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Tibial torsion measurement by surface curvature

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Abstract

Background. Tibial torsion is the angle between the transverse axes of the proximal and distal tibial articular surfaces. It measures the degree of twisting of the tibia around its own longitudinal axis. The accurate measurement on the magnitude of tibial torsion is of great use in monitoring derangements. It is also useful as a baseline in the event of surgical intervention. Various methods have been developed but none of them have gained wide acceptance. Even the CT scan technique, which is considered the "gold standard", produces varying results when executed by different researchers. A quick, objective and non-invasive method is thus very much needed for the effective monitoring of tibial torsion in clinical environments.

Methods. Eighteen adult men's lower legs were scanned by a laser scanner to give the surface coordinates of the leg surfaces. By calculating curvature maps of legs from the 3D coordinates, stable anatomical landmarks such as the lateral and medial malleoli can be located. The angle indicating the degree of tibial torsion can then be derived from these landmarks.

Findings. The objective determination of the various anatomical landmarks results in a reproducible measure of tibial torsion. The results obtained in this study are generally in agreement with the measurements reported previously.

Interpretation. The reproducibility of the results allows for the objective observation, monitoring and comparison of tibial torsion over time and across subjects. It allows also for the development of a system of measurement that is fast, convenient, accurate and radiation-free.

Keywords: Tibial torsion; Surface curvature; Anatomical landmark; Laser scanner; FastSCAN

1. Introduction

Tibial torsion is the twisting of the tibia about its longitudinal axis. This changes as people grow older. Knowing the normal range of tibial torsion at different ages and being able to track these changes is important, especially if a person suffers derangements. The accurate determination of tibial torsion is also necessary in order to reduce irreversible lower-limb rotational defects such as in-toeing and out-toeing in adults. In addition, the accurate measurement of tibial torsion allows for the study of its relationship to congenital clubfoot (Herold and Marcovich, 1976; Reikeras et al., 2001) and its relationship to the pathology of the knee, for example, conditions such as patellofemoral instability and Osgood–Schlatter disease (Turner and Smillie, 1981).

Tibial torsion has been studied using various methods. The most accurate technique found thus far involves measurement of the angle formed by the pins passing through the transcondylar axis of the head of the tibia and the axis of the distal articular surface of the tibia. This method however, cannot be used in vivo (Jakob et al., 1980). Milner and Soames (1998) compared four simple and inexpensive methods of

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