Effects of tibial torsion on distal alignment of extramedullary instrumentation in total knee arthroplasty

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Background and purpose **Whether tibial torsion affects the positioning of extramedullary instrumentation and is a possible factor in malalignment of the tibial component in total knee arthroplasty (TKA) is unknown. We assessed the influence of tibial torsion on distal alignment of extramedullary systems for TKA, using the center of the intermalleolar distance as anatomical reference at the ankle joint.**

Patients and methods **We analyzed CT scans of knee and ankle joints of 50 patients with knee osteoarthritis (mean age 73 years, 52 legs). The tibial mechanical axis was identified and translated anteriorly at the level of the medial one-third (proximal AP axis 1), at the medial border of the tibial tuberosity (proximal AP axis 2), and at the level of the talar dome (distal AP axis). The center of the intermalleolar distance and the width of the medial and lateral malleolus were calculated. The proximal AP axes 1 and 2 were translated at the level of the ankle joint and any difference between their alignment and the distal AP axis was calculated as angular and linear values.**

Results **The center of the ankle joint was located, on average 2 mm medial to that of the intermalleolar distance. The distal AP axis was externally rotated by 18° and 27° compared to the proximal AP axes 1 and 2, respectively. Overall, the center of the ankle joint was shifted laterally by 9–11 mm with respect to the proximal AP tibial axes.**

Interpretation **To avoid a varus tibial cut in TKA, extramedullary alignment systems should be aligned more medially at the ankle joint than previously thought, due to the effect of tibial torsion and—to a lesser extent—to the different malleolar width.**

Experimental and clinical investigations have shown that proper implant positioning may reduce the incidence of aseptic loosening and increase the longevity of TKA (Hsu et al. 1989, Green et al. 2002, Perillo-Mercone and Taylor 2007, Fang et al. 2009). However, tibial alignment with current extremedullary or intramedullary instrumentations is not entirely satisfactory since varus-valgus malalignment greater than 3° has been reported in 2–40% of cases (Teter et al. 1995, Reed et al. 2002, Mihalko and Krackow 2006, Chiu et al. 2008).

Extramedullary systems need to be aligned in the coronal and sagittal planes using anatomical landmarks in the proximal and distal tibia. While several studies have assessed the most appropriate anatomical landmarks in the proximal tibia (Akagi et al. 2004, Huddleston et al. 2005, Aglietti et al. 2008, Cobb et al. 2008, Lützner et al. 2010), anatomical references at the distal tibia and ankle joint have not been thoroughly investigated. In particular, with the exception of one study addressing the accuracy of palpable tendons as anatomical landmarks for the center of the ankle joint (Schneider et al. 2007), no other investigations have substantiated the reliability of the reference points currently used in TKA (Akagi et al. 2005, Mizu-uchi et al. 2006, Lützner et al. 2010).

A major issue in the correct alignment of an extramedullary guide at the ankle joint is external tibial torsion, i.e. axial rotation of the tibia along its longitudinal axis, which causes an external rotation of the distal tibial epiphysis relative to the proximal one (Takai et al. 1985, Eckhoff and Johnson 1994, Akagi et al. 2005, Mizu-uchi et al. 2006). As a result, tibial torsion leads to a lateral shift of the anterior projection of the center of the ankle joint, and if this translation is not taken into account during the alignment of the extramedullary guide, a varus tibial cut is likely to occur (Akagi et al. 2005). However, the extent to which tibial torsion may affect the position of the extramedullary guide at the level of the ankle joint is unknown.

We investigated whether the center of the intermalleolar distance, or a definite distance from it, overlaps the center of the ankle joint and can be used as an anatomical landmark for distal alignment of extramedullary systems in TKA. Our hypothesis was that when the center of the intermalleolar axis is used as a reference point to align the distal extramedullary guide, the effects of tibial torsion on the coronal alignment of the ankle joint must be taken into account to avoid a malalignment of the tibial component.

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