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Review Article

Integrating Salivary Diagnostics: A Need for Dental Education Advancement

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Abstract

Saliva, a readily accessible bodily fluid, offers a non-invasive window into our health. It can be used to monitor various systemic conditions, from diabetes to cardiovascular disease, and even detect infections like COVID-19 and HIV. Recent advancements in salivary liquid biopsies have shown promise in early cancer detection, particularly for oral and breast cancers.

Despite its potential, employing salivary diagnostics is overlooked in dental education. Dental curricula primarily focus on traditional methods like clinical exams and X-rays, neglecting the valuable insights that saliva can provide. This lack of training limits dentists' ability to assess oral health comprehensively.

Dental students are not adequately trained in modern caries management techniques. These techniques involve assessing saliva properties, such as flow rate, buffering capacity, pH, and bacterial levels, to identify and address risk factors for tooth decay. This lack of training leads to a continued reliance on traditional "drill and fill" methods, which often neglects a broader approach to oral health.

To address this, dental schools should integrate salivary diagnostics into their curriculum. This would equip future dentists with the skills to assess salivary parameters to determine the oral and general health status. Adopting this holistic approach, dentists can better understand the connection between oral health and general well-being, leading to improved patient care and preventive measures.

Keywords: Biomarker; Dental Curricula; Holistic Approach; Salivary Diagnostics

Introduction

Saliva is a composite biological fluid principally composed of water (98-99%). It is derived from the exudation of serum and, therefore, contains a comprehensive array of organic components, including hormones, growth factors, antibodies, enzymes, microorganisms, and their metabolic byproducts. It plays a critical role in maintaining oral health by facilitating digestion, protecting against pathogens, and aiding in wound healing.

It has emerged as an increasingly valuable diagnostic fluid in medical and dental sciences. Its non-invasive collection, wide range of detectable biomarkers, and unique properties make it a powerful alternative to blood for diagnosing various diseases and monitoring health conditions [1].

Using saliva as a diagnostic fluid offers several benefits over the use of blood. Saliva can be collected without needles, reducing discomfort and anxiety for patients. This is particularly advantageous for children, elderly individuals, and those with needle phobia. It significantly reduces the risk of exposure to infectious diseases for patients as well as healthcare workers. Moreover, collection requires minimal equipment and does not need trained personnel or sterile environments, making it suitable for large-scale screening programs and point-of-care diagnostic. Patients can easily collect saliva themselves, which is beneficial for remote healthcare in underserved communities.

Human saliva comprises a diverse array of biomolecules that serve as potential biomarkers for the detection of various oral and systemic diseases [2-4].

- **Proteins and Enzymes:** Useful for detecting oral diseases like periodontitis and cancer.
- **Hormones:** Cortisol and testosterone levels in saliva reflect stress and endocrine disorders.
- **Genetic Material (DNA/RNA):** Enables the detection of genetic mutations, viral load (e.g., for HIV or COVID-19), and epigenetic changes.
- **Electrolytes and Metabolites:** Indicative of hydration, metabolic health, and systemic diseases.

Saliva demonstrates diagnostic accuracy comparable to traditionally used blood. Several studies confirm its efficacy across numerous conditions. It can monitor diabetes mellitus by measuring salivary glucose levels and assess cardiovascular health through inflammatory markers. Saliva also enables the detection of viral infections and bacterial infection [5]. Saliva-based liquid biopsies have successfully identified biomarkers for oral and breast cancers and multiple other systemic diseases [6]. Home-based saliva testing kits are available for online purchase, enabling aging individuals to assess their cholesterol levels and evaluate their risk of developing prostate cancer [7]. Calcium and phosphate ions are among the most extensively studied salivary ions in relation to dental caries and periodontal disease. Tooth or bone demineralization results in an increased release of calcium ions into saliva. Elevated salivary calcium levels serve as biomarkers, reflecting the presence and severity of dental caries or gums disease [8].

Despite its increasing significance in healthcare, the incorporation of salivary diagnostics into dental education at both undergraduate and postgraduate levels remains insufficient [9]. This inadequacy is similarly observed in the majority of universities across the subcontinent and middle east. Most dental curricula focus predominantly on traditional diagnostic methods like clinical exams and radiographs, sidelining diagnostic potential of saliva. Dental students are rarely trained to collect, analyze, and interpret salivary biomarkers. The incorporation of salivary diagnostics in existing dental curriculum is essential, as it promises long-term benefits. A study reveals that dental students lack training in implementing modern caries management approaches, which require evaluating saliva flow rate, its buffering capacity, pH, and the presence number of Streptococci and Lactobacilli colonies in it [10]. As a result, graduating dentists continue to rely on the traditional drilling and filling method for caries treatment. Undergraduate dental students are primarily trained to focus on treating teeth that neglects a holistic approach that considers the oral cavity connection to general health [11]. This narrow focus limits their ability to address broader factors like systemic health, diet, and patients' habits, which are integral to comprehensive dental care.

Equipping dentists with salivary diagnostic skills will broaden their ability to detect both oral and systemic conditions early. Early and accurate detection of a condition will lead to better treatment planning and outcomes. It will reduce patient discomfort associated with invasive diagnostic methods.

With advancements like lab-on-a-chip devices and biosensors, dentists trained in salivary diagnostics can adopt front-line technologies in their practices. Future dentists with knowledge of salivary diagnostics will be able to work closely with medical doctors, contributing to a holistic approach to healthcare.

Dental educators and researchers have proposed integrating salivary diagnostics into the dental curriculum to better prepare students for modern, evidence-based practice. Many Western universities have integrated advanced salivary testing technologies into their curricula. Notably, one institution has collaborated with a pathology laboratory to enhance its educational program. This partnership enables students to utilize cutting-edge diagnostic tools, such as the HR5 salivary test, which identifies high-risk oral pathogens [12]. The program emphasizes bridging medicine and dentistry, equipping students to integrate oral-systemic care into routine practice and address underserved populations effectively.

Proposed curriculum enhancements

Theoretical modules

- Basics of salivary composition and its role in health and disease.
- Overview of salivary biomarkers and their diagnostic relevance.

Practical training

- Techniques for salivary sample collection and preservation.
- Use of diagnostic tools for analyzing salivary biomarkers.

Interdisciplinary learning

- Collaborative modules with biochemistry, pathology, and medical departments to understand systemic implications.

Exposure to Technology

- Training on advanced salivary diagnostic tools, such as biosensors and portable devices.

Research Opportunities

Encouraging students to engage in research projects on salivary diagnostics to drive innovation and evidence-based practice.

Incorporating salivary diagnostic skills into the dental curriculum is not just an option but a necessity for advancing the profession. It will align with the evolving role of dentists as primary healthcare providers and addresses the growing demand for non-invasive diagnostic methods.

Conclusion

Universities in the subcontinent and middle east should follow the example of Western institutions by encouraging dental educators to integrate saliva testing into their curricula. However, making this transition requires overcoming challenges such as training educators, updating laboratory infrastructure, and ensuring cost-effective implementation. Collaboration with pathology labs and research institutions can streamline this process, equipping future dentists with the skills needed to embrace modern diagnostic techniques and improve patient outcomes in the region.

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