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Footwear in rock climbing: Current practice

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HIGHLIGHTS

- Rock climbers often wear ill-fitting and overly tight footwear.
- Foot injury and deformity, including hallux valgus, is common in the group.
- The extent of shoe-size reduction amongst rock climbers has been quantified for the first time, showing a mean reduction of almost 4 UK shoe sizes for rock climbing footwear.
- A shoe-size reduction was also found between an ideal fit and that of rock climber's everyday footwear.
- A greater than previously reported prevalence of foot pain during climbing activity is reported (91.07%).

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ABSTRACT

Background: Many rock climbers wear ill-fitting and excessively tight footwear during activity. However, there is insufficient evidence of the extent or harms of this practice.
Objectives: To investigate footwear use in rock climbers with a focus on issues surrounding fit.
Methods: A cross-sectional study with active rock climbers of over one year of experience completing a survey on their activity and footwear.

Additionally, the authors quantified foot and shoe lengths and sizes alongside demographic data.
Results: Ill-fitting and excessively tight footwear was found in 55 out of 56 rock climbers. Foot pain during activity was also commonplace in 91% of the climbers. A mean size reduction of almost 4 UK shoe sizes was found between the climbers' street shoe size and that of their climbing footwear using a calibrated foot/shoe ruler. There is an unfortunate association of climbers of higher abilities seeking a tighter shoe fit ($p < 0.001$).
Conclusion: With the elucidation of footwear use amongst rock climbers, further investigation may aim to quantify its impact and seek a solution balancing climbing performance while mitigating foot injury.

1. Introduction

Rock climbing is an increasingly popular sport with a literature base primarily investigating injury, often with a focus on the upper limbs [1–4]. There is an unmet need for research into the impact of rock climbing footwear on the foot structure of rock climbers [5]. In particular there has been limited investigation into the effects of the common practice of wearing rock climbing footwear that is too small or unnaturally formed [6–10].

1.1. The climber's foot

Existing literature on the climber's foot has established that the majority of active rock climbers will have had some form of pain or injury to the foot or ankle while climbing [6–8]; alongside a finding that the percentage of injuries sustained increases with greater climbing skill [3]. Common foot deformities and injuries amongst rock climbers include pressure marks, subungal haematoma, splinter haemorrhage, cuts and bruises to the toes, dystrophic and infected nails, and a worrying prevalence of hallux valgus deformities [6–9]. However, there is suggestion of benefits of the sport to the longitudinal arch of participants' feet [10]. Much of this injury has been linked to a pervasive culture amongst rock climbers to accept a degree of foot pain and discomfort in footwear to attain enhanced performance [6–10].

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However, some of the problems associated with rock climbing footwear remain ill-defined and unpublicised. The dangers of excessively tight footwear may not be adequately realised by rock climbers, with a recent study of the epidemiology of rock climbing injuries making no mention of specific foot injury on self-reported questionnaires, despite evidence for its prevalence [4].

1.2. The climber's shoe

Despite this relative paucity of research into the problems of tight footwear, some effort has been concentrated on a solution. Van der Putten and Snijders' [9] investigation into, and the development of, a better biomechanically adjusted climbing shoe asserted the critical importance of not only appropriate shoe design, but also correct sizing. The authors recognised the dichotomy of a good fit in climbing footwear between a shoe that is too small, causing foot injury and restricting toe extension, and one that is too big, giving difficulty when standing on small edges and slippage of the shoe on the foot. No study to date has comprehensively assessed the degree of size reduction in climbers footwear, though an average shoe-size reduction of 2.3 sizes is often quoted [6,7].

The relationship between incorrectly fitted footwear and foot deformity remains inadequately defined. A recent review of the literature surrounding hallux valgus deformity found only one reliable study of the link between footwear and hallux valgus, specifically highlighting lack of width as a factor in hallux valgus deformity development [11,12]. The same study also associated lack of shoe width with the presence of corns on toes and foot pain, and lack of length in footwear to lesser toe deformity. In addition, Harrison et al. [13] presented the difficulties encountered in the investigation of shoe size and the link to pathology. Nevertheless, case reports have shown that restrictive footwear has serious long-term clinical consequences that may only be revealed in later life [14].

Current recommendations warn against the wearing of excessively restrictive rock climbing shoes and for removal of shoes between successive climbs, although no study to date has assessed the scientific basis for the use of such restrictive footwear, nor have these recommendations been investigated [15]. However, more recent comment suggests much of this advice is ignored; excessively tight shoes remain commonplace [5].

2. Methods

2.1. Participants

Fifty-six adult rock climbers, 11 female and 45 male, with over one year of experience, were recruited at the Avertical World (AW) Climbing Centre. Mean age was 33.6 years (SD 11.66), mean height was 174.9 cm (8.61), mean weight was 73.6 kg (12.49), mean BMI was 24.0 (3.20) and mean years of climbing experience was 10.8 Years (11.21). Volunteers were given briefing on the aims and objectives of the study, and written consent was gained. The project was approved by the University Research Ethics Committee.

2.2. Study design

Volunteers were recruited over 10 weekday evenings at the AW Climbing Centre. All of the climbers approached completed a questionnaire, with any queries or clarifications explained by the lead author.

Participants were asked to provide background information on their activity levels, including their duration of climbing experience. The highest grades of rock climb that they had completed over a range of activities within the sport were also recorded. Participants were asked to give details of any foot pain or injury sustained through rock climbing.

On completion of the questionnaire the length in millimetres of the participants' feet in bipedal stance and climbing shoe length were recorded with a 'Ritz Stick' type device. The size stated on participants' climbing shoes was noted. Climbing footwear was measured along its longest axis, from the most posterior point on the heel to the furthest point anteriorly, often found anteromedially in modern asymmetric climbing shoes. In more radical shoe designs involving a downturned forefoot, shoes are flattened along the longitudinal arch during measurement to account for the change in shape during use, Fig. 1 illustrates this method. Clinical photographs of each participant's feet were taken as a record to identify any obvious foot abnormality.

2.3. A note on quantifying ability

The comparison of different styles of climbing is a difficult one - though there is some consensus at how difficulties of routes in different disciplines of rock climbing interact. Efforts have been

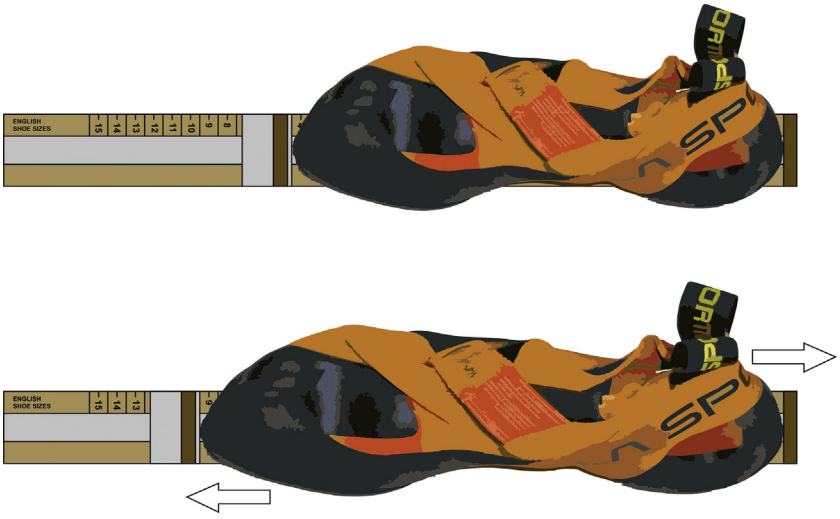

Fig. 1. Figure illustrating the method of measuring the length of a climbing shoe.