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Runner's knowledge of their foot type: Do they really know?

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ABSTRACT

Background: The use of correct individually selected running shoes may reduce the incidence of running injuries. However, the runner needs to be aware of their foot anatomy to ensure the "correct" footwear is chosen.
Objectives: The purpose of this study was to compare the individual runner's knowledge of their arch type to the arch index derived from a static footprint.
Methods: We examined 92 recreational runners with a mean age of 35.4 ± 11.4 (12–63) years. A questionnaire was used to investigate the knowledge of the runners about arch height and overpronation. A clinical examination was undertaken using defined criteria and the arch index was analysed using weight-bearing footprints.
Results: Forty-five runners (49%) identified their foot arch correctly. Eighteen of the 41 flat-arched runners (44%) identified their arch correctly. Twenty-four of the 48 normal-arched athletes (50%) identified their arch correctly. Three subjects with a high arch identified their arch correctly. Thirty-eight runners assessed themselves as overpronators; only four (11%) of these athletes were positively identified. Of the 34 athletes who did not categorize themselves as overpronators, four runners (12%) had clinical overpronation.
Conclusion: The findings of this research suggest that runners possess poor knowledge of both their foot arch and dynamic pronation.

1. Introduction

Modern society is placing increasing emphasis on physical activity and fitness [6]. Running is a highly popular recreational activity used to enhance physical fitness. In the United States, an estimated 30 million runners participate in regular running competitions [26]. Despite the obvious health benefits with physical activity, running can cause both acute and overuse injuries [4,9,18,31,48,49]. The reported incidence is as high as 59 per 1000 h of running [28].

The cause of most running injuries remains unclear and is most likely of multifactorial origin [26]. Foot deformities such as flatfoot and excessive pronation of the hindfoot have been described to cause "*shin splints*" and "*medial tibial exertion syndrome*" [15,17]. It has been postulated that the use of appropriate running shoes can reduce the incidence of injuries by absorbing ground reaction forces [22,29,40,45].

In contrast, incorrect footwear may predispose the recreational athlete to injury [3,46]. However these arguments are based on two published case reports and have to be viewed critically. For example in a case report Burgess and Ryan reported bilateral fatigue fractures of the distal fibulae after changing to a new pair of running shoes in a 26-year-old male athlete [3]. Similar a case report by Wilk et al. documented the development of plantar fasciitis in a 40-year-old male triathlete using inappropriate shoewear [46].

If shoes are matched to the correct foot type, injuries can potentially be reduced [5,51]. This may especially be beneficial for both high and low arch runners who have a reported higher incidence of overuse injuries [23]. Shoe manufactures market three classes of running shoes designed for individuals with high, normal, and flat arches [24]. These shoes are suggested to reduce running injuries by compensating for presumed differences in running mechanics [24,37]. Many running shoe companies and popular running magazines offer a web-based assessment tool to assess the foot arch based on the shape of the bottom of the foot [16]. However, whilst these tools may be used by the running community and retail shoe outlets, they have yet to undergo scientific validation.

Enke et al. [12] have recently suggested that athletes identified arch type compatibility with shoe design as the most important

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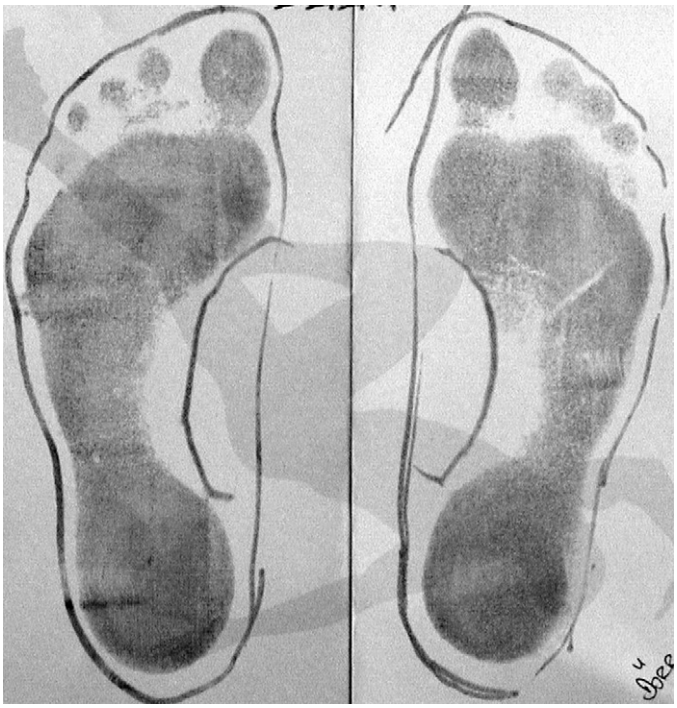

Fig. 1. A static footprint of both feet was taken with the subject standing comfortable on carbon paper with the hands placed on the hip and the feet placed 30 cm apart.

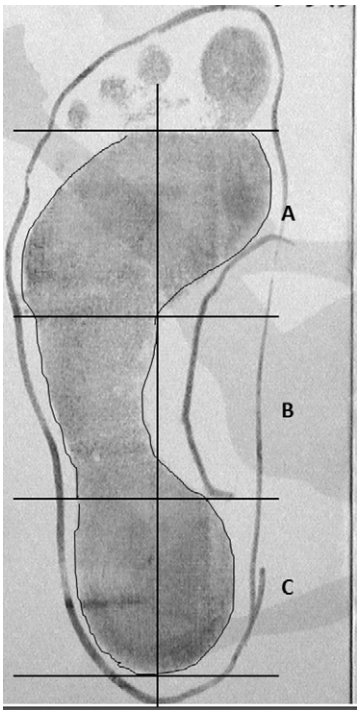

Fig. 2. Footprints were digitalized and imported into a computer-aided-design 2D software (Auto CAD 2000). A line was drawn from the centre of the heel to the tip of the second toe. A perpendicular line is then drawn tangential to the most anterior and posterior part of the footprint. The footprint was divided into three equal thirds (A, B, and C) and the outline of the foot print was marked using a lining tool. The software then calculated the area of each third (A, B, and C). The arch index was calculated as described.

factor in choosing a running shoe. In order to match foot type and running shoe, the runner needs to have basic knowledge about their anatomy and be able to identify their own individual arch type correctly.

The purpose of this study therefore was to compare the individual runner's self-determined arch type derived from a questionnaire to the arch index derived from a footprint by a clinician. In addition, the athlete was asked to define whether they were "over-pronators" or not. This was compared to a standardised clinical examination including a clinical gait analysis.

2. Methods

2.1. Subjects

92 participants (51 males, 41 females) who had enrolled into a 60-min time trial run in preparation for the Munich Marathon and Half Marathon volunteered to take part in the study. All subjects were experienced recreational athletes with more than 12 month regular weekly training distances of more than 20 km. Subjects were mainly recruited from the Munich Road Runners Club which was the responsible organisation for the time trial.

2.2. Arch height measurement

Following written registration for the time trial, a static footprint (Fig. 1) of both feet was taken by an experienced sports podiatrist. The footprint was taken with the participant subject standing barefoot, comfortable and evenly balanced on carbon paper with the hands placed on the hip and the feet at shoulder width.

Staheli et al. [43] have previously demonstrated a significant correlation ($r = 0.93$) between the right and the left foot arch index. Subsequently, for all further analysis, the left footprint was used and the arch index analysed and classified according to Cavanagh's criteria [7]. The arch index was calculated as the ratio of the area of the middle third of the foot to the entire footprint excluding the toes (Fig. 2). This measurement was selected as it provides an objective measure with reported within and between-day reliability coefficients of between 0.94 and 0.96. Using Scott's et al. criteria [41], a normal arched foot posture was defined as a ratio between 0.11 and 0.25, a flat arched foot was defined as a ratio of >0.32 using 2 standard deviations as a safety margin, and a high arched foot was defined as a ratio of <0.07.

Footprints were digitalized and imported into a computer-aided-design 2D software (Auto CAD 2000). This software allows the creation of lines on images and thus the ability to measure geographic variables with high precision and reproducibility (Hohmann et al., unpublished data 2003). A line was drawn from the centre of the heel to the tip of the second toe. A perpendicular line was then drawn tangential to the most anterior and posterior part of the footprint excluding the toes. The software was then used to divide the outlined footprint into three equal thirds. The outline of the foot print was marked using a lining tool (Fig. 2). The software then calculated the area of each third. The arch index was calculated using the following formula:

$$\text{Arch index} = \frac{B}{A + B + C}$$

2.3. Questionnaire

Following arch height measurements participants were asked to complete a questionnaire addressing the following subjective variables: height, body weight, current and past running shoe (which company, differences in comfort), professional activity (mainly sitting, standing, walking, physical or heavy manual work), time of main running activity (morning, lunch, afternoon, and evening), main running surface (tarred roads, gravel, grass/beach, artificial surfaces or a combination), weekly training distances (<20 km, 20–40 km, 40–60 km, >60 km), use of orthoses (yes/no). The results