

Can Orthopaedic Oncologists Agree on What Is and Is Not a Pathologic Fracture?

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INTRODUCTION:

There has been an extensive amount of discussion regarding treatment of pathologic fractures and assessing the risk of impending pathologic fractures. However, somewhat surprisingly, no consensus exists on the definition of a pathologic fracture. Although simple in concept, agreement on a reproducible definition of a pathologic fracture is important for patient care, research, and procedural coding. This survey-based study aims to identify areas of agreement and disagreement among orthopaedic oncologists as the initial step to creating a concise and informative definition of pathologic fracture to be applied for future research and practice management.

METHODS:

We developed a survey of 20 cases and distributed to 30 orthopaedic oncologists holding committee or leadership positions in the Musculoskeletal Tumor Society (MSTS) at 2 different timepoints separated by 6 months. Each question consisted of a PowerPoint slide with representative xrays, CT, and MRI when available. On the first survey, there was only one question for each case, "Is there a pathologic fracture?" (Figure 1). Respondents were required to respond simply yes/no. In the second survey, we asked the participants to provide additional insight and rationale behind their selection to further investigate areas of differences in interpretation or assessment. Fleiss' Kappa was used to evaluate inter-rater agreement while Cohen's Kappa assessed intra-rater agreement for the binary classification of pathologic fractures. The strength of agreement was classified on an interval scale based on kappa value from 0.0-1.0.

RESULTS:

We removed two participants from the final analysis – one who did not complete the second survey and one who was an extreme outlier, making the Kappa statistics unreliable. Fleiss' Kappa for inter-rater reliability was 0.54 for the first survey, indicating moderate agreement ($p < 0.001$) and 0.64 for the second, reflecting substantial agreement ($p < 0.001$). Fleiss' Kappa was 0.47 for the description of imaging findings, reflecting moderate agreement (Figure 2). Of the 28 raters, 64.3% demonstrated moderate or better intra-rater reliability and 35.7% demonstrated fair or poor internal consistency. Several cases were evenly split between participants, suggesting current assessment of the presence of a pathologic fracture remains subjective and undefined.

DISCUSSION AND CONCLUSION:

Overall, we found moderate intra- and inter-rater reliability in assessing the presence of a pathologic fracture. When we looked deeper on a question-by-question basis we found clear agreement that cases with a complete fracture line or bone displacement represented a pathologic fracture. Similarly, cases with bone erosion but no obvious complete cortical disruption were reliably determined to not represent a pathologic fracture. The major areas of discrepancy were 1) the bone demonstrated a cortical perforation with a soft tissue component from the underlying tumor, 2) the cortex was severely compromised but difficult to determine whether there was a true discontinuity, or 3) there was an incomplete fracture line or callus formation in a portion of the cortex. Often raters would agree on the imaging findings but would draw opposite conclusions regarding whether this represents a pathologic fracture. Further review and consensus agreement on imaging findings based upon these data will allow for a clear definition of a pathologic fracture that can be universally applied. This work is currently informing a consensus project within the MSTS.

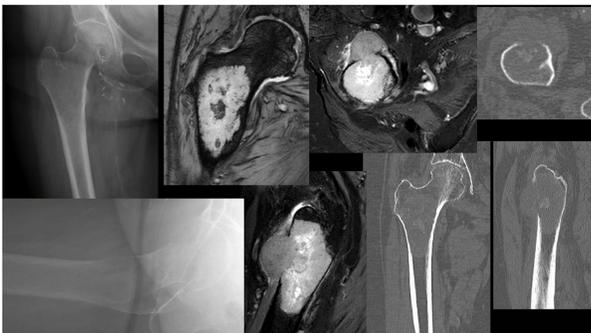


Figure 1. Case example with substantial disagreement between participants

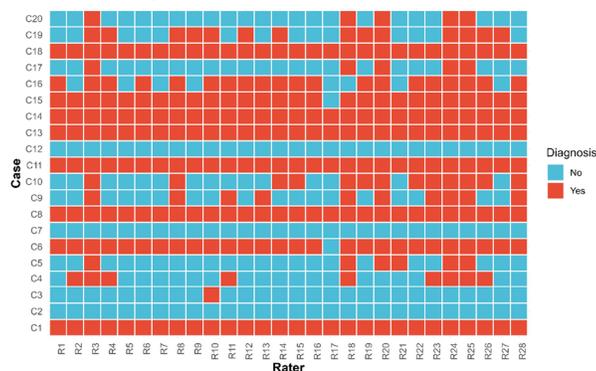


Figure 2. Heatmap of inter-rater agreement on pathologic fracture diagnosis from the second review