



Bone Stress Injury Classification Systems

REF: Blazeney P, Forester B, Ardern C. Bone stress injury classification systems: why are there so many, and how should we put them to use in the clinic. Aspetar Sports Medicine Journal. 18-24.

▼ Key Findings

- ▼ Athletes who suffer high-risk BSIs may never return to sport
- ▼ A "cautious" approach may work for non-professional athletes, but is almost always undesirable to the athlete (detrimental effects to the career) and team (decreased performance)
- ▼ Therefore, understanding the earliest possible opportunity that an athlete can return to sport is important
- ▼ The hx of BSI classification systems
 - ▼ The first MRI BSI classification systems emerged in the mid-1990s using the bone continuum model

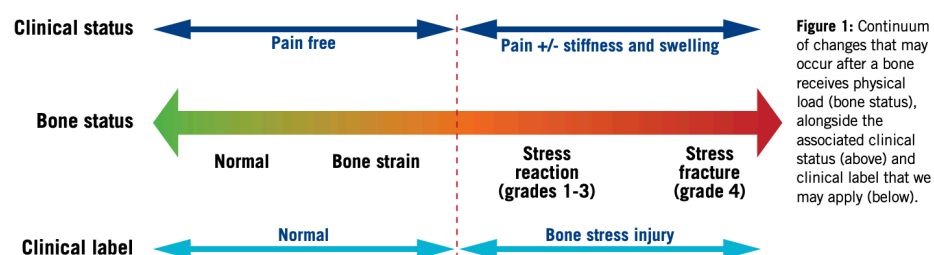
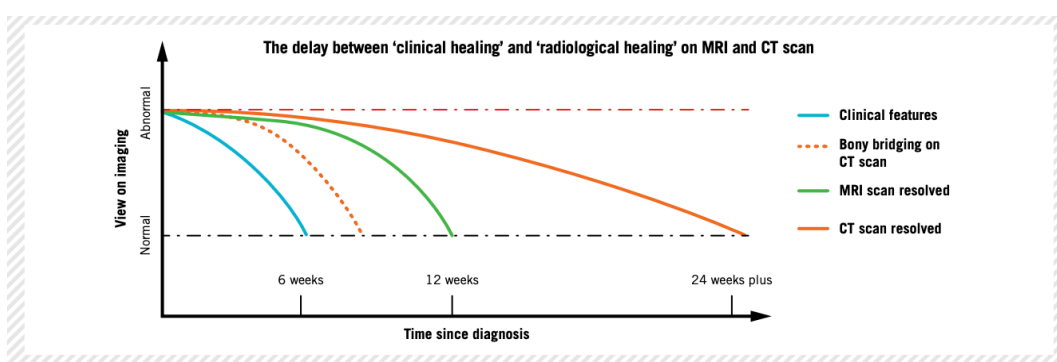


TABLE 1

<i>Classification system (1st author and year)</i>	<i>General or site-specific</i>	<i>Imaging modality</i>	<i>Rationale for development</i>
<i>Fredericson (1995)</i>	<i>Tibia</i>	<i>MRI</i>	<i>Developed for BSI in the tibia (validated on posteromedial injuries, not the high-risk anterior tibial cortex injury). Guides prognosis and time to return to sport.</i>
<i>Arendt (1997)</i>	<i>General</i>	<i>MRI</i>	<i>Extended grading to all BSI sites and altered grading categories based on MRI imaging. Included general treatment guidelines.</i>
<i>Saxena (2000)</i>	<i>Navicular</i>	<i>CT (computer tomography)</i>	<i>Specific to high-risk BSI in the navicular. Goal to aid treatment decision-making (non-surgical vs surgical)</i>
<i>Nattiv (2013)</i>	<i>General</i>	<i>MRI</i>	<i>Extended Arendt (1997) by including risk factors to enhance prognostic capabilities of the classification system.</i>
<i>Kaeding (2013)</i>	<i>General</i>	<i>Multiple (X-ray, CT, MRI)</i>	<i>Included clinical symptoms in grading, and a focus on imaging accessibility (i.e., access to MRI)</i>
<i>Rohena-Quinquilla (2017)</i>	<i>Femoral neck</i>	<i>MRI</i>	<i>Specific to high-risk BSI in the femoral neck. Goal to aid treatment decision-making (non-surgical vs surgical) and predict time to return to duty (in military population)</i>



▼ The need for multiple systems

▼ There are four reasons why consensus doesn't exist on classification systems

▼ Terminology

▼ the term bone strain refers to normal adaptation to load

▼ In asymptomatic athletes it may be difficult to separate bone strains from stress reactions, especially if **there is some debate whether or not periosteal changes alone should be considered stress reactions or a normal response to bone loading**

▼ Those who should be treated as having a bone stress versus undergoing a normal reaction to load or bone strain is based on whether or not they have clinical symptoms

▼ Multiple imaging modalities

▼ MRI is the gold standard, but specific locations may require different imaging modalities (such as the navicular) to characterize the injury

▼ Site-specific classifications

▼ The Saxena classification recommends CT for the navicular bone (better at characterizing a fracture line).

▼ There's some debate whether the 50% rule (Quinilla) is necessary for surgical management of a FNSF.

▼ The author isn't confident we need separate classification systems for spongy versus cortical locations

▼ Prognostic or treatment-guided capacity

TABLE 3		
Bone affected	Initial investigations, including MRI-grading	Likely management
All low-risk BSIs	Grade injuries 0-4 using MRI. Begin non-surgical management and provided prognosis.	Non-surgical. Reduce activities, address risk factors and apply gradual return to sport monitoring for symptom reoccurrence.
Femoral neck (both compression- and tension-sided)	Grade injury 0-4 using MRI. Attempt to measure the severity of fracture line based on MRI if grade 4 BSI is observed.	Most often non-surgical, with evidence for good outcomes even with severe grade 4 injuries.
Anterior tibial diaphysis	Grade injury 0-4. Consider CT to characterise the extent of injury if a grade 4 BSI is observed on MRI.	Initial trial of non-weight bearing, optimizing nutrition and lifestyle factors and surgical consultation.
Navicular	Grade injury 0-4. Consider referral to CT as a standard follow-up with navicular BSI to best characterise the presence and extent of a fracture line.	Mixed. Evidence has supported both non-surgical (8-weeks of full immobilisation) and surgical approaches for fractures graded Saxena class-2 or greater. Benefits and risks may be discussed with the athlete, and a shared decision can be derived on best management for their individual case and preferences.
Base of fifth metatarsal	Grade injuries 0-4. Plain radiographs may be sufficient in determining the site and extent of an injury using either the Torg or Lawrence and Botte classifications for 5th metatarsal fractures (including stress fractures)*	For those with a confirmed fracture line at the 'true' stress fracture location (zone 3) – surgery is the optimal choice of treatment. Evidence in athletes has consistently demonstrated improved return to sport times and reduced risk of re-injury ^{23,33} . However, accurate treatment relies on identifying the zone of the 5th metatarsal in which the fracture lies, and surgical complications are not uncommon ^{34,35} .

*for a more detailed discussion of 5th metatarsal fractures, see the critical review by Buskova et al (2021)³⁶.

Table 3. Suggested process for classifying high-risk BSIs

▼ Author recommendations

▼ For the athlete

- ▼ Clinical experience suggests athletes present to the clinic after a cortical break (higher-graded MRI)
- ▼ Most overuse BSIs are easily managed if detected early and still in grades 1-3.

▼ For the coach

▼ For the practitioner

▼ Suggestions

- ▼ Follow MRI standard for low-risk BSIs (0-4 scale)
- ▼ For high-risk anterior tibia, navicular, and base of the 5th, CT is added to MRI standard to assess for the presence, extent, and specific location of a

cortical fx. MRI is typically sufficient for the femoral neck.

▼ Repeat imaging of high-risk BSIs at 6-8 weeks to gauge return to sport decisions

▼ No repeat is needed with low-risk sites that are asymptomatic