Relationship Between Physical Factors and Tibial Motion in Healthy Subjects: 2D and 3D Analyses

Murat Sari, PhD
Department of Mathematics
Pamukkale University
Faculty of Art and Science
Denizli, Turkey

ABSTRACT
This study was undertaken to determine the relationship between physical factors and vertical axial rotation through the tibial shaft caused by passive knee and subtalar joint rotation in healthy subjects. The data collected were analyzed in detail to determine the relationship between various physical parameters, such as age, body mass, height, and sex, and tibial rotation. A total of 484 healthy subjects were examined with the measuring the vertical axial rotation through tibial shaft (MVARTS) system. Evaluators passively measured internal and external tibial rotation. The effects of any 2 simultaneous variables and outcomes with a single variable were analyzed; the results were documented graphically. Data were also examined through multiple regression analysis (stepwise regression). Agreement between right and left internal tibial rotations was observed to be strong, as was agreement between right and left external rotations. Female patients exhibited a greater amount of internal/external rotation than did male patients. Differences between female and male patients were noted to be significant. A highly significant and inverse relationship between physical parameters and tibial rotations was noted. Findings suggest that as age, body mass, and height increase, tibial motion is reduced.

Keywords: healthy subjects; physical factors; tibial rotation

INTRODUCTION
The knee joint is one of the most complex joints in the musculoskeletal system. Instrumented arthrometry is a widely used technique for quanti-
fying the knee joint. Knee joint laxity is of particular interest, and many techniques have been used to describe the range of motion of the knee joint, particularly flexion and extension.2-9

Despite the large number of studies in the literature, few investigations have examined tibial motion, including internal and external rotation10-15; however, it has been shown that some knee injuries are caused by an excessive internal tibial rotation or a delayed external tibial rotation.16,17 Because external rotation is linked to knee extension, excessive internal rotation during the stance phase of walking or running may delay natural external rotation as the knee begins to extend. The resultant increase in torsional joint stresses at the knee or through the tibial shaft in turn may cause knee injury.16,17

Assessment of tibial motion upon clinical examination is generally difficult. Despite the findings of important studies in the literature, normal amounts of internal and external rotation of the tibia have not yet been clearly specified. In the literature, several methods of assessing tibial rotation have been described, such as clinical computed tomography,18,19 magnetic resonance imaging,5,20 clinical goniometry,19,21,22 gravity goniometry,23 videotaping,24 surface curvature,25 electronic digital inclinometry,26 roentgenography,27 fluoroscopy,28 and ultrasonography.29 In addition to their well-known advantages, these techniques have many disadvantages, including the fact that they are costly, difficult to use, and time consuming, and their daily use is restricted. Because excessive internal rotation or delayed external tibial rotation leads to specific types of knee injury, it is important for clinicians to know the amount of tibial rotation that is occurring. This provides a warning before development of injury. For this reason, the investigator conducted the current study.

The main purpose of this study was to show the relationship between physical factors such as age, body mass, and height versus tibial motion.

METHODS

Participants and Study Design

A total of 484 healthy subjects from Kutahya, Turkey, were included in this study. All gave their informed consent for participation. Each participant was informed about test equipment and procedures and was examined individually in a test room by a trained physical therapist who had worked for at least 3 y in this role. All physical factors of the sample, including sociodemographic data that included personal information, were collected before testing began. After data collection was completed, right and left knee internal and external tibial rotations were measured.

The table presents physical characteristics, including age, body mass, height, and measurements of internal and external tibial rotation by sex. The subjects studied in the current investigation had no musculoskeletal, neurologic, or systemic disease that might have an effect on testing. To determine the relationship between body mass, height, age, and sex (N=484; F=238; M=246) versus tibial rotation, subjects who met the inclusion criteria were studied.