

**Center for Cellular Biointerfaces in Science and Engineering (CCBSE)  
Mechanobiology of Cancer through direct nanoindentation**

Kalpana Katti, University Distinguished Professor, Civil and Environmental Engineering (NDSU)

Dinesh Katti, Jordan A. Engberg Presidential Professor, CEE (NDSU)

Students: Shahjahan Molla, Sumanta Kar (both NDSU)

<i>Award Title:</i>	<b>New Discoveries in the Advanced Interface of Computation, Engineering, and Science: ND-ACES</b>
<i>NSF Award Number:</i>	OIA-1946202
<i>Principal Investigator:</i>	Kelly A. Rusch, Ph.D., P.E., BCEE
<i>Lead Institution Name:</i>	North Dakota State University
<i>Award Start Date:</i>	7/1/2020
<i>Award End Date:</i>	6/30/2025
<i>Highlight Submission Date:</i>	4/1/2020

**What is the outcome or accomplishment?** CCBSE developed a novel direct nanoindentation-based methodology to demonstrate the degree of elastic modulus and the mechanical plasticity of cancer cells as a measure of the metastasis progression for prostate cancer (Figure 1). Prostate cancer tumoroids were created on tissue engineered bone scaffolds. In addition, dynamic nanoindentation experiments with breast cancer cells indicate softening of tumors as well as an increase in viscoelasticity with metastasis progression. These mechanics-based data are correlated to changes in F-actin organization and volume content in cancer cells at progression of metastasis.

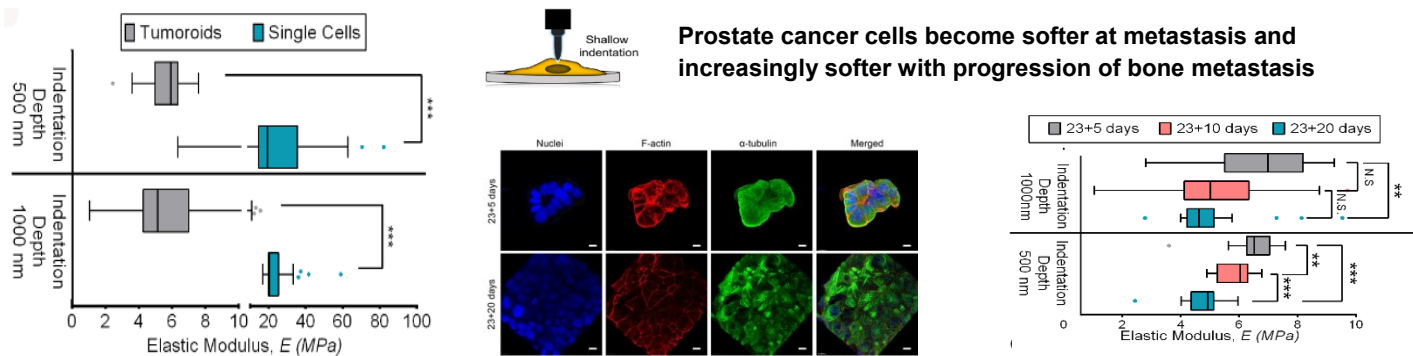


Figure 1. Nanoindentation results showing softening of tumor cells resulting from reduced F actin in tumoroids as compared to individual cells and further softening with progression of bone metastasis of prostate cancer. (Molla, Katti, Katti, J of Biomech.(2021) 114:110142).

**What is the impact?** Currently, there are no effective biomarkers for bone metastasis or its progression. CCBSE presents a direct nanoindentation derived mechanics-based marker for the progression of prostate and breast cancer metastasis. In addition, static and dynamic mechanical properties are useful in the development of tumoroids via computational modeling.

**What explanation/background does the lay reader need to understand the significance of this outcome?** Mechanics-based data collected by CCBSE researchers for cancer tumoroids will aid in the development of more robust predictive models for prostate and breast cancer metastasis progression.