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Rotational profile of the lower limb in 1319 healthy children

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Abstract

Lower limb rotational profile in children may cause great concern to parents and relatives. In order to give parents clear information, there is a need for referential studies giving normative data of lower limb rotational profile and its normal changes expected over growth. Our aim was to collect a large clinical series of healthy children, out of a clinic, selected from a non-consulting population and to analyse Tibial Torsion and Femoral Anteversion according to age and gender.

One thousand three hundred and nineteen healthy children underwent a clinical evaluation. Tibial Torsion was assessed using the method described by Staheli and Engel, whereas Femoral Anteversion was assessed using the method described by Netter. Our results showed that there was a significant difference between males and females in Femoral Anteversion, whereas there was no significant difference between the right side and the left side. Femoral Anteversion was higher in females, and was markedly correlated with age in both genders. There was no significant difference between males and females in Tibial Torsion, nor significant difference between the right side and the left side. Tibial Torsion was slightly correlated with age in both genders. Normative data were statistically defined in this work using the ±2 S.D. range. To our knowledge, there is no large and comprehensive series in the English speaking literature that gives normative data of Femoral Anteversion. Concerning Tibial Torsion, our results compared to those published in the literature.

Keywords: Femoral Anteversion; Tibial Torsion; Children

1. Introduction

Lower limb rotational profile in children may cause great concern to parents and relatives, and lead to a consultation in a paediatric orthopaedic outpatient clinic [1]. In most cases, the rotational profile that appears abnormal to parents is transient and will correct within the range of normality without any treatment [2]. In order to provide parents with clear information, reference studies including normative data of lower limb rotational profile and its normal changes during growth are required. Most of the series published in the literature attempting to address this issue have significant drawbacks, and to date, there is no comprehensive clinical series available: some series are not based on sufficient numbers to be significant, e.g. the one from Staheli [2,3]. Furthermore, Staheli used internal and external hip rotation to describe the torsional alignment of the femur. In some others (Craxford et al. [4]), patients were not divided according to their gender, despite the established difference in the lower limb morphology between males and females. Some studies are only radiological (Fabry et al. [5]), while others focussed only on the rotational range of motion of the hip, without any assessment of the Femoral Anteversion (Svenningsen at al. [6], Cheng et al. [1]). Our aim was to collect a large clinical series of healthy children, outside clinical practice, selected from a non-consulting population and to analyse the distribution, according to age and gender of Tibial Torsion and Femoral Anteversion,

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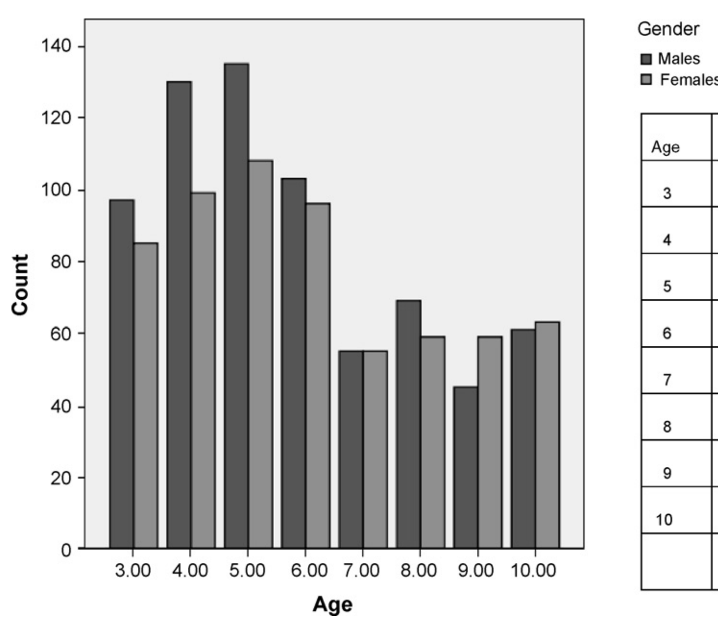
2. Materials and methods

The senior author (MJ) performed the clinical evaluation, after agreement from parents and educational authorities. This work has also been approved by the ethical committee related to our institution. One thousand four hundred and thirty-five children were considered for inclusion. The inclusion criterion was an age between 3 and 10 years. Thirty-four children were not included because of parental refusal. All these children had a previously diagnosed pathological orthopaedic condition. One thousand four hundred and one children underwent a clinical examination. Clinical examination was carried out at school, class after class. Males and females were examined separately. Children were examined barefoot, wearing shorts. The patient was seated as described by Staheli and Engel [7]: knee flexed, legs hanging from the edge of the table with the thigh directly in front of the hip joint, and heels against a flat vertical surface. The forefoot was held by the examiner at right angle to the back wall in both the sagittal and horizontal planes and the Tibial Torsion was assessed using the method described by the above authors [7]. The patient was then placed in the prone position, and the Femoral Anteversion was clinically assessed using the method described by Netter (cited by Ruwe et al. [8]). To measure the right hip, the examiner stood on the contralateral side of the patient, and, with the patient's knee flexed to 90°, the examiner used his left hand to palpate the greater trochanter, while the right hand internally rotated the hip. At the point of maximum trochanteric prominence, representing the most lateral position of the trochanter, the neck of the femur was parallel to the floor. The angle subtended between the tibia and true vertical, representing the Femoral Anteversion, was measured with a goniometer. Eventually, the child was asked to walk on an 8 m × 40 cm surface. Any child with obvious gait disturbance was excluded from the series. An ''abnormal'' foot progression angle was not considered as a gait disturbance as far as it did not cause any functional impairment. This visual gait analysis was performed by the senior author (MJ). Eleven children were excluded because of an obvious pathological orthopaedic condition (Legg-Calvé-Perthes disease, Cerebral Palsy, personal history of lower limb surgery). Seventy-one children were excluded because they were under 3 or over 10 years old. Eventually, 1319 children were included. There were 695 males and 624 females.

In order to assess the intra-observer reliability of our clinical evaluation, 3 months after the first evaluation a second set of measurements was performed by the same observer in 18 randomly chosen children. Outcome statistical evaluation was performed using SPPS 11.0 Software. The reliability of the measurements of Tibial Torsion and Femoral Anteversion was assessed using paired sample t tests. A comparison of means of Tibial Torsion between males and females, and between right and left side was performed. In the same way, a comparison of means of Femoral Anteversion between males and females, and between right and left side was performed. The threshold of significant difference was chosen at $p > 0.05$. A Pearson correlation matching age and Tibial Torsion was performed. The same analysis was performed for Femoral Anteversion. When significant correlations were identified, a linear regression was performed. In each cluster of age (see Fig. 1) and gender, children were divided into groups according to their Femoral Anteversion: children with a Femoral Anteversion under −2 S.D. were classified into the low Femoral Anteversion group, children with a Femoral Anteversion between −2 S.D. and +2 S.D. were classified into the normal Femoral Anteversion group, and children with a Femoral Anteversion over +2 S.D. were classified into the high Femoral Anteversion group. Children were then divided into three other groups according to their Tibial Torsion: children with a Tibial Torsion under −2 S.D. (i.e. internal Tibial Torsion) were classified into the low Tibial Torsion group, children with a Tibial Torsion between −2 S.D. and +2 S.D. were classified into the normal Tibial Torsion group, and children with a Tibial Torsion over +2 S.D. were classified into the high Tibial Torsion group (i.e. external Tibial Torsion). The rotational profile was defined by combining these groups.

3. Results

Fig. 1 shows the distribution of our population in each cluster of age and gender and summarizes the number of children in each cluster of age.



Age	Number of individuals
3	182
4	229
5	243
6	199
7	110
8	128
9	104
10	124
	1319

Fig. 1. Number of individuals in each cluster of age and gender.