Author's response to reviews

Title: Comparison of radiographs to 1.5T and 3T MRI scanners in evaluation of acute bone stress in the foot

Authors:

Markus J Sormaala (markus.sormaala@welho.com)
Juha-Petri Ruohola (j-p.ruohola@pp.inet.fi)
Ville M Mattila (ville.mattila@uta.fi)
Seppo K Koskinen (seppo.koskinen@hus.fi)
Harri K Pihlajamäki (harri.pihlajamaki@gmail.com)

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Comparison of radiographs to 1.5T and 3T MRI scanners in evaluation of acute bone stress in the foot

Markus J Sormaala, Juha-Petri Ruohola, Ville M Mattila, Seppo K Koskinen and Harri K Pihlajamäki

Response to reviewers

The authors would like to thank you reviewers Craig Ranson and Harri Sievanen for the constructive comment concerning our manuscript now titled “Comparison of radiographs to 1.5T and 3T MRI scanners in evaluation of acute bone stress in the foot”

The main criticism of Craig Ranson was, that asymptomatic acute bone stress changes were not differentiated for symptomatic bone stress injuries. The text has been rewritten so that it focuses on the sensitivity and characterization of the edema. The term “injury” has been removed from the text as suggested.

Both Craig Ranson and Harri Sievanen suspected that there might not be any significant difference in the sensitivity between the 3T and 1.5T images. The conclusions of the study have therefore been changed to:

“Owing to slightly better accuracy of 3T images, edema characterization is easier, which might aid in the differential diagnosis of the bone marrow edema. There was, however, no noteworthy difference in the sensitivity of the 1.5T and 3T images to bone marrow edema. Routine identification of acute bone stress changes and suspected stress injuries can, therefore, be made with 1.5T field strength.”
We have also written a point-by-point response to the concerns presented by the reviewers. In addition to the changes presented here, numerous minor typos have been corrected.

Yours truly,
Markus Sormaala, MD, PhD
Corresponding author

Abstract

Craig Ranson suggested rewording in background part of abstract:
"Acute bone stress is often visible on MRI as bone marrow edema..." &
“To investigate the ability of X-ray, 1.5T and 3T MRI to identify acute bone stress changes in the foot.”

The suggested change was made.

Craig Ranson commented on methods part of abstract:
It would be interesting to know the agreement results i.e. in how many cases were there differences in grading?

Harri Sievanen commented:
How many disagreements there were between raters and consensus was required?

The following information was added:
“The kappa-value for inter-observer variability was 0.86 in the MRI indicating substantial inter observer agreement.”

Craig Ranson commented on results part of abstract:
In what way were they superior?

The following information was added:
“One T1-weighted sequences, 3T images were slightly superior to 1.5T images in visualizing the demarcation of the edema and bone trabeculae.”

Craig Ranson suggested rewording in conclusions part of abstract:
“Routine identification of acute bone stress changes can be made with 1.5T field strength.”

The suggested change was made.

Harri Sievanen commented:
Whether 3T is better than 1.5T is not so clear to me - different performance was evident only in one case out of ten patients (10%) or two mild metatarsal injuries out of total 63 injuries (3%). Therefore I suggest that the authors are more
cautious in their conclusions and rephrase them.

The conclusions in the abstract were rephrased, so that they would not suggest, that 3T was clearly superior to 1.5T in detecting edema:
“3T images are at least equal to 1.5 T images in detecting lower-grade bone stress at an early stage.”

Background

Craig Ranson commented on first sentence

“MRI is the gold standard in the diagnosis of stress fractures”:
This is not a correct statement and contradicts the statement made in the background section of the abstract. The 'gold standard' for diagnosis of bone stress injuries is probably MRI as the first line investigation to identify bone stress changes such as marrow edema and periostitis. This should be followed by CT scan to visualize the bony architecture and allow staging of the injury if no fracture is evident on MRI.

The sentence was changed into:
“MRI is the plays an important roll in the diagnosis of stress fractures and in imaging acute bone stress changes in bone”

Craig Ranson commented:

Terms such 'bone stress changes' or 'the MRI appearance of acute bone stress' should replace 'bone stress injury' throughout the text as the presence of bone stress indicators such as marrow edema aren't necessarily 'injuries' and may in fact be normal asymptomatic responses to the type of loading sustained by groups such as military recruits and endurance runners.

The term “bone stress injury” has been replaced in the text by the terms “bone stress changes" and “the MRI appearance of acute bone stress” as suggested.

Craig Ranson commented:

Again, the type of changes described in this paper may not necessarily be 'pathology'. Suggest rewording e.g. '...in the evaluation of bone stress changes in the foot.'

The suggested change was made.

Methods

Craig Ranson commented:

References required. Is the incidence of foot stress fracture in this group known?

References the Defense Forces and to previous studies on bone stress injuries in the study population have been added
Craig Ranson commented:
The abstract suggests that stress fractures were confirmed using plain radiographs, rather than just a suspicion. Please clarify if this was the case?

The sentence was rephrased to:
“The inclusion criteria for the study were pain during exercise in the ankle or foot, and a fracture line, callus or faded cortex on plain radiography indicating stress injury of the foot.”

Craig Ranson commented:
Was edema associated with all cases where a fracture line was visible i.e. were there any old, chronic stress fractures identified that had no edema and if so, how were these dealt with in classification.

The following sentence was rephrased in the results:
“No other pathology than the stress acute injuries and acute bone marrow changes were seen in any of the patients.”

Results
Craig Ranson commented:
As per previous comments, I don't think the majority of these 63 MRI bone stress changes can be labelled 'injuries' unless there were concomitant symptoms such as local tenderness and localised pain on activity.

The term “injury” has been replaced in the text by the term “acute bone stress changes” as suggested.

Craig Ranson commented:
How many of these 63 incidences of acute bone stress changes had corresponding symptoms?

The following sentence was added to the results:
“All the patients enrolled in the study had pain in the foot during exercise and generalized tenderness in on physical exam.”

Craig Ranson commented:
Does this mean that only one stress fracture was identified using MRI alone as 12 were reported as visible on Xray?

The following sentence was added to the results:
“All of the stress fractures seen in the metatarsal bones could be seen on the radiographs. In addition to these 12 metatarsal fractures, one additional fracture in the cuboideum was detected with MRI.”

Craig Ranson Suggest reword to:
The number of incidences of acute stress changes in a single foot ranged from
one to 11 with an average of five per foot. (use full spelling with numbers under ten).

The suggested change was made.
Craig Ranson commented:
Need to be consistent with use of 3T or 3.0T
The inconsistency has been corrected, and only 3T is now used in the text.
Harri Sievanen commented:
Obviously it is not justified to calculate PPV as there were no false positive cases in this study. PPV is always 100% in this case.
The PPV values were omitted from the text.
Craig Ranson commented:
Is this correct - did only 2 out of 63 not being seen on 1.5T result in statistical significance? What were the sensitivity statistics?
Harri Sievanen commented:
Page 7, para 2. Where is the statistical evidence that the STIR sequence at 3T was significantly better than at 1.5T? Statistical methods should be specifically described.
The following sentence was omitted from the results:
“Though the difference in the images was subtle, there was, but statistically significant difference between the 3T and 1.5T images in the sensitivity of detecting bone marrow edema in the STIR sequences.”
And replaced with:
“…more clearly...”
The suggested change was made.
Discussion
Craig Ranson commented:
'Bone stress changes...' This is not the case with stress fractures, some of which are high risk and often have poor prognosis e.g. navicular, talar neck and base of 5th metatarsal.

“Bone stress injuries” has been changed to “Bone stress changes” as suggested
Craig Ranson commented:
Again, need to differentiate symptomatic injuries and benign bone stress changes.

The word “symptomatic” has been added to the paragraph to differentiate between symptomatic injuries and benign bone stress changes.

Craig Ranson commented:
MRI was primarily used as a method of identifying acute bone stress changes, not as a diagnostic tool.

The term “diagnostic tool” was omitted from the text as requested and the sentence now stands: “According to our study, 3T higher field strength MRI scanners are at least equally sensitive to equal 1.5T scanners MRI scanners in detecting bone stress edema.”

Craig Ranson commented:
This is probably not the case. Quite severely symptomatic and disabling injuries may only have subtle radiographic bone stress changes whilst sometimes florid edema may be asymptomatic and may resolve without an 'injury' ever being registered.

The following sentence was omitted
“Because the extent of the bone marrow edema in the bones of the foot determines the severity of the stress injury, correct evaluation of the edema on the MRI scans is a vital part of the diagnosis.”

And replaced with
“Based on our results, 3T MRI can be considered a good tool in evaluating the extent of acute bone marrow changes in the foot and enables the correlation these finding with the clinical status of the patient.”

Craig Ranson commented:
This conclusion cannot be drawn for the results presented.

The term “injury” was removed from the sentence and it was rephrased to:
“Based on our results, the 3T images provide the clinician with a good estimate of the extent of acute bone stress changes in the foot.”

Craig Ranson commented:
Need to mention some of the limitations of the study e.g. availability of 3T scanners, not correlating bone stress incidences with corresponding symptoms. Also it seems as though the 3T pictures may have been clearer they didn’t really add much to the identification process with 1.5T picking up almost all incidences of bone stress seen on 3T 61/63.

The conclusions of the study were changed so that they do not present 3T
images as more sensitive than 1.5T images. Also the following limitations were added to the end of the discussion:

“It must, however, also be considered, that 3T scanners also have potential disadvantages compared to 1.5T scanners. The availability of 3T scanners might not be as good as with more common 1.5 scanners. Also the cost of new 3T images might be higher and some artifacts might be more prominent in 3T images. Though all the patients in the study were symptomatic the study primarily focused on their imaging findings.”

Craig Ranson commented:
This last paragraph is a closer representation of the results of the study.
The study has identified that 'acute bones stress changes' such as marrow edema, periosteal reactions and in a few cases, acute stress fracture, are common in army recruits and can be identified by MRI with 3T perhaps offering some advantages over 1.5T scanning.
What is not known if their is any association between MRI findings of 'bones stress changes' and symptoms and disability.
What is also not known is how many of the incidences of isolated marrow edema are associated with fractures. One additional fracture was identified using MR however CT would have been required to determine whether fracture lines were also present alongside the other 60 incidences of acute stress as plain radiographs or MRIs may have missed subtle fractures.
We agree Beond the svope of the study

Conclusions
Craig Ranson commented:
There is no evidence presented that all stress fractures present in these subjects were identified using MRI. Comparative CT would have been necessary to determine this. Not a conclusion of this study. Tendon and ligament examination findings were not presented or discussed so should not be mentioned in the conclusion.
The following sentences were omitted from the text:
“The slightly higher quality of the 3T images will, however, help in evaluating the small joints and cartilages of the foot [12]. Also, the evaluation of tendons and ligaments is easier with the slightly better accuracy provided by the higher field strength of 3T MRI.”

Figures & Tables
Craig Ranson commented:
Needs a label as very difficult to spot Please label the stress fracture. Perhaps, however the stress changes and the fracture line (need to label) are still pretty obvious on both. Not much to be gained from using 3T?
The acute bone stress changes and stress fractures have been labeled.

Harri Sievanen commented:

Supplementary table: Give the grades in Roman numbers as they are given in the text. Table 1. Please spell out the MRI abbreviations for non-specialists.

The suggested change was made.