



UNIVERSITY OF
SASKATCHEWAN

Improving Elbow MRI Quality

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Disclosures and Conflicts of Interest

None to Declare

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Background

- Elbow MRI is a relatively infrequently ordered and technically challenging¹
 - Only 32 studies at Saskatoon's Royal Univeristy Hospital over 12 months
 - Painful MSK conditions can make maintaining position difficult, with potential for motion artifact
 - With significant motion, there may be incorrect plane orientation, and/or exclusion of key anatomical landmarks
- Poor quality scans may lead to suboptimal assessment²

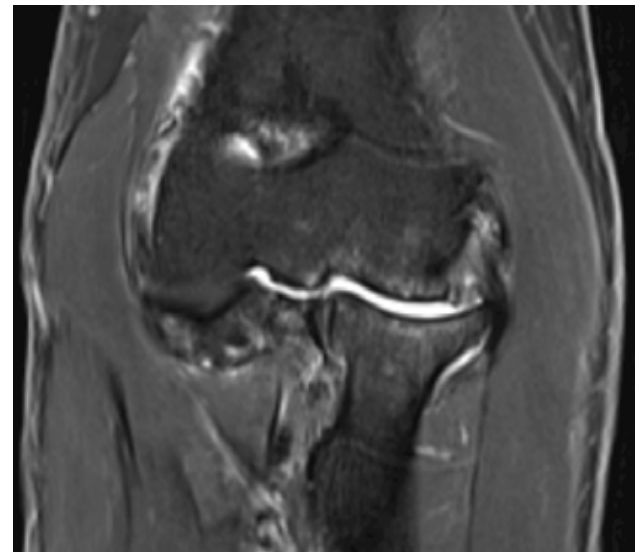
1. Anderson M (Principal Reviewer). ACR-SPR-SSR practice parameter for the performance and interpretation of magnetic resonance imaging (mri) of the elbow. Amended 2014 - Resolution 39.
2. Chew ML, Giuffre BM. (2005). Disorders of the Distal Biceps Brachii Tendon. Radiographics 25:1227-1237.

Study Aim

- To determine the technical adequacy of Elbow MRI using specific and objective parameters
- If studies are inadequate, intervene to address issues



FABS



Coronal

Standard^{2,3}

Audit Target

- Coronal and Sagittal planes should be oriented at 90 degrees to the axial
- Axial and FABS scans must fully include the insertion of the biceps tendon at the radial tuberosity

- Orientation to within +/- 10 degrees of 90
- 100% inclusion

No guidelines specifying *numerical* values for ideal scan coverage

2. Chew ML, Giuffre BM. (2005). Disorders of the Distal Biceps Brachii Tendon. Radiographics 25:1227-1237.

3. Sampath SC, Bredella MA. (2013). Magnetic Resonance Imaging of the Elbow: A Structured Approach. Sports Health 51(1):34-49.

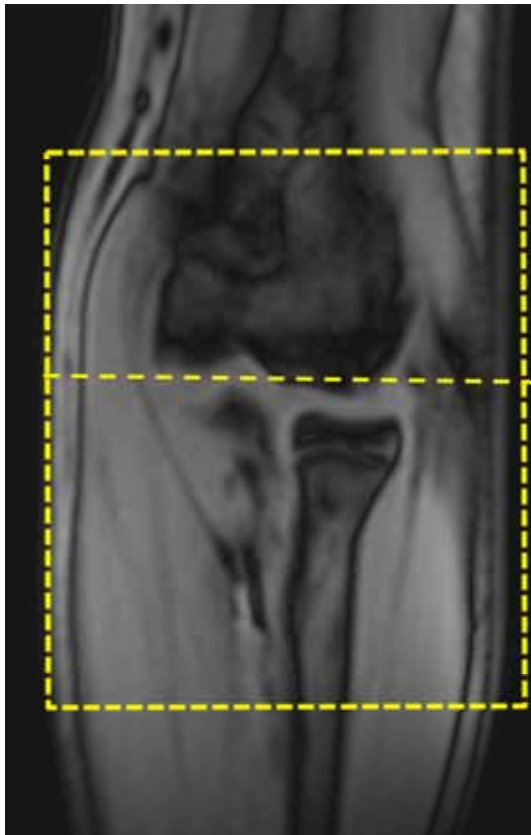
Methodology (1)

Pre-intervention

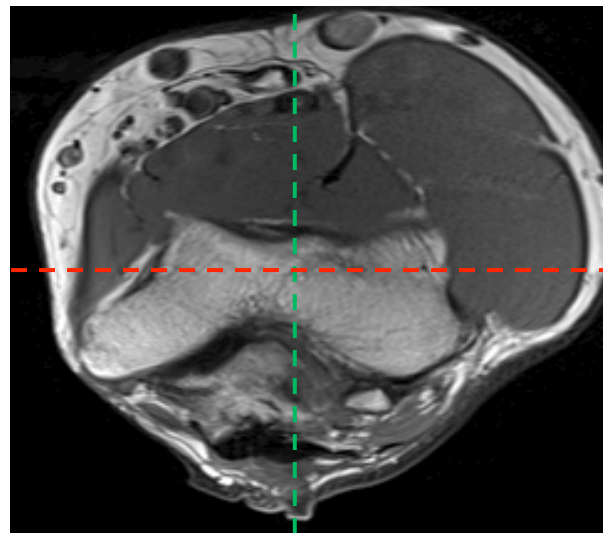
- Using Phillips iSite Radiology PACs software, data was collected on Elbow MRI studies from the Saskatoon Health Region's Royal University Hospital
- Pre-intervention studies were examined between January 1, 2014 and August 31, 2015
- Data from both 3T and 1.5T MRIs was collected, with existing routine elbow and FABS protocols
- Exclusion criteria
 - Non-routine studies

Methodology (2)

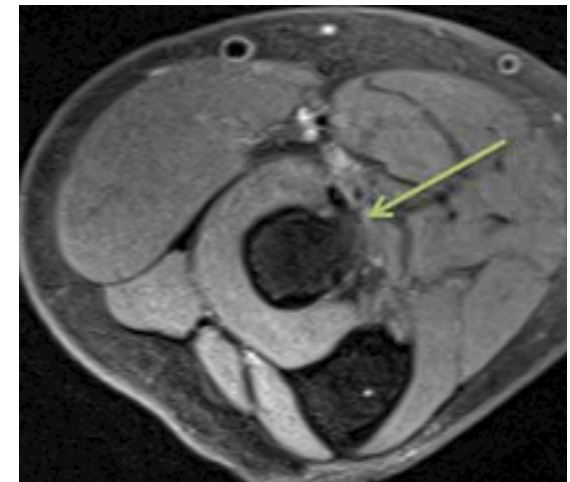
Pre-intervention parameters



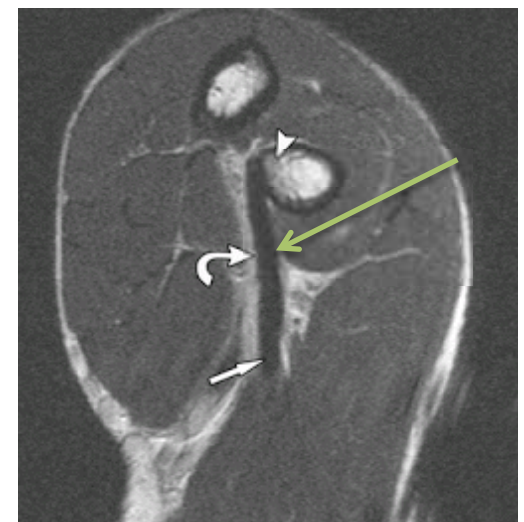
1. Scan coverage relative to radiohumeral joint line in all 3 planes



2. Orientation of **SAGITTAL** and **CORONAL** images relative to the axial plane



3. Inclusion of **radial tuberosity** on Axial (ABOVE) and FABS (BELOW)



Results – Orientation and Inclusion of Anatomic landmarks

- Routine protocol, n=63



- Mean sagittal vs axial orientation was 2.18 degrees from 90



- Mean coronal vs axial orientation was 0.05 degrees from 90 on average

- Axial images - radial tuberosity was *fully included* on **71.4%**, *marginally imaged* on **25.4%** and *not included* on **3.2%** of images



- FABS protocol, n=17

- 100% of images showed full inclusion of the radial tuberosity

Results – not scanning low enough

Inclusion of Radial Tuberosity	Average Axial scan coverage below joint line(mm)	Range of Axial scan coverage below joint line(mm)
Full inclusion	58.8	41.2 – 92.7
Marginal inclusion/not included	39.0	24.6 - 51.6

Table 1: Elbow MRI Axial scan coverage **below** the radio-humeral joint line comparing full inclusion vs marginal/absent radial tuberosity

Technical Parameter		Average (mm)	Range (mm)
Distance from radio-humeral joint line (mm)	COR above	64.3	35.6 - 90.3
	COR below	62.5	38.4 - 103.4
	SAG above	66.2	30.3 -94.7
	SAG below	62.0	41.1 - 107.8
	Ax above	49.8	33.5 - 87.8
	Ax below	53.0	26.5 -101.8

Table 2: Tri-plane elbow MRI scan coverage with respect to the radio-humeral joint line for routine elbow MRI protocol

Audit Assessment

- Coronal and Sagittal planes should be oriented at 90 degrees to the axial
- FABS scans must fully include the insertion of the biceps tendon at the radial tuberosity
- Axial scans must fully include the insertion of the biceps tendon at the radial tuberosity
- Acceptable orientation
- Acceptable for FABS
- Unacceptable for axial series
 - Requires intervention and reassessment

Methodology

Intervention

- Results, including inadequate axial coverage, were presented by the chief technologist at a technologist staff meeting
- An online educational survey was developed for MRI technologists pertaining to:
 - Identification of key anatomical landmarks e.g. radial tuberosity, biceps tendon, radio-humeral joint line
 - Recommended scanning technique including ideal plane orientation and coverage
 - i.e. sagittal at 90 degrees to axial plane and coverage to include radial tuberosity
- Anonymous feedback was solicited

Methodology

Post-intervention

- After intervening, Pre-intervention methods were repeated on data from September 2015 – March 15, 2016
- Data was compared to prior results

Intervention – Educational Survey

- Ten question online educational survey was developed for MRI technologists to provide real time feedback on:

- 1) basic elbow MRI anatomy,
- 2) scan technique, and
- 3) solicit feedback

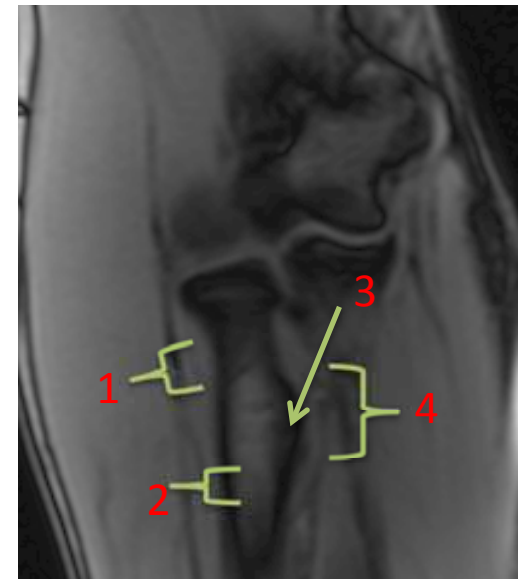
- Unfortunately, limited participation by technologists with n=3

- Only 66% of participants correctly identified the radial tuberosity on coronal scout (n=3)

- 66% of participants chose a field of view that **transected** the radial tuberosity on coronal scout

- To ensure inclusion of the radial tuberosity and biceps tendon on future scans, 3/3 Technologists preferred:

- Coverage of at least 2 distal images below the radial tuberosity OR
- 100 mm of standardized coverage centered on the radial neck



Sample Question: Identify the Radial tuberosity

1. X
2. X
3. X
4. 😊

Re-audit Results – Anatomic Inclusion

Inclusion of Radial Tuberosity (Routine Protocol)	Pre-intervention, n=63	Post-intervention, n=13
Full inclusion	71.4% (45)	84.6% (11)
Marginal inclusion	25.4% (16)	7.7% (1)
Exclusion	3.2% (2)	7.7% (1)

Table 3: Inclusion of radial tuberosity on Routine Protocol elbow MRI before and after intervention

- Sagittal vs axial orientation was 2.54 degrees from 90 on average
- Coronal vs axial orientation was 0.03 degrees from 90 on average
- 100% of FABS images again showed full inclusion of the radial tuberosity

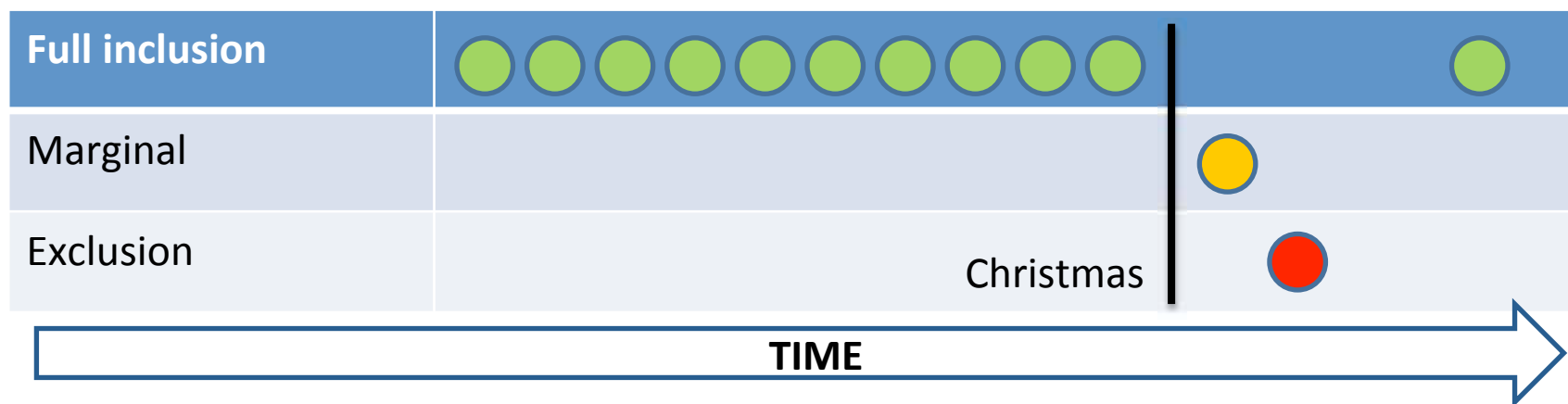


Figure 1: Graphical depiction of post-intervention re-audit results over time

Discussion – Preaudit and Intervention

- Coronal and sagittal plane orientation was acceptable
- FABS imaging was acceptable
- Inclusion of the radial tuberosity did not meet target even after intervention
- 2 interventions
 - Educational survey - potentially beneficial, but limited uptake
 - Results were discussed at staff meeting

Discussion – Reaudit and future directions

- Initial improvement to 100% inclusion, but overall, post-intervention results showed that 15.4% of axial elbow MRIs had marginal inclusion/absence of radial tuberosity (vs. 28.6% pre-intervention)
- Possible reasons might include:
 - People forget overtime and fall back into bad habits
 - Limited participation in educational survey
 - Inadequate knowledge of anatomy – importance of biceps tendon, endpoint of radial tuberosity
 - No standardized protocol calling for xx mm of coverage
- Next step:
 - Protocol to be modified specifying standard coverage of 50 mm centered on the radial neck for axial elbow MRI scans

Conclusions

- MRI quality was good, except for inclusion of radial tuberosity on axial images
- Following intervention, there was better inclusion on axial images
- While the intervention was beneficial, it may need to be periodically repeated for greatest benefit
- Elbow MRI protocols should be standardized – e.g. specifying at least 50 mm of coverage above and below the radial neck on axial