rev bras ortop. 2016;xxx(xx):xxx–xxx

SOCIEDADE BRASILEIRA DE ORTOPEDIA E TRAUMATOLOGIA

RBO REVISTA BRASILEIRA DE ORTOPEDIA

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Original Article

Index of fatigue quadriceps in soccer athletes after anterior cruciate ligament reconstruction☆

Maria Luzete Costa Cavalcante[a], *Paulo Renan Lima Teixeira*[a,*], *Tamara Cristina Silva Sousa*[b], *Pedro Olavo de Paula Lima*[a], *Rodrigo Ribeiro Oliveira*[a]

[a] *Universidade Federal do Ceará (UFC), Hospital Universitário Walter Cantídio (HUWC), Fortaleza, CE, Brazil*
[b] *Universidade Unichristu, Fortaleza, CE, Brazil*

ARTICLE INFO

Article history:
Received 12 March 2015
Accepted 14 December 2015
Available online xxx

Keywords:
Fatigue
Anterior cruciate ligament
Football

ABSTRACT

Objective: The present study aimed to evaluate the muscle fatigue of the quadriceps muscle in high-performance soccer players undergoing (anterior cruciate ligament) ACL reconstruction.

Methods: We evaluated 17 high-performance soccer players from three professional soccer teams of a state in Brazil from August 2011 to July 2012. All subjects were evaluated between 5.5 and 7 months after ACL reconstruction with a Biodex®isokinetic dynamometer (System 4 Pro) with test protocol CON/CON at 60°/s and 300°/s with 5 and 15 repetitions, respectively. In the calculation of local muscle fatigue, the fatigue index was used, which is calculated by dividing the labor done in the first one-third of the repetitions by that done at the final one-third of the repetitions, and multiplying by 100 to express a unit in percentage (i.e., as a discrete quantitative variable).

Results: All subjects were male, with a mean age of 21.3 ± 4.4 years and mean BMI 23.4 ± 1.53 cm; left dominance was observed in 47% ($n = 8$) of athletes, and right dominance, in 53% ($n = 9$) of athletes; and the limb involved in the lesion was the dominant in 29% ($n = 5$) and the non-dominant in 71% ($n = 12$). Fatigue rates were 19.6% in the involved limb and 29.0% in the non-involved limb.

Conclusion: The results allow us to conclude that there was no significant difference between the limbs involved and not in ACL injuries regarding local muscle fatigue. No association was observed between the dominant side and the limb involved in the ACL injury.

☆ Study conducted at the Orthopedics and Traumatology Service, Hospital Universitário Walter Cantídio (HUWC), Universidade Federal do Ceará (UFC), Fortaleza, CE, Brazil.

* *Corresponding author.*
E-mails: renanteixeira.ortopedia@hotmail.com, prenanlt@yahoo.com.br (P.R. Teixeira).

http://dx.doi.org/10.1016/j.rboe.2016.08.009

Please cite this article in press as: Cavalcante ML, et al. Index of fatigue quadriceps in soccer athletes after anterior cruciate ligament reconstruction. Rev Bras Ortop. 2016. http://dx.doi.org/10.1016/j.rboe.2016.08.009

Índice de fadiga do músculo quadríceps femoral em atletas de futebol após reconstrução do ligamento cruzado anterior

Palavras-chave:
Fadiga
Ligamento cruzado anterior
Futebol

RESUMO

Objetivos: O presente estudo propõe avaliar a fadiga muscular do músculo quadríceps em atletas de futebol de alto rendimento submetidos à ligamentoplastia do ligamento cruzado anterior (LCA).

Métodos: Foram avaliados 17 atletas de futebol com alto rendimento que pertenciam conjuntamente a três times de futebol profissional de um determinado estado brasileiro, de agosto de 2011 a julho de 2012. Todos foram avaliados entre 5,5 e 7 meses de pós-operatório de ligamentoplastia do LCA no dinamômetro isocinético da marca Biodex®(System 4 Pro) com protocolo de teste CON/CON nas velocidades de 60°/s e 300°/s com 5 e 15 repetições, respectivamente. No cálculo da fadiga muscular local, usamos o índice de fadiga que é calculado com a divisão do trabalho feito no terço inicial das repetições pelo terço final das repetições e a multiplicação por 100 para expressar uma unidade em porcentagem (i.e., variável quantitativa discreta).

Resultados: Todos eram do sexo masculino, com média de 21,3 ± 4,4 anos; IMC médio de 23,4 ± 1,53 cm; com dominância à esquerda em 47% (n = 8) dos atletas; e a direita em 53% (n = 9) dos atletas; o membro envolvido na lesão foi o dominante em 29% (n = 5) dos casos e o não dominante em 71% (n = 12). Os índices de fadiga foram de 19,6% no membro envolvido e de 29,0% nos membros não envolvidos.

Conclusão: Os resultados nos permitem concluir que não há diferença significativa entre os membros envolvidos e não envolvidos na lesão de LCA no que diz respeito à fadiga muscular local. Também não foi observada associação entre ser destro ou canhoto com o membro envolvido na lesão de LCA.

Introduction

Rupture of the anterior cruciate ligament (ACL) is a recurring and functionally limiting injury among soccer players. The literature indicates that in European soccer, a high performance athlete will injure the ACL for every 2000 hours of sports practice, that 14% of knee sprains injure this structure, and that every season each club plays 12.8 matches understrength due to ACL rupture.[1] This injury is common in high performance soccer players, who make sudden hyperextension, valgus twist, and excessive knee rotation movements with the foot planted on the ground.[2]

In addition to the large number of individuals exposed to such lesions, injuries resulting from soccer practice and the high risk for their occurrence have been the subject of interest and concern of healthcare professionals. After all, in most cases these injures are incapacitating and prevent the athletes from participating in training and competition for various periods of time, so that the injury can be correctly and consistently treated.[3]

In addition to the known biomechanical functions, anatomical studies have also shown that the ACL has a sensory function, due to the presence of mechanoreceptors.[4] After total or partial ACL rupture, individuals may present joint proprioception deficit,[5] deficiency in perception of change position during passive movement,[6] and contraction reflex of the muscles posterior to the tibia relative to the femur, especially the hamstring group of the affected side.[7] These proprioceptive changes, in turn, inhibit the action of the motor units of the knee extensor muscle group, thus reducing the strength, power, and endurance, leading to a possible loss of performance.[2]

ACL reconstructive surgeries are commonly performed in orthopedic practice. Choosing the best autograft for ACL reconstruction in knees with insufficiency of this ligament has been the subject of debate. Grafts from the central third of the patellar ligament were widely used in the 1980s and 1990s. In the late 1990s, the use of the flexor tendons of the semitendinosus and gracilis increased. So far, there is disagreement in the choice of graft for ACL reconstruction.[8]

The muscle dysfunction observed in patients after ACL reconstruction includes weakness of the quadriceps muscle, promoted by reduction of the overload, as well as joint swelling and pain, which can even persist more than six months after surgery with aggressive rehabilitation. This weakness is due to an incomplete voluntary muscle activation arising from arthrogenic muscular inhibition, which is a reflection of the continuous inhibition of the muscles around the knee when there is damage to this joint; it slows down rehabilitation as it prevents muscle strength gain in the quadriceps femoris and changes proprioception.[9]

Muscle fatigue can be defined as a decrease in muscle performance during physical activity, making the individual unable to maintain the expected strength, power, and/or endurance. This fact is accompanied by changes in muscle

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