3

IMAGING AND HEALING PROGRESSION OF POST-TRAUMATIC BONE BRUISE

Berruto M, Ferrua P, Uboldi F, Parente A, Usellini E

Knee Joint Surgery Department, G. Pini Orthopaedic Institute, Milan, Italy

In 1988 Wilson et al. introduced the term bone marrow edema in describing a group of patients with a-traumatic debilitating knee and hip pain. On T2-weighted Magnetic Resonance (MR) images, they recognized an ill-defined hyper-intensity in the bone marrow where standard radiographs showed nonspecific osteopenia or normal findings. This discrepancy in the imaging studies was labeled bone marrow edema owing to the "lack of a better term and to emphasize the generic character of the condition." The proposed pathogenesis of these marrow changes asserts that increased blood pooling, edema, reactive hyperemia, and possible microfracture of the trabecular subchondral bone alter the marrow signal intensity.

The pathophysiology of bone marrow edema is currently nonspecific, and differentiation of the different causes can be difficult. In particular, distinguishing among osteochondritis dissecans, spontaneous osteonecrosis of the knee, and idiopathic transient bone marrow lesion syndrome is difficult because ischemic and microtraumatic factors both contribute to their presentation.

In time, bone marrow edema earned the moniker bone bruise to reflect its traumatic nature.

Bone Bruise usually results from either a direct and sudden force or from repetitive compressive forces that are not strong enough to break or fracture a bone. There are many ways one can suffer from a Bone Bruise: sports injuries, especially in those which involve a lot of falling or getting into hard contact with objects or other players; twisting injuries, causing the involved bones to collide with each other forcefully and high velocity trauma to a bone; in general, any type of direct impact or high velocity trauma to a bone brought about by an incident such as a car accident, a high fall, or a blunt force can result in a hematoma, a contusion, or a bruise to the bone affected.

The ability to identify a Bone Bruise is unique to MR studies. MR Imaging sensitivity is reported to be 91-96% and the specificity 86-96%.

On T1-weighted images, the alterations in the subchondral bone marrow signal are characterized by ill-defined low signal intensity, compared with the unaffected bone marrow.

In contrast, on T2-weighted, proton density-weighted, fat-suppressed fast spin echo or short tau inversion recovery images, these lesions are characterized by areas of high signal intensity. The hypervascularity in the involved areas is clearly illustrated as the administration of intravenous contrast agents results in further enhancement of these bone marrow signal alterations.

The term Bone Bruise should be applied exclusively to subchondral lesions that exhibit the typical MR findings. These lesions are acute traumatic non-cystic areas of bone marrow edema, and they can be distinguished from cystic a-traumatic presentations.

Distinction between post traumatic Bone Bruising and non-cystic marrow edema syndromes is primarily based on a clinical history of trauma, as the radiological features are largely indistinguishable.

Swelling is the most common sign of a bone bruise and occurs in most people with this type of injury. Many other injuries can cause swelling, and it is not always apparent that the bone is bruised at the time of injury. Sometimes the bruise is visible on the skin when other soft tissues are bruised, but the only definitive way to determine if swelling is the result of a Bone Bruise is with MRI.
Pain is the most universal symptoms of a Bone Bruise. Pain at the time of injury is common, but the pain often intensifies over the next few days and may last for weeks. People with a Bone Bruise can help control pain during the healing process with over-the-counter pain relievers.
Stiffness can occur, particularly if the injured bone is part of a joint or near a joint. The knee and elbow are common injury sites for bone bruises, especially for athletes. Stiff joints can be indicative of other injuries as well.
Most Bone Bruises heal in 60 days, but the healing time may be as long as 2 years.
Few studies to date address resolution of bone contusions or long-term sequelae.
Vellet et al. (3) demonstrated complete resolution of MRI contusions at 6-12 months but osteochondral sequelae in 67% of cases were noted. The commonest finding was an overt cartilage defect (48%), but features of osteosclerosis, cartilage thinning and osteochondral defects were also seen.
Bretlau et al. (1) recently reported persistent bruising in 69% and 12% of patients rescanned at 4 and 12 months respectively. Miller et al. (Am J Sports Med 1998; 26: 15-19), in contrast, suggested the majority of lesions resolved in 2-4 months but his study involved patients with isolated medial collateral ligament knee injury, the benign nature of which may have influenced the rate of recovery.
Much anecdotal evidence that contusions resolve within the first few months is inferred from earlier studies on incidence. In Graf's series (Am J Sports Med. 1993; 21: 220-223) with a 48% incidence of contusions, no lesions were seen in scans later than 6 weeks. Tung et al. (2) reported a significantly shorter interval from injury to MR imaging when bone bruising was present (mean 4.3 weeks) than in those with normal medullary signal (mean 24 weeks). Dimond et al. (Am J Knee Surg 1998; 11: 153-159) found scans were consistently negative for contusions by 6 months, but showed a greater incidence of meniscal tears and chondromalacia. Whether these are secondary injuries from instability, or indeed sequelae of a resolved bone bruise is open to question.
Two year follow-up studies suggest that 10-15% of patients have persistent marrow edema at 2 years and up to one third have some evidence of subchrondral osteonecrosis or articular cartilage de generation.

References

1. Bretlau T, Tuxøe J, Larsen L, Jørgensen U, Thomsen HS, Lausten GS. Bone bruise in the acutely injured knee. Knee Surg Sports Traumatol Arthrosc 2002; 10: 96-101
2. Tung GA, Davis LM, Wiggins ME, Fadale PD. Tears of the anterior cruciate ligament: primary and secondary signs at MR imaging. Radiology 1993; 188: 661-667
3. Vellet AD, Marks PH, Fowler PJ, Munro TG. Occult posttraumatic osteochondral lesions of the knee: prevalence, classification, and short-term sequelae evaluated with MR imaging. Radiology 1991; 178(1): 271-276