"Outliers" in Osteoarthritic Knees Concerning Distal Femoral Valgus Angle and Femoral Rotation Angle

To the Editor:

We read with interest the article in press at your journal entitled "Variability in distal femoral anatomy in patients undergoing total knee arthroplasty: measurements on 13,546 computed tomography scans" written by Meric et al [1]. We congratulate them for their inspiring work.

The authors analyzed 13,546 computed tomographic (CT) scans of arthritic patients undergoing total knee arthroplasty (TKA) and measured distal femoral valgus angle (DFVA) between the anatomic and mechanical axis, and femoral rotation angle (FRA) relative to posterior condylar line. However, the study itself has some methodological drawbacks:

1. Although the purpose of the study was to better understand average femoral anatomy and the incidence of outliers in their arthritic population, they disregarded severity of varus deformity at the knee and the relationship of this deformity with femoral bowing concerning the DFVA. Negative correlation is reported in literature between the severity of varus deformity and the femoral condylar-mechanical axis angle [2–5]. A lesser femoral condylar-mechanical axis angle in patients with severe varus deformities along with an increased distal femoral axis–mechanical axis angle supports the finding of increased varus femoral bowing in these patients [2–5]. Therefore, it is not surprising to find out the patients with varus deformities and femoral bowing are outliers with DFVA angle of more than 9°. In addition, valgus arthritic knees constituted the other side of outliers with <2° DFVA (Fig. 4 in the original article). If the patients with varus deformity and femoral bowing, and those with valgus arthritic knees had been assessed in separate groups, the average anatomy and outliers in arthritic population would have been evaluated accordingly to get better understanding of the results in clinical setting. Furthermore, to our knowledge, there are no such studies reporting the incidence and severity of femoral bowing in this large consecutive series of patients undergoing TKA for gonarthrosis.
2. There are conflicting results in the literature concerning the correlation between FRA and DFVA but the number of cases in most of these series is limited [6,7]. Grouping the patients regarding the distal femoral morphology would also be helpful to define correlation between FRA and DFVA.
3. Since the authors analyzed CT scans of patients, it should be kept in mind that FRA measurements may differ with or without cartilage and it was reported in the literature that condylar twist angle in the absence of cartilage is greater than the angle with cartilage [8]. There is also intra-individual difference in distal femoral anatomy that can range from 1° to 5° in bilateral measurements [6].

Actually, the data in these large series of patients with osteoarthritic knees contain much more information than the authors gave us. Careful planning of methodology by the researchers could have improved our understanding of the deformity in this patient group.

Harun R. Gungor, MD
Nusret Ok, MD
Kadir Agladioglu, MD
Orthopedics and Traumatology Department, Medical Faculty, Pamukkale University, Kinikli, Denizli, Turkey
Reprint requests: Harun R. Gungor, MD, Orthopedics and Traumatology Department, Medical Faculty, Pamukkale University 20070, Kinikli, Denizli, Turkey

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In Reply

We have read with the comments of the "Outliers in Osteoarthritic Knees Concerning Distal Femoral Valgus Angle and Femoral Rotation Angle" and we would like to appreciate and thank the authors of the letter and for their interest in our study.

The authors have made some interesting comments with regard to our publication and they clearly have a high level of understanding of the anatomy of the lower extremity. We designed our study as an anatomic study of arthritic knees undergoing total knee arthroplasty (TKA), with the purpose of understanding the variability of distal femoral anatomy. In the literature, many anatomic studies have been performed with non-arthritic knees. We agree that femoral bowing may be an important anatomic variable, but the main goal of our study was to measure the distal femoral valgus angle (DFA) and distal femoral rotation angle (DFRA), which are key anatomic relationships that are used to achieve proper mechanic alignment in arthritic knees undergoing TKA. We found that the distal femoral anatomy is highly variable in patients undergoing TKA. While it is true that our computed tomographic (CT) data contain a wealth of anatomic information, we chose to present the most relevant data for arthroplasty surgeons performing TKA. Although potentially interesting, our purpose was not to investigate the relationship of varus or valgus deformity to femoral bowing. The authors were right that grouping the patients regarding the distal femoral morphology would also be helpful to define correlation between FRA and DFVA. As is true for so many scientific endeavors, seeking the answer to one question usually leads to as many new questions as answers.

We agree that cartilage erosion of the posterior femoral condyle can affect the measurement of the FRA [1]. During TKA surgery surgeons use posterior femoral condyle based guides, whose position may be affected by asymmetric cartilage wear as well as overall condylar anatomy. We used 3D-CT scan data to evaluate patients' anatomic variables of the distal femur, which allows for direct measurement of bony landmarks independent of cartilage thickness. CT is an excellent imaging modality for identifying bony landmarks and determining 3D geometry [2].

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The authors are correct that there is much more information to be gleaned from our data and we appreciate their input. We chose to present the most clinically relevant information to the readership of *Journal of Arthroplasty* and to stimulate a discussion about the interaction between instruments used in TKA surgery, patient anatomy and surgical accuracy. Nonetheless, we hope this dataset can be helpful in designing more in depth anatomic studies of arthritic knees.

Gokhan Meric, MD
Shiley Center for Orthopaedic Research and Education, Scripps Clinic La Jolla, California
Department of Orthopaedic Surgery, Balikesir University, Balikesir, Turkey

Guilherme C. Gracitelli, MD
Shiley Center for Orthopaedic Research and Education, Scripps Clinic La Jolla, California
Department of Orthopaedic Surgery, Federal University of São Paulo, Brazil

William D. Bugbee, MD
Department of Orthopaedic Surgery, University of California, San Diego School of Medicine, La Jolla, California
Department of Orthopaedic Surgery, Scripps Clinic, La Jolla, California
*Reprint requests: William D. Bugbee, MD, Department of Orthopaedic Surgery, Scripps Clinic, 10666 N. Torrey Pines Rd., La jolla, CA

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Comment on: "*Diagnosis of Periprosthetic Joint Infection: The Role of Nuclear Medicine May Be Overestimated*" by Claudio Diaz-Ledezma, Courtney Lamberton, Paul Lichtstein and Javad Parvizi

To the Editor:

We read with interest the article by Diaz-Ledezma et al entitled "Diagnosis of Periprosthetic Joint Infection: The Role of Nuclear Medicine May Be Overestimated" recently published in The Journal of Arthroplasty [1].

We agree with the authors that an accurate and efficient diagnosis of prosthetic joint infection (PJI) is a challenge and of invaluable importance for the patient and for the whole medical community, since PJI leads to a high morbidity and a significant increase in financial costs [2]. The aims of the Infection and Inflammation Committee of the European Association of Nuclear Medicine (EANM) are to develop clear interpretation criteria for the various existing nuclear medicine techniques, to teach each centre how to correctly acquire and interpret the images and to develop, in collaboration with other societies, common diagnostic flow charts to state clearly to the clinician what we can offer and at which time point in the diagnostic work-up of the patient.

The article by Diaz-Ledezma et al raised some concerns to us, since some interpretations they made need to be clarified.

First of all, the authors state in the first paragraph that two workgroups "could not find concrete evidence in support of using bone scan or nuclear imaging for diagnosis of PJI". This sentence is misleading since most of the published systematic reviews agree on the role of nuclear medicine, and particularly with the high diagnostic accuracy of scintigraphy with radiolabelled white blood cells (WBC) [3–5]. Also a large workgroup with both imaging specialists and orthopaedic surgeons conducted a critical appraisal of studies reporting the accuracy of nuclear imaging for diagnosis of PJI by using the QUADAS-2 tool and recommended, based on their findings, that there is substantial evidence regarding the effectiveness of nuclear imaging in diagnosing PJI, although it should be limited to select cases [6].

Later on, they state that "there is a dire need for further evidence to support the use of this otherwise invasive and relatively expensive diagnostic modality". We would like to emphasise that nuclear medicine procedures are non-invasive and non-expensive as compared to other diagnostic modalities.

Furthermore, authors included in their analysis studies performed with ^{67}Gallium-citrate, radiolabelled white blood cells (WBC) and radiolabelled anti-granulocyte antibodies. These methods cannot be pooled together since they have different diagnostic accuracies and different indications.

In general, there are two strategies for using nuclear medicine techniques in PJI: (1) Use the bone scan with radiolabelled diphosphonates to see if there is an increased osteoblastic activity. It is universally accepted that a normal bone scan can be considered as a strong evidence against the presence of an infection. However, a positive bone scan cannot distinguish infections from other bone inflammatory conditions and therefore a positive bone scan is aspecific. To further clarify when this technique should be used, one has to keep in mind that a bone scan may be positive for at least 2 years after hip prosthesis placement and 5 years after knee prosthesis placement due to physiological bone re-modelling after implantation. During these intervals, the bone scan should not be used as a first imaging technique. (2) Use radiopharmaceuticals that are able to image infection. The first nuclear imaging modality of choice is based on the use of radiolabelled autologous WBC. When using the correct acquisition and interpretation criteria this technique has a high diagnostic accuracy (>90%). The scintigraphy with radiolabelled anti-granulocyte antibodies can be used as an alternative to WBC-scintigraphy in centres that are not able to label the autologous white blood cells. ^{67}Gallium scintigraphy – one of the search criteria in this study! – is an obsolete technique that is outperformed by other techniques and should not be used anymore for diagnosing PJI. Another imaging technique that is frequently used in PJI is ^{18}F-fluorodeoxyglucose for positron emission tomography (FDG-PET) which is not mentioned at all by the authors.

To our regret, the studies included in the paper of Diaz-Ledezma et al show a huge variety of radiopharmaceuticals but not always the correct ones used in modern nuclear medicine.

Another striking concern is the timeframe for inclusion of the studies (January 1, 2004 till July 31, 2012). On the contrary, in the discussion a paper from 2014 is discussed that states that nuclear medicine studies should be abandoned as a first diagnostic approach for PJI. In the last years there has been a huge development in nuclear medicine techniques. Not only better camera systems were developed, they were also hybrid systems, which made it possible to perform 3D images of the patient and to exactly localise the pathological uptake of any radiopharmaceutical (combining pathophysiology with anatomy, the so called SPECT-CT) leading to high diagnostic accuracy. Furthermore, several studies have recently been published for WBC scintigraphy, focusing on how to correctly acquire the images and how to correctly interpret the scans.

One or more of the authors of this paper have disclosed potential or pertinent conflicts of interest, which may include receipt of payment, either direct or indirect, institutional support, or association with an entity in the biomedical field which may be perceived to have potential conflict of interest with this work. For full disclosure statements refer to http://dx.doi.org/10.1016/j.arth.2015.07.002.

Alberto Signore is chair of the Inflammation and Infection Committee of the European Association of Nuclear Medicine (EANM) and Andor W.J.M. Glaudemans, Paola A. Erba, Elena Lazzeri are members of this Committee. Paul Jutte is member of the European Bone and Joint Infection Society (EBJIS) and Nicola Petrosillo is member of the European Society of Clinical Microbiology and Infectious Diseases (ESCMID). Authors jointly contribute to the preparation of shared guidelines for diagnosis of prosthetic joint infections.