

Abstract

Squamous cell carcinoma is the most common cancer of oral cavity. This oral cancer (OC) is usually preceded by oral potentially malignant disorders (OPMDs). Hence early and precision diagnostics of OPMDs' malignant potentiality are vital in improving survival rates of OC patients. However, gold standard histopathological diagnostic method for OPMDs suffers from ambiguity and subjectivity which may be addressed by revelation of more quantitative attributes and by adapting group decision making (GDM) techniques to reduce subjective bias. This study has adopted methods for analyzing multimodal attributes of epithelium and sub-epithelium including Raman micro-spectroscopy of basement membrane along with fuzzy GDM approach based endorsement of onco-pathological domain knowledge for precise histopathological evaluation of OPMDs [viz. oral sub-mucous fibrosis (OSF) and leukoplakia (OLKP)]. Significantly different nano-scale textural attributes of epithelium and sub-epithelium is found in OSF compared to normal. Further, in exploring micro-scale textural features of oral sub-epithelial connective tissue in OPMDs (viz. OSF and OLKP) and OC, multifractal analysis is employed. Significant differences of multifractality among study groups demonstrated effectiveness of multifractal features as statistical biomarker. Considering significance of critical understanding regarding alterations in stratified oral epithelium during development and progression of OPMDs, different epithelial layers are examined in terms of nuclear morphometric and textural attributes including quantitative evaluation of pleomorphic nuclei. It registered changes in nuclear morphometric features based correlations between adjacent epithelial layers in OPMDs. Higher differences in pleomorphic nuclei are noted between moderate and severe dysplasia of OLKP than OSF. Raman spectroscopy of basement membrane shows significant difference in biochemical components in OPMDs. In improving dysplasia grading of OPMDs, an index has been devised using Fuzzy GDM algorithm. The proposed severity index based on standard histopathological features is statistically different for different grades of dysplasia. Present study elucidating multidimensional quantitative attributes and GDM based index for epithelial dysplasia grades will add value to the precision diagnostics of OPMDs. It has futuristic impact on developing an integrated diagnostic method for OPMDs using both qualitative and quantitative attributes and by adopting analytical means to encompass subjective variability in medical domain knowledge.

Keywords: Oral potentially malignant disorders, Multi-scale analysis, Textural analysis, Multifractal, Fuzzy group decision making, Oral dysplasia grading index.