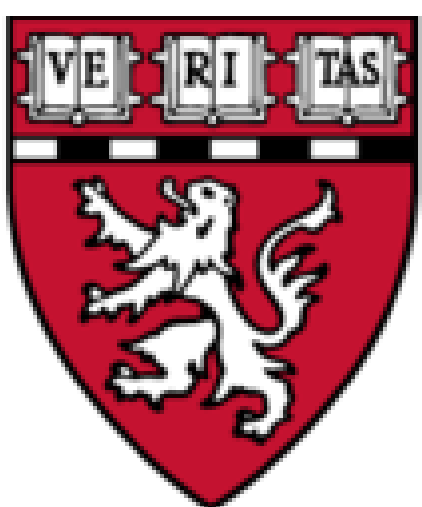


3D Head Model With AI Pattern Recognition For The Identification Of Nerve Pain In Patients With Headache Disorders



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Background:

Nerve pain screening in patients with headache disorders requires specialized clinical knowledge that is frequently not readily accessible at the initial point-of-care. This results in restricted access to early treatment, thereby increasing the risk of chronic pain refractory to therapy and predisposing patients to long-term disability and narcotic dependence. Therefore, there is a need for a simple screening tool that enables timely and accurate diagnosis of nerve pain.

Methods:

NerveAI, a 3D head and neck model that allows for an Artificial Intelligence-driven pattern recognition of nerve pain, was developed. The algorithm was trained using 1,299 head and neck pain drawings based on anatomic nerve paths and radiation patterns. Input features were constructed using coordinates of the pain drawings. We evaluated the model performance using 5-fold nested cross-validation with AUROC as the primary metric.

Results:

The best performing model to detect nerve pain was the multilayer perceptron model (AUROC: 0.879 ± 0.044). When identifying specific nerve pain types, the model demonstrated high AUROC values of $0.928 (\pm 0.025)$, $0.930 (\pm 0.017)$, $0.884 (\pm 0.031)$, and $0.954 (\pm 0.025)$ for occipital, frontal, temporal, and trigeminal neuralgia, respectively.

Conclusion:

Our findings demonstrate NerveAI's potential to enable broader screening by non-specialized providers, allowing for early diagnosis and treatment to improve patient outcomes regardless of geographic, socioeconomic, or healthcare literacy barriers.

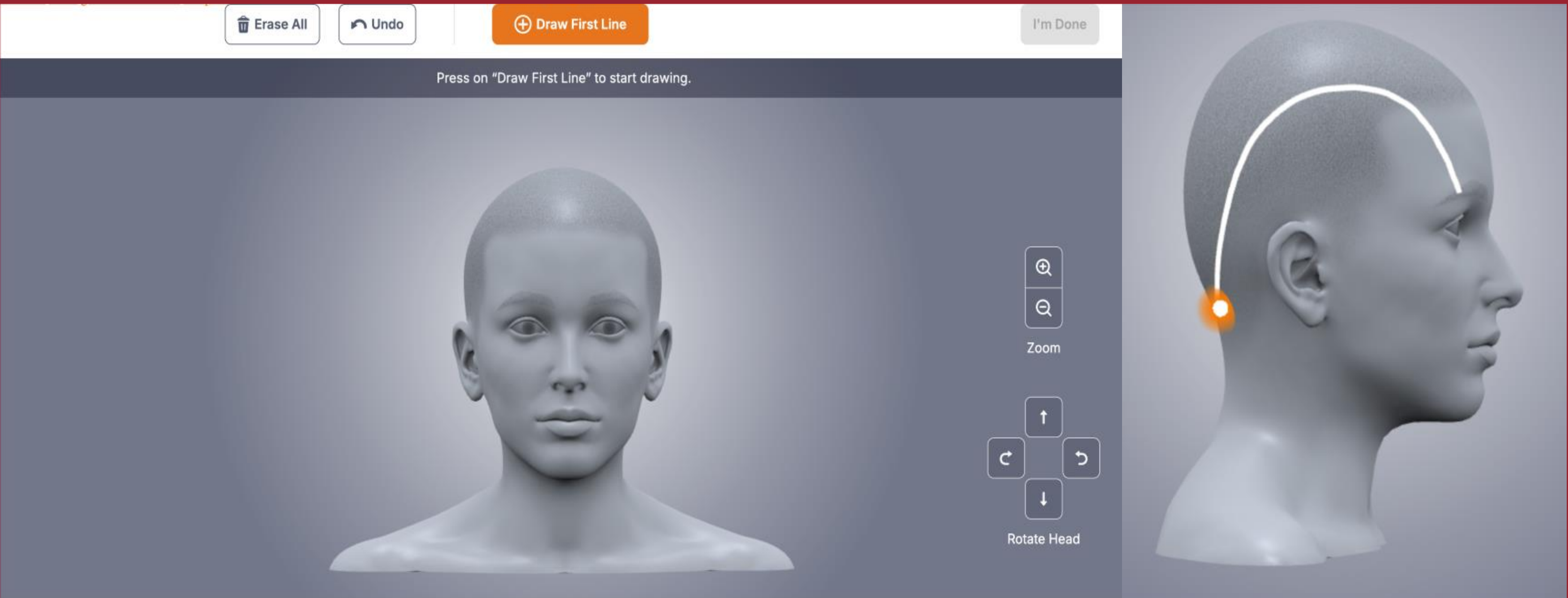


Figure 1. Web and app-based model for electronic tracing of pain patterns interpreted by NerveAI

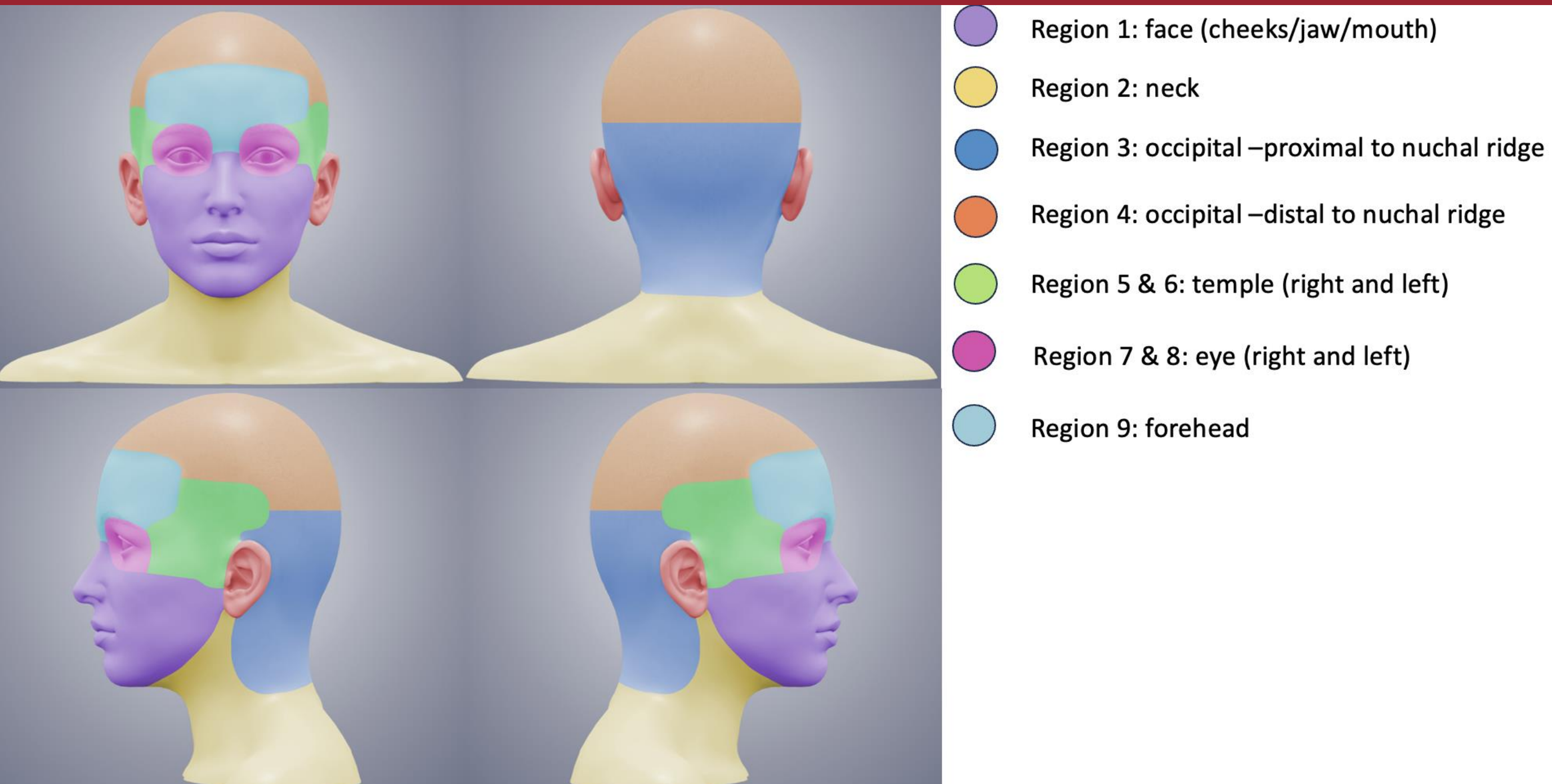


Figure 2. Regions on the 3D head model used to construct feature vectors.

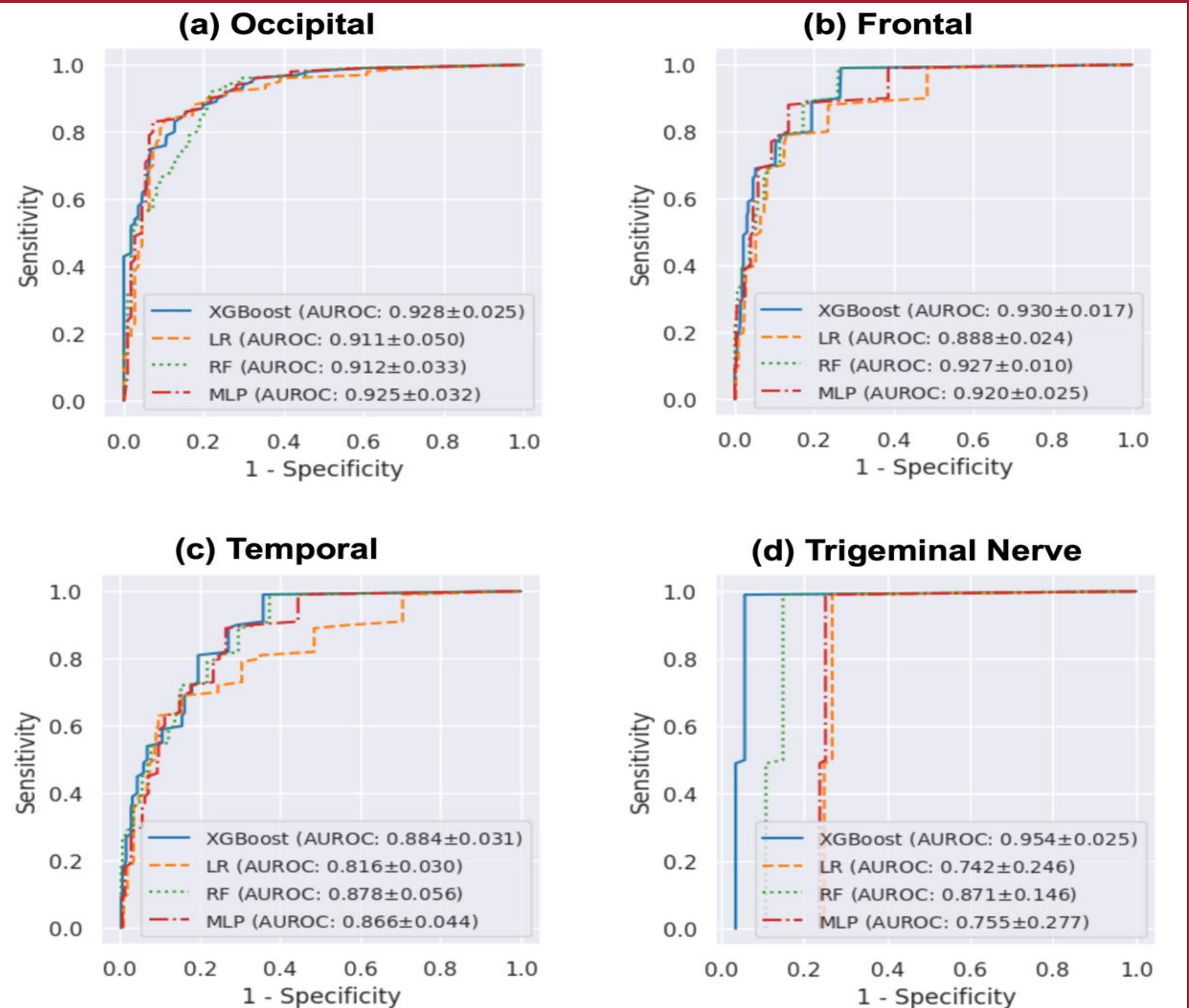


Figure 3. Machine learning model performance (AUROC) predicting nerve pain in Occipital, Frontal, Temporal, and Trigeminal regions using XGBoost, Logistic Regression (LR), Random Forest (RF), and Multilayer Perceptron (MLP) models.