



Oral Cancer Screening, Molecular Diagnostics and Biomarkers

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Citation: Natalia I (2025) Oral Cancer Screening, Molecular Diagnostics and Biomarkers. Dent Health Curr Res 11: 259

Received: 01-Oct-2025, Manuscript No. dhcr-25-182382; Editor assigned: 4-Oct-2025, Pre-QC No. dhcr-25-182382 (PQ); Reviewed: 19-Oct-2025, QC No. dhcr-25-182382; Revised: 26-Oct-2025, Manuscript No. dhcr-25-182382 (R); Published: 30-Oct-2025, DOI: 10.4172/2590-0886.1000259

Introduction

Oral cancer is a significant global health concern, with high morbidity and mortality rates largely due to late-stage diagnosis. Early detection greatly improves treatment outcomes and survival rates, yet many cases are identified only after the disease has progressed. Oral cancer screening plays a critical role in identifying premalignant and malignant lesions at an early stage. Recent advances in molecular diagnostics and the identification of specific biomarkers have enhanced the accuracy and effectiveness of screening methods, enabling earlier diagnosis and more personalized patient management [1,2].

Discussion

Conventional oral cancer screening relies on visual examination and palpation of the oral tissues, often supplemented by biopsy for definitive diagnosis. While these methods are essential, they may not always detect early molecular changes that precede visible lesions. Molecular diagnostics have emerged as valuable tools that detect genetic, epigenetic, and proteomic alterations associated with oral carcinogenesis. These techniques allow clinicians to identify high-risk lesions before clinical symptoms become evident [3,4].

Biomarkers are measurable biological indicators that reflect normal or pathological processes. In oral cancer, biomarkers can be identified in tissues, blood, or saliva, making them useful for noninvasive or minimally invasive screening. Commonly studied biomarkers include DNA mutations, altered gene expression, microRNAs, protein markers, and inflammatory mediators. Salivary biomarkers are particularly promising due to the ease of sample collection and their direct contact with oral tissues. These biomarkers can help differentiate benign lesions from potentially malignant disorders and predict disease progression [5].

Molecular diagnostic techniques such as polymerase chain reaction, next-generation sequencing, and proteomic analysis have improved the sensitivity and specificity of oral cancer screening. These methods support risk stratification, enabling targeted surveillance of high-risk individuals such as tobacco users, alcohol consumers, and patients with a history of oral potentially malignant disorders. Early

identification through molecular diagnostics also facilitates timely intervention and personalized treatment planning.

Despite their potential, challenges remain in the clinical implementation of molecular diagnostics and biomarkers. Variability in biomarker expression, high costs, and the need for standardization limit widespread adoption. Large-scale clinical validation is necessary to establish reliability and cost-effectiveness in routine practice.

Conclusion

Oral cancer screening is evolving from purely clinical examination toward a more precise, biology-driven approach. Molecular diagnostics and biomarker-based screening offer promising opportunities for early detection, risk assessment, and personalized management of oral cancer. By integrating these advanced tools into routine dental and medical practice, clinicians can improve early diagnosis, enhance patient outcomes, and reduce the burden of oral cancer through timely and targeted interventions.

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