Microscopic invasion patterns in canine mast cell tumors and soft tissue sarcomas
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Introduction
Stromal invasion is commonly identified in cutaneous malignancies; however, invasive patterns are inconsistently defined with uncertain clinical relevance. This study aimed to:
1. Define objective, quantifiable histomorphological invasive patterns in grade I/II canine mast cell tumors (MCTs) and soft tissue sarcomas (STSs)
2. Correlate invasive patterns with histologic excisional status

Materials and Methods
Hematoxylin and eosin stained glass slides prepared for routine histopathology of surgically-excised tumors from client-owned dogs were used for the study. Each tumor had radial sections prepared in four circumferential (e.g. cranial, caudal, dorsal, and ventral) and deep directions. Each slide was evaluated for:
1. Microscopic invasion beyond the subgross tumor edge (mm; Figure 1)
2. Asymmetrical invasion (mm; calculated by subtracting the minimum from the maximum length of circumferential neoplastic infiltrates for each tumour; larger values indicate a more asymmetrical invasive pattern)
3. Satellite lesions (both present / absent; also mm between the satellite lesion and the subgross tumor edge)
4. Lymphovascular invasion (present / absent)
5. Perineurovascular growth (present / absent)
6. Growth along fascial planes (present / absent)
7. Intramuscular invasion (present / absent)
8. Multicompartmental involvement (present / absent)

Incomplete excision was defined as digital histological tumor-free margins < 1 mm in any direction.

A professional biomedical statistician was hired to perform analyses using commercially available computer software.

Results
Sixty-nine tumors (50 MCTs and 19 STSs) from 51 dogs were included in the study.

Invasion in both circumferential and deep directions was significantly greater in MCTs compared with STSs (exact 2-tailed P < 0.0001 circumferential; P = 0.0095 deep).
Within the MCT group, circumferential invasion was greater than deep invasion (P = 0.0076; figure 2).

Multivariate logistic regression analysis found two variables that were significantly associated with incomplete MCT excision:
1. Intra-operative grossly normal circumferential surgical margin size (odds ratio of 0.776, 95% confidence interval: 0.651 - 0.925)
2. Asymmetrical invasion (odds ratio of 1.318, 95% confidence interval: 1.039 - 1.671).

(All enrolled dogs are being followed with DVM examinations (with re-staging if suspicion of local recurrence is noted) at 3, 6, 12, 18, and 24 months post-op to allow correlation of these findings to clinical outcomes.)

Discussion
These data may help create evidence-based strategies for planning different surgical strategies for MCT and STS excisions.

Presence of asymmetrical microscopic invasion might prompt pathologists to perform more comprehensive surgical margin evaluation.

Figure 2. Scatter plot of microscopic invasion length beyond the subgross tumor edge, in circumferential directions (e.g. cranial, caudal, dorsal, and ventral) from grade I/II canine (A) mast cell tumors (MCT; n = 50) and (B) soft tissue sarcomas (STS; n = 19). Neoplastic invasion length was not significantly different between the circumferential directions within MCTs or STSs, but was significantly greater for MCTs compared with STSs (median of 1.7 mm versus 0.0 mm; P < 0.0001). Scale is consistent within the figure.

Figure 1. Microscopic invasion length (mm) was measured from the subgross tumour edge (visually identified on the glass slide using the unaided eye; marked with an ultra-fine tip permanent felt marker as seen on the image provided) to the furthest point of microscopic tumour invasion (black measurement bar). Magnified box shows clusters of neoplastic cells associated with the tunica adventitia of a large vein (black arrows). Bar = 1 mm.