A Dual Approach to Subtype Differentiation in Basal Cell Carcinoma: Classical Morphometry and Artificial Intelligence-Based Segmentation

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Abstract

Introduction: Basal cell carcinoma (BCC) is the most frequent type of skin cancer. Histologically it comprises low and high-risk subtypes. Given the difference in behavior between these subtypes, we propose a morphology study aimed to identify differences between the most common low-risk BCC, nodular (N) and a high-risk BCC, micronodular (MN), using a classical morphometric approach with gray-level co-occurrence matrix and histogram analysis, as well as deep-learning-based semantic segmentation. *Material and Methods:* We analyzed consecutive BCCs diagnosed between 2019 and 2021 at Cluj-Napoca Clinical Municipal Hospital, Romania, of which 46 were N, 12 MN and 31 mixed subtypes. From whole-slide images, pathologists selected 216 N and 201 MN BCC images, which were manually segmented and analyzed based on four morphological components: tumor (T), touching tumor (TT), peritumoral cleft (PC), and surrounding stroma (S). The differences between these components were assessed using Haralick texture features and deep-learning segmentation models. *Results:* Our analysis revealed that TT exhibited the least variability, whereas PC demonstrated the most significant differences between the two subtypes. Haralick texture feature analysis showed 4/14 and 2/14 significant differences in T and TT, respectively, suggesting high similitude in the palisading region. In contrast, 12/14 features significantly differed in PC, indicating that cleft formation may contribute to biological differences. The S component exhibited 5/14 significant differences, aligned expectations, as the normal tissue remained similar across subtypes. Deep-learning segmentation identified distinctive stromal inflammatory infiltrates, with MN exhibiting a more intimate pattern than the dispersed infiltration seen in N. *Conclusion:* The findings highlight key morphological distinctions between N and MN subtypes, particularly in the T and PC components. Combining classical morphometric and deep-learning approaches provided novel insights into BCC morphology, which may aid in improved subclassification and risk stratification.

Keywords: Basal Cell Carcinoma; Morphometry; Deep Learning; Image Processing; Computer-Assisted.