



CONVENTIONAL RADIOGRAPHIC REVIEW OF TIBIAL STRESS INJURIES IN ADOLESCENT ATHLETES WITH POSITIVE MAGNETIC RESONANCE IMAGING

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OBJECTIVES

To determine if the presence of periosteal or endosteal new bone formation seen on adolescent athletic lower leg radiography was associated with bone stress injury findings on MRI and coincided with clinical examination.

METHODS

Eighty adolescent athletes with a history of shin pain underwent clinical examination by orthopedists. On day of clinical examination, tibial radiographs and MRIs were obtained. MRI Images were reviewed utilizing Fredericson grading. Radiographic images were re-evaluated later by two radiologists, blinded to MRI and clinical exam results, who reviewed the radiographs for evidence of bone stress injury including new bone formation. Results of review were compared with clinical exam and MRI findings. Sensitivity, Specificity, negative and positive predictive values were calculated.

DISCUSSION

Identification of new bone formation is not a new concept; however, this study was one of the first studies to compare a large group of adolescent radiographs with clinical and MRI findings. Our study group was unique from existing published literature, but our sensitivity was similar to existing literature 27% vs 15% - 33% of their findings [Giladi 1984, Fredericson 1995].

The literature notes that there is a strong association between the presence of periosteal reaction on radiographs at the site of the clinical symptoms and a Fredericson grade 4 stress injury on MRI. [Mulligan 1995].

Though we only had five grade IV tibias in our study, we found all five had evidence of periosteal new bone on radiograph. In the adolescent population in our study as the severity of injury increased, so did frequency of radiographic findings.

Since the tibia is not uniform in shape utilizing two dimensional images often make subtle injury hard to identify. This is particularly true with endocortical findings and in comparison of cortex width. Findings of PNB are much easier to identify and subtle findings become more apparent with image enhancement that is available with digital films.

RESULTS

Radiographs from 80 adolescent athletes were reviewed and originally read as normal, however 87% of tibia showed evidence of bone stress injury on MRI (127/146). Retrospective review of radiographs identified 27% (34/127) with evidence of abnormality (new bone growth) that correlated with MRI based on Fredericson rating, with presence more common with higher grades:

- Grade 0: 0/19, Grade I: 0/19,
- Grade II: 11/75 (12%),
- Grade III: 18/28 (64%),
- Grade IV: 5/5 (100%)

The average thickness of PNB ranged 1.5mm – 5mm (avg. 2.5mm) and all findings (27/146) on lateral view films were located on the posterior cortex. PNB was found in the proximal diaphysis of the tibia on 9 radiographs, the middle diaphysis on 19, and 6 on the distal tibia. Bone sclerosis was seen on 3 radiographs of which 2/3 were seen in the distal third of the tibia. A non-ossifying fibroma was found on 4/146 (2.7%) of tibias imaged. Evidence of PNB or ENB on radiograph yielded a sensitivity of 27%, specificity of 100% and a PPV of 100% and NPV 17%. Chi Square utilizing 2 x 2 modeling; X² (1)=6.63, p=.0100

CONCLUSIONS

Radiography should be utilized acutely with adolescent athletes who report tibial pain from a suspected BSI. Though sensitivity is low, use of digital images with enhancement and notation of subtle findings of PNB or ENB may indicate a higher level of BSI that may require advanced imaging and more conservative treatment. Care should be taken to identify radiographic findings with clinical symptoms as discordant findings are possible especially with athletes who have had prior BSI.

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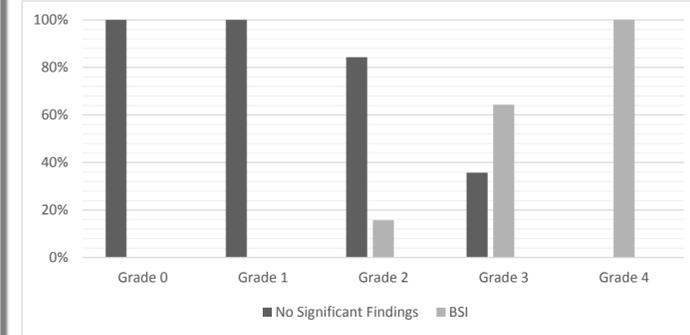


Chart 1. Radiographic BSI corresponding to MR tibia stress injury utilizing Fredericson grading on Re-review

| Fredericson Grading | No Sig Finding N (%) | ENB N (%) | PNB N (%) | Both ENB/PNB N (%) |
|---------------------|----------------------|-----------|-----------|--------------------|
| Grade 0 | 19 (100%) | 0 (0%) | 0 (0%) | 0 (0%) |
| Grade 1 | 19 (100%) | 0 (0%) | 0 (0%) | 0 (0%) |
| Grade 2 | 59 (84%) | 1 (1%) | 8 (11%) | 1 (1%) |
| Grade 3 | 10 (36%) | 3 (11%) | 11 (39%) | 2 (7%) |
| Grade 4 | 0 (0%) | 0 (0%) | 5 (100%) | 0 (0%) |

