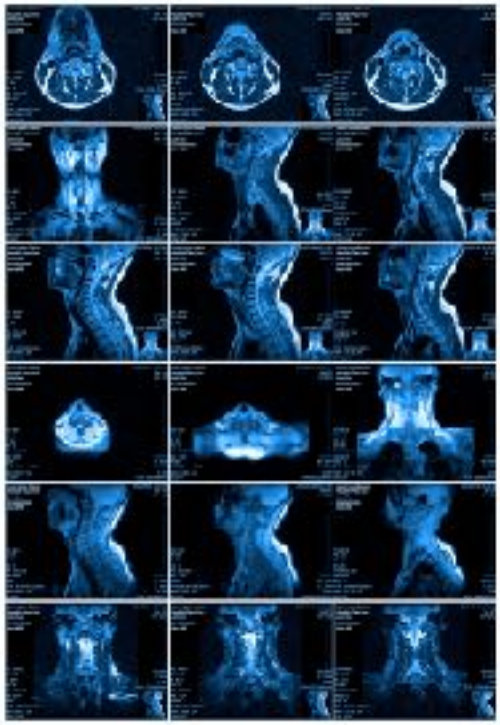
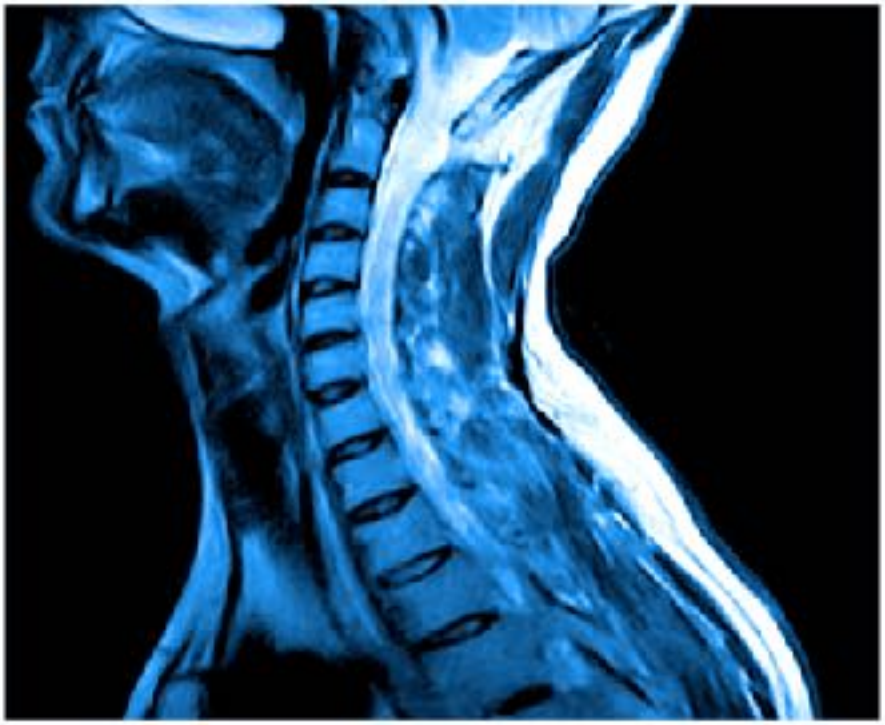
Interpreting MRI Reports





A Primer for Lawyers: Part One

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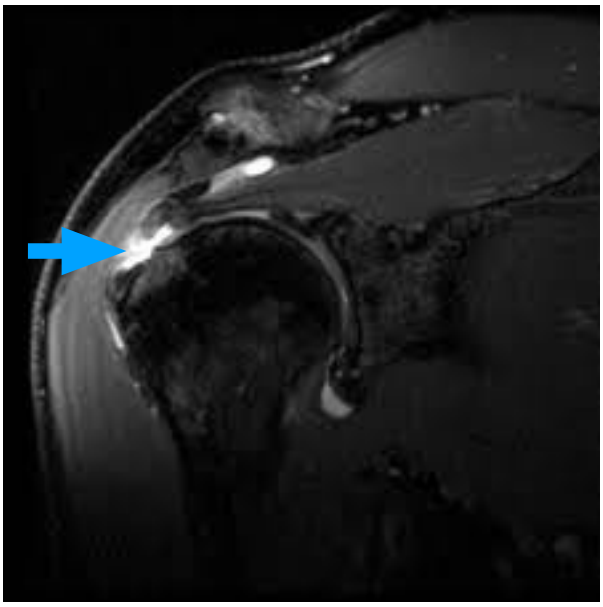
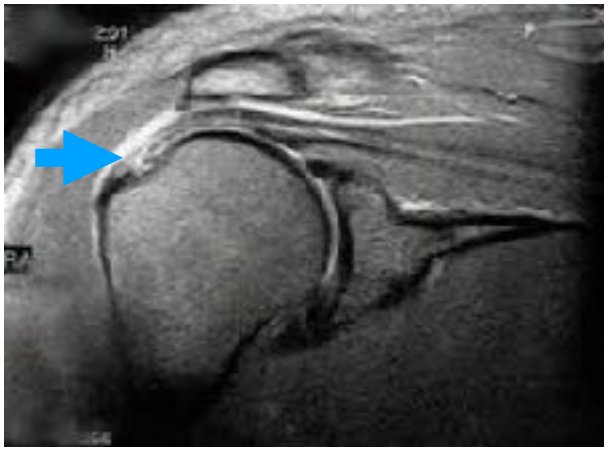
Introduction

Sometimes everything works out fine. Your client falls at work and injures his shoulder. He never had a shoulder problem prior to this. The orthopedic surgeons diagnoses a rotator cuff tear and orders a MRI. The study confirms the diagnosis. The claim is covered and the surgery is approved.



Other times it doesn't work out so well. Your client has a history of shoulder pain. The MRI report talks about bursitis, tendinosis, interstitial tears and degenerative changes. The claim gets denied.



MRI Images can be difficult to decipher. The pathology isn't always straightforward. Some radiologists are better and more thorough than others. The radiologist's reading and the treating physician's reading may disagree. Even if they do agree, false negatives and false positives do occur. The results can be vague and contain catchall terms.

What's in the report and what does it mean? Understanding MRI reports can help you advocate for you clients. We don't need to turn you into a radiologist. The goal here is to give you a better understanding of the techniques, terminology, and thought processes included in MRI reports. Let's look at a typical report and break it down.

The Report

An MRI report can be divided into three sections. The first section contains a variety of information ranging from where the study was done to what settings were used on the machine to get the images. It is often skipped over to get right to the results. However, it can contain information that is useful in determining if the optimal study was done and therefore if your client is getting the best treatment.

Sections two and three, Findings and Impression, make up the bulk of the report and have the most impact on treatment. While the assorted information in the first section is primarily statements of facts, the Findings and especially the Impression sections contain more opinion and can be open to debate.

This primer will deal with the first section. Findings and Impressions will be taken on in upcoming publications. I plan to address anatomic areas individually and include primers on the shoulder, knee and spine.

On the next page is an example of the first section of a report on a shoulder MRI exam.

Acme Diagnostic Imaging
100 1st Street
Hometown, USA
Phone: 555-555-5555

Patient: John Doe
DOB: 12/10/62
File #: 98765
Physician: Dr. Jones
Exam: MRI left Shoulder
Date: 10/01/2017

Clinical Information: Fall onto left shoulder 08/03/2017, possible rotator cuff tear

Comparison: None

Technique: Imaging performed through left shoulder per protocol including axial PD FS, coronal PD FS and PD, sagittal T1 and PD FS using 3T magnet without contrast.

The top half provides the basics - Where, Who, What and When. It should go without saying that this be reviewed to be sure it's the correct patient, body part and date of exam.

The information contained under the headings Clinical Information, Comparison and Technique is what we will review in the following pages.

Clinical Information

This section gives a brief summary of the reason for the exam. Some facilities will even use the heading: Reason for Exam. These descriptions can vary greatly in detail. Some will do no more than state “shoulder pain” or “back pain”. Others may provide details about what the requesting physician is looking for and why.

The amount of detail may be due to how the order was placed by the provider or how it was entered into the system by a technician or clerical person. In our example the radiologist will be looking for evidence of trauma from the fall and will pay particular attention to the rotator cuff. The more information the radiologist has, the more specific the final impression will be.

Comparison

This section indicates whether there are any prior or concurrent studies to which this MRI was compared. Previous MRI studies are most commonly compared, but x-rays, CT scans, bone scans, etc can also be included if relevant. Comparisons will only be with studies performed at the same facility unless a request is made otherwise and outside studies are provided.

Technique: Planes

Here is where you will find information on how the study was done. The images will be obtained using the facility's standard protocol for the body part, unless a special request is made. MRIs are typically performed in three planes: Axial, Coronal and Sagittal. Occasionally an oblique plane will be added. Some reports will list the individual planes imaged, others will just say it was multi-planar.

Axial

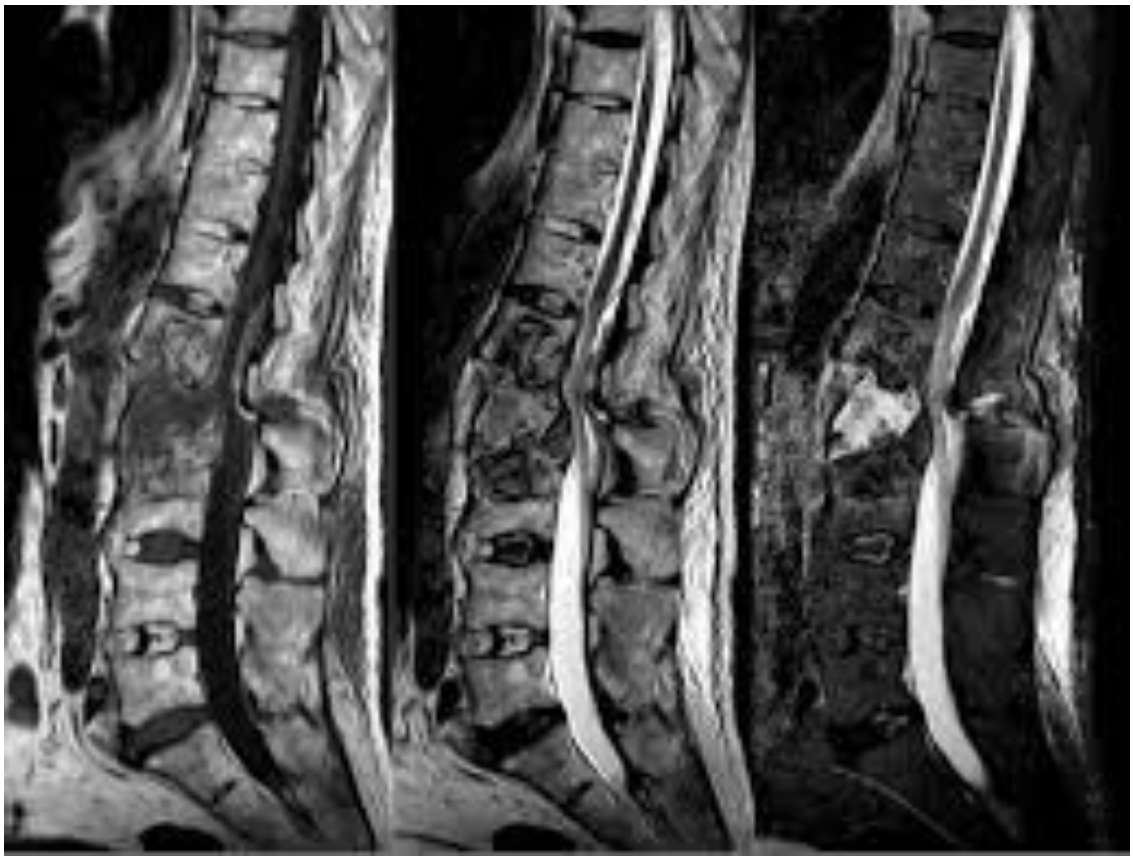
Coronal

Sagittal

Technique: Pulse Sequences

Anatomical planes are fairly straightforward. What about these letters and numbers like “T1 and PD FS”? These are specific parameters or settings on the magnet and radio frequency of the MRI machine called pulse sequences. In this example they mean T1-weighted and Proton Density Fat Saturated images.

Different pulse sequences allow better visualization of various structures and processes within the tissues. By manipulating the magnet and radio frequencies the appearance of things like edema, infection and fat can be highlighted or suppressed. A typical musculoskeletal MRI will use between 3 and 6 different pulse sequences. As with the planes imaged, some reports will list the sequences, others will just say multi-sequence.



MRI of Spine

Same view with three different pulse sequences

Do you have to remember the abbreviations and their characteristics? Thankfully, no. I still have to look them up from time to time. I have included the following list of common sequences and a table of some of their characteristics for reference.

Pulse Sequence Glossary

DWI - Diffusion Weighted Imaging
FLAIR - FLuid Attenuated Inversion Recovery
FS - Fat Saturated
FSE - Fast Spin Echo
GRE - Gradient Recalled Echo
PD - Proton Density
STIR - Short Tau Inversion Recovery
T1 - T1-weighted or longitudinal relaxation Time
T2 - T2-weighted or transverse relaxation Time

Pulse Sequence: Strengths and Weaknesses

Sequence	Strength	Weakness
T1	Anatomic detail Fat, subacute bleeding, meniscal and marrow pathology, contrast enhancement	Poor detection of soft tissue edema
Proton Density	Anatomic detail Meniscal pathology	Poor detection of fluid and marrow pathology
T2	Detection of fluid and pathologic processes: tumor, infection, injury	Long imaging times (No longer used)
FSE T2	Short imaging times Marrow pathology with fat saturation Good in patients with metal hardware	Poor detection of marrow pathology without fat saturation
GRE T2	Meniscus, labrum, loose bodies, hemorrhage, 3D imaging	Metallic hardware artifact
STIR	Marrow and soft tissue pathology	Should not be used with gadolinium contrast

Adapted from Helms CA, et al. Musculoskeletal MRI, 2nd Edition. Philadelphia: Saunders; 2009

Technique: Magnet strength

Sometimes, not always, the strength of the magnet in the machine will be stated. Our example uses a 3T, or 3 Tesla magnet. A Tesla is a unit of magnetic field strength named after Nikola Tesla. Most MRIs done today will be with a 1.5T or 3T magnet.

How strong are these magnets?

Earth's magnetic field - 0.000032T
Typical refrigerator magnet - 0.005T
Junkyard magnet - 1T
Medical MRI magnets - 0.5T to 3T
Superconductor at CERN - 4T

MRI magnets are strong enough to cause unsecured metal objects nearby to fly into them injuring patients. Patients need to be screened for metal shavings or slivers under the skin, especially around the eyes, common in metal workers, and for metal and electronic implants. Some implants, even some pacemakers, are ok in MRI scanners. The implant will affect the quality of the images adjacent to it.

The stronger magnets can produce a better, higher resolution image. The 1.5T machines are still standard, however. Even mobile MRIs in trailers used by rural clinics can have 1.5T magnets. Newer imaging centers, hospitals and secondary and tertiary referral institutions are more likely to use 3T magnets.

Technique: Contrast

The Technique section will also indicate if contrast was used. Gadolinium based contrast agents, sometimes listed as Gd-DTPA or just Gd, can be injected to enhance visualization of certain

processes. The contrast injection can be intravenous or intra-articular. If the report simply says “with contrast”, this would indicate an IV injection. If injected into the joint it should state that intra-articular contrast was given or an arthrogram was done. Contrast is not given IV for most musculoskeletal MRI exams. The indications for IV contrast in extremity MRIs include tumors, infection and differentiating between a cystic and solid mass.

IV contrast is used more often for MRI exams of the spine. It is useful in post-operative patients to differentiate between scar tissue and disk material. It is also helpful in evaluating spinal cord lesions, infection and cancer metastases.

MR arthrograms are most often done for shoulder and hip problems. Distention of the joint can be extremely helpful in detecting labral tears. Some research is showing similar results using 3T scanners without injection. Shoulder arthrograms can also be very useful for evaluating partial thickness and very small full thickness rotator cuff tears. Previous rotator cuff or labral repair can make images difficult to read, arthrograms are helpful here too. Although rarely done, knee arthrograms can help distinguish a meniscus tear from scar due to healed previous tear.

Conclusion

I hope this has given you some insights that will be helpful in evaluating your medical cases. Knowing how much clinical background the radiologist had when interpreting the images can help if there is disagreement between the Impression on the report and the treating provider’s reading. Comparison to previous MRIs or other imaging studies can be critical in determining causation and developing medical theories. Not all MRI exams are equal, knowing how an exam was done can make a difference. You should be able to use this information when discussing the case with the treating providers and your consultants.

There is obviously a lot that can be discussed regarding the Findings and Impressions on MRI reports. I originally developed this as a SlideShare presentation for LinkedIn and had planned on covering some aspects of these topics. As I got going it became obvious that there was too much to include in one, easy to digest, presentation. I plan to do separate presentations/publications going over facets of radiologist descriptions in Findings and interpretations in Impressions for shoulder, knee and spine MRIs if you would like to see them.

Your Feedback Needed

Your input is invaluable. Please let me know if this was worthwhile and if you would like to see more. Would a webinar on-demand format, that would allow more detailed explanations, be helpful? Any interest in seeing these types of presentations offered for CLE credit?

Look forward to hearing from you.

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