Acta orthop. scand. 47, 112–117, 1976

TIBIAL TORSION IN UNTREATED CONGENITAL CLUBFOOT

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Current methods of measurement were reassessed by the study of tibial torsion in 1000 normal legs using the tropometer, the caliper and X-rays. No significant difference in the reproducibility of results was found and the simpler clinical methods appeared to be satisfactory for practical purposes. The spontaneous evolution of leg torsion in clubfoot was studied in forty-two neglected and previously untreated cases, who were seen for the first time after they had begun walking. Comparison with the torsion observed in the legs of healthy children of a corresponding age proved that untreated clubfoot is not associated with pathological torsion. The place of rotation osteotomy in the treatment of clubfoot is discussed.

Key words: clubfoot; tibial torsion

Accepted 18.vii.75

It is doubtful if torsion of the tibia occurs more frequently in association with clubfeet than in the legs of healthy children. Several authors have assumed that internal tibial torsion occurs in clubfoot. This has been reported by Haglund in 1923, Steindler 1950 (as cited by Fripp & Shaw (1967)), and Lelievre in 1961. Wynne-Davies (1964) has reported that no clubfoot patient was found to have a tibial torsion outside the normal range, whereas according to Lloyd-Roberts et al. (1974) and Swann et al. (1969) pathological external rotation is an important component of the residual deformity in incompletely corrected clubfoot.

The correct treatment of clubfoot relies on determination of the direction of torsion. The present study has two purposes: 1) to find a simple and satisfactory way of measuring tibial torsion for clinical use, from among the many possible methods described in the orthopedic literature; and 2) to determine the torsion of the tibia in a series of neglected and previously untreated clubfeet after the patients have begun walking. Settle (1963) studied torsion in embryos and infants, Lloyd-Roberts et al. (1974) and Swann et al. (1969) studied torsion in treated but uncorrected clubfeet and Wynne-Davies (1964) investigated this factor in patients whose treatment had been completed. The clinical material studied by us permits an evaluation of the natural evolution of the torsion of the tibia in cases of clubfoot uninfluenced by treatment. In this aspect the present paper differs from any previous publication in this field.

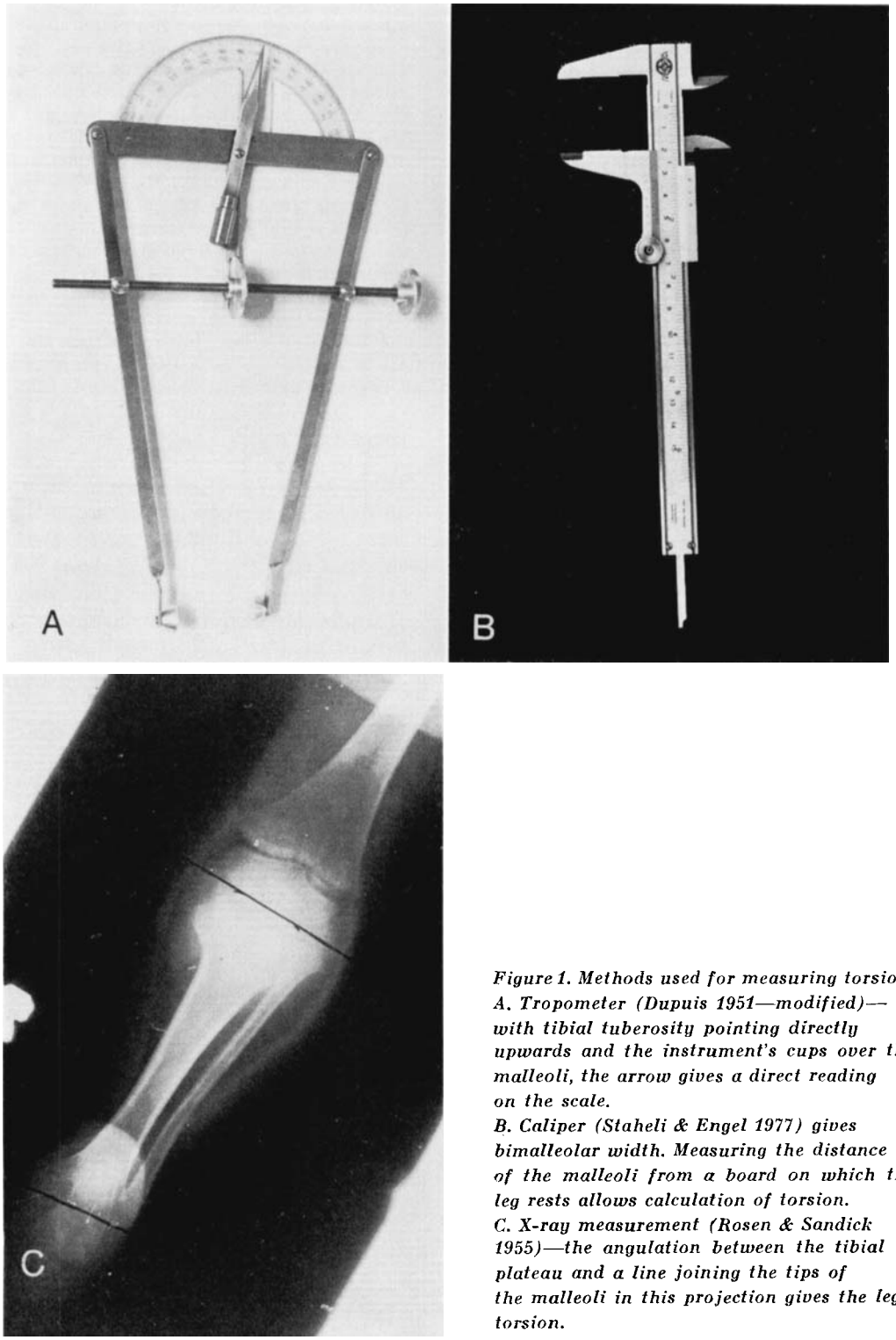

Figure 1. Methods used for measuring torsion. A. Tropometer (Dupuis 1951—modified)—with tibial tuberosity pointing directly upwards and the instrument's cups over the malleoli, the arrow gives a direct reading on the scale.
B. Caliper (Staheli & Engel 1977) gives bimalleolar width. Measuring the distance of the malleoli from a board on which the leg rests allows calculation of torsion.
C. X-ray measurement (Rosen & Sandick 1955)—the angulation between the tibial plateau and a line joining the tips of the malleoli in this projection gives the leg's torsion.

MATERIAL AND METHODS

The torsion of the tibia in 100 healthy adults was measured independently by two observers, using three methods of measurement in each case (Figure 1 A, B, C). These methods were: A) the tropometer as described by Dupuis in 1951. B) caliper measurement as described by Staheli & Engel in 1972. C) X-ray measurement as described by Rosen & Sandick in 1955. The difference in torsion as measured by the two observers in each case was noted and a statistical evaluation of the reproducibility of the results was possible (Table 1).

After obtaining the results of the study described above, torsion was measured in more than 900 legs of healthy individuals using only the tropometer. A chart of mean torsion according to age was thus established (Table 2).

Forty-two neglected and previously untreated clubfeet were seen by us for the first time after they had begun walking. The youngest patient was 2 years old and the oldest was 17. All these cases were quite severe, combining varying degrees of varus, adduction and equinus. The rotation of their legs showed the natural evolution of the syndrome, unaffected by previous treatment. Tibial torsion was measured by the methods mentioned previously. Since it seemed possible that adduction of the forefoot was related to the degree of external rotation at the ankle, this parameter was also noted. Forefoot adduction was calculated on an antero-posterior X-ray of the foot, by measuring the deviation of the axis of the first metatarsal from a line perpendicular to the base of the cuboid (Figure 2). Values observed in this way denote the combined adduction, due to subluxation at the talonavicular joint as well as to metatarsus varus. This method of measurement presents some difficulties in small babies where the cuboid is round, but it appeared practical in our hands when measuring adduction in older children after walking had begun. Where deformity is most severe and the base of the cuboid unclear, the longitudinal axis of the calcaneus may be used as a line of reference. Though such a method of measurement is less exact, it is quite sufficient for all practical purposes.

The values of tibial torsion observed in the clubfeet were compared with those observed in the feet of healthy children of the same age. Tibial torsion was also studied as to its possible correlation with the adduction of the forefoot.

RESULTS

Table 1 compares the values of torsion observed by the two physicians, using the three methods of measurement. It is evident that the method of Staheli & Engel (1972) using the caliper gave the most reproducible results. Measurement using X-rays by the method of Rosen & Sandick (1955) was not more exact than the simpler clinical methods.

Table 2 shows the mean values of tibial torsion observed by us in a large series of normal subjects, classified ac-

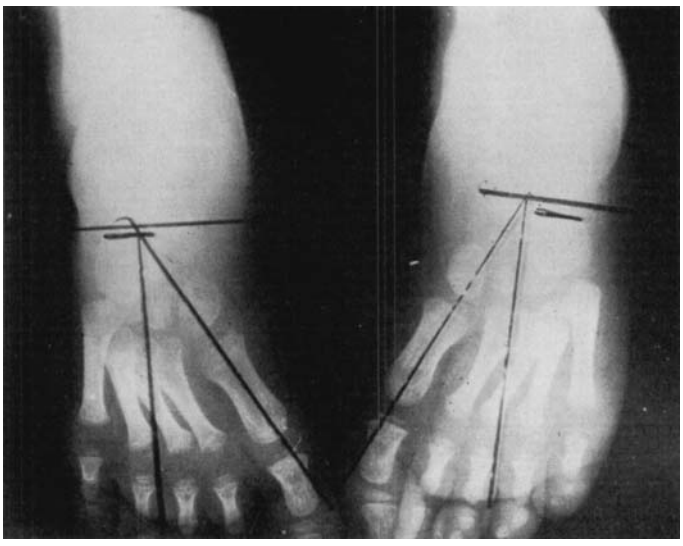

Figure 2. Adduction of the forefoot measured on the antero-posterior X-ray as the angle of deviation from a line perpendicular to the calcaneo-cuboid joint.

Table 1. Tibial torsion measured independently by two observers in 100 normal legs: Reproducibility of results.

Method of measurement	Average difference in degrees. Result of two observers*	Range (in degrees)
Tropometer	3 ± 1	0 – 8
Caliper	1.5 ± 0.5	0 – 5
X-rays	3 ± 1.2	0 – 10

* mean ± standard deviation.

Table 2. External tibial torsion in normal subjects according to age.

Age	No. of cases	Mean torsion in degrees*
Under 2 years	20	4 ± 2
2–4 years	23	9 ± 3
4–10 years	35	16 ± 6
Over 10 years	850	16 ± 3

* mean ± standard deviation.

cording to age. This table confirms the fact that the amount of external rotation is rather small in younger children. Beyond 4 years of age external torsion does not increase. This table serves as a reference for comparison with the values of tibial torsion observed in clubfeet.

All three methods of measurement were used in each case of clubfoot. The direction and the degree of torsion found was almost the same whichever method was used. Internal rotation of the leg was found in two cases only (less than 5 per cent). In one case the internal rotation was 4 degrees and in the other case 6 degrees.

The tibial torsion in clubfeet was compared with that found in the legs of healthy children by pairing the measurement of every affected leg with that of a healthy leg in a child of the same age. The average external rotation for the clubfoot cases was 7.5 degrees, whereas the average external rotation in healthy children of corresponding ages was 8 degrees (Table 3). The difference is not significant.

In 11 children with a unilateral clubfoot, the average external rotation on the affected side was 8 degrees, whereas the average external rotation on the unaffected side was 11 degrees. The difference is not significant.

Looking for a possible correlation between the rotation of the leg and forefoot adduction, 12 cases with marked adduction (over 60 degrees) were compared with 15 clubfeet where adduction was mild (less than 40 degrees). The mean external rotation in cases with severe adduction of the forefoot was 7 degrees. Average external torsion in cases

Table 3. A comparison of tibial torsion in healthy legs and in clubfeet.

Average torsion for the age group studied	Healthy children 8 ± 2.5° *	Legs with CTEV 7.5 ± 2.5° *	Average difference 0.5°	Remarks Not significant
Torsion in unilateral clubfoot cases**	Torsion healthy leg 11°	Torsion affected side 8°	3°	Not significant
Tibial torsion related to forefoot adduction	Cases with mild adduction 9°	Cases with severe adduction 7°	2°	Not significant

* mean ± standard deviation.
** the group of unilateral cases is too small for calculating the standard deviation.
CTEV = congenital talipes equinovarus.

with a mild adduction of the forefoot was 9 degrees. The difference is insignificant and the values of torsion correspond to those observed in normal children of the same age group. Thus, tibial torsion and forefoot adduction are not correlated.

DISCUSSION

There are several publications on precise methods for measuring tibial torsion (Khermosh et al. 1971, Mebs & Schrems 1973, Tohno 1973). The method described by Tohno at the 12th congress of SICOT in 1973, using axial tomography, is perhaps the most precise, but is also the most complicated, costly and time consuming. Methods like this one must be reserved for theoretical research and have little place in wide-scale clinical screening. Some of the simpler clinical methods as reported by Dupuis in 1951 or Weissman in 1954 use the patella as a point of reference, so that the resultant values obtained are a combination of rotation at the knee and torsion of the leg itself. We measured tibial torsion using three methods, which seemed most practical for everyday clinical use. In our experience, the direction of torsion observed with all three methods of measurement was always the same. There were only minor differences in the degree of torsion found in any case, depending on the method of measurement. The X-ray measurement described by Rosen & Sandick (1955) is relatively costly and time consuming as compared to the simpler clinical methods and is no more precise. As to the two clinical methods tested—the tropometer and the caliper—the main practical difficulty was exact location of the medial malleolus in severely deformed feet of small children. This accounted for the difference in values as reported by the two observers. The caliper appeared, however, to give more reproducible results and we have adopted it for routine use in our department in the future.

The study of tibial torsion in clubfoot has previously been limited to embryos, young babies and children with uncorrected clubfeet or with residual deformities after incomplete treatment. Wynne-Davies (1964) reviewed 80 cases after completion of treatment. Not one of the 110 legs measured by her had a tibial torsion outside the normal range. The only difference between the clubfeet and the controls was the tendency for more of the clubfeet to have higher than average lateral torsion. According to Lloyd-Roberts et al. (1974) and Swan et al. (1969), the hind foot and ankle mortise of incompletely corrected clubfeet are laterally rotated on a tibia which itself has no rotational deformity. Such a rotation is a complication of previous treatment. To cite McCauley (1959): "I do not imply that a perfect score could result even from the application of an ideal treatment program, but I am convinced that we who treat these early deformities are responsible for a large proportion of the later and much more perplexing problems."

The present study has shown that the spontaneous evolution of clubfoot is unassociated with a pathological torsion of the tibio-fibular component. Lateral rotation osteotomy of the leg masks the adduction of the forefoot, but does not contribute to a "physiological" repair of clubfoot. Forefoot adduction has no correlation whatsoever with tibial torsion. Medial rotation osteotomy of the tibia has no place in the treatment of neglected clubfoot, but it might be considered for some cases of residual deformities remaining after unsuccessful treatment. The latter point was discussed in the paper of Lloyd-Roberts et al. (1974), where medial rotation osteotomy was advised as a means of helping to bring out the inverted heel. Since torsion of the leg in previously untreated clubfoot lies

within the normal range, rotation osteotomy of the leg has no place in the primary treatment of this syndrome.

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