

# Database level evidence demonstrates improved outcomes following prophylactic fixation of impending fractures compared to pathologic fracture fixation

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## INTRODUCTION:

Prophylactic fixation is an established strategy to reduce the risk of impending pathologic fractures in patients with bone metastases. However, in clinical practice, many patients are not referred until after a fracture has occurred – often in the setting of advanced disease, functional decline, and increase perioperative risk. While prior studies suggest improved outcomes with prophylactic fixation, these have largely been limited to single-institution cohort, and few have leveraged large, multi-institutional datasets. To our knowledge, no prior study has stratified these outcomes by primary malignancy, despite known differences in tumor biology and skeletal disease patterns. Moreover, existing literature has predominantly focused on mortality and reoperation, with limited evaluation of other clinically meaningful endpoints such as surgical complications, medical morbidity, and markers of early recovery. This study aims to comprehensively compare outcomes following prophylactic versus post-fracture fixation for long bone metastases, with stratification by cancer type to better inform tumor-specific decision-making.

## METHODS:

Using the TriNetX Research Network, a retrospective cohort study was conducted of adults with metastatic carcinoma, myeloma, or lymphoma to bone who underwent intramedullary nailing of long bones. Patients were stratified by timing of surgery: fixation for an impending fracture versus fixation after a completed fracture. Propensity score matching was performed on age, sex, comorbidities, and cancer type. Outcomes assessed included 90-day and 1-year mortality, surgical complications (e.g., infection, implant failure), and medical complications (e.g., thromboembolism, sepsis, transfusion requirements). Subgroup analyses were conducted by primary malignancy to assess cancer-specific trends.

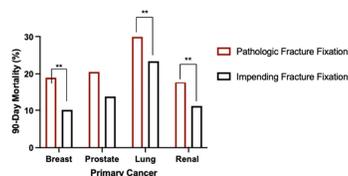
## RESULTS:

Of 3,349 patients included, 1,974 underwent post-fracture fixation and 1,375 underwent prophylactic fixation. Prophylactic fixation was associated with significantly lower 90-day mortality overall (15.4% vs. 22.1%,  $p < 0.0001$ ) and within key cancer subgroups. In breast cancer, 90-day mortality was reduced from 15.7% (post-fracture) to 10.3% (prophylactic,  $p < 0.0001$ ), with corresponding reductions in sepsis rates, infection, and transfusion. Similar patterns were observed in patients with lung and prostate cancers, with post-fracture fixation linked to increased thromboembolic events and implant-related complications. Though statistical significance varied, consistent trends favoring prophylactic fixation were also noted in renal cell carcinoma, thyroid cancer, multiple myeloma, and lymphoma. Revision rates at 1 year were low and comparable between groups, suggesting durable fixation outcomes irrespective of timing.

## DISCUSSION AND CONCLUSION:

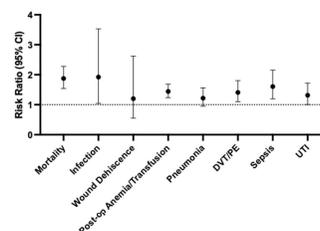
Post-fracture fixation of patients with metastatic bone disease is associated with increased short-term mortality and higher rates of medical and surgical complications compared to prophylactic fixation, with consistent trends across primary malignancies. These findings underscore the clinical consequences of delayed intervention and emphasize the importance of early identification and referral for surgical evaluation in patients at risk for pathologic fractures. Stratifying outcomes by cancer type adds critical context and suggests that timely fixation may be especially beneficial in high-risk groups, such as patients with breast or lung cancer. These data support a shift toward earlier, risk-informed decision-making in the multidisciplinary care of patients with skeletal metastases.

Figure 1: 90-Day Mortality Following Fixation of Impending Versus Pathologic Fracture, Stratified by Primary Cancer Type



Comparison of 90-day mortality between fixation of impending pathologic fractures and fixation following pathologic fracture, stratified by primary malignancy type.  $p < 0.01$  for indicated comparisons.

Figure 2: Risk of Postoperative Complications Following Fixation of Pathologic Fractures Versus Impending Fractures



Risk ratios with 95% confidence intervals for postoperative complications following fixation of pathologic fractures versus impending fractures. All comparisons were statistically significant at  $p < 0.05$ , except for wound dehiscence and pneumonia. The dotted line at risk ratio = 1 indicated no difference between groups.