

Direction and Phase Swap on Shoulder MRI Imaging Leading to Horizontal Flip on Coronal Images on Shoulder MRI Exams - Frequency and Proposed Method to Avoid this Error

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Received: August 16, 2019; **Published:** August 26, 2019

Abstract

To evaluate the frequency of horizontal flip on coronal images on Shoulder MRI Exams and propose a method to avoid it. This audit could set standards to prevent the frequent horizontal flip of Coronal images on Shoulder MRI Exams.

Keywords: MRI Imaging; Horizontal Flip; Coronal Images

Background

It is common that coronal images on Shoulder MRI Exams come up flipped, almost always on left side. This pitfall is related to high obliquity (45° or higher) of the shoulder (Figure 1), leading to a swap in phase and direction.

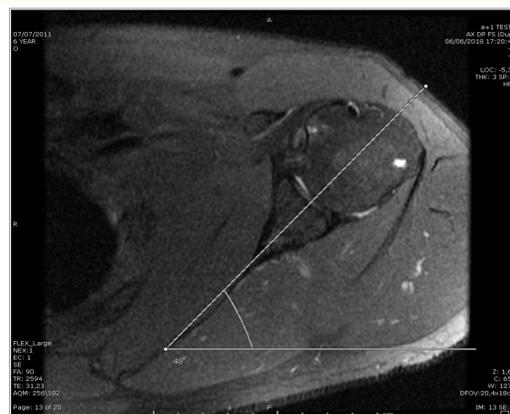


Figure 1: Image demonstrating the frequently high angle used when programming a Shoulder MRI Exam in order to obtain real coronal plane images.

This horizontal flip can be an error predisposing factor to radiologists and even orthopaedic surgeons and can lead to analysis mistakes, and even, eventually to reports informing the wrong side.

The Cycle

Current situation

Once designed our audit proposal we reviewed the last 50 Shoulder MRI Exams (2th February 2018 - 29th March - 2018) from 4 different radiology wards under our supervision, 25 each side.

None of the right shoulder coronal images were flipped. 18 coronal images (72%) from left shoulder were flipped.

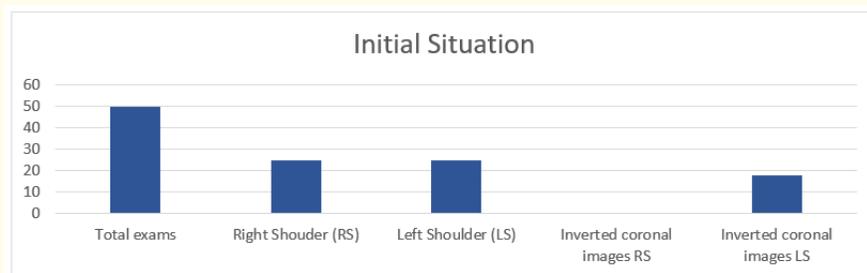


Figure a

The proposed measure

Every patient undergoing an Shoulder MRI exam should have a small cushion under the contralateral shoulder, aiming to keep a sustainable ideal position to the opposite shoulder in study and avoiding an increased angulation on MRI programming, which, when higher than 45°, is responsible for axis inversion and consequent image flip on coronal planes.

This axis inversion is described by Westbrook [1] as something to be avoided but she does not elaborate ways to prevent it. Our idea consists in some elevation of the contralateral shoulder in order to allow ideal MRI programming, not exceeding 45°, since the shoulder itself will be somewhat angled, reducing the need for over angulating during MRI programming (Figure 2).

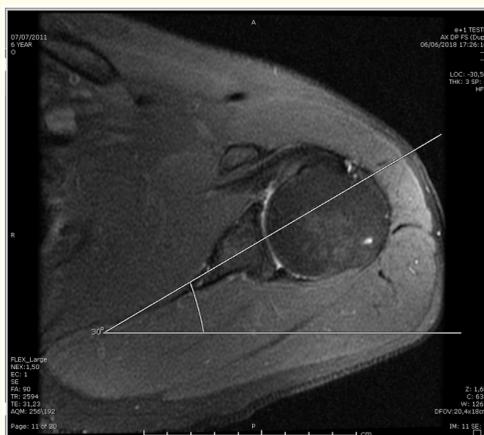


Figure 2: Same patient from figure 1 with a cushion under the contralateral shoulder. This action provides a slightly angled shoulder position, reducing the necessity to higher programming angles in order do obtain real coronal plane images.

MRI operators were clearly instructed, personally and through our Moodle system (available at our intranet system), about the proposed measure by our operator manager and the reasons we were implementing this.

Target

Our target is to achieve at least 90% correct coronal images in our patients. We are allowing a 10% margin in order to accommodate difficult patients (obese, extreme pain on shoulders preventing the use of cushions, etc).

MRI operators were instructed to fill an extra question in our technician form enlightening if the cushion was used and, whether not, why it was not used.

Results – Re-audit

After an approximately 3 weeks (30th March 2018 – 22th April 2018) period of orientation (personally and via Moodle) we reviewed the next 50 Shoulder MRI Exams, 25 each side, from our 4 different radiology wards 23th April 2018 – 28th May 2018).

To summarize, orientation to technicians consisted of explaining all why we were implementing this change and how we should perform exams from this point forward, presenting them images similar to figure 1 and 2.

After this training the technicians were given a short questionnaire with the following questions:

- Did you understand clearly why this change is being implemented?
- Did you understand how this change should be done?
- Does your ward have adequate tools to implement this change?
- Did you observe a reduction on phase swap (horizontal flip) with this change?

At re-audit, we found, just like in the original situation, no horizontal flip on all right shoulders coronal MRI images.

However, we found only 1 patient with horizontal flip out of 25 in left shoulder exams (5%). This particular patient was obese and even with the use of cushion it was not possible to provide satisfactory elevation of contralateral shoulder.

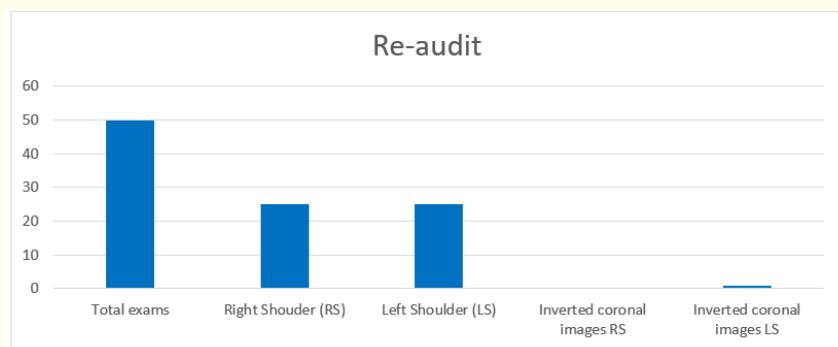


Figure b

Conclusion

Our goal was to assess the frequency of horizontal flip on shoulder exams, which by our daily observation, was high and virtually always on left side, and then propose a method to reduce this occurrence.

The results of this audit paper revealed the high frequency of this issue at our wards (72% on left shoulder studies) and supported our proposed measure, which reduced significantly its incidence (5%).

No differences were observed on right shoulder studies before and after our proposed measure (no horizontal flips).

Concluding, we found in this audit a high incidence of horizontal flip on coronal images in shoulder MRI exams (at our study restricted to left shoulder). Additionally, we concluded that a small cushion placed under the opposite shoulder undergoing examination is an effective method to prevent horizontal flip on shoulder MRI exams.

Despite simple, this procedure allows correct sided images and therefore faster and more confident MRI readings, contributing to prevent wrong sided reports that regardless of its low incidence are usually ominous when occurs.

Future Plans

After one year we intend to re-audit our shoulder MRI exams to check if adherence to use of cushions to perform Shoulder MRI exams keep strong, as well to check if our horizontal flip coronal images percentage keep under 10%. Additionally, we will try to develop measures to obtain 100% of correct sided images.

Bibliography

1. Handbook of MRI Technique, Catherine Westbrook (2014).

Volume 10 Issue 9 September 2019

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