Editorial Commentary: Advances in 3-Dimensional Imaging are the Key to Improving our Surgical Precision in Hip Arthroscopy and Beyond

Kwadwo Adu Owusu-Akyaw, M.D., Editorial Board

Abstract: Advances in high-resolution magnetic resonance imaging have driven a wealth of knowledge in orthopaedic basic science. The application of these novel techniques to clinical practice is the next logical step for enhancing our understanding of intra-articular pathology and morphology. The specific diagnostic challenge presented by hip labral and chondral pathology is a particular point of interest, given the increasing popularity of hip arthroscopy. As our field continues to progress in complexity, the integration of new, higher-resolution imaging sequences such as multiple-echo recombined gradient echo and double-echo steady state provide the potential to enhance preoperative planning and ultimately the effectiveness of our arthroscopic techniques.

See related article on page 2857

The ability to effectively create and execute a perioperative plan is the dividing line separating the best surgeons from the good ones. In a field with increasing complexity of procedures and an ever-growing library of instrumentation, presurgical planning is the key to maintaining control in a storm of potential unpredictability. To this end, advances in 3-dimensional magnetic resonance imaging (MRI) techniques create the opportunity to improve our understanding of articular morphology[1,2] and joint biomechanics.[3] This is a field of study that has been of personal academic interest to me and continues to grow as high-resolution qualitative and quantitative MRI become more common. It is now pertinent to apply these advances to clinical practice.

In "Comparison Between 3-Dimensional Multiple-Echo Recombined Gradient Echo Magnetic Resonance Imaging and Arthroscopic Findings for the Evaluation of Acetabular Labrum Tear,"[4] Higashihira, Kobayashi, Oishi, Choe, Ike, Tezuka, and Inaba explore the utility of a novel MRI technique in the identification of labral tears. This subject matter is particularly relevant, given the specific diagnostic challenge that preoperative evaluation of intra-articular hip pathology presents.[5-7] Although controversy remains regarding the utility of advanced imaging in the diagnosis of hip pathology,[7] the potential benefit of improved characterization of labral tears in the preoperative period is difficult to argue against.

In the present study, the authors evaluate the diagnostic accuracy of the multiple-echo recombined gradient echo (MERGE) MRI sequence for labral tears versus arthroscopic visualization as the reference standard. The MERGE MRI sequence is notable for its "wide-band acquisition," which is "suitable for the visualization of cartilage and soft tissue."[4] Moreover, the use of multiplanar reconstruction allowed for reconfiguration of the acquired axial images into the radial plane. The combination of the MERGE sequence with radial plane multiplanar reconstruction improves the ability "to accurately capture the full circumference of the labrum" while eliminating the potential risk and patient discomfort associated with arthrography.[4]

The findings of this study are quite interesting. For a cohort of 71 hips, the anterolateral region was the most common location for labral tears. Within this region of interest, the MERGE MRI sequence had a remarkably high sensitivity of 96%, although the specificity was only 50%. The diagnostic power of the sequence did notably drop off in the other regions of the labrum; however, the

The author reports the following potential conflicts of interest or sources of funding: K.A.O-A. is an Editorial Board Member, Arthroscopy: The Journal of Arthroscopic and Related Surgery. Full ICMJE author disclosure forms are available for this article online, as supplementary material.

0749-8063/19720/$36.00
https://doi.org/10.1016/j.arthro.2019.06.001

pooled sensitivity and specificity for all regions of the labrum were 85% and 56%, respectively. Although there is little data evaluating the specific MERGE sequence for this purpose, previous authors have recently evaluated the accuracy of nonarthrographic MRI for intra-articular hip pathology. In 2017, Linda et al[8] performed a similar investigation using a high-resolution TSE protocol with radial plane acquisition. When compared to arthroscopic evaluation, Linda et al[8] demonstrated that high-resolution TSE had a sensitivity of 100% with a specificity of 50%. Schleich et al[9] used a 3D double-echo steady-state sequence to perform a similar investigation, also in 2017. The double-echo steady-state sequence is like the previously described MERGE sequence in that it provides high-resolution contrast between bone and cartilaginous structures.[1,2,10] In their investigation, Schleich et al[9] found sensitivity, specificity, and accuracy of 98%, 76.2%, and 95.9%, respectively, for the detection of labral tears.

A large part of what makes the study by Higashihira et al[4] unique, and ultimately compelling, is the description of labral tear frequency relative to acetabular location. In my opinion, therein lies the potential for this line of study to truly enhance clinical practice. The capacity to accurately evaluate not only the presence of pathology, but the precise location of said pathology, may affect many aspects of operative planning for hip arthroscopy, from portal positioning to even the selection of anchors for labral repair. Increasing the detail of a surgeon's preoperative knowledge of intra-articular morphology will inevitably increase efficiency and accuracy of treatment, ultimately improving the experience for the patient. Although the present study is a small retrospective cohort, the principles and concepts explored here merit further investigation. To this end, larger prospective evaluations of this type of advanced imaging modality is an exciting future direction of study, with the potential to truly enhance arthroscopic surgery.

References

1. Owusu-Akyaw KA, Heckelman LN, Cutcliffe HC, et al. A comparison of patellofemoral cartilage morphology and deformation in anterior cruciate ligament deficient versus uninjured knees. *J Biomech* 2018;67:78-83.
2. Zhang H, Heckelman LN, Spritzer CE, et al. In vivo assessment of exercise-induced glenohumeral cartilage strain. *Orthop J Sports Med* 2018;6(7):2325967118784518.
3. Owusu-Akyaw KA, Kim SY, Spritzer CE, et al. Determination of the position of the knee at the time of an anterior cruciate ligament rupture for male versus female patients by an analysis of bone bruises. *Am J Sports Med* 2018;46:1559-1565.
4. Higashihira S, Kobayashi N, Oishi T, et al. Comparison between 3-dimensional multiple-echo recombined gradient echo magnetic resonance imaging and arthroscopic findings for the evaluation of the acetabular labrum tear. *Arthroscopy* 2019;35:2857-2865.
5. Smith TO, Hilton G, Toms AP, Donell ST, Hing CB. The diagnostic accuracy of acetabular labral tears using magnetic resonance imaging and magnetic resonance arthrography: A meta-analysis. *Eur Radiol* 2011;21:863-874.
6. Smith TO, Simpson M, Ejindu V, Hing CB. The diagnostic test accuracy of magnetic resonance imaging, magnetic resonance arthrography and computer tomography in the detection of chondral lesions of the hip. *Eur J Orthop Surg Traumatol* 2013;23:335-344.
7. Cunningham DJ, Paranjape CS, Harris JD, Nho SJ, Olson SA, Mather RC 3rd. Advanced imaging adds little value in the diagnosis of femoroacetabular impingement syndrome. *J Bone Joint Surg Am* 2017;99(24):e133.
8. Linda DD, Naraghi A, Murnaghan L, Whelan D, White LM. Accuracy of non-arthrographic 3T MR imaging in evaluation of intra-articular pathology of the hip in femoroacetabular impingement. *Skeletal Radiol* 2017;46:299-308.
9. Schleich C, Hesper T, Hosalkar HS, et al. 3D double-echo steady-state sequence assessment of hip joint cartilage and labrum at 3 Tesla: Comparative analysis of magnetic resonance imaging and intraoperative data. *Eur Radiol* 2017;27:4360-4371.
10. Ruehm S, Zanetti M, Romero J, Hodler J. MRI of patellar articular cartilage: Evaluation of an optimized gradient echo sequence (3D-DESS). *J Magn Reson Imaging* 1998;8:1246-1251.