Journal of Tissue Viability (2015) **24**, 153—164

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JOURNALOF tissueviability

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Basic research

Clinical signs in the foot that are predictors of ligamentous laxity in the adult population

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KEYWORDS
Ligamentous laxity;
Foot;
Beighton criteria

Abstract *Objectives:* This study evaluates the influence of ligamentous laxity on the foot from observation of clinical signs and quantification of certain joint ranges.
Methods: The sample consisted of 400 subjects — 200 in the non-lax control group (ages 32.49 ± 11.06 years) and 200 in the lax group (ages 29.82 ± 9.41 years). The Beighton criteria were applied to each subject to diagnose laxity or non-laxity after noting their gender, age, and 2 joint ranges and 2 clinical signs for both feet. This was an observational analytical study of cases and controls, in which a multivariate binary logistic regression model was applied.
Results: Extension of the first metatarsophalangeal joint (MTPJ) ≥95°, extension of the 1st toe's interphalangeal joint (IPJ) ≥14°, and the signs 1st "*in the plantar footprint, marked and narrowly confined support under metatarsal heads*" and 2nd "*in the plantar footprint, continuity of the 1st toe to the 1st metatarsal*" presented significant differences between the lax and the non-lax groups. These are usable as parameters with which to detect laxity. The Beighton criteria were confirmed as being the most appropriate for diagnosis.
Conclusions: We propose the use of 2 clinical signs that can be evaluated in plantar footprints ("*1st*" and "*2nd*") and 2 exploratory manoeuvres (extension of the first

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http://dx.doi.org/10.1016/j.jtv.2015.07.002

MTPJ ≥95° and extension of the 1st toe's IPJ ≥14°) as factors present in the foot which allow the detection of ligamentous laxity in the adult population, for subsequent confirmation by applying the Beighton criteria.

1. Introduction

Articular or ligamentous laxity is a clinical entity characterized by increased joint mobility, beyond the range of motion regarded as normal [1]. Some 5—10% of lax subjects suffer an associated set of painful musculoskeletal conditions known as "benign joint hypermobility syndrome (BJHS)" [2]. These alterations are located in segments where connective tissue is present due to genetic abnormalities in the collagen fibres and other proteins forming those tissues [3]. In particular, the alteration of these proteins makes these structures more elastic than normal, but also more fragile [4], leading to lesions occurring after relatively light trauma [5].

Clinical manifestations can range from joint and muscle pain [4], subluxation, meniscopathy, back pain, scoliosis [6], repetitive strain [7], tendinitis and bursitis, etc., to the appearance of ecchymosis following the lightest of traumata, to thin, elastic skin prone to hypertrophic scars and stretch marks, and to dysautonomia [8]. Multiple sites may be affected, with the foot being one of the most commonly referred to zones [9—11]. There may be associated foot deformities such as ankle sprains [12], flexible flatfoot [13], overpronation [14], plantar fasciitis [1], hallux abductovalgus [10], tarsal tunnel [15], and interdigital callus [16].

Diagnosing laxity is purely a clinical matter with an objective system of evaluation being used. The most accurate system today is the Brighton's score [17]. These criteria are based primarily on the classic work of Beighton [18] which is still used unchanged by most workers in studies of the diagnosis of ligamentous laxity [3,19,20].

Evaluation of the foot is not present in either version of this model of diagnostic criteria. Other work has used it, however, as a diagnostic mechanism. Examples are the analysis of ankle dorsiflexion [19,21,22], the range of eversion of the subtalar joint [13], exploration of the extension of the first metatarsophalangeal joint (MTPJ) [22—24], and measurement of the extension of the first toe's interphalangeal joint (IPJ) [24], although none of those authors contemplate such tests for the diagnosis of laxity.

The objective of the present study was to examine the influence of ligamentous laxity on the foot by observation of clinical signs in the plantar footprint and by quantification of some of the foot's joint ranges. A high frequency of any of these clinical signs or tests could mean that they might be applicable as predictive podiatric criteria of laxity in the adult population.

2. Material and methods

The study sample consisted of 400 subjects (200 in a laxity group and 200 controls), of whom 126 were men (38.5%) and 274 women (61.5%), ages from 18 to 65 (mean 31.16 ± 10.34) years. The control (non-laxity) group comprised 89 men (44.5%) and 111 women (55.5%), ages from 19 to 65 (mean 32.49 ± 11.06) years. The laxity group comprised 37 men (18.5%) and 163 women (81.5%), ages from 18 to 61 (mean 29.82 ± 9.40) years.

The inclusion criteria were: (i) aged from 18 to 65 [8,25] because epiphyseal plate closure is at 17 years of age, and, after 60 years of age, osteoarthritic processes may limit the joints [26]; (ii) Caucasian ethnicity because race is a factor in the prevalence of BJHS [27], with the syndrome being less frequent in Caucasians [28—30].

The exclusion criteria were: (i) the presence of some degenerative disorder [1] (such as osteoarthritis or rheumatoid arthritis), neuromuscular disorder [31], or inflammatory or metabolic disorder (such as gout) [14]; (ii) surgery in the preceding 6 months [14], including the insertion of an endoprosthesis [8]; (iii) musculoskeletal injury in the preceding 6 months [10,25]; (iv) use of some lower limb orthosis in the preceding 6 months [26] since these might influence the movement of the joints of the foot either negatively (e.g., the control of valgus) or positively (e.g., in the case of the range of extension of the first MTPJ to control rearfoot pronation [32]); (v) the presence of moderate hallux limitus (15°—35° extension) or hallux rígidus (<15°) [33]; and (vi) pregnancy [8,10,34,35] because the range of joint movement may be increased by the greater laxity [36].