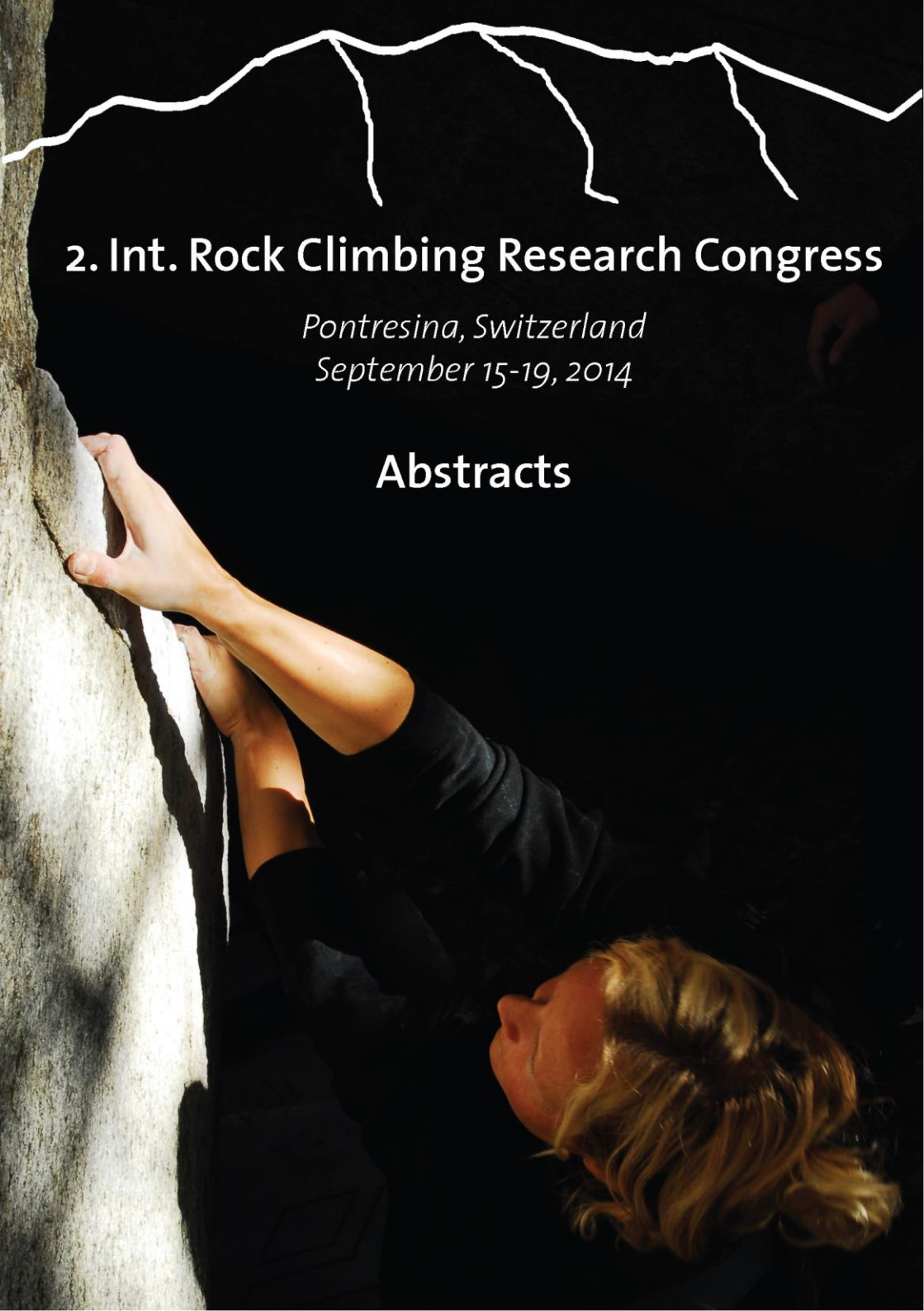
2. Int. Rock Climbing Research Congress

Pontresina, Switzerland
September 15-19, 2014

Abstracts



Program Overview

Monday, September 15, 2104

13h00	**Conference start** **Welcome notes**
13h10	**Keynote Biomechanics** ***L. Vigouroux*, Prehensile capabilities of rock-climbers**
14h10	**Oral Session 1** *L. Donath*, Effects of climbing-wall inclination on trunk muscle activation during various static climbing positions: Implications for therapeutic climbing *F.Mally*, Surface electromyography measurements of stabilizing ventral muscles in therapeutic climbing *S.Fryer*, Forearm muscle tissue re-oxygenation kinetics in male sport rock climbers
15h10	Coffee break
15h30	**Oral Session 2** *J.Balas*, Finger flexors strength measurement using electronic scales in sport climbers & The effect of arm and grip position during finger flexor strength measurement in sport climbers *M. Fanchini*, Internal responsiveness of two methods for assessing maximal strength and peak rate of force development in lead rock climbers *P.Wolf*, Interaction forces in climbing: Cost-efficient complementation of a 6dof instrumentation
16h30	**Special: Expedition I** ***R. Schäli*, Recent adventures**
17h30	Information on Mountaineering
19h00	**Conference Dinner**

Tuesday, September 16, 2014

08h30	**Keynote Material** ***T. Fuss*, Climbing equipment and friction**
09h30	**Oral Session 3** *K. Raine,* Benefits of 3D topos for information sharing and planning in rock climbing *S. Beekmeyer,* Discovering climbing in artificial structures using digital design and fabrication technology
10h15	Coffee break
10h45	**Oral Session 4** *M. Spoerri*, A new program to calculate a climber's fall *D. Orth*, Hold design supports transfer of fluidity in climbing skill *L. Seifert*, Full-body movement pattern recognition in climbing *L. Seifert*, Movement phase detection in climbing
12h05	Lunch break
13h00	**Forum Session Grading** led by *N. Draper* Consensus on climbing ability grouping
13h30	**Oral Session 5** *P. Watts*, Geometric Entropy During Rock Climbing – Lead vs Top-Rope Ascents *K. Phillips*, Body position and technique effects on displacement in the dyno maneuver in rock climbing *A. Amca*, Relationship between climbing specific grip techniques, hold depth and maximal finger force capacity of rock climbers
14h30	Preparation Mountaineering

Wednesday, September 17, 2014

	Mountaineering or Climbing

Thursday, September 18, 2014

08h30	**Keynote Training I** ***P. Matros*, Impact of feedback provided by a trainer**
09h30	**Oral Session 6** *G. Gonzales*, A preliminary analysis of motivation and goal orientation in rock climbers *V. España-Romero*, Anthropometry, physical fitness and psychological profile of adolescent rock climbers from South of Spain: predictors of performance
10h15	Coffee break
10h45	**Oral Session 7** *B. Smith*, Human Factors in Avalanche Decision Making Among Mountaineers in Scotland *M. Panackova*, Physiological demands of indoor wall climbing for children *D. Giles*, Current understanding in climbing psychophysiology research
11h45	Lunch break
12h30	Climbing Morteratsch
19h00	**Special: Expedition II** ***U. Hefti*, Swiss Himlung Expedition**
20h00	**Conference Dinner**

Friday, September 19, 2014

08h30	**H.P. Bircher Memorial Lecture** ***V. Schöffl*, Finger injuries in rock climbing**
09h30	**Oral Session 8** *K. Bonetti*, Talus fractures in climbers *T. Bayer*, Epiphyseal stress fractures of adolescent climbing athletes – a 3.0T MRI evaluation
10h15	Coffee break
10h45	**Oral Session 9** *M. Kilgas*, Static Stretching does not impair sport specific measures of upper-limb force and power in rock climbing *F. Bourassa-Moreau*, Computer connected force platform performance assessment and training tool for rock climbing *L. Roland*, Postural adaptations in female elite rock climbers: the Climber's Back *M. Schneeberger*, Results of conservative treatment of closed finger flexor tendon pulley rupture with a pulley protection ring
12h25	**Farewell**

Forearm muscle tissue re-oxygenation kinetics in male sport rock climbers

S. Fryer[1], L. Stoner[2], A. Lucero[2], T. Witter[2], C. Scarrott[3], T. Dickson[4], K. Stone[1], N. Draper[5]

[1]*School of Sport and Exercise, University of Gloucestershire, Gloucester, United Kingdom.*
[2]*School of Sport and Exercise, Massey University, Wellington, New Zealand.*
[3]*Department of Mathematic and Statistics, Christchurch, New Zealand.*
[4]*School of Sport and Physical Education, University of Canterbury, Christchurch, New Zealand.*
[5]*School of Sport Performance and Outdoor Leadership, University of Derby, Buxton, United Kingdom.*

Summary **– The current study quantified muscle tissue oxygenation kinetics during and after a sustained isometric contraction at 40% of MVC. Oxygen saturation was assessed in the flexor digitorum profundus (FDP) and flexor carpi radialis (FCR). Elite climbers used significantly more O2 during the contraction, and had a significantly faster time to half recovery than the intermediate and advanced climbers, as well as the control group. Elite climbers appear to have an increased ability for oxyhaemoglobin to off-load O2 into the muscle during exercise, and may have an enhanced PCr-resynthesis during recovery[1].**

INTRODUCTION

Previous research into the performance of rock climbing has focused on de-oxygenation and re-oxygenation kinetics during open crimp contractions to failure [2, 3]. However, no known study has attempted to determine oxygenation kinetics during both the contraction and subsequent recovery period. An assessment of re-oxygenation during recovery in multiple ability groups of rock climbers may provide insight into some of the underlying physiological mechanisms which enable elite performers to sustain intense isometric contractions for prolonged periods of time. As Near Infrared Spectroscopy (NIRS) has previously been correlated to PCr recovery [1], this area is of particular interest. Therefore, the aim of this study was assess MVC, maximal de-oxygenation, and re-oxygenation time to half recovery after a sustained contraction to failure in different ability groups of rock climbers.

METHOD

Thirty-eight participants were categorized into 4 ability groups as defined by Draper et al., [4] (intermediate (n=9), advanced (n=10), elite (n=10) and control (n=9)). A climbing specific handgrip ergometer was developed to accurately measure force (newtons), and regulate ±5% error during the contraction.

Participants were asked to apply 40% of MVC to the climbing hold until volitional fatigue occurred. During both contraction and recovery (passive, 5min), NIRS was used to assess muscle tissue oxygenation kinetics.

RESULTS

Table 1 Mean (SD) tissue de-oxygenation (%) Δ, and time to half recovery (s) post sustained contraction in the FDP and FCR of intermediate, advanced and elite climbers as well as non-climbers.

	% (Δ) de-oxygenation (SD)	**Time (s) to ½ recovery (SD)**
FDP		
Control	32 (14.3)*	94.7 (63.2)
Intermediate	34.3 (9.5)*	46.7 (32.3)
Advanced	42.8 (9.3)*	12 (8.9)***,**
Elite	63.1 (7.6)	8.4 (3.4)***,**
FCR		
Control	22.7 (16.8)	30.4 (25.3)
Intermediate	14.6 (7.8)*	97.2 (65)
Advanced	28.9 (15)	15.5 (18.1)**
Elite	36.5 (0.4)	6.8 (4.9)**

% de-oxygenation Δ represents the difference between baseline O_2% and maximal de-oxygenation % achieved during the contraction.
*Shows the group is significantly different ($p < 0.05$) from the elite group
**Shows the group is significantly different ($p < 0.05$) from the intermediate group
***Shows the group is significantly different ($p < 0.05$) from the control group

DISCUSSION

Findings of the current study suggest that not only was maximal de-oxygenation significantly greater in elite rock climbers, but the time taken to reach half recovery was also significantly less. All elite climbers de-oxygenated the FDP and FCR to a similar extent, the small SD (Table 1) suggests they may have been close to the physiological limit of being able to perfuse O2 within the muscle. The significantly quicker time to half recovery in the FDP and FCR is suggestive of the elite and advanced climbers having potential differences in oxidative metabolism, more specifically, being able to re-synthesis PCr at a faster rate. What is not known is whether these are pre-requisites which govern performance, or muscle adaptations.

REFERENCES

[1] T. Sako, T. Hamaoka, T. Higuchi, Y. Kurosawa, and T. Katsumura. Validity of NIR spectroscopy for quantitatively measuring muscle oxidative metabolic rate in exercise. J Appl Phys, 1, 90, pp. 338-344, 2001.
[2] D. MacLeod, et al., Physiological determinants of climbing-specific finger endurance and sport rock climbing performance. J Sports Sci, 12, 25, pp.1433-1443, 2007.
[3] M. Philippe, D. Wegst, T. Muller, C. Raschner, and M. Burtschar. et al., Climbing-specific finger flexor performance and forearm muscle oxygenation in elite male and female sport climbers. Eur J Appl Phys, pp. 1-9, 2011.
[4] Draper, N., et al., Reporting climbing grades and grouping categories for rock climbng. Iso Exer Sci, 19, pp. 1-8, 2011.