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Comparative study of plantar footprints in youth with Down syndrome

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KEYWORDS

Down syndrome;
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Abstract

Introduction: Musculoskeletal disorders of the locomotive apparatus are common in young people with Down syndrome (DS), especially in the feet. Early diagnosis by examination of podiatric footprints can help prevent orthopaedic symptoms. Our objective was to analyse, measure and classify footprints on the basis of podiatric indices (gold standard) in young people with DS.

Method: Cross-sectional study; 86 footprints were analysed from 2 groups; there were 21 healthy subjects, 11 men 20.45 (2.16) years and 10 females 20.00 (1.70) years; and 22 subjects with DS, 11 men 23.82 (3.12) years and 11 females 24.82 (6.81) years. Footprints were recorded in standing position using an optical pedoscope and a digital camera system. We calculated the Hernández-Corvo index, Chippaux-Smirak index, Clarke's angle and Stahelli index. We then compared the results of both samples and analysed the concordance between types of feet and right and left feet by Chi-square test.

Results: Footprints in individuals with DS showed flatfoot and/or pronated foot of 38.6% according to Hernández-Corvo index; 50%, to Chippaux-Smirak; 70.4%, to Stahelli; and 59.1%, to Clarke's angle. In healthy subjects the rates of cavus foot were 57.1%, according to Hernández-Corvo index; 59.5%, to Chippaux-Smirak index; and 81%, to Stahelli index; while 57.1% showed a normal foot based on Clarke's angle. Differences between the 2 groups were statistically significant ($P < .01$) in Chippaux-Smirak index, Stahelli index and Clarke's angle. The correlation between the right and left foot was not significant.

Conclusions: Young people with DS had a higher percentage of pronation and a lower percentage of cavus foot than the control group.

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PALABRAS CLAVE

Síndrome de Down;
Huella plantar;
Gold standard;
Índices podológicos;
Clasificación clínica

Estudio comparativo de las huellas plantares en jóvenes con síndrome de Down**Resumen**

Introducción: Los trastornos musculoesqueléticos a nivel del pie son frecuentes en las personas con síndrome de Down (SD). Por ello el diagnóstico precoz mediante examen podológico de las huellas plantares puede ayudar a prevenir las manifestaciones ortopédicas. El objetivo es analizar, medir y clasificar la huella plantar mediante los índices podológicos (gold standard) en jóvenes con SD.

Método: Estudio transversal comparativo; se analizaron 86 huellas plantares correspondientes a 2 grupos: 21 sujetos sin SD, 11 hombres de 20,45 (2,16) años y 10 mujeres de 20 (1,70) años; y 22 sujetos con SD, 11 hombres de 23,82 (3,12) años y 11 mujeres de 24,82 (6,81) años. Se registraron las huellas plantares en bipedestación estática mediante la utilización de un podoscopio óptico y una cámara digital. Los índices analizados son Hernández-Corvo, Chippaux-Smirak, Stahelli y ángulo de Clarke. Se compararon los resultados de ambas muestras y se analizó la concordancia entre los tipos de pies, derecho e izquierdo, mediante la prueba de Chi-cuadrado.

Resultados: Los sujetos con SD se clasifican con pie plano y pronador en un 38,6% según el índice de Hernández-Corvo; Chippaux-Smirak 50%; Stahelli 70,4%; y ángulo de Clarke 59,1%. Los sujetos control presentan pies cavos en un 57,1% según el índice de Hernández-Corvo; Chippaux-Smirak 59,5%; Stahelli 81%; y como pie normal según el ángulo de Clarke en un 57,1%. Hay diferencia significativa ($p < 0,01$) en los índices Chippaux-Smirak, Stahelli y el ángulo de Clarke. La concordancia entre pie derecho e izquierdo no fue significativa.

Conclusión: Los jóvenes con SD presentan más porcentaje de pie plano pronador y menos cavos que el grupo control.

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Introduction

Individuals with Down syndrome (DS) present musculoskeletal disorders. The most common are those of instability of the upper cervical spine: atlantooccipital and atlantoaxial joints and thoracogenic scoliosis. There are also disorders of the lower limbs: at the level of the hips, acetabular dysplasia, displacement of the femoral epiphysis and osteonecrosis or Perthes disease; at the level of the knees, patellar instability; and at the level of the ankles and toes, metatarsus valgus (pigeon toe) and pes planus (flat feet).¹⁻⁴

The musculoskeletal abnormality most often observed in individuals with DS is that of flat feet. It is considered a congenital orthopaedic problem that affects approximately 70% of people with DS.^{2,5-8} Other clinical manifestations are the external rotation of hips and tibia, knees in flexion and tendency to valgus, pronated flat feet, hallux valgus malformation and hammertoes.⁷ Clubfoot can also appear combined with some of these most common orthopaedic alterations, which is characteristic of subjects with DS.⁹

These orthopaedic manifestations are related and accompanied by muscular hypotonia, ligament laxity and plantar dysfunction.^{6,10} Individuals with DS have been described anecdotally due to their foot influence as having duck feet and a Chaplin-like walk because of the externally rotated position of the lower limbs.^{5,7} Foot position involves mechanisms of sensorial and motor integration that guarantee good balance in a standing position and later walking.¹¹ It is also thought that foot position correlates closely with the standing phase.¹²

Early podiatric diagnosis is essential for detecting the presence of orthopaedic problems of the lower limbs that are so habitual in individuals with DS; for this reason, Concolino et al.¹³ used a podoscope as a morphostatic examination to analyse footprints. Calculating podiatric indexes from footprints provides information on the surface contact of the instep, midfoot and rearfoot.⁶

Other authors assess foot arches in healthy youngsters using other measurement tools such as inked paper and the photo-podoscope.¹⁴⁻¹⁶ They also take note of the sinking of the inner foot arch to diagnosis flat feet and heel valgus as a frequently seen malformation in paediatric orthopaedics in healthy individuals; they relate it with factors such as the growth in children, foot morphotype and shoe type using the podoscope.¹⁷

Podiatric indexes that belong to the gold standard are the following: the Hernández-Corvo Index (HCI), Chippaux-Smirak Index (CSI), Staheli Index (SI) and Clarke Angle (CA). These indices serve to calculate the surface contact of the footprint.¹⁸⁻²⁰ The HCI makes it possible to establish foot type in agreement with the following classification: 0-34% flat foot, 35-39% flat-normal, 40-54% normal, 55-59% normal-cavus, 60-74% cavus, 75-84% high cavus and 85-100% extreme cavus foot. The CSI assesses the occupation of the isthmus. Normal values are 35 ± 10 . The upper values establish a tendency to flatness or pronation, while the lower values indicate a tendency towards cavus foot. The SI establishes a relationship between the mid-foot and heel. The normal range lies between 0.600 and 0.699. Again, higher figures indicate a tendency towards

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