MRI EVIDENCE OF BONE EDEMA IN KNEE OA INDICATES MORE RAPID PROGRESSION TO TKA

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INTRODUCTION
The terms bone bruise or bone edema are interchangeably used in the description of decreased intensity in T1 weighted magnetic resonance images (MRI). Conversely bone marrow edema has an increased intensity in a T2 weighted image. The water that replaces the fat may be a product of edema or increased vascularity. Following an anterior cruciate rupture one or more areas of bone marrow edema may appear. It is suspected that bone microdamage is responsible for this finding. Most instances of bone edema following this type of trauma disappear over a period of months(1).

Bone marrow edema in the knee is also seen in association with bone cysts. Bone cysts are known to be associated with a process of initial osteoclastic bone absorption followed by cyst formation(2). When seen on MRI the cyst is bright on the T2 weighted image and is typically surrounded by an area of less intense signal(3). Bone marrow edema is often seen associated with knee osteoarthritis (OA). In a recent study the degree of bone edema appeared to be associated with the severity of angular deformity at the knee(4).

The senior author (FN) suspected that the pattern of bone edema might be predictive of a more rapid progression of OA leading to total joint replacement. We felt that the criteria for total knee replacement would be relatively uniform at a single institution relying on fellowship trained major joint surgeons. We therefore selected the time of total knee replacement as a reasonable endpoint.

METHODS
A database of over 300 MRI studies of knee OA from 1995-1997 was used to select individuals who had at least a three year follow-up record from the time of the MRI study. There were two groups, those who had an absence of bone edema and those with reported bone edema. Initially there were 30 patients in the OA only group and 35 in the OA with bone edema group. The reviewing radiologist was blinded to the original interpretation of the MRI and reviewed all 65 studies. His interpretation was 28 patients with no edema and 37 with bone edema.

The bone edema group was then divided into four patterns: Type I was a wedge shape affecting only a portion of a compartment, Type II was a linear appearance horizontally located just below the joint surface, Type III was a global pattern occupying the entire compartment, and Type IV was a focal edema associated with a bone cyst.

RESULTS
12 of the 37 knees with bone edema were replaced within 3 years of MRI. Only 2 of the 28 knees in the group with no bone edema were replaced within 3 years of MRI. There were no statistical differences in age, sex, or the length of time of symptoms prior to MRI. Of the 12 knees that were replaced and had bone edema 7 had a global pattern, 3 had a focal pattern, and 2 had a cyst pattern. Of the 25 knees that did not have joint replacement within three years 3 had a global pattern, 21 had a focal pattern, one had linear pattern and none a cyst pattern.

DISCUSSION
To our knowledge this is the first attempt to describe bone marrow edema seen on MRI in a fashion that might reflect separate if not overlapping biological responses to osteoarthritis in the knee. Current methods of classifying osteoarthritis do not reflect specific characteristics that may distinguish predominant biochemical responses in specific groups of patients. This study may provide some insight into these biochemical differences. Prior authors have correlated the degree of bone edema with increased degree of angular deformity. However the shape and pattern of the edema is not clear from that study.

The cause of bone edema is not clear in most instances. It is known that there is an increased blood supply and bone turnover in the area of bone cysts. This could account for the findings of bone edema associated with some bone cysts. It would be inviting to imply that linear subchondral bone edema is a stress reaction in bone but the pattern is not the same as is seen in classic “stress fractures”. The global patterns seen in our series are restricted to one compartment and thus are not likely to represent a whole joint hyperemia as is seen in inflammatory joint disease.

It will require a number of years of prospective longitudinal study to be able to correlate the clinical course with specific patterns of radiologic changes including focal versus more generalized finding on radiographs, bone scans, and arthroscopic evaluations.

CONCLUSION
The use of a non graded non linear classification system for the interpretation of MRI studies appears to help predict the relative rate of progression to total joint replacement. This finding will help lead to a better classification method that reflects the biological events that are associated with those individuals who have an accelerated course of joint degeneration.

REFERENCES

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