

## Research Aid Award Dr. Jie Liu, *The Ohio State University*

## Biography

Dr. Jie Liu is currently a second-year orthodontic resident at The Ohio State University, College of Dentistry. She completed her dental degree at Southern Medical University in China, and a specialty in Implantology with master's degree at Wuhan University in China, then she continued education and

received her PhD at Queen Mary University of London, United Kingdom.

Dr. Liu's research includes multiscale characterization of bone from various disease models, biomaterials and stem cell-based approach in bone regeneration as well as pulp-dentin regeneration. The current research focuses on bone morphology characterization of Paget's disease and osteoporosis by artificial intelligence (AI).

## **Project Description**

Paget's disease of the bone (PDB) is the second most common metabolic bone disorder, with poorly understood causes. Osteoclast hyperactivation leads to excessive bone resorption and irregular bone remodeling, resulting in an increased bone volume with disorganized architecture and structural weakness. Optineurin, a protein encoded by OPTN gene, was found to increase the risk of PDB by ~60%. Our recent findings reveal a novel OPTN-mediated mechanism in PDB and successfully generated OPTN global knockout (OPTN-/-) mice to develop polyostotic osteolytic lesions that are reminiscent of clinical findings in PDB patients.

Osteoporosis is the most common chronic metabolic bone disease, with similar bone characterization and pathology to PBD. Our recent study on osteoporosis bone from ovariectomy (OVX) rats found that trabeculae number, thickness and volume were significantly decreased while no change in mechanical properties of module, hardness and viscosity. However, in our study on PDB bones from OPTN-/- mice, it showed different morphology and mechanical patterns, including increased trabeculae number, thickness and volume but decreased mechanical module, hardness and viscosity. It indicates PDB and osteoporosis, two clinical similar metabolic bone diseases, may have different morphology and mechanical patterns, which may be a new direction to better understand the diagnosis and mechanism of PDB, through detailed and deep comparison with osteoporosis.

Our pilot study developed a computational approach using AI algorithm to effectively identify PDB-like bones from OPTN-/- mice with 85% accuracy versus wild type bones, based on micro-CT scans. In this project, we hypothesize that AI is more effective and accurate in delineate difference in bone morphology between PDB and osteoporosis bones.

## **Importance of AAOF**

With the gracious support of the American Association of Orthodontists Foundation (AAOF), this project aims to provide a novel approach in the diagnosis of Paget's disease of the bone by utilizing AI, which will contribute to the mechanism investigation as well as treatment improvement. Outcomes from this project will further support Dr. Liu's future research projects as well as grant seeking. Support from AAOF will help to develop her orthodontic career as a clinician-educator-scientist.