

Meniscal Tears: High-resolution Images with 50-mm-FOV using MR Microscopy Coil

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Introduction: The present technology of the microscopy imaging has accomplished high-resolution imaging up to a few microns of resolution [1]. Applying a microscopy coil to live imaging, in vivo study raises many problems, and few animal studies in vivo have been reported [2]. To our knowledge, limited numbers of human studies in vivo were performed for skin [3] and hyaline cartilage of the joint [4]. This study was aimed to demonstrate the utility of microscopic images with FOV of 50 mm and thickness of 1.5 mm in delineation the medial meniscus of the knee.

Materials and Methods: On a 1.5 T clinical scanner, a commercially available MR microscopy coil consisting of a single turn with inner diameter of 47 mm was used. And for comparison, a pair of flexible coils with two elliptical coil elements of 140 mm x 170 mm, which works as phased-arrays was also applied. The imaging protocols for the individual coils are summarized in Table 1. Intermediate-weighted, coronal images were obtained at the medial aspect of the knee. Identifying the medial joint cleft by hand, the microscopy coil was placed at the center of the medial corner of the patient knee. A pair of the phased-array coils was also set on the bilateral aspect of the patient knee, facing each other.

Table 1 Protocol using the microscopy and the regular coil

Coil	sequence TR/TE	FOV	thickness/gap	matrix	NSA	ETL	slice	scan time
microscopy	FSE 1600/15	50 mm	1.5mm/0.1mm	512x256	2	5	15	5:05
regular coil	FSE 1500/11	150 mm	3.0mm/0.3mm	512x256	2	5	18	4:46

26 patients whose arthroscopic examinations were performed within a five-week interval after MR examinations were examined by routine and microscopic imaging. Coronal images from the routine series with FOV of 150 mm were printed at a magnifying power of three. Comparing the paired images for delineation of the meniscus, a qualitative image analysis using a four-point scale was performed by two readers, reading each pair of images side by side, and a consensus was obtained. To ensure consistency in the rating, before reviewing the images the two readers were presented with six selected cases serving as examples. A four-point scale was used; 1, poor; 2, moderate; 3, good; 4, excellent. Wilcoxon's matched-pair signed-rank test was used for comparisons for qualitative results.

Results: Subsequent arthroscopic examinations revealed eleven medial meniscus tears, where MR microscopy delineated all the cleavages including tiny pits containing fluid on the meniscal surface and intra-substance split (Fig. 1). However, routine images missed two of the tears. The mean value of qualitative evaluation of the MR microscopy was 3.5 ± 0.72 , which was higher than that of the regular coil of 3.0 ± 0.64 with statistical significance ($P < .0001$).

Discussion and Conclusion: Tears of the medial meniscus were readily demonstrated on the MR microscopy images. The precise configurations of the meniscal tears including superficial cleavages and extent to the inner substance were demarcated. The medial meniscus is frequently involved in knee injuries. With the progress of MR hardware and acquisition strategies, the demonstrability and diagnostic accuracy of the meniscus have been improved. However, the MR delineation of the meniscal pathologies cannot reach that of arthroscopy [5]. MR microscopy can add to the demonstrability of the fine irregularities of the meniscus. A microscopy coil cannot read the signals from anterior or posterior edge of the meniscus and its scope is limited, however, MR microscopy can provide further detailed morphologies of the meniscus to complement routine MR examination. In conclusion, high-resolution imaging with 50-mm-FOV delineated the normal and pathological structures of the medial meniscus of the knee.

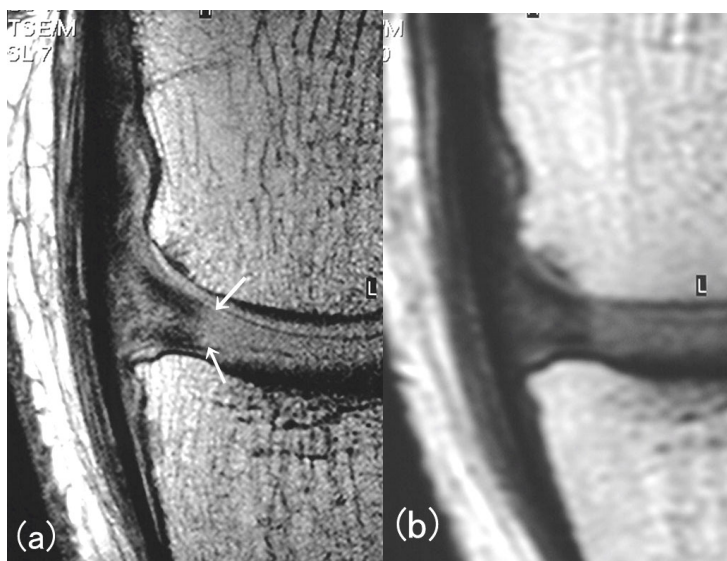


Figure 1. Knee with a medial meniscus tear from a 39-year-old male. (a) MR microscopy image with 50-mm-FOV, (b) Magnified (x3) routine image with 150-mm-FOV. A free edge blunting (arrows, a) combined with a horizontal cleavage is clearly noted on MR microscopy images. However, magnified routine images fail to delineate the detailed pathologies. Subsequent arthroscopic examination proved a horizontal tear at the free edge of the medial meniscus.

References

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