.34 yrs; height 1.64±0.07 m; body mass 58.2±7.2 kg) volunteered to participate in the study.**RESULTS:** Gender differences were found, with a statistical significance ($P<0.05$) or interesting magnitude (Cohen $d>0.5$). The most relevant ones were the differences in hip extension of the kicking leg when the foot of the supporting one touches the ground, just before the impact on the ball (independent sample t-Test; $P=0.03$; Cohen $d=1.64$) and the speed of the ball, reached immediately after kicking ($P<0.001$; $d=1.23$).**CONCLUSIONS:** These results, together with the greater pelvic acceleration shown by men compared to women, highlight the need to develop a gender-differentiated training model, in order to customize the kicking technique in women and to reduce the likelihood, currently higher than for men, of kicking related injuries.*(Cite this article as: Ruscello B, Esposito M, Siligato G, Lunetta L, Marcelli L, Pantanella L, et al. Gender differences in instep soccer kicking biomechanics, investigated through a 3D human motion tracker system. J Sports Med Phys Fitness 2020;60:1072-80. DOI: 10.23736/S0022-4707.20.10676-5)***KEY WORDS:** Soccer; Imaging, three-dimensional; Exercise.

Kicking is a soccer fundamental, which depends on many different and complex factors (technique, foot-ball interaction, ball flight, etc.).¹ Kicking is the characterizing technique of soccer and the ability to perform it skillfully is a vital requisite to play efficaciously at any level.²⁻⁵ Indeed, soccer would not be possible without mastering the fundamental abilities to control, dribble and kick the ball, for both passing or shooting at goal.⁶ Several researches have aimed at investigating the basics of kicking instep biomechanics, in order to provide insights of this technique and to report the relevant information useful to train it properly, with the

purpose of technique optimization and talent development.⁷⁻¹²

A good knowledge of the kicking instep biomechanics, and its gender peculiarities, is definitively important to correctly manage the technical training in every level of players' qualification, for both men and women.

Given the extremely dynamic and situational nature of soccer, it is impossible to describe all the variables that may influence the technical execution of ball kicking in open play situations.

For this reason, most of the studies regarding kicking have been directed to investigate the ability to kick