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Letters to the Editor to:

Scientific Articles:
Stephen M. Howell, Stacey J. Howell, and Maury L. Hull
Assessment of the Radii of the Medial and Lateral Femoral Condyles in Varus and Valgus Knees with Osteoarthritis
J Bone Joint Surg Am 2010; 92: 98-104 [Abstract] [Full text] [PDF]

Letters to the Editor: Submit a response to this article

Electronic letters published:

- **Dr. Howell and colleagues respond to Drs. Schnurr and König**
  Stephen M. Howell, MD, Stacey J. Howell, Maury L. Hull, PhD (16 April 2010)
- **Anatomy of the Distal Femoral Condyle in Valgus Deformities**
  Christoph Schnurr, Dietmar Pierre König (16 April 2010)

Dr. Howell and colleagues respond to Drs. Schnurr and König

16 April 2010

Stephen M. Howell, MD
University of California at Davis, Davis, California,
Stacey J. Howell, Maury L. Hull, PhD

Send letter to journal: Re: Dr. Howell and colleagues respond to Drs. Schnurr and König

E-mail Stephen M. Howell, MD, et al.

Thank you for your interest in our study and for restating the importance of studying the anatomy of the distal femur in the knee with varus and valgus deformities because of the impact the anatomy has on aligning the femoral component and restoring kinematics in total knee arthroplasty. We believe you are correct in pointing out that a difference in methods, or more precisely a difference in the 'perspective' of how our two studies viewed the anatomy of the distal femur, explains why our study found no clinically important asymmetry between the radii of the medial and lateral femoral condyles in either the varus or valgus knees and your study found a hypoplastic lateral femoral condyle in the valgus knee. We agree with you that the difference in the reference axes explains the difference in findings between our studies, which directly impacts how we prefer to align the femoral component in total knee arthroplasty.

In our study, the difference between the radii of the medial and lateral femoral condyles was measured from the 'kinematic' perspective of how the knee moves 3-dimensionally. The most important kinematic axis of the knee passes through the center point of the best-fit circles of the medial and lateral femoral condyles, and is termed the primary femoral axis about which the tibia flexes and extends (1-5). Our study referenced the primary transverse axis in the femur about which the tibia flexes and extends. This axis is a line connecting the centers of circles fit to the bony articular surfaces of the condyles (2-8). The primary transverse axis of the knee has no relationship to the mechanical axis of the femur, the mechanical axis of the tibia, or the transepicondylar axis. The only intraoperative morphologic reference to guide the surgeon is the articular surface of the femoral condyles. No other morphologic feature of the knee or limb will lead the surgeon reliably and repeatedly to the

primary transverse axis in the femur about which the tibia flexes and extends (3). We measured the largest radii of the femoral condyles from the primary transverse axis in the femur about which the tibia flexes and extends and in a plane perpendicular to this axis.

In your study, the difference between the medial and lateral femoral condyles was measured from the 'non-kinematic' or a 'mechanical' alignment perspective as determined intraoperatively by computer navigation. Your study referenced a line drawn perpendicular to the mechanical axis of the femur in the coronal plane, and the transepicondylar axis in the axial plane.

In the coronal plane, you constructed a line perpendicular to the mechanical axis of the femur, which is not a kinematic reference axis because the normal distal femoral joint line is not perpendicular to the mechanical axis of the femur in most knees. Studies have shown that the normal distal femoral joint line is not perpendicular to the mechanical axis of the femur because there is wide variability in the bow of the femur (8), and because 98% of normal subjects do not have a neutral hip-knee-ankle angle (4). The smaller resection from the lateral femoral condyle and the large resection from the medial femoral condyle in the valgus knee you mentioned you observe are caused by the line perpendicular to the mechanical axis of the femur being oblique to the primary transverse axis in the femur in most knees. Aligning the joint line of the femoral component perpendicular to the mechanical axis of the femur has undesirable consequences of changing the distal femoral joint line from normal and kinematically malaligning the knee resulting in ligament releases and mid-flexion instability (3,4).

In the axial plane, you constructed a line connecting the 'best' point in the region of the medial and lateral epicondyles with a navigational probe, which is not a kinematic reference axis for several reasons. One reason the transepicondylar axis is not a kinematic reference axis is the 5° difference (range 2-110) between the primary transverse axis in the femur and the transepicondylar axis in 3-dimensional space (3,4). The transepicondylar axis passes through the distal femur proximal and anterior to the origin of the anterior and posterior cruciate ligaments with no apparent relationship to these important soft tissues of the knee. In contrast, the primary transverse axis in the femur about which the tibia flexes and extends remains equidistant from the surface of both posterior femoral condyles passing through the origins of the anterior and posterior cruciate ligaments (3). A second reason that the transepicondylar axis is not a kinematic reference is that precisely identifying the transepicondylar axis with navigational and conventional instruments is highly unreliable. Siston et al. showed a rotational error of placing the femoral component from 13° internal rotation to 16° external rotation when 11 highly-skilled surgeons constructed the transepicondylar axis by selecting the 'best' point in the region of the medial and lateral epicondyles with a navigational probe (9).

To summarize, our observation that the valgus knee does not have a hypoplastic lateral femoral condyle remains true when the knee is studied from a kinematic perspective in a plane perpendicular to the primary transverse axis in the femur. Surgeons who view the knee from a mechanical perspective with navigational or conventional instruments need to understand that aligning the femoral component perpendicular to the mechanical axis of the femur and parallel to the transepicondylar axis kinematically malaligns most knees (2-8). Eckhoff has correctly warned that the use of navigation that does not incorporate reference axes that describe the kinematics of the knee, may "more accurately" align the limb but malalign the knee leading to altered kinematics and increased wear and, ultimately, to premature failure of the arthroplasty (4). We encourage those who use navigational instruments to investigate the use of kinematic alignment as it has the potential to improve motion, stability, and clinical outcome (7,10).

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Anatomy of the Distal Femoral Condyle in Valgus Deformities

16 April 2010

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Send letter to journal: Re: Anatomy of the Distal Femoral Condyle in Valgus Deformities

E-mail Christoph Schnurr, et al.

To the Editor:

We read the article by Howell et al. (1) with interest. Especially in valgus knee deformities, the alignment of the femoral total knee component remains a challenge. Therefore, studies concerning the anatomy of the distal femur in varus and valgus deformities are required. However, routinely we have perceived the lateral femoral condyle in valgus deformities to be smaller than the medial one - large resections of bone from the medial distal and posterior femoral condyle go together with small bone resections from the lateral femoral condyle. Similar concepts have been published by other groups (2-5). Recently, we analyzed the computer navigation data of our last 500 total knee arthroplasties. The most distal points of the femoral condyles were measured perpendicular to the mechanical femoral axis, and the most posterior points were measured parallel to the primary knee axis. Our analysis resulted in a significantly smaller lateral condyle in valgus deformities in comparison to varus deformities (the difference between the most distal point of the medial and lateral condyles: valgus 4.3mm, varus 0.2mm [$p<0.001$]; the difference between the most posterior point of the medial and lateral condyles: valgus 2.8mm, varus 1.5mm [$p=0.033$]). The inaccuracy of the imageless navigation device has been proven to be less than 1mm or 1° (6), hence we believe these results to be reliable. From our point of view, these results are not in line with the published study. Can methodical issues explain the discrepancy?

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