Acta Orthop Scand 1988;59(4):441–442

Tibial torsion measured in normal adults

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A mobile fluoroscope was used to measure tibial torsion bilaterally in a random sample of 100 adults without a medical history of injury to the lower extremities. From a chosen neutral position, the difference in torsion between the right and the left tibia in the same subject ranged from −11 to 15°, with a mean value of + 2.1°, indicating greater outward rotation of the right tibia in two thirds of the subjects. A difference in torsion of more than 6° was found in a fourth of the subjects.

Torsion of the tibia changes with growth (Dupuis 1951, Staheli and Engel 1972). At birth there may be an inward or neutral torsion; by the age of about 5 years, the adult level of outward tibial torsion is reached (Turner and Smillie 1981). Studies of the difference in torsion between the right and the left tibia in the same normal adult have been sparse (Elgeti et al. 1980, Jakob et al. 1980, Jend et al. 1981, Larsson et al. 1983).

The aim of this radiographic investigation was to study the occurrence of differences in tibial torsion in a series of normal adults.

Subjects and methods

Tibial torsion was measured bilaterally in a random sample of 100 hospital employees, 40 men and 60 woman, aged 18 to 61 years (Table 1). None of them had an injury to the knee, tibia, or ankle. At examination, all of them had normal knee and ankle joints, and a normal gait.

The subject was placed supine with the leg to be examined fully extended on an examination table, which was radiolucent at the level of the ankle joint. The foot was firmly supported in the neutral position against a vertical support at the end of the table to allow the leg to be in a reproducible position. The leg awaiting measurement rested with the knee flexed against a side support to allow the x-ray beams to pass uninterrupted through the examined knee.

During the fluoroscopic examination with the Philips C-arm BV 21, the leg was rotated so that the posterior contours of the femoral condyles were observed to coincide in the horizontal plane. The leg was allowed to rest in this basic position. The C-arm was then moved to the level of the ankle joint, and the new line of reference equal to the tangent of the inner surface of the medial malleolus was found. The *tibial torsion* was defined as the angle between the normal perpendicular to the horizontal plane and the line of reference at the medial malleolus.

Both tibias were measured in all the subjects. The standard error of a single measurement was 0.74° when both tibias of each of 10 subjects under study were measured on three different occasions.

In the case of a difference in torsion between the right and the left tibia, a dominant outward torsion of the left tibia was indicated by a minus sign.

The Student's *t*-test was used.

Table 1. Age and sex distribution

Age	Males	Females	Total
15–24	7	28	35
25–34	13	20	33
35–44	12	9	21
45–54	3	2	5
55–64	5	1	6

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Table 2. The mean values of torsion in the right and the left tibia and the individual difference (degrees)

Subjects	Torsion				Difference (range)	SD
	Right	SD	Left	SD		
Males (n 40)	30.2	8.0	27.1	7.2	3.1 (−7.1 – 14.5)	5.4
Females (n 60)	31.1	7.7	29.7	7.7	1.4 (−11.1 – 11.2)	4.9
Total series (n 100)	30.7	7.8	28.6	7.6[a]	2.1 (−11.1 – 14.5)	5.2

[a] $P < 0.001$ for difference from 0 degrees.

Table. 3. Bilateral tibial torsion in 100 adults

Torsion (degrees)	Males (n 40)		Females (n 60)	
	Right	Left	Right	Left
10–14	1	1	1	0
15–19	3	6	4	4
20–24	4	10	8	14
25–29	14	11	14	14
30–34	8	5	14	12
35–39	5	5	12	10
40–44	2	2	6	4
45–49	3	0	1	2
Mean torsion (SD)	30.2 (8.0)	27.1 (7.2)	31.1 (7.7)	29.7 (7.7)
	$P < 0.001$		$P < 0.05$	

Results

The mean value of the individual difference in torsion for the total number of subjects was 2.1° (Table 2). In 30 percent of the subjects, the difference was within the mean ± 2°. A difference of more than 6° was found in 25 percent of the subjects (Figure 1). In 68 percent of the subjects, the right tibia was more outwardly rotated than the left tibia.

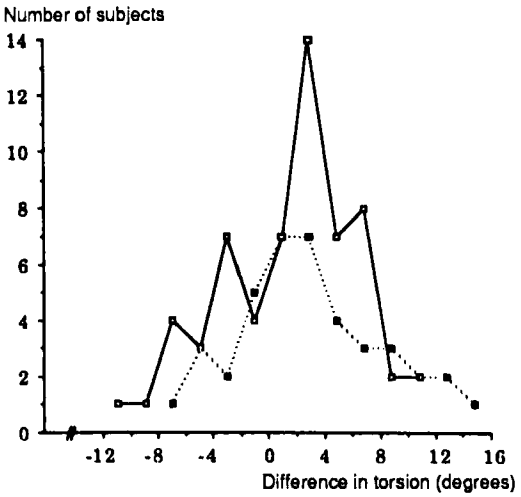

Figure 1. Variation of difference in torsion between right and left tibias. Positive values indicate right-sided dominance. ■ males (n 40), □ females (n 60).

Discussion

The right dominance in outward torsion confirms the findings of LeDamany (1909) and Dupuis (1951). In their studies, however, measurements were not performed bilaterally in the same subject, but right- and left-sided tibias were collected and measured.

The difference in torsion between the right and the left tibia in a large part of the population and the distribution of torsional values have not been previously observed. The greatest difference in our series was 14.5°. In the case of a tibial fracture, this would normally be regarded as a rather severe malrotation.

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