

Using Artificial Intelligence to Predict Nodal Metastases in Squamous Cell Carcinoma of the Tongue

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INTRODUCTION

- Early-stage squamous cell carcinoma (SCC) of the oral tongue is associated with an approximately 30% rate of occult regional nodal metastasis
- Neck dissection is commonly performed in this setting to determine the status of regional lymph nodes, but 70% of these surgeries are unnecessary
- Artificial intelligence (AI) algorithms may be able to predict the status of regional lymph nodes based on evaluation of the primary tumor alone without performing a neck dissection

OBJECTIVE

Train and validate an AI algorithm to predict the presence or absence of nodal metastases in SCC of the oral tongue using histopathology from the primary tumor only.

METHODS

- One group with nodal metastases, the second group without nodal metastases
- Convolutional neural network designed for visual data trained on half the cases to discern between the two groups
- **Two methods were used to train two different algorithms: Method A (tumor only) and Method B (tumor + margin)**
- The other half of cases are used to test the algorithm, analyzed using receiver operating characteristic (ROC) curves

RESULTS

There were 45 cases in the training set and 44 cases in the testing set. A pathologist marked each slide using Method A (tumor only) (Fig. 1A) or Method B (tumor + margin) (Fig. 1B)

Results from algorithm testing are reported as a % Area of Distribution (AD), with a mosaic showing which part of the slide the algorithm called positive and negative (Fig. 2) We used the positive % AD as the threshold for analysis. The ideal positive % AD threshold identified by ROC curve analysis is listed in Table 1 and shown in Figure 3 as the red dot.

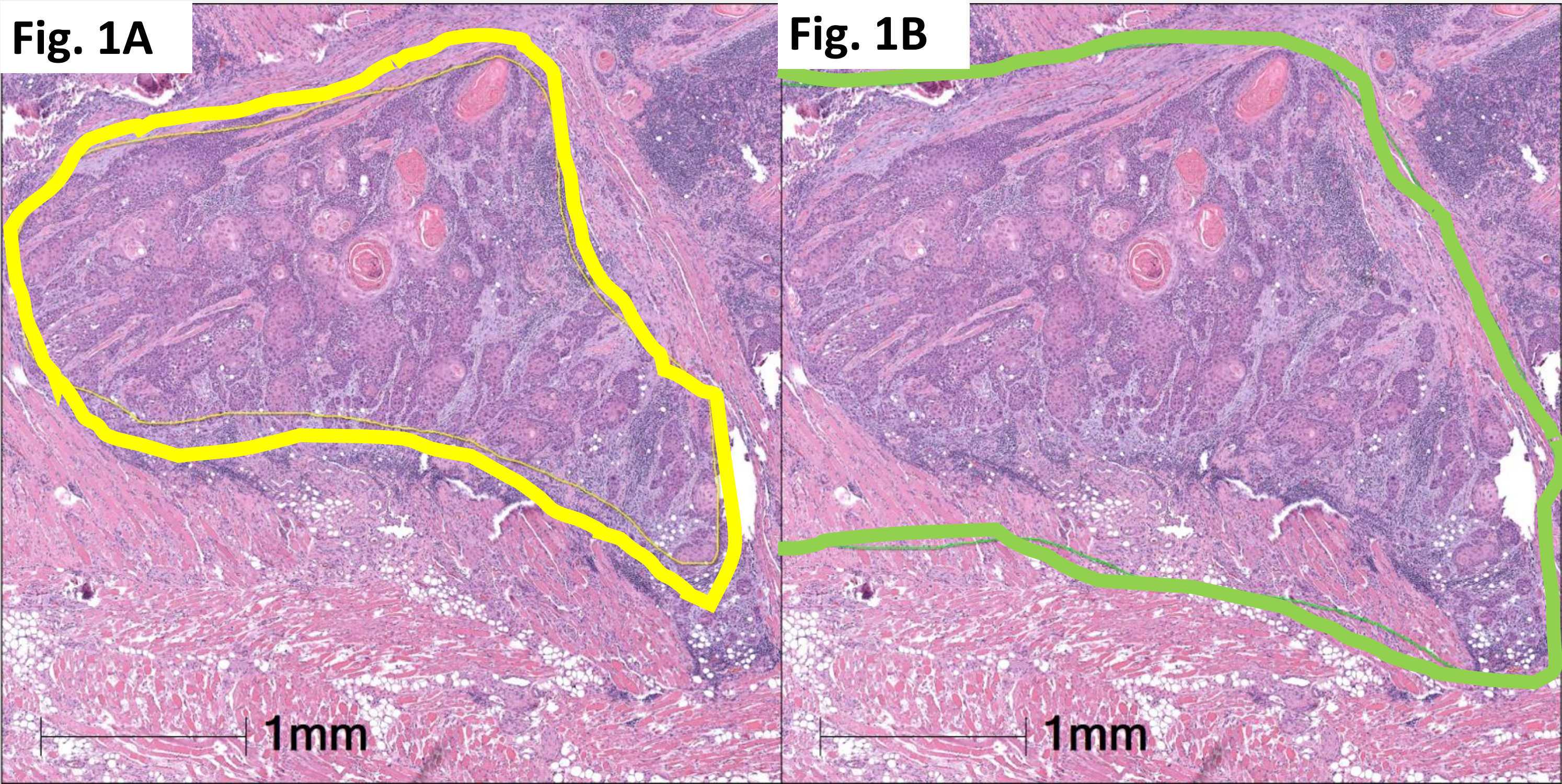
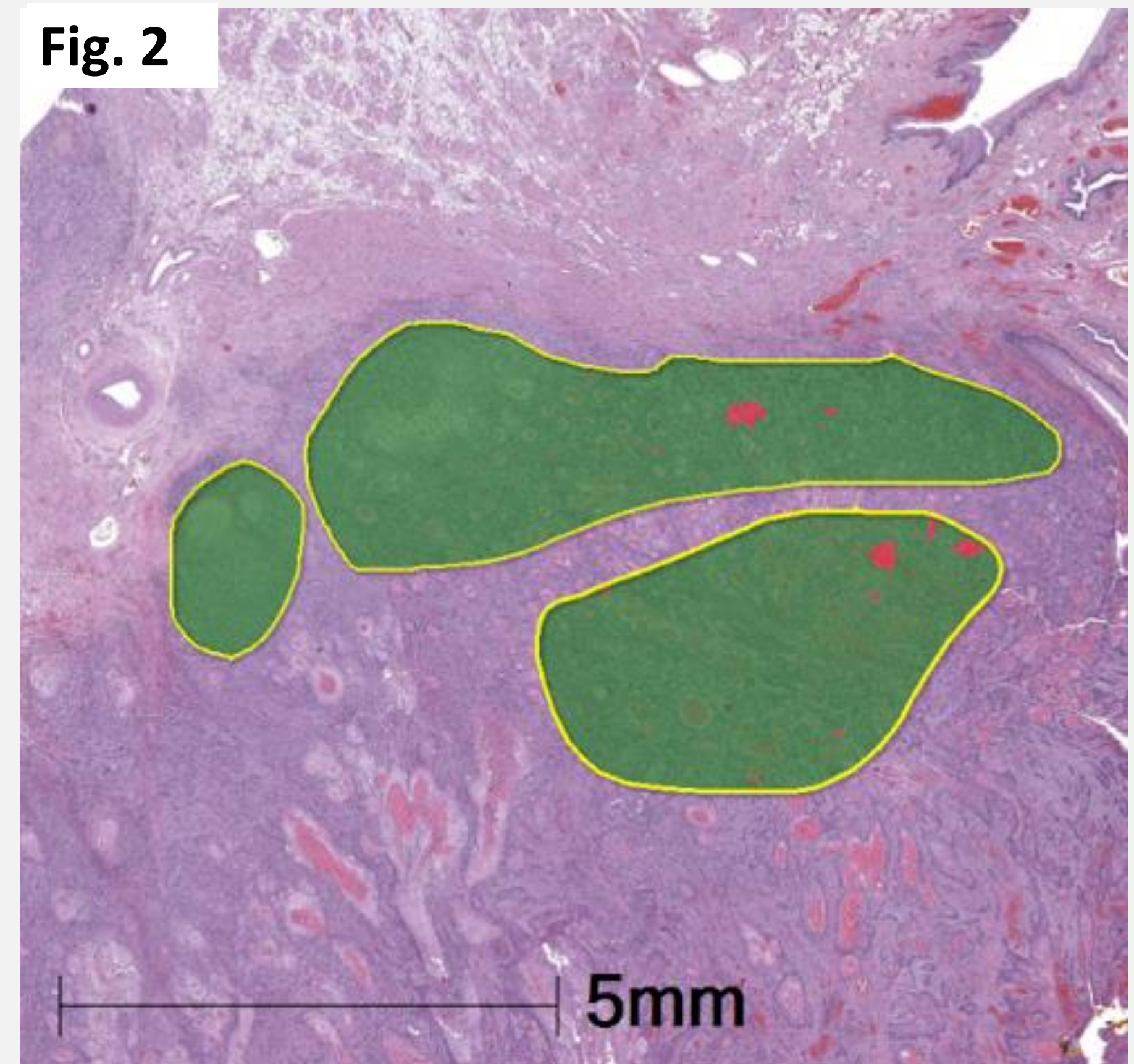


Fig 3A: ROC for Method A

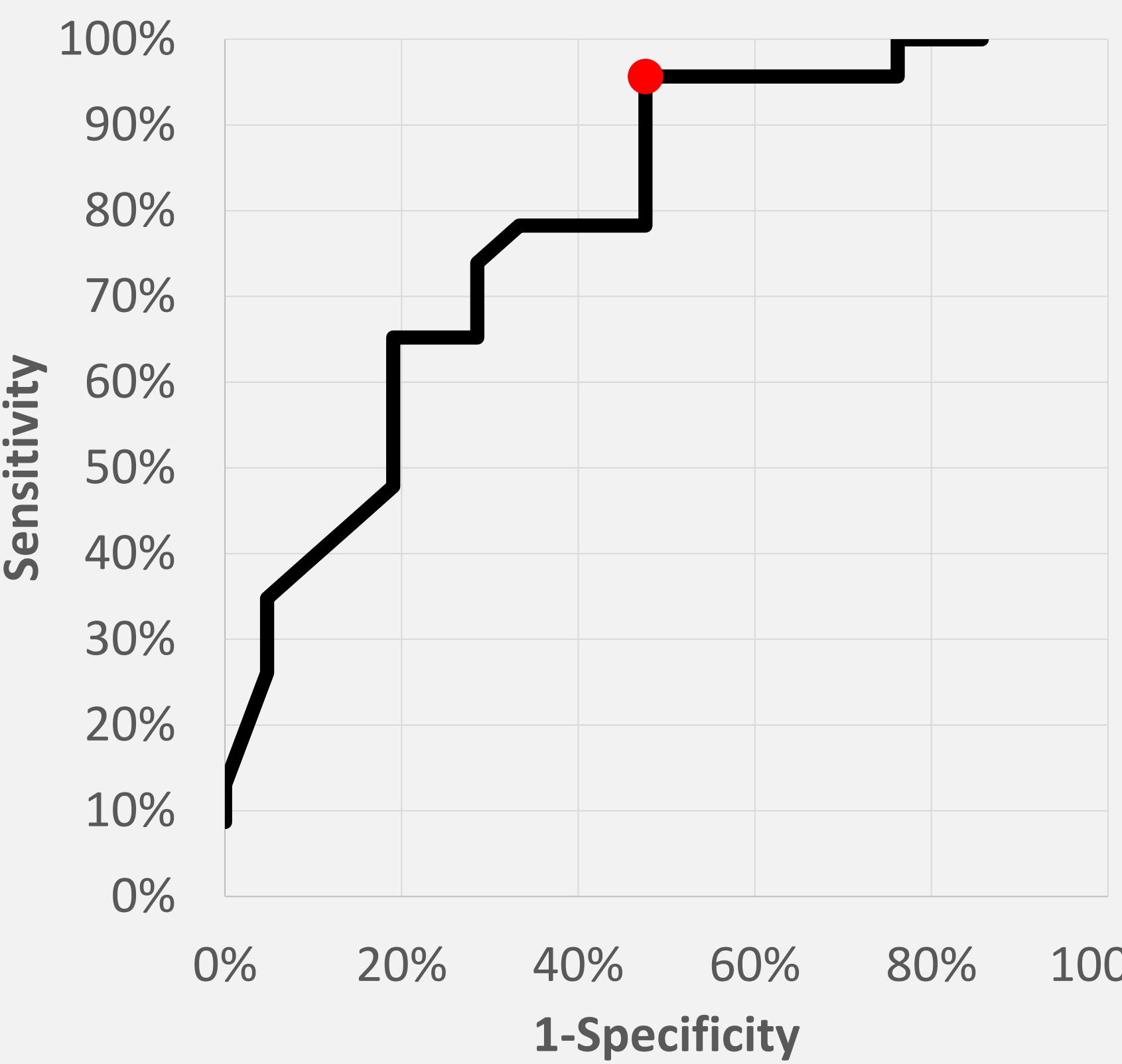
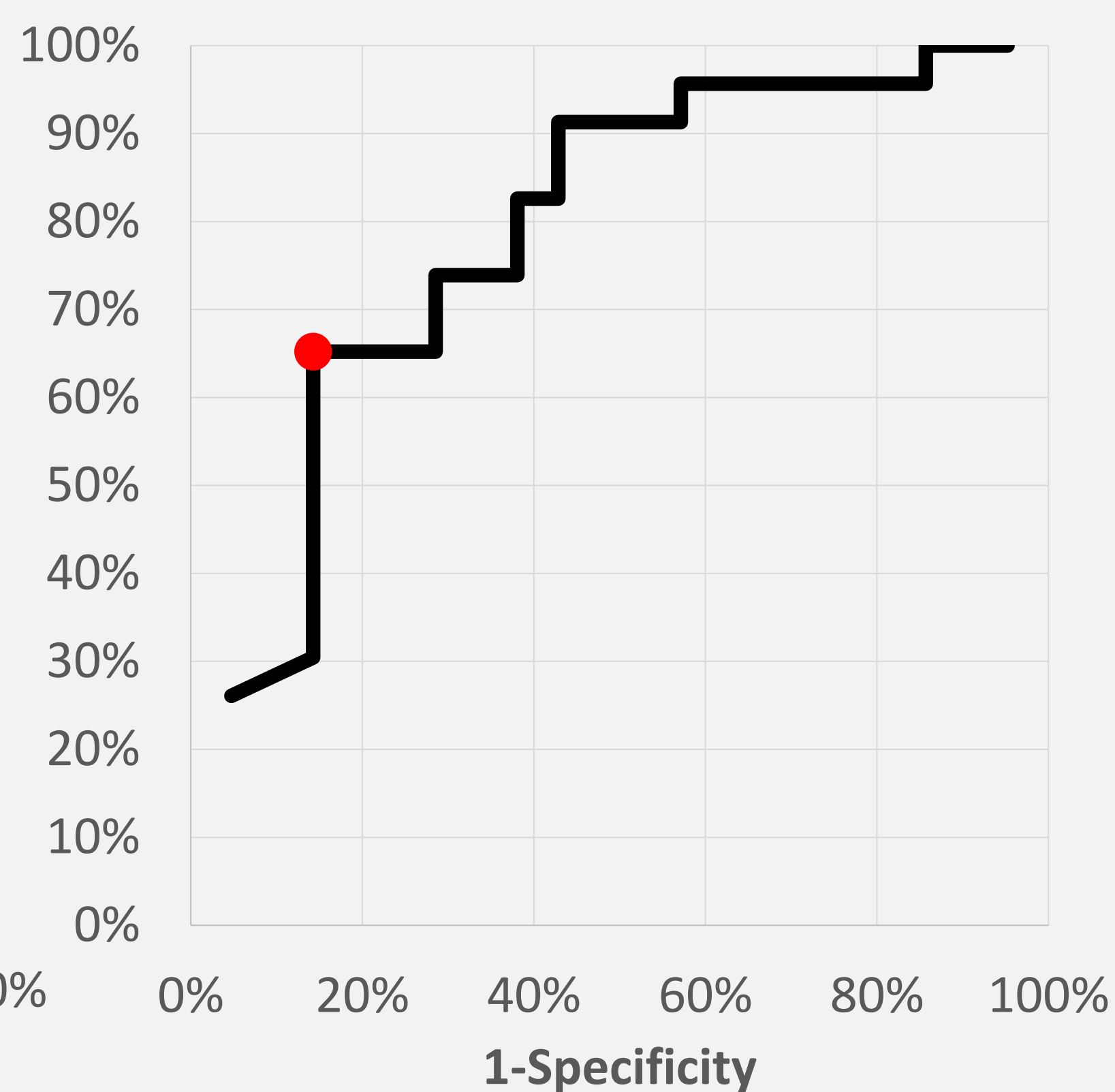


Fig 3B: ROC for Method B



ROC curves were used to determine the ideal threshold for each method (red dot). Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and the area under the curve (AUC) are reported in Table 1. The AUC is a measure of test utility from the ROC curves where 1 is the maximum value.

Table 1

	Method A	Method B
Ideal AD	90%	44%
Sensitivity	65%	96%
Specificity	86%	52%
PPV	83%	69%
NPV	69%	92%
AUC	0.729	0.647

DISCUSSION

- Proof of concept study
- Compared to current practice (using depth of invasion), this algorithm is more sensitive and specific¹
- Ongoing multi-institutional analysis to reduce chance of overfitting and produce more reliable algorithms
- Next steps include prospective analysis with frozen samples

¹Aaboubout, Yassine, et al. "Is the Depth of Invasion a Marker for Elective Neck Dissection in Early Oral Squamous Cell Carcinoma?." *Frontiers in Oncology* 11 (2021): 434.

CONCLUSION

A convolutional neural network can be used to accurately predict the likelihood of nodal metastases in SCC of the oral tongue using visual data from the primary tumor alone. Further study, including a prospective trial and additional algorithm development using frozen section histopathology, is necessary to fully integrate this tool into clinical practice.