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The effectiveness of session rating of perceived exertion to monitor resistance training load in acute burns patients

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ABSTRACT

Session-rating of perceived exertion (RPE) is a method frequently utilised in exercise and sports science to quantify training load of an entire aerobic exercise session. It has also been demonstrated that session-RPE is a valid and reliable method to quantify training load during resistance exercise, in healthy and athletic populations. This study aimed to investigate the effectiveness of session-RPE as a method to quantify exercise intensity during resistance training in patients with acute burns. Twenty burns patients (mean age = 31.65 ($\pm$10.09) years), with a mean TBSA of 16.4% (range = 6–40%) were recruited for this study. Patients were randomly allocated to the resistance training ($n = 10$) or control group ($n = 10$). All patients completed a four week resistance training programme. Training load (session-RPE $\times$ session duration), resistance training session-volume and pre-exercise pain were recorded for each exercise session. The influence of; age, gender, %TBSA, exercise group (resistance training vs. control), pre-exercise pain, resistance training history and session-volume on training load were analysed using a multilevel mixed-effects linear regression. Session-volume did not influence training load in the final regression model, however training load was significantly greater in the resistance training group, compared with the control group ($p < 0.001$). Pre-exercise pain significantly influenced training load, where increasing pain was associated with a higher session-RPE ($p = 0.004$). Further research is indicated to determine the exact relationship between pain, resistance training history, exercise intensity and session-RPE and training load before it can be used as a method to monitor and prescribe resistance training load in acute burns patients.

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1. Introduction

Resistance training is an important component of rehabilitation for adults who have sustained burns [1,2]. It is essential to monitor intensity during exercise as a sufficient level of intensity is required to induce a training effect without aggravating abnormal clinical symptoms. Typically heart rate is used to monitor aerobic exercise intensity, however it is difficult to quantify the intensity of resistance training using

physiological measurements [3]. Additionally, heart rate is significantly increased following burn, due to the hypermetabolic response associated with major burns [4]. Some medications, the mode of exercise, environmental conditions, and psychological influences may also affect heart rate and the heart rate response to exercise [6]. Rating of perceived exertion (RPE) is frequently used in exercise prescription as a method to subjectively monitor an individual's perception of exercise intensity for a given activity, without relying on heart rate.

The 'Borg scale' is the most frequently used method to assess an individual's RPE [5]. This scale requires individuals to rate their level of perceived exertion on a scale from 6 (no exertion at all) to 20 (maximal exertion). A shorter category-ratio scale (CR10-RPE) has since been developed, which rates RPE on a scale from 0 (nothing at all) to 10 (extremely strong) [7,8]. While RPE typically assesses intensity for a given bout of exercise, Foster et al. have suggested session-RPE as an effective method to quantify aerobic exercise training load for an entire training session [3]. Session-RPE is calculated by multiplying the clients RPE using the CR10-RPE scale (with modified verbal anchors; 0 = rest, 10 = maximal), by the session duration in minutes. Session-RPE has since been demonstrated to be valid in athletes during a number of different aerobic exercise modalities and sports [9–13].

Whilst session-RPE was originally proposed to quantify training load of an aerobic exercise session, it has also been demonstrated to be a valid and reliable method to quantify training load during resistance exercise at varying intensities [14–16] and modalities [17,18], in healthy individuals. The intensity of resistance exercise can be adjusted by manipulating a number of different variables including; number of sets, number of repetitions, the load lifted, inter-set rest and time under tension etc. Therefore adjusting one or more of these variables has the potential to influence an individual's perception of effort [18]. It has been reported that performing fewer repetitions at a higher intensity is perceived to be more difficult than performing more repetitions at a lower intensity [14,19]. Kraft et al. reported that session-RPE was greater with higher loads, despite matched total volumes and work rates [20]. In contrast, Pritchett et al. reported that in resistance exercise performed to failure, total work influences session-RPE to a greater extent than the load lifted [21]. It is evident that altering resistance training variables may influence an individual's RPE. This may be of particular concern in clinical populations, where the prescription of resistance exercise may vary greatly depending on the clinical population concerned.

Whilst session-RPE is typically used in healthy adult populations, it has been validated as a method to monitor training intensity in individuals with chronic heart failure, during both continuous and interval aerobic training [22]. Little is known about the use of session-RPE to monitor resistance training loads in adult clinical populations. McGuigan et al. investigated whether session-RPE could be utilised to monitor resistance training intensity in overweight and obese children [23]. They demonstrated that session-RPE was reliable in overweight and obese children; however it provided different information to average RPE reported for each set of individual exercises across the entire resistance training session [23]. This is in contrast to the findings in healthy

adult populations, and they proposed that this may be owing to the fact that children often underestimate their perceived exertion, which may be because of their decreased psychological maturity. They also suggested that their increased ratings of session-RPE may be as a result of residual fatigue that was not perceived during individual sets of exercises [15,23]. This may be of concern when utilising session-RPE to determine training load in clinical populations.

Perception of effort may also be influenced by a number of psychosocial and environmental factors including; anxiety, extroversion, age, fitness level, ambient temperature, glycaemia etc. [24]. Therefore RPE may be implicated in burns patients due to the complex and traumatic nature of burns. Given that physiological measures of exercise intensity (such as heart rate) are often not valid in burns patients, session-RPE could significantly influence clinical practise in terms of monitoring and administering exercise intensity in this population. Therefore the aim of this study was to determine the effectiveness of session-RPE as a method to quantify training load during resistance exercise in patients with acute burns. A secondary aim was to determine if age, gender, burn size, pain, resistance training history and training session-volume influence training load in individuals with burns.

2. Methods

2.1. Participants

Patients were recruited if they were aged 18 years or over and had sustained a burn to 5–40% total body surface area (%TBSA), that underwent admission to the state adult burns unit. Patients were recruited between Jan and Dec 2015. All patients were recruited within 48 h of injury and commenced the resistance training intervention, within 72 h of injury. Patients were excluded if they had; sustained an electrical injury, palmar burns (unable to grip weights), any pre-existing musculoskeletal injuries preventing them from performing resistance exercise, type 1 diabetes or other metabolic conditions, cognitive or neurological impairment, poor English language or been discharged from hospital within 72 h. Patients in this cross-sectional study were recruited as part of a larger randomised controlled trial (RCT). This study was approved by the Fiona Stanley Hospitals Human Research Ethics Committee (FSH 2014-099) and all patients provided informed consent prior to participation.

2.2. Resistance training protocol

As part of the RCT, patients were block randomised (according to %TBSA) into either the resistance training group or the control group. Patients were blinded to their group allocation. All patients included in this study completed three resistance training sessions per week, in addition to standard physiotherapy, which includes bi-daily sessions, five days per week All training sessions were supervised. All patients were required to complete a 10 min general warm up on an arm ergometer or treadmill. Daily non-linear periodisation based on the results of daily maximal isometric testing was utilised. Maximal isometric muscle strength testing was completed for