Lateral Ulnar Collateral Ligament of the Elbow: Optimization of Evaluation with Two-dimensional MR Imaging

PURPOSE: To compare, in a cadaveric model, magnetic resonance (MR) imaging techniques with differing contrast and spatial resolution properties in the evaluation of disruption of the lateral ulnar collateral ligament (LUCL) at the elbow.

MATERIALS AND METHODS: LUCL tears were surgically created in eight of 28 cadaveric elbow specimens. All specimens underwent 1.5-T MR imaging with the following pulse sequences: T1-weighted spin echo (SE), intermediate-weighted fast SE, fat-suppressed T2-weighted fast SE, gradient-recalled echo (GRE) with high spatial resolution, intermediate-weighted fast SE with high spatial resolution, and fat-suppressed T1-weighted SE with intraarticular administration of gadopentetate dimeglumine (MR arthrography). All images were obtained in the oblique coronal plane. Two radiologists independently graded the LUCL with separate and side-by-side assessment.

RESULTS: Areas under the receiver operating characteristic curve were as follows for readers A and B, respectively: T1-weighted SE imaging, 0.64 and 0.62; intermediate-weighted fast SE imaging, 0.87 and 0.67; T2-weighted fast SE imaging, 0.68 and 0.69; GRE imaging, 0.56 and 0.68; MR arthrography, 0.84 and 0.85; and intermediate-weighted imaging with high spatial resolution, 0.92 and 0.88. Interobserver reliability was poor with T1-weighted SE imaging (κ = 0.13) and GRE imaging (κ = 0.18), fair with T2-weighted fast SE imaging (κ = 0.36), and moderate with MR arthrography (κ = 0.46), intermediate-weighted fast SE imaging (κ = 0.55), and intermediate-weighted imaging with high spatial resolution (κ = 0.59).

CONCLUSION: Intermediate-weighted imaging with high spatial resolution and MR arthrography showed the greatest overall ability to enable the diagnosis of LUCL tears.

The diagnosis of posterolateral rotatory instability of the elbow is a difficult clinical challenge despite insights and innovations derived since the recent description of this entity by O’Driscoll et al (1). Posterolateral rotatory instability may be a result of an acute injury to the lateral ulnar collateral ligament (LUCL) or chronic elbow instability. Posterolateral rotatory instability is less common than valgus instability (from medial collateral ligament disruption) and is diagnosed clinically with a lateral pivot-shift test of the elbow (1,2). Today, this evaluation can be enhanced by performing a physical examination with anesthesia (local or general) or by using advanced imaging techniques such as magnetic resonance (MR) imaging (3). Surgical treatment is aimed at reconstruction of the LUCL. Determination of the status of the LUCL may help identify patients likely to benefit from surgical reconstruction and establish appropriateness criteria as surgical techniques continue to develop (4).

The purpose of this study was to compare MR imaging techniques with differing contrast and spatial resolution in the evaluation of complete disruption of the LUCL in a
Materials and Methods

Imaging Protocol

Twenty-eight fresh frozen cadaveric arms amputated above the elbow joint were thawed to room temperature. There were 17 male and 11 female cadavers. The age of the cadavers at the time of death ranged from 54 to 86 years (mean age, 71 years). Standard anteroposterior and lateral radiographs of the elbow were obtained to ensure that the specimens were free from posttraumatic or arthritic deformity. Two orthopedic surgeons performed extraarticular dissections of each specimen and inspected the ligaments to determine whether they were intact. Complete tears of the LUCL were created along its proximal extent in eight of the 28 specimens.

All 28 specimens underwent MR imaging with the following six pulse sequences: (a) T1-weighted spin echo (SE), (b) intermediate-weighted fast SE, (c) fat-suppressed T2-weighted fast SE, (d) gradient-recalled echo (GRE) with high spatial resolution, (e) fat-suppressed T1-weighted SE with intraarticular administration of gadopentetate dimeglumine, and (f) intermediate-weighted fast SE with high spatial resolution. The imaging parameters are summarized in Table 1. The pulse sequences chosen for this study were developed on the basis of clinical experience and reports in the literature (3,5–7).

The following common parameters were also used for each of the sequences: the section thickness was 3.0 mm with an intersection gap of 0.3 mm, and the field of view was asymmetric (15 × 11 cm). Saturation pulses were placed inferi-orly and superiorly, outside the field of view. Frequency-selective chemical presaturation was performed (CHEMSAT; GE Medical Systems, Milwaukee, Wis) for the fat-suppressed sequences. The MR images were obtained with a 1.5-T magnet (Signa 5x; GE Medical Systems). Each elbow was placed in a receive-only extremity coil in full extension. For the first series, localizer images were obtained in the standard coronal plane. For the next series, oblique transverse images were obtained with the imaging plane perpendicular to the long axis of the distal humerus (true axial with respect to the humerus). From this series, an oblique coronal plane was selected to be parallel to a line drawn between the humeral epicondyles. The imaging plane for all sequences was oblique coronal, prescribed to be parallel to the humeral epicondyles (Fig 1). The plane was prescribed on the basis of a transverse localizer image to identify 12 locations that covered the entire elbow joint from anterior to posterior.

Each of the 28 elbows was imaged before and after the intraarticular administration of gadopentetate dimeglumine. With fluoroscopic guidance, a 25-gauge needle was placed in the anterior radiohumeral joint and 12 mL of 1.0 mmol/L gadopentetate dimeglumine (1 mL in 100 mL of saline) was injected. Before injection, the intraarticular location of the needle was confirmed with 1–2 mL of diatrizoate meglumine (Hypaque 60%; Nycomed, Princeton, NJ). All injections and imaging were performed by one radiologist (J.A.C.), who was not involved in interpretation of the images.

Image Analysis

The images were evaluated independently by two musculoskeletal radiologists (W.B.M., W.N.S.) (designated reader A and reader B) experienced in the interpretation of MR images and blinded to the integrity of the LUCL. Training in the

<table>
<thead>
<tr>
<th>Sequence</th>
<th>Flip Angle</th>
<th>Repetition Time (msec)</th>
<th>Echo Time (msec)</th>
<th>Echo Train Length</th>
<th>Fat Saturation</th>
<th>Matrix Size</th>
<th>No. of Signals Acquired</th>
<th>Imaging Time (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1-weighted SE</td>
<td>90°</td>
<td>500</td>
<td>18</td>
<td>0</td>
<td>No</td>
<td>256 × 256</td>
<td>2</td>
<td>3:16</td>
</tr>
<tr>
<td>Intermediate-weighted fast SE</td>
<td>90°</td>
<td>2,000</td>
<td>48</td>
<td>4</td>
<td>No</td>
<td>256 × 256</td>
<td>2</td>
<td>3:16</td>
</tr>
<tr>
<td>T2-weighted fast SE with fat suppression</td>
<td>90°</td>
<td>3,100</td>
<td>72</td>
<td>8</td>
<td>Yes</td>
<td>512 × 256</td>
<td>3</td>
<td>4:52</td>
</tr>
<tr>
<td>GRE</td>
<td>30°</td>
<td>500</td>
<td>10</td>
<td>0</td>
<td>No</td>
<td>256 × 256</td>
<td>1</td>
<td>3:28</td>
</tr>
<tr>
<td>MR arthrography</td>
<td>90°</td>
<td>500</td>
<td>18</td>
<td>0</td>
<td>Yes</td>
<td>256 × 256</td>
<td>2</td>
<td>3:16</td>
</tr>
<tr>
<td>Intermediate-weighted fast SE with high spatial resolution</td>
<td>90°</td>
<td>2,000</td>
<td>48</td>
<td>4</td>
<td>No</td>
<td>512 × 256</td>
<td>2</td>
<td>3:55</td>
</tr>
</tbody>
</table>

Figure 1. Coronal oblique imaging plane. Transverse image perpendicular to the long axis of the humerus that contains the epicondyles is used. Coronal oblique images are obtained by selecting an imaging plane parallel to a line bisecting the epicondyles.
form of a didactic session and case reviews was provided for the identification and evaluation of the LUCL ligament with review of literature on the anatomy of the lateral ligaments on MR images (3,5–7). The main criterion for LUCL tear with all sequences was discontinuity of the ligament signal. For MR arthrography, extension of intraarticular contrast material into the tissues superficial to the LUCL was also considered evidence of ligament tear. The first set of evaluations consisted of separate interpretations of each of the images at different sittings separated by an interval of at least 2 weeks. Cases were given in a random order. A standardized score sheet with a five-point scale was used to grade the status of the LUCL, as follows: 1, definitely normal; 2, probably normal; 3, possibly normal (indeterminate); 4, probably abnormal; 5, definitely abnormal. The sensitivity and specificity values were calculated empirically at the cutoff point between grades 3 and 4 by analyzing counts and proportions. The $A_r$ is the resulting area under the ROC curve calculated as an overall measure of diagnostic accuracy of each of the combinations. $\kappa$ values represent the interobserver agreement between readers A and B assessed by using a dichotomous $\kappa$ statistic at the clinically meaningful cutoff point (between grades 3 and 4) for each sequence. Data are given as the mean ± standard error of the mean.

**Statistical Methods**

The following statistical analytic tools were used: (a) univariate receiver operating characteristic (ROC) curve analysis, (b) pairwise bivariate ROC curve analysis, (c) sensitivity and specificity pairs at a clinically meaningful cutoff point, and (d) assessment of interreader agreement. Two-tailed statistical pairwise comparisons were also conducted.

We evaluated the ability of the six sequences to enable differentiation of specimens with and specimens without LUCL disruption. Six sequences were performed for each elbow, and each sequence was rated by reader A and reader B; thus, there were 12 sequence-by-reader combinations.

For each of the 12 sequence-by-reader combinations, the diagnostic accuracy was measured by using ROC curve analysis. An ROC curve is a plot of sensitivity against specificity at all possible cutoff points. Because we were dealing with ordinal rating data, we fitted a parametric smooth ROC curve under a binormal probit link for each of the combinations (ROCT; Metz CE, Shen JH, Wang PL, et al, Department of Radiology, University of Chicago, 1994). The resultant area under the ROC curve ($A_r$) was calculated as an overall measure of diagnostic accuracy for each of the combinations. $A_r$ is a popular measure of the overall accuracy, ranges from 0.5 to 1.0 and represents the accuracy of “chance” to “truth” (8). To evaluate reader sensitivity and specificity, we then focused on the clinically meaningful cutoff point in the interpretation of LUCL status, between grades 3 and 4. This cutoff point was chosen because it represents a change in reader confidence from normal to abnormal. The sensitivity and specificity pairs were calculated empirically at this cutoff point with an analysis of counts and proportions.

Next, within each reader, the rating data generated with each sequence often showed correlation; therefore, we performed statistical pairwise comparisons of the two correlated $A_r$ values from any of the two sequences applied on the same ligaments (CORROC2; Metz CE, Kronman HB, Department of Radiology, University of Chicago, 1994). Only statistically significant ($P \leq .05$) differences in the pairwise comparisons were reported.

For each sequence, interobserver agreement between readers A and B was assessed by using a dichotomous $\kappa$ statistic at the clinically meaningful cutoff point. $\kappa$ values range between −1 and 1. The strength of agreement was interpreted according to the guidelines suggested by Altman (9), as adapted from Landis and Koch (10), as follows: very good, $\kappa = 0.81–1.00$; good, $\kappa = 0.61–0.80$; moderate, $\kappa = 0.41–0.60$; fair, $\kappa = 0.21–0.40$; and poor, $\kappa \leq 0.20$.

The data gathered from the side-by-side evaluation (subjective comparison) of image quality were analyzed separately for each reader. Percentages of each subjective preference category (least preferred, most preferred) were calculated for each sequence for each reader.

MR arthrographic images with false-negative and false-positive results were reevaluated by a radiologist reviewer (J.A.C.) who was not one of the readers to determine the nature of the discrepancy, if possible (eg, if interpretive error was the cause of the discrepancy).

**RESULTS**

The results are summarized in Table 2. The sensitivity ranged from 0.38 to 0.88 for reader A and from 0.50 to 0.88 for

<table>
<thead>
<tr>
<th>Sequence</th>
<th>Sensitivity</th>
<th>Specificity</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1-weighted SE</td>
<td>Reader A</td>
<td>Reader B</td>
</tr>
<tr>
<td>Intermediate-weighted fast SE</td>
<td>0.63 ± 0.17</td>
<td>0.50 ± 0.18</td>
</tr>
<tr>
<td>T2-weighted fast SE</td>
<td>0.63 ± 0.17</td>
<td>0.50 ± 0.18</td>
</tr>
<tr>
<td>GRE</td>
<td>0.38 ± 0.17</td>
<td>0.75 ± 0.15</td>
</tr>
<tr>
<td>MR arthrography</td>
<td>0.75 ± 0.15</td>
<td>0.88 ± 0.11</td>
</tr>
<tr>
<td>Intermediate-weighted fast SE with high spatial resolution</td>
<td>0.88 ± 0.11</td>
<td>0.88 ± 0.11</td>
</tr>
</tbody>
</table>

Note.—Each reader rated the status of the LUCL by using a five-point scale (1, definitely normal; 2, probably normal; 3, possibly normal [indeterminate]; 4, probably abnormal; 5, definitely abnormal). The sensitivity and specificity values were calculated empirically at the cutoff point between grades 3 and 4 by analyzing counts and proportions. The $A_r$ is the resulting area under the ROC curve calculated as an overall measure of diagnostic accuracy of each of the combinations. $\kappa$ values represent the interobserver agreement between readers A and B assessed by using a dichotomous $\kappa$ statistic at the clinically meaningful cutoff point (between grades 3 and 4) for each sequence. Data are given as the mean ± standard error of the mean.

* Data are for reader 1 versus reader 2.
reader B. For both readers, the sensitivity was improved by using MR arthrography (0.75 and 0.88 for readers A and B, respectively) and intermediate-weighted imaging with high spatial resolution (0.88 for both). For reader A, the difference between sensitivities with intermediate-weighted imaging with high spatial resolution and GRE imaging was statistically significant ($P = .02$). The remaining comparisons were not significantly different. For reader B, none of the differences between sensitivities were statistically significant.

The specificity ranged from 0.70 to 0.90 for reader A and from 0.45 to 0.90 for reader B. For reader A, the specificity was greatest with MR arthrography. For reader B, the specificity was greatest with T2-weighted fast SE imaging. For reader A, none of the differences between specificities were statistically significant. For reader B, the differences between the following pairs were statistically significant: intermediate-weighted imaging with high spatial resolution and T1-weighted SE imaging ($P = .02$); intermediate-weighted imaging with high spatial resolution and GRE imaging ($P < .01$); MR arthrography and GRE imaging ($P = .02$); intermediate-weighted fast SE and GRE imaging ($P = .02$); and intermediate-weighted fast SE imaging and T1-weighted SE imaging ($P = .04$). The remaining comparisons were not significant. For reader B, the difference between GRE imaging and MR arthrography was statistically significant ($P < .01$); all other comparisons were not. For reader B, comparisons between intermediate-weighted imaging with high spatial resolution and the other sequences were not possible owing to a degenerate ROC curve for that sequence (constant at a true-positive rate of 0.88).

Interobserver variability (Table 2) measured with the $\kappa$ statistic suggested poor agreement for T1-weighted SE imaging ($\kappa = 0.13$) and GRE imaging ($\kappa = 0.18$), fair agreement for T2-weighted fast SE imaging ($\kappa = 0.36$), and moderate agreement for MR arthrography ($\kappa = 0.46$), intermediate-weighted fast SE imaging ($\kappa = 0.55$), and intermediate-weighted imaging with high spatial resolution ($\kappa = 0.59$). For the following sequences, the differences in interobserver variability were statistically significant: T1-weighted SE imaging and intermediate-weighted imaging with high spatial resolution ($P = .03$).

The results of subjective image quality analysis are as follows. GRE imaging was the sequence least preferred by both reader A (22 of 28 cases [78%]) and reader B (20 of 28 cases [71%]). Intermediate-weighted imaging with high spatial resolution was the sequence most preferred by reader A (14 of 28 cases [50%]); however, MR arthrography was also favored (12 of 28 cases [43%]). Intermediate-weighted imaging with high spatial resolution was also the sequence most preferred by reader B (26 of 28 cases [93%]). None of the images obtained with any of the sequences had excess artifact that precluded assessment of the LUCL.

Review of discrepancies focused on MR arthrography because our hypothesis was
that this would be the most robust sequence. Reader A had two false-positive and two false-negative findings, and reader B had nine false-positive findings and one false-negative finding. Two false-positive findings were the same for both readers. The LUCL was not well depicted in either case, and there was no extravasation of contrast material. In both cases, the readers classified the LUCL as grade 4; however, almost all true-positive findings were classified as grade 5. For reader B, the additional seven false-positive findings were believed to be related to poor visualization of the ligament without contrast material extravasation \((n = 2)\), misinterpretation of fascial extravasation of contrast material \((n = 2)\), and interpretative error \((n = 3)\). One false-negative finding was the same for both readers, and, on review, this case did not fulfill the criteria for a tear at MR arthrography. For reader A, there was one additional false-negative finding that did meet the criteria for a tear (the LUCL was detached); this was also considered to be an interpretive error.

**DISCUSSION**

The radial collateral ligament (RCL) complex is composed of four ligaments (Fig 4): the RCL proper, the LUCL, the annular ligament, and the accessory lateral collateral ligament. These components vary widely among individuals (11). The RCL attaches proximally to the anteroinferior aspect of the lateral epicondyle and distally to the annular ligament and lies deep to the common extensor tendon. The LUCL attaches proximally to the anteroinferior aspect of the lateral epicondyle and distally to the annular ligament and lies deep to the common extensor tendon. The UCL attaches proximally to the anteroinferior aspect of the lateral epicondyle and distally to the supinator crest of the ulna (Fig 5). In anatomic dissections, the humeral attachment of the LUCL has been noted to be indistinguishable from the RCL and may be considered the posterior portion of the RCL proper (12,13). Hence, this ligament can be difficult to differentiate from the RCL on coronal oblique images and has been reported to be poorly depicted on the routine coronal oblique sections commonly used (14). The LUCL usually tears near its common attachment with the RCL.

In this study, we evaluated the ability to diagnose complete tears of the LUCL with six different two-dimensional MR pulse sequences performed in the coronal oblique plane. Our results suggest that accuracy as measured by means of sensitivity, specificity, and \(A_z\) is improved by using sequences with either a high signal-to-noise ratio (eg, intermediate-weighted fast SE imaging and intermediate-weighted imaging with high spatial resolution) or a high contrast-to-noise ratio (eg, MR arthrography). The least amount of interobserver variability was present with intermediate-weighted imaging with high spatial resolution (HRIW) and MR arthrography (all showed moderate concordance). Subjectively, intermediate-weighted imaging with high spatial resolution was preferred for overall image quality. Methods used for bias control in this study include training for each reader, use of a standardized score sheet, use of independent readings for calculations, and temporal separation of readings for each sequence by at least 2 weeks.

To our knowledge, there has been only one previous report with regard to MR evaluation of patients suspected of having posterolateral rotatory instability. In the study by Potter et al (3), MR imaging was performed with three-dimensional...
GRE and fast SE sequences in nine symptomatic patients and nine asymptomatic subjects. Tears of the LUCL were noted in all symptomatic patients, who subsequently underwent surgical exploration and reconstruction, where all tears of the LUCL were confirmed. In that series, conventional MR imaging for LUCL disruption relied on a high-spatial-resolution thin-section three-dimensional GRE technique. Although GRE sequences can provide high spatial resolution, there are substantial limitations in the contrast resolution. Spurious signal, which is often present in tendons or ligaments, may be related to degenerative phenomena (senescent mucoid changes) or MR artifact (eg, magic angle phenomenon).

One pitfall for two-dimensional imaging is that artifactual ligament discontinuity may be perceived either with an inappropriate imaging plane or secondary to volume averaging. This may be the predominant reason for the false-positive diagnoses with the nonenhanced pulse sequences tested in this study. The optimal section plane has been previously addressed in a study of cadavers. Cotten et al (14) concluded that the collateral ligamentous structures of the elbow were best depicted with either a coronal plane aligned with the humeral shaft, with the elbow in 20°–30° of flexion, or, alternatively, a 20° posterior oblique coronal plane with respect to the humeral shaft, with the elbow in full extension. Findings from images obtained with either method of coronal oblique acquisition were nearly identical. These techniques were concluded to be more useful because the ligamentous structures (which have an oblique course) were demonstrated with improved conspicuity. We have no direct experience with interpreting images based on these prescriptions. Although we did not evaluate different imaging planes in this study, we recognize that alternative positioning protocols hold promise.

The implications of the results of this study are important for enabling a preoperative and relatively noninvasive evaluation of the LUCL of the elbow. The LUCL is taut with varus stress and acts as the primary stabilizer of the elbow to both varus and posterolateral stress (1,15). The contribution of the RCL to valgus stability is 15% in extension and decreases to 10% with 90° of flexion (16). The RCL is taut throughout elbow flexion. O’Driscoll et al (1) describe the progression of capsuloligamentous disruption in a lateral to medial “circle” with posterolateral rotatory instability evolving subsequently to disruption of the common proximal attachment of the LUCL (and perhaps the RCL proper) off of the humerus. Posterolateral rotatory instability, a clinical phenomenon, is characterized by transient rotatory subluxation of the ulnohumeral joint with secondary subluxation of the radiohumeral joint. At physical examination, this is manifested by a positive pivot-shift test. Although usually performed without sedation, this test was originally performed with general anesthesia (1,2). Nevertheless, the diagnosis of posterolateral rotatory instability may be difficult (especially in acute LUCL injuries), and an accurate relatively noninvasive imaging study could be very useful.

Our data must be interpreted in the context of the study design. First, cadaver models have inherent flaws. Furthermore, in this study, only ligament disruption was tested; we did not make a clinical diagnosis of posterolateral rotatory instability. Tissue quality and altered contrast material (from water absorption) can affect the MR image. This study focused on ligamentous structures with no signal, which minimizes the potential effects of tissue quality on image interpretation. Additionally, postoperative changes could allow contrast material to dissect along the fascial planes (from the injection site), thus contributing to the false-positive rate with MR arthrography. We did not use three-dimensional sequences, different elbow positions, or specialized imaging planes (other than the traditional coronal oblique sections), and comparison of these different image planes was beyond the scope of this study. The small sample size was also a limitation of this study. The cadaver elbows were positioned in the center of the MR bore, which is difficult to achieve with patients in a clinical setting. Additionally, the longer sequences (especially GRE) would be expected to have more motion artifact than the other sequences in a clinical population. Therefore, our results may not be directly transposed to the clinical setting.

The results of our study indicate that the detection of LUCL disruption with two-dimensional pulse sequences is optimized with a sequence with a high contrast-to-noise ratio (eg, MR arthrography) or a high signal-to-noise ratio (eg, intermediate-weighted fast SE imaging or intermediate-weighted imaging with high spatial resolution) (Fig 6). It is interesting that, for the intermediate-weighted pulse sequences, a matrix size of 512 × 256 (high spatial resolution) provided improved sensitivity but diminished specificity compared with a conventional matrix (256 × 256). MR arthrography and intermediate-weighted pulse sequences tended to provide the best sensitivity, specificity, ROC curves, and interobserver reliability. Subjective preference for these two sequences was also very strong compared with the other sequences tested. An interesting issue, which was an exploratory hypothesis in our study, is related to observer performance. We anticipated that a technique like MR arthrography would substantially reduce interobserver variability (because of increased conspicuity of findings that are dichotomous, that is, extravasation or no extravasation) and thus have an added value even if the overall accuracy was not substantially better than that with the other sequences. Our results, however, suggest only that MR arthrography had only a marginal effect on concordance.

Avenues for future research include technical developments of MR pulse sequences, alternative applications of existing techniques, and linking of the diagnosis with patient outcome. The use of novel volumetric pulse sequences such as three-dimensional fast SE offers the ability to combine the advantages of isotropic voxels (thin-section oblique planes) with a pulse sequence with high signal-to-noise ratio and favorable contrast-to-noise ratio (eg, intermediate-weighted fast SE). Newer magnets being developed
for cardiovascular imaging are available with improved gradients and faster slew rates, which allow even higher spatial resolution (1,024 × 1,024) or thinner sections while maintaining reasonable imaging times. An MR arthrographic effect may be accomplished by injecting contrast material with a percutaneously placed needle (direct), as in this study, or by injecting the contrast material intravenously (indirect) (17). Homogeneous intraarticular enhancement with gadolinium chelates can be achieved by means of intravenous injection, if aptly performed, and may be preferable for joints in which distention is not crucial (18). Of paramount importance is determination of the value of MR imaging as a preoperative tool in the selection of patients who are likely to experience an improved outcome from LUCL reconstruction.

**Practical application:** The practical application of this study relates to our findings of reasonable diagnostic accuracy for LUCL tears with MR pulse sequences that can be used with most currently available imaging systems, with parameters that maintain imaging times suitable for clinical use (<5 minutes). We believe that although MR arthrography greatly improves the conspicuity of LUCL tears, routine prescriptions for MR imaging pulse sequences with high signal-to-noise ratio (intermediate-weighted fast SE imaging or intermediate-weighted imaging with high spatial resolution) are also competitive for the noninvasive diagnosis of LUCL disruption.

**Acknowledgments:** The authors thank Desirée V. Uy for her help in the preparation of the manuscript; James A. Cooper, MD, for providing the diagram of the elbow; and Mark E. Schweitzer, MD, and Robert C. Smith, MD, for their comments.

**References**

7. Desharnais L, Kaplan PA, Dussault RG. MR imaging of ligamentous abnormali-

---

**Figure 6.** MR images of LUCL tear. (a) T1-weighted SE image (500/18), (b) intermediate-weighted fast SE image (2,000/48 [effective]), (c) fat-suppressed T2-weighted fast SE image (3,100/72 [effective]), (d) GRE image with high spatial resolution (500/10), (e) gadolinium-enhanced fat-suppressed T1-weighted SE MR arthrogram (500/18), and (f) intermediate-weighted fast SE image with high spatial resolution (2,000/48 [effective]). All images show discontinuity of the proximal portion of the LUCL (arrow), which is better discerned on the intermediate-weighted images (b, f) and the MR arthrogram (e).