UNIVERSITÄT AUGSBURG
Universitätsbibliothek

OPEN ACCESS
OPUS AUGSBURG

Multimodal classification of parotid tumors - a proof of concept [Abstract]

Varvara Kondratyeva, Zoe Reinke, Julian Valentin Karg, Marija Blažytė, Johannes Zenk, Thomas Wendler

Angaben zur Veröffentlichung / Publication details:

Kondratyeva, Varvara, Zoe Reinke, Julian Valentin Karg, Marija Blažytė, Johannes Zenk, and Thomas Wendler. 2026. "Multimodal classification of parotid tumors - a proof of concept [Abstract]." *Biomedical Engineering / Biomedizinische Technik* 71 (s1). https://doi.org/10.1515/bmt-2026-1001.

Nutzungsbedingungen / Terms of use:

CC BY 4.0

Dieses Dokument wird unter folgenden Bedingungen zur Verfügung gestellt: / This document is made available under these conditions:
CC-BY 4.0: Creative Commons: Namensnennung
Weitere Informationen finden Sie unter: / For more information see:
https://creativecommons.org/licenses/by/4.0/deed.de

Multimodal Classification of Parotid Tumors - A Proof of Concept

Varvara Kondratyeva, Chair for Computer-Aided Medical Procedures and Augmented Reality, Technical University of Munich, Germany; Dept. of Diagnostic and Interventional Radiology and Neuroradiology, University Hospital Augsburg, Germany
Zoe Reinke, Dept. of Diagnostic and Interventional Radiology and Neuroradiology / Digital Medicine, University Hospital Augsburg, zoe.reinke@uni-a.de
Julian Valentin Karg, Dept. of Diagnostic and Interventional Radiology and Neuroradiology, University Hospital Augsburg, Augsburg, Germany
Marija Blažytė, Dept. of Otorhinolaryngology, University Hospital Augsburg, Augsburg, Germany
Johannes Zenk, Dept. of Otorhinolaryngology, University Hospital Augsburg, Augsburg, Germany
Thomas Wendler, Dept. of Diagnostic and Interventional Radiology and Neuroradiology / Digital Medicine, University Hospital Augsburg; Chair for Computer Aided Medical Procedures and Augmented Reality, Technical University of Munich; Bavarian Center for Cancer Research (BZKF); Center for Advanced Analytics and Predictive Sciences, University of Augsburg, Augsburg/Munich, Germany

Introduction

Preoperative differentiation between benign and malignant parotid tumors is challenging, but can influence treatment and outcome. We investigated how artificial intelligence can support this process by multimodal classification.

Methods

Clinical tabular data and ultrasound images from 658 patients (507 benign, 151 malignant) were used, and a dedicated preprocessing pipeline addressed common issues in real-world clinical data. After preprocessing, 594 patients remained (449 benign, 145 malignant). We evaluated unimodal and multimodal approaches for binary parotid tumor classification. XGBClassifier was used for tabular classification and ResNet-18 for image classification. To combine the unimodal classifiers, we injected the results of image classifier aggregated by patient in the table data and trained a new tabular classifier.

Results

The tabular classifier achieved good performance, with an accuracy of 0.88 and a weighted F1-score of 0.88. Malignant tumors were detected with a recall of 0.80 and precision of 0.75, while benign tumors showed a recall of 0.91. The image-level classifier showed moderate performance, with an accuracy of 0.73 and a weighted F1-score of 0.74. Patient-level aggregation of image-level predictions slightly improved performance, reaching an accuracy of 0.75. The combined model achieved the best overall balance, maintaining an accuracy of 0.88 while increasing the weighted F1-score to 0.89. Malignant recall improved to 0.93, although malignant precision decreased to 0.70, indicating increased sensitivity at the cost of more false-positive malignant predictions.

Conclusion

Injecting image classifier knowledge into the tabular model improved sensitivity for malignant tumors, increasing malignant recall from 0.80 to 0.93. Aggregated image-derived features contributed substantial predictive value, accounting for 35.87% of the normalized gain. These findings suggest that clinically relevant information can be extracted even from imperfect retrospective imaging when combined with clinical variables. Our results support the feasibility of multimodal parotid tumor classification and motivate future validation on larger cohorts and higher-quality imaging data, as well as optimizing fusion strategy.

Open Access. © 2026 The Author(s), published by De Gruyter. This work is licensed under the Creative Commons Attribution 4.0 International License.