Precision Neuromodulation and the New Tinnitus Neuroscience:

An Interview with Professor Hui Wang, Shanghai Jiao Tong University

Professor Hui Wang's team at The Sixth People's Hospital Affiliated to Shanghai Jiao Tong University School of Medicine has become one of the most influential groups advancing tinnitus neuroscience. Their programme follows a vertically integrated model that links basic circuit mechanisms with clinical neuromodulation so discoveries in the laboratory directly inform patient treatment. This combined approach reflects their broader goal of developing mechanism-based therapies for chronic subjective tinnitus.

ENT tinnitus study team at The Sixth People's Hospital, Shanghai Jiao Tong University

The clinical arm of the programme centres on establishing a precision medicine model for repetitive Transcranial Magnetic Stimulation. Instead of relying on fixed stimulation parameters, the team uses TMS EEG combinations to measure each patient's cortical excitability and connectivity patterns before therapy begins. These physiological signatures are then fed into predictive models that help determine which form of rTMS is most suitable for an individual. In this way, treatment becomes tailored to the patient's neurobiology rather than imposed as a standard protocol.

Running in parallel, the laboratory group studies the top down neural circuits that shape auditory perception. Their work moves beyond traditional bottom up explanations and instead examines how prefrontal, cingulate and salience related networks influence auditory activity and contribute to the persistence of tinnitus. Multimodal imaging combined with neuromodulation is allowing the team to map the interactions between these systems, revealing how higher order networks contribute to the maintenance of phantom auditory sensations.

"TINNITUS NEUROMODULATION IS SHIFTING TOWARD A PRECISION-MEDICINE APPROACH IN WHICH RTMS IS TAILORED TO EACH PERSON'S NEURAL SIGNATURES WHILE PARALLEL RESEARCH MAPS THE HIGHER-ORDER BRAIN NETWORKS THAT SUSTAIN THE CONDITION."

One of the most important developments from Professor Wang's group in the past year was the identification of a detailed EEG signature for bothersome tinnitus. Specific patterns of theta to beta and gamma coupling were observed in auditory and non auditory regions and these patterns correlated closely with the degree of tinnitus related distress. Machine learning models trained on this oscillatory profile were able to distinguish patients with bothersome tinnitus with very high accuracy. These findings indicate that EEG based neural signatures are moving closer to practical clinical use, guiding decisions about rTMS targets, stimulation frequency and the potential integration of neuromodulation with pharmacological interventions. Professor Wang also brings a distinctive perspective to the relationship between functional tinnitus and pulsatile or structural tinnitus. In her view, the traditional separation between these conditions is too simplistic. A structural cause may initiate tinnitus, but over time the brain can develop maladaptive responses that continue even after the structural abnormality is corrected. This suggests that many forms of pulsatile tinnitus may gradually converge on central networks similar to those seen in functional tinnitus. Early diagnosis and timely intervention therefore become essential to prevent the transition from peripheral triggering to central maintenance.

When asked what would most accelerate progress in the coming decade, Professor Wang highlights two priorities. The first is personalised neuromodulation based on each patient's neural oscillation profile. The second is deep phenotyping through genetics, imaging, neural markers and clinical data to identify biologically meaningful tinnitus subtypes. Together, these approaches create a framework in which clearly defined subgroups can receive targeted therapy informed by their specific mechanisms. This integration of subtyping and personalised intervention offers one of the most promising routes to genuinely effective treatment. Professor Wang's programme illustrates a shift in tinnitus medicine toward a more precise and biologically grounded model. By combining circuit level discovery with tailored clinical intervention, her team is helping build a future in which tinnitus treatment is informed by objective biomarkers and aligned with the underlying mechanisms that sustain the condition.

The Sixth People's Hospital, Shanghai Jiao Tong University, China

HUI WANG ON BIOLOGICAL SUBTYPING

Meaningful progress in tinnitus treatment will come from integrating deep biological subtyping with personalised neuromodulation so that each patient receives therapy matched to their specific neural mechanisms.