

## Kinematic Magnetic Resonance Imaging

Deborah Pate, DC, DACBR

Kinematic MRI is now becoming more widely used and more accessible to the clinician. Kinematic MR imaging involves evaluation of the various interactions of the important soft tissue and bony anatomic features that comprise a joint, and the relative alignment of these structures through a specific range of motion. A static view magnetic resonance imaging is extremely beneficial for assessing abnormalities of the joints. However, patients frequently present with arthralgia associated with particular positions, movement, or forceful loading of the joint; the causes of these problems are often difficult to evaluate on static images, especially when there is no apparent abnormality demonstrated anatomically. With the use of kinematic MR imaging, the movement of a joint in one plane can be evaluated. Kinematic MR imaging protocols have been used most effectively to evaluate the temporomandibular and patellofemoral joints. Studies are presently in progress to evaluate the role of this diagnostic technique in the assessment of the wrist, ankle, and cervical spine.

Kinematic MRI has been extremely valuable in the biomechanics of the temporomandibular joint. The meniscocondylar dysfunction of the TMJ can be evaluated, along with the internal derangement and displacement of the meniscus. Asymmetrical motion can also be evaluated. Kinematic MRI has been used extensively to evaluate the TMJ joint, therefore many imaging centers are equipped to perform this procedure.

Abnormalities of the patellofemoral joint are a major cause of knee pain and occur as frequently as meniscal lesions. Patellar malalignment and its associated sequelae is the primary pathologic entity that affects the patellofemoral joint. The diagnosis of patellofemoral incongruence by physical examination alone is extremely difficult, because the clinical signs may mimic other forms of internal derangements of the knee and there is a high incidence of combined abnormalities. In addition, patients whose symptoms persist after patellar realignment surgery may become a particularly difficult diagnostic challenge. A kinematic MR imaging technique has been developed to identify and characterize the abnormal functional aspects of the patellofemoral joint. Many abnormalities occur during the early degrees of flexion and kinematic MR imaging is an extremely sensitive and effective means of evaluating the patellar alignment and tracking during the initial increments of flexion of the knee.

Kinematic MR imaging has only recently been applied to the examination of the wrist; its full potential in this application has not yet been realized. Despite limited experience to date with this imaging technique, kinematic MR has been helpful in detecting subtle abnormalities of carpal motion, as well as other instability patterns that are not easily evaluated by routine static MR imaging.

Like kinematic MR imaging of the wrist, kinematic MR imaging of the ankle is a relatively new procedure, and its role in the diagnostic assessment of this joint is still being defined. Initial data suggest that kinematic MR imaging helps provide a more thorough examination of the ankle, particularly in cases of functional abnormalities associated with bony subluxations or soft-tissue

impingement.

Kinematic MRI studies of the cervical spine are also a relatively new procedure and limited experience to date suggests that alignments of the joints and disc displacements may be more accurately evaluated as to the areas of impingement with kinematic studies.

In the future, the use of echo planar and ultrafast MR imaging techniques will provide several benefits for kinematic MR studies of tjoints. The time required to perform these examinations will be significantly reduced, producing sufficient temporal resolution to allow actual dynamic movement of the joints. Kinematic MR imaging of the joints implemented in this manner will permit a more physiologic and functional examination to be performed, allowing the examination of contracting muscles and related soft-tissue structures to be assessed. Stay tuned for more kinematic developments in MR.

*Deborah Pate, DC, DACBR*  
*San Diego, California*

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