Correlating Toxicity Outcomes with Spatial Patterns of Lymph Node Metastasis for Oropharyngeal Cancer Patients

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PURPOSE / OBJECTIVE(s)

Imaging is an integral tool in radiation oncology, starting from initial diagnosis to follow-up post-therapy. In head and neck cancer treatment, toxicity and tumor control depend on the tumor locational geometry and systematic predictable spread of disease to affected lymph nodes (LN) levels. However, a rigorous methodology for integrating imaging spatial information into treatment outcome prediction models remains an unmet need. We hypothesized that integrating tumor and LN spatial information derived from routine diagnostic images can aid in prediction model development for both oncologic outcomes and post-therapy toxicity.

MATERIAL & METHODS

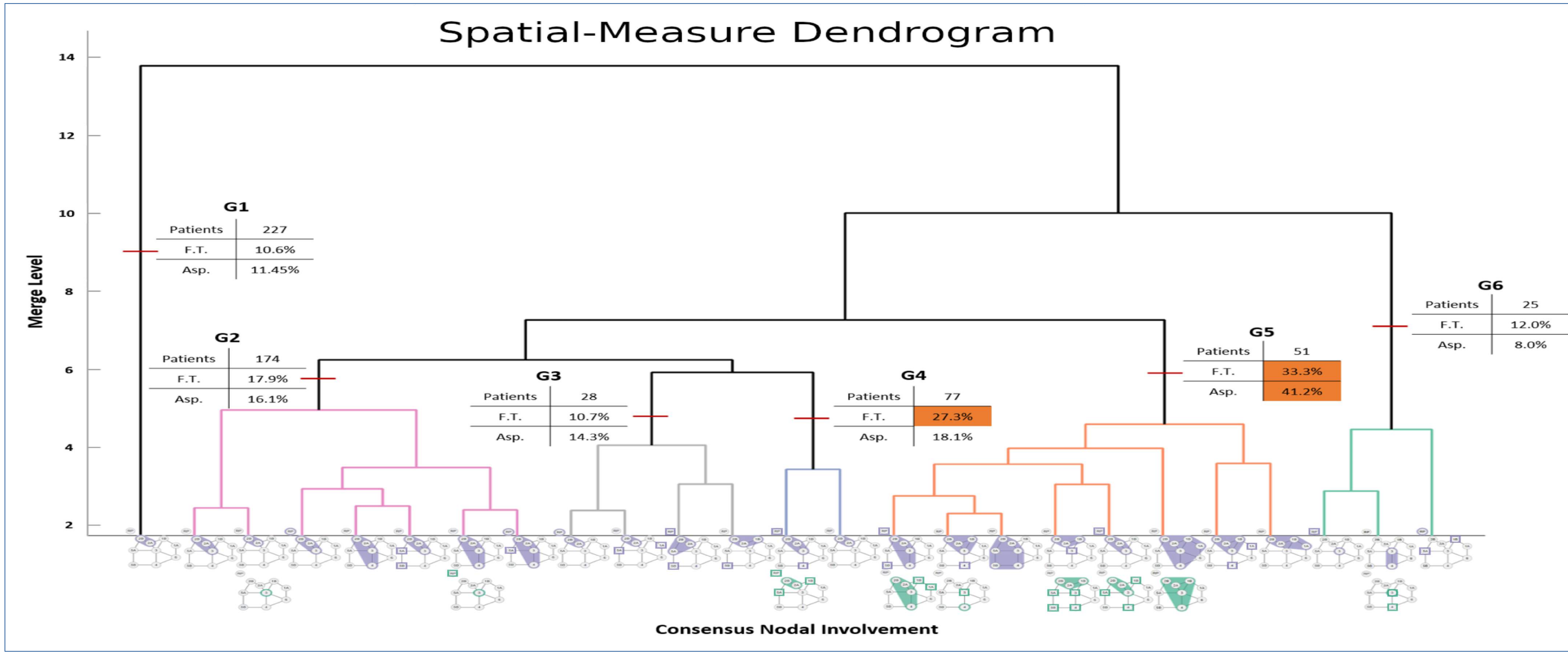
We retrospectively collected 582 oropharyngeal cancer (OPC) patients with affected regional LNs under an approved IRB. Clinical, outcome and toxicity data (feeding tube (FT) and aspiration rate at 6 months post-therapy) were collected. LN levels were identified from initial diagnostic CT. 2D LN topological map was constructed for each nodal region based on each location level and surrounding structures, followed by coding the laterality of nodal levels based on patients' tumor location. We constructed a dual graph representation over the map to compute patients' similarity using a spatial metric. Rand index was used to compare the similarity metric output performed by hierarchical agglomerative clustering against naive categorical binning metric output. Fisher's exact test was used to test whether post-treatment toxicity outcomes differed by clusters. A visual representation (informational dendrogram) of different groups (Gs) was developed to facilitate clinical interpretation.

RESULTS

A discrimination based on spatial information derived from diagnostic CT was able to differentiate patients with unilateral and bilateral nodal involvement and separate them into 6 Gs. The spatial metric was more informative than categorical binning (non-spatial) metric.

Two Gs with basic involvement patterns (G1 & G6) which were consistent between both metrics were removed; Rand index (a measure of overlap) of the resulting 4 Gs of each metric was of 0.55, indicating the metrics result in significantly different inpatient grouping.

In testing Gs associated with toxicological outcomes, the spatial metric was able to find a statistically significant difference in FT placement and aspiration rate between different Gs ($p<0.01$) with G4 & G5 had a double incidence for outcome based on the spatial metric.



		FT Placement	Aspiration
Group	Patient Count	Patients with outcome (%)	Patients with outcome (%)
G2	174	31 (17.9%)	28 (16.1%)
G3	28	3 (10.7%)	4 (14.3%)
G4	77	21 (27.3%)	14 (18.1%)
G5	51	17 (33.3%)	21 (41.2%)

SUMMARY / CONCLUSION

Our approach integrates LN level spatial information derived from routine diagnostic imaging and correlates to toxicity outcomes. Spatial information provides additional information for toxicity prediction.

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