Journal of Science and Medicine in Sport xxx (2018) xxx–xxx

Contents lists available at ScienceDirect

Journal of Science and Medicine in Sport

journal homepage: www.elsevier.com/locate/jsams

Original research

Predictors of clinical success in runners with patellofemoral pain: Secondary analyses of a randomized clinical trial

Jean-Francois Esculier[a,b,c], Laurent J. Bouyer[a,b], Blaise Dubois[a,c], Jean Leblond[b], Mélanie Brisson[d,e], Luc Chau[d,e], Jean-Sébastien Roy[a,b,*]

[a] Faculty of Medicine, Laval University, Canada
[b] Centre for Interdisciplinary Research in Rehabilitation and Social Integration, Canada
[c] The Running Clinic, Canada
[d] Centre Hospitalier Universitaire (CHU) de Québec, Canada
[e] Radiologie Mailloux, Canada

ARTICLE INFO

Article history:
Received 29 March 2017
Received in revised form
26 September 2017
Accepted 14 January 2018
Available online xxx

Keywords:
Treatment
Knee
Education
Sensitivity
Specificity

ABSTRACT

Objectives: To identify predictors of outcome to a rehabilitation program focused on education and management of training loads in runners with patellofemoral pain (PFP).
Design: Secondary analyses of a randomized clinical trial.
Methods: Fifty-eight runners with PFP (62% female, aged 31.2 ± 6.6 years, running 20.3 ± 5.6 km/week) were included in analyses. Following baseline collection of demographics, anthropometry, symptomatology, isometric strength, running mechanics and radiological data, runners were randomized to one of the three 8-week intervention program: (1) Education on symptoms management and training modifications; (2) Education + Exercise program; (3) Education + Gait retraining. Clinical success was defined as an increase ≥13.6% on the Knee Outcome Survey – Activities of Daily Living Scale (KOS-ADLS) at 3 months following program completion. Potential predictors were entered into logistic regression analyses.
Results: Forty-five runners (78%) were categorized as Success. Together, KOS-ADLS score (<70%), knee extension isometric strength (<70% bodyweight), presence of patellar tendinopathy (Grade >0) and level of usual pain (>2/10) at baseline predicted treatment outcome with 87.9% accuracy. The model provided sensitivity of 0.93 (95% C.I. 0.82–0.98), specificity of 0.69 (95% C.I. 0.42–0.87), positive likelihood ratio of 3.0 (95% C.I. 1.3–6.9), and negative likelihood ratio of 0.1 (95% C.I. 0–0.3). The best individual predictors were KOS-ADLS score and knee extension strength.
Conclusions: The combination of KOS-ADLS, knee extensors strength, patellar tendon integrity and usual pain best predicted clinical outcome of runners with PFP following an intervention that had a common education component. Further testing is needed before a clinical prediction rule can be recommended to clinicians.

1. Introduction

Patellofemoral pain (PFP) is common among runners,[1] and represents a frequent reason for seeking help from sports medicine practitioners.[2] To provide optimal care, it is paramount that clinicians determine which patients are more likely to respond to specific treatment approaches.[3] Given that symptoms of PFP can persist in as much as 73% of recreational athletes at an average 5.7-year follow-up,[4] it is necessary to identify possible predictors of success following rehabilitation interventions.

In addition to their symptoms and functional limitations, runners with PFP may present with deficits in lower limb strength and running mechanics.[5,6] According to the current literature, different subgroups of runners with PFP may exist. For example, some studies have reported deficits in knee extensors[6] or hip musculature[7] isometric strength when compared to uninjured runners, although such findings are not consistent across studies.[8] Deficits in running mechanics have also been identified in runners with PFP.[5] Indeed, faulty proximal kinematics, particularly increased hip adduction (HADD), hip internal rotation (HIR) and contralateral pelvic drop (CPD) have been observed.[5] However, dis-

* Corresponding author.
E-mail address: jean-sebastien.roy@rea.ulaval.ca (J.-S. Roy).

https://doi.org/10.1016/j.jsams.2018.01.006
1440-2440/

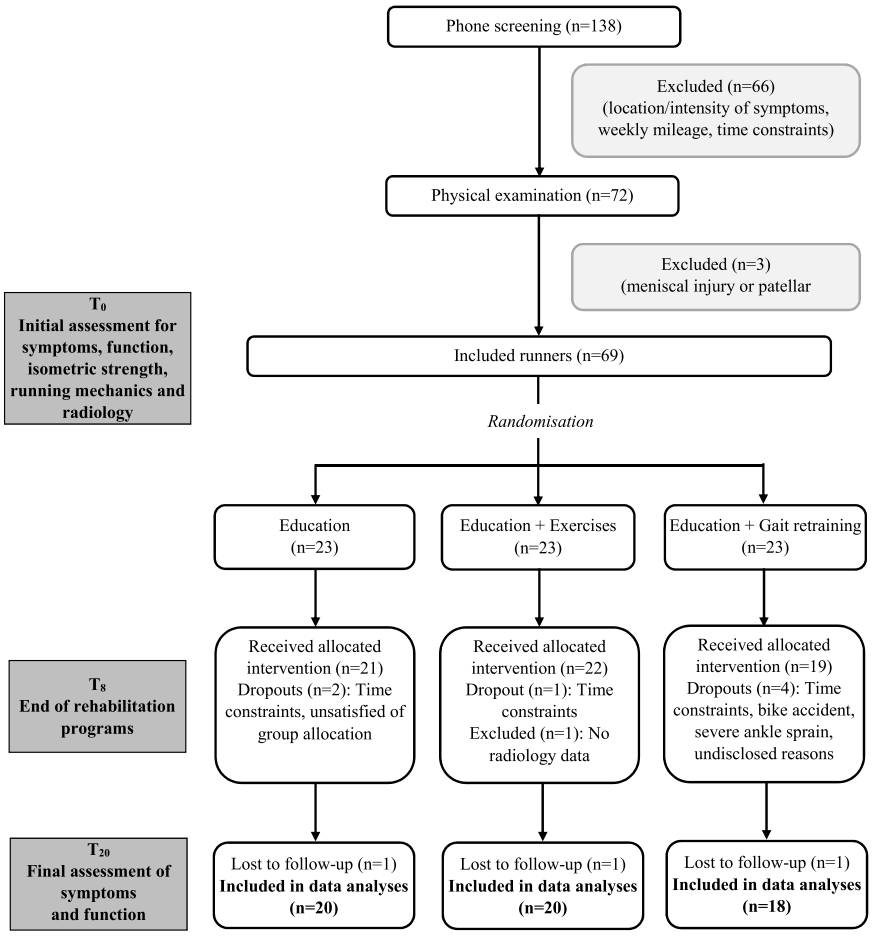

Fig. 1. Flowchart of the study process. T_0: baseline evaluation; T_8: evaluation at the end of the 8-week rehabilitation program; T_{20}: evaluation at 3-month follow-up.

parities in reported deficits between studies suggest that treatment options need to be tailored accordingly.

Previous research in non-runners with PFP has identified patient profiles associated with favourable treatment outcomes.[9] For example, Vicenzino et al. reported age, height, pain severity and foot morphometry as significant predictors of clinical success following implementation of foot orthoses.[10] Specifically, their model based on at least 3 predictors accurately predicted treatment outcome in 86% of individuals. Another study by Watari et al. reported that recreationally active individuals with PFP responding to exercises presented with lesser ankle dorsiflexion, knee abduction and hip flexion while running.[11] Finally, Selfe et al. established three distinct profiles of individuals with PFP, described as 'strong', 'weak and tighter' and 'weak and pronated'.[3] However, their classification's accuracy remains unknown. Thus, in accordance with previously published studies, a variety of factors need to be considered when determining potential predictors of outcome in runners with PFP.

Recently, our group conducted a randomized clinical trial (RCT) comparing three rehabilitation programs for runners with PFP. Interestingly, adding exercises or gait retraining to education did not provide supplementary benefits compared with education alone.[12] While 78% of runners reported clinical success in that study, a subset did not. Therefore, the objective of the current study is to perform secondary analyses to identify possible predictors of success following rehabilitation programs focused on education and management of training loads in runners with PFP. The study protocol is registered (ClinicalTrials.gov: NCT02352909) and published.[13]

2. Methods

Sixty-nine runners were recruited from the running community of Quebec City, Canada. The same experienced physiotherapist performed physical examination for all potential participants. To be included, runners had to (1) be aged 18–45 years, (2) run $\geq$ 15 km per week, (3) report PFP for a duration of 3 months, (4) report pain level $\geq$ 3/10 on a visual analog scale during running and during three activities among: kneeling, squatting, stairs and resisted knee extension, and (5) score a maximum of 85% on the Knee Outcome Survey – Activities of Daily Living Scale (KOS-ADLS). Potential participants were excluded if they presented with pain originating from menisci[14] or primarily from the patellar tendon,[15] pain following an acute trauma, injuries other than PFP or history of lower limb surgery or neurological, inflammatory or degenerative disease. Ethics approval was obtained from the Quebec Rehabilitation Institute, and participants provided signed informed consent.

A baseline evaluation (T_0) took place in a motion analysis laboratory. After confirming the diagnosis of PFP, data on demographics, symptomatology and running habits were collected, before isometric strength and running kinetics and kinematics were assessed (Fig. 1). Following baseline evaluation, runners were referred to a radiology clinic to obtain radiographs of their patellofemoral joint and diagnostic ultrasound of their patellar tendon. Thereafter, runners were randomized to one of three 8-week rehabilitation programs. Finally, runners completed the KOS-ADLS three months after the end of the program (T_{20}; Fig. 1).

Potential predictors of outcome collected at T_0 were related to participants' characteristics, physical examination, running

Please cite this article in press as: Esculier J-F, et al. Predictors of clinical success in runners with patellofemoral pain: Secondary analyses of a randomized clinical trial. *J Sci Med Sport* (2018), https://doi.org/10.1016/j.jsams.2018.01.006