Project 4 (Dr. Ehsanul Hoque Apu)

Title: Preclinical Imaging of Temporomandibular Joint Microarchitecture.

Abstract:
The temporomandibular joint (TMJ) is a complex load-bearing articulation comprising the mandibular condyle, temporal bone, and an interposed fibrocartilaginous disc. Its intricate microstructure and biomechanical demands make it particularly susceptible to temporomandibular disorders (TMDs), which affect a significant portion of the population and often lead to chronic orofacial pain and functional limitations. Despite decades of research, the internal architecture of the TMJ—especially the disc and osteochondral interface—remains insufficiently characterized due to its deep anatomical location and heterogeneous tissue composition. Recent advances in high-resolution imaging modalities, particularly micro-computed tomography (microCT), have enabled detailed three-dimensional (3D) visualization of mineralized and soft tissues within the TMJ. When integrated with complementary techniques such as high-resolution magnetic resonance imaging (MRI) and histological validation, these approaches offer unprecedented insights into the spatial organization, mineral density, and structural integrity of the joint. This review highlights the potential of preclinical imaging to quantitatively assess TMJ microstructure, paving the way for improved understanding of TMD pathophysiology and the development of targeted therapeutic strategies.

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The specific aims are to:

1. Search and analyze existing literature on the biology of temporomandibular joint (TMJ) and the relation with TMJ osteoarthritis (OA).
2. Identify and categorize the recent advances in high-resolution imaging modalities for 3D visualizing of TMJ and TMJ-OA.
3. From literature, we will evaluate the stages of osteochondral junction lesions in TMJ and evaluate the existing pre-clinical models to study TMJ-OA.
4. Draft a review manuscript and plan for an original study based on the findings.

What is the specific research question being addressed by the research project?

- What is the current evidence on stages of osteochondral junction lesions in TMJ by existing computational models for predicting the progression of hard and soft tissue injuries.