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Original Article

A new method for tibial torsion measurement by computerized tomography

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ABSTRACT

Background: Computerized tomography (CT) is the gold standard technique for tibial torsion assessment. This study compared two methods of tibial torsion assessment and proposed a new method, which could be of value in cases of abnormal fibular changes.

Methods: The CT-scanograms of 60 participants were assessed by using two different techniques, differed in determination of the distal tibial axis.

Results: The interobserver reliability was 0.861 and 0.863 in the first and second methods, respectively. The intraobserver reliability in both measurement methods was 0.868.

Conclusions: We proposed a reliable method, independent of the fibular midpoint, in assessment of tibial torsion by CT.

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1. Introduction

Tibial torsion is defined as the twist of proximal versus distal articular axes of tibia around its longitudinal axis.^{1,2} Deformities related to tibial torsion are usually presented with minimal clinical symptoms. Most common complaints of patients suffering from abnormal tibial torsion are cosmetic issues. However, in case of severe abnormal tibial torsion resulting in functional disorders, surgical intervention could be taken into consideration. Moreover, tibial torsion could contribute to abnormal posture of lower extremity.^{3–6}

Numerous attempts since early 20th century have been made to establish a precise assessment method for tibial torsion including clinical,⁷ anthropometric, and cadaveric skeletal measurement^{8,9} and imaging techniques including computerized tomography (CT),^{10–14} fluoroscopy,¹ magnetic resonance imaging (MRI),¹⁵ and ultrasonography.¹⁶

The method commonly used for assessment of tibial torsion is to measure the angle formed by proximal and distal articular axes of tibia in the transverse computerized tomograms which is considered as an accurate and reliable method and “golden standard” for tibial torsion assessment.^{10,17–21} Assessment of tibial torsion using CT scan was performed for the first time in 1980 by Jakob et al.¹⁷ In 1981,

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Jend et al. proposed a similar method using CT scan for tibial torsion assessment.¹⁰

The current method (traditional method) of tibial torsion assessment requires both fibular and tibial axial CT-scanograms. But it must be taken into consideration that in a group of patients with abnormal or displaced distal fibula, validity of measurement using middle point of fibula, in the transverse cut of CT-scanograms for drawing distal axis of tibia is uncertain. The following conditions might result in an inaccurate measurement of tibial torsion by the traditional method: fracture of distal fibula, deformity of distal fibula, tumors, disruption of normal alignment of fibula and tibia like rupture of syndesmosis.

In this study, we compared two methods of tibial torsion assessment, and proposed a new method, which excludes the role of fibula and could be of value in cases of abnormal fibular changes.

2. Methods

2.1. Human subjects and entry criteria

This study has been approved by the appropriate ethics committee and has therefore been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments. All participants gave their informed consent prior to their inclusion in the study. In this study, 60 participants, 30 males and 30 females, with an average age of 32.7 ± 8.3 years were included. All participants needed to be assessed for tibial torsion regarding their orthopedic complaints. Those with history of trauma or previous fracture were excluded. All subjects signed an informed written consent to participate in this study. The ethics committee of Shahid Beheshti University of Medical Sciences approved this study.

2.2. Tibia torsion assessment

This was a diagnostic study, investigating the reliability of two methods to measure tibial torsion values using CT-scanograms. CT scan imaging of all subjects were performed at the same radiologic center. Tibial torsion in both lower extremities of the participants was assessed by low dose lower extremity spiral CT-scan. All patients had supine position during imaging and extremities were immobilized by a band in order to achieve maximal accuracy. For each participant, 2-mm CT-scan cuts from proximal and distal of tibia were obtained. Proximal cuts distal to the knee joint and proximal to the fibula (exactly just before appearance of the head of fibula) were selected and distal cuts were exactly proximal to tibiotalar joint (Fig. 1).

In this study, main distal and proximal axes of tibia were drawn in CT scan cuts and the angle between main axis of distal and proximal tibia was measured as the value of tibial torsion. In order to determine the main axis of proximal tibia in CT scanograms, the tibial plateau line was drawn which crossed tangentially posterior to both proximal condyles (Fig. 2).

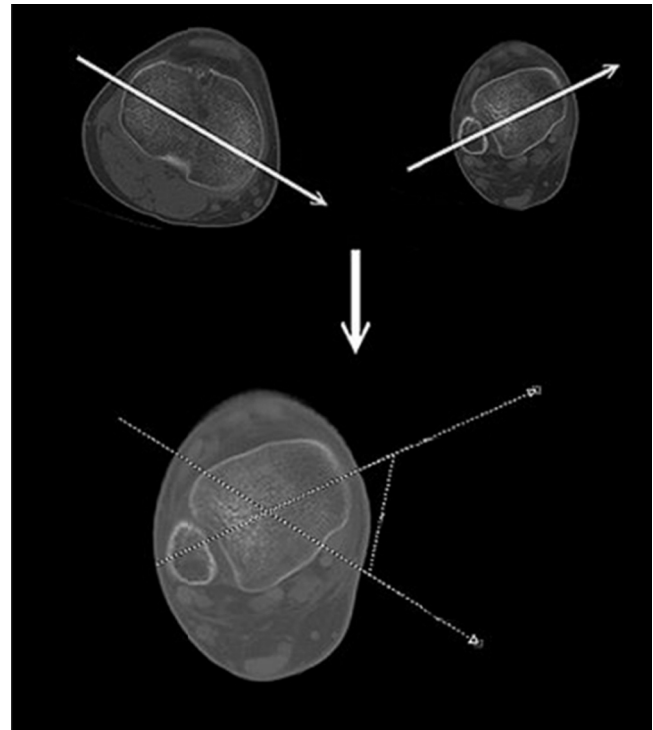


Fig. 1 – Traditional method for measurement of tibial torsion.

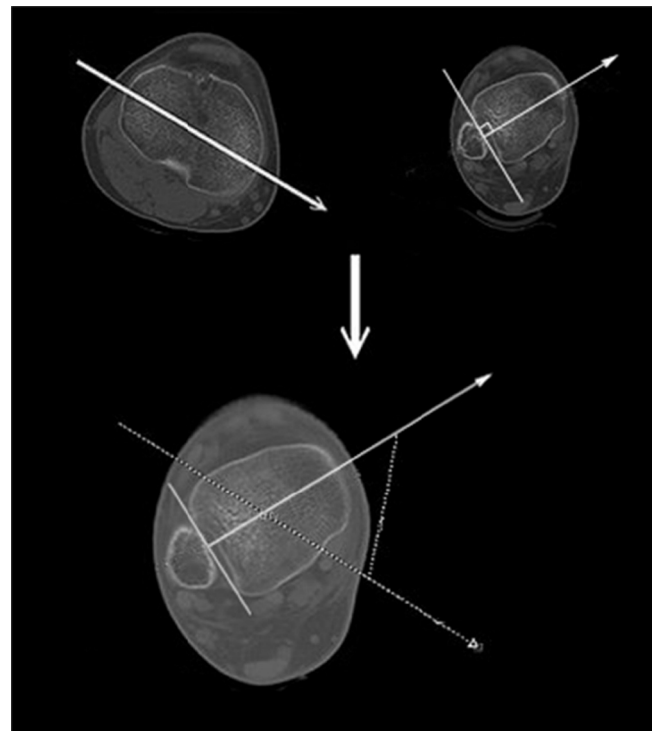


Fig. 2 – New method for measurement of tibial torsion.

In the traditional method, the middle of tibia and fibula was used as reference points; in the new technique, first introduced by this article, the perpendicular axis to the line connecting the distal fibular notches of the tibia on CT

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