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BRIEF NOTE

A new performance threshold in sport climbing: A change in how climbing trainers work?

Un nouveau seuil de performance dans l'escalade sportive: un changement dans la manière de travailler des entraîneurs d'escalade

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Summary

Objectives. – Previous research has shown that the finger flexor's occlusion threshold (OT) could be different among sport climbers when expressed as a percentage of their maximum finger force (OT%), and that there is no association between the OT% and the climbers' ability level. The aim of the present study was to evaluate the possible association between the relative finger force applied at the OT% (rff-OT%) and climbing ability level.

Equipment and methods. – We approximated the finger flexor's OT of 34 sport climbers by finger hang endurance test analyses at different intensities between 35% and 85% of their individual maximum finger force on a previously individually adapted edge depth, and we valued their rff-OT% as the relative force they could perform at that intensity.

Results. – We found a high correlation between the rff-OT% and climbing ability in elite climbers. These findings suggest that having an OT at the highest possible percentage is critical, in

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MOTS CLÉS

Force des doigts ;
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addition to having a high relative finger force, as this would enable climbers to express relative force at a wider range of intensities with favorable metabolic conditions.

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Résumé

Objectifs. – Des recherches précédentes ont montré que le seuil d'occlusion (SO) des fléchisseurs des doigts peut être différent parmi les escaladeurs lorsque celui-ci est exprimé comme un pourcentage de la force maximale des doigts (SO%), et qu'il n'existe aucune relation entre le SO% et le niveau sportif de l'escaladeur. Le sujet de cette recherche était d'évaluer une possible association entre la force relative de doigts exercée à l'intensité du SO% (FRD-SO%) et le niveau sportif ou d'escalade.

Matériel et méthodes. – Nous avons effectué notre approche pour mesurer le SO des fléchisseurs des doigts de 34 escaladeurs par l'analyse de tests de résistance en suspension sur les doigts réalisés à différentes intensités allant de 35 % à 85 % de la force maximale des doigts de chaque individu, et sur une réglette de profondeur adaptée à chacun. Nous avons défini leurs FRD-SO% comme la force relative qu'ils pouvaient exprimer à cette intensité.

Résultats. – Nous avons trouvé une forte corrélation entre la FRD-SO% et le niveau sportif chez les escaladeurs de plus haut niveau. Ceci suggère qu'il est important d'avoir un SO équivalent au plus haut pourcentage possible, outre une force relative de doigts élevée, puisque ceci permettrait à l'escaladeur d'exprimer sa force relative dans un éventail d'intensités plus large tout en maintenant des conditions métaboliques favorables.

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1. Introduction

The finger flexors are the most important muscles in sport climbing [1]. These muscles contract in an isometric and intermittent way during each climb. Their endurance to these type of contractions is considered a key performance factor for this discipline, and is mainly conditioned by the presence of blood flow in the muscle [2]. When an isometric contraction is performed above a certain intensity, named occlusion threshold (OT) [3], there will be no blood flow. The OT will determine the prevalent metabolism responsible for performing these contractions. Thus, it will be critical to identify the finger flexor's OT to assess specific endurance in climbing.

Only one study [4] has approximated the finger flexor's OT in different ability level climbers. The results of that study suggest that the OT, expressed as a percentage of the maximal finger force (OT%), could happen at different intensities ($65 \pm 8.9\%$ of maximal finger force), independently of the finger force level and the climbing ability. Surprisingly, no association was found between the OT% and climbing ability (measured by the maximum red-point level in the last six months), which could be explained by the way the OT was expressed (as OT%). Physical fitness variables associated with climbing performance have traditionally shown higher associations when expressed relative to body weight because the force that a climber will have to apply to maintain him/herself from a hold will be partially determined by his or her body weight.

The aim of the present short report is to analyze the association between the relative finger force that can be manifested at the OT% (rff-OT%) and climbing ability.

2. Methods

2.1. Participants

We used data from a previous study [4] ($n=34$) in which sport climbers were divided into two groups: advanced (AG, $n=14$, 18 to 23 IRCRA red-point level) and elite (EG, $n=20$, 24 to 27 IRCRA red-point level) groups.

2.2. Procedures

We assessed the climbers in four different days by finger hangs on an individually adapted wooden edge depth. This edge depth was calculated on the first test day as the minimum edge depth on which a climber was able to dead hang for 40 s (MED_40). Later on the first day, we assessed the maximum finger force of the participants by a maximum added weight hang test to 5 s on the MED_40 (MAW_5). For the remaining three days, we re-tested the MAW_5 and performed two more endurance tests every day at different intensities to approximate the finger flexor's OT% of every climber. The intensities of these OT% approximation tests ranged from 85% to 35% of the maximum finger force. All these tests and the statistical procedures to approximate the OT% are explained in detail in a previous study [4].

2.3. Measurements

We estimate the rff-OT% as the product between the approximated OT% for each climber and his/her finger force expressed relative to his/her body weight and the depth of the edge used to measure it, i.e. as the product between

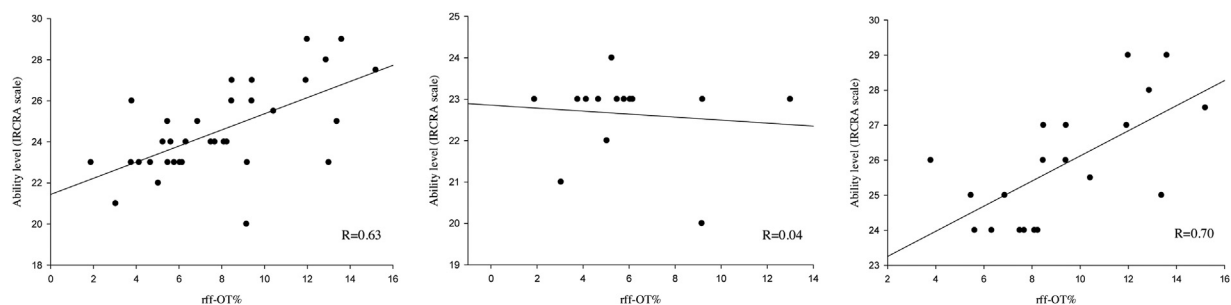


Figure 1 Relationship between the rff-OT% and climbing ability.

the individual finger flexor’s OT% and the MAW_5 value of every climber.

2.4. Statistical analysis

We used Spearman correlations (R) to explore possible associations between the rff-OT% and climbing ability for the whole group, and stratified by ability level groups (advanced and elite climbers). All the tests were two-sided, and the significance level adopted was $\alpha < .05$.

3. Results

Fig. 1 presents the relationships between the rff-OT% and climbing ability for the whole sample (Fig. 1a) and for each ability level group (Fig. 1b; advanced climbers, and Fig. 1c; elite climbers). We found a high and significant association between the rff-OT% and climbing ability for the whole sample ($R=0.63$; $P<0.001$), and the elite group ($R=0.70$; $P=0.001$), while no association was found for the advanced group ($R=0.04$; $P<0.889$).

4. Discussion

Our results show that the rff-OT% presents a high association with climbing ability in the elite group but not in advanced climbers. This could be due to the multifactorial nature of climbing performance, being the non-physical factors (e.g. fear to fall, technical factors, etc.), those that could affect to a greater extent the performance at lower climbing levels, as proposed by previous literature. Our findings suggest that, in addition to having a high relative finger force, it is critical to have an OT at the highest possible percentage, as this would enable climbers to express relative force at a wider range of intensities with favorable metabolic conditions. Therefore, a higher rff-OT% would have a beneficial effect for specific endurance due to an efficiency criteria, which could improve climbing performance.

Let’s see it with an example. Suppose two climbers with the same body weight and relative finger force have different rff-OT% (“A” has a higher OT% than “B”). If both climbers apply the same force in each hold while climbing a route, “A” will show a lower fatigue in each hold because he/she will have more muscle blood flow as he/she will be further away from his/her rff-OT% than “B”. This will entail that:

- “A” can stay longer in each hold, optimizing his/her perceptions and decisions that will determine climbing success;

- if both climbers spend the same amount of time in each hold, “A” will get to the hardest section of the route (normally the highest intensity section called crux), with a more favorable local metabolic environment than “B”, and consequently increase his/her probabilities of success as he/she will be able to express a higher force at that point due to the lower impairment reached by the force production mechanisms.

5. Conclusions

Strengthening the rff-OT% could be an important factor for sport climbing performance due to an energetic optimization criteria. Assessing relative force and OT% of the finger flexors will facilitate an objective and informed decision making in regard to adaptations that could optimize the rff-OT%. For that purpose, trainers should evaluate the relative finger force on an individually adapted edge depth to each sport climber, and approximate the OT% following the finger hangs protocol described in previous research [4].

Disclosure of interest

The authors declare that they have no competing interest.

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