



Role of the “Salivary Microbiome” in Forensic Investigations-A Mini Review

Dineja R*, Divya B, Narayan M and Vasanthi V

Department of Oral Pathology & Oral Microbiology, SRM Dental College, India

***Corresponding author:** Raman Dineja, MDS, Senior Lecturer, Department of Oral Pathology & Oral Microbiology, SRM Dental College, Bharathi Salai, Ramapuram, Chennai, India, Email: drdineja@gmail.com

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Abstract

Evidence collection in forensic investigation contribute very important role. There are different types of evidence among which saliva plays an important role. For forensic purpose DNA can be isolated from saliva samples whereas collection requires high precaution and precision training. Salivary samples can be collected from food remaining or even from cigarette butts, also from body parts in crime scenes. Salivary microorganisms differ from one individual to other thereby reflecting their health status and dietary habits. Hence Salivary microbiome plays an important role in forensic investigation. With the help of these salivary microbial analysis; individual age, ethnicity, and so on information can be used for forensic contexts. 16S rRNA gene sequencing is used for forensic microbiome analyses. This mini review comprises the advantages and some insights of salivary microbiome in forensic investigations.

Keywords: Forensic Investigation; Saliva; Salivary Microbiome

Introduction

Now a day's Microbiome science becomes more accepted in forensic investigations [1]. Saliva is a complex biological fluid secreted by acinar cells of the salivary glands. Its role is to maintain the homeostasis of oral structures such as tooth integrity, it also plays a critical role in genomics, proteomics, metabolomics, and bioinformatics. Recently, saliva is starting to play an important role as a diagnostic and forensic tool. It is an important discriminating element in forensic biology, acting as an indicator of salivary gland conditions, toxicological and drug monitoring [2].

Advantages of Using Saliva as Tool in Forensic Investigations

- Ease of availability
- Non-invasive

- Cost effective collection methods
- Saliva is the medium of choice among all body fluids
- Saliva can be retrieved from bite marks and lip prints [1]
- Human DNA can be extracted from dried saliva stains
- Used for biologic profiling to determine age and gender
- When salivary secretion is combined with well-documented salivary biomarkers, it can provide vital information about the suspect's lifestyle, cohabitation, and medical condition [3,4].

Significance of Saliva in Forensics

Kapoor P, et al. [5] did the scoping review and listed the constituents of saliva related to its significance in forensics, specifically in biologic profiling of individual, based on which the authors proposed the concept of Salivary Signature in reconstructive forensic identification.

Different Salivary Investigatory Tools Used in Forensics

1. Starch-iodide test
2. Phadebas Reagent
3. RSID (Rapid Stain Identification) Test
4. ABO Group Identification
5. DNA Identification [5]

Salivary Microbiome

The study of proportions of various bacteria presents in saliva is potentially useful for individual identification. Streptococcus, Neisseria, Prevotella, Haemophilus, Veillonella, Porphyromonas, Rothia, and Fusobacterium are the common salivary microbiome which constitutes more than 70 percentage of total bacterial population [2].

Reason Why Salivary Microbiome is Important in Forensic Investigation

In the human body, Microorganisms, are stable for a considerable period of time, it can also be found throughout the body and are present in any habitat involving human beings. Therefore, they can play a prominent role in identification of Individuals [6]. The salivary microbiome is affected by various factors and seems to reflect the oral and general health status, with the bacterial composition associated with oral and systemic diseases [7]. Additionally, salivary microbial analysis provides information to identify an individual and/or his personal habits, age, ethnicity, and so on, providing useful clues in the forensic contexts [8,9].

Method to Detect Salivary Microbiome

Generally Individual identification acts a fundamental component when gathering forensic evidence. In recent years, this procedure depends on DNA fingerprinting technologies and short tandem repeat (STR) composite amplification detection technology [10]. The 16S rRNA gene has been widely used for phylogenetic studies [11]. With the development of high-throughput sequencing (HTS), it has been possible to use 16S rRNA gene sequencing in forensic microbiome analyses for the identification of individuals [12].

Effect of Antibiotic in Salivary Microbiome

Karaday B, et al. [13] conducted a study to examine the antibiotic use-related temporal diversity of the saliva microbiota. They collected saliva from 14 participants in 4 different time intervals therefore which comprises 54 salivary samples. 16S rRNA region was isolated and PCR analysis was done prior to sequence analysis to determine the microbiome structure of the samples at phylum, genus,

and species levels. After antibiotic administration changes in the salivary microbiome in saliva samples are observed. Change was also in accordance with the type of given antibiotic. This was statistically significant for Firmicutes, Spirochetes, and Verrucomicrobiota. Even though the oral microbiome tends to return back to its previous state at the phylum and genus level within a 4-week period after the start of antibiotic use, but in some bacterial species, change continues. With these results they found that the inability of stabilization at species-level in a period of 4 weeks from the start of antibiotic use, hence it is not suitable to assess saliva samples at species-level for forensic identification.

Discussion

The oral microbiome harbours microbial community signatures that also differ among individuals, highlighting the highly individualized information that can be garnered from these samples. Saliva, a common body fluid with significant forensic value, has been used in criminal investigations involving murder and assault. There are certain studies conducted to identify salivary microbiome:

- Leake SL, et al. [3] 2016 conducted a study and found that the salivary microbiome exhibits a significant biodiversity and by using a PCR-based metagenomic approach the discrimination of two unrelated individuals were possible.
- Lovisolo F, et al. [14] 2020 conducted a study to examine the oral and skin microbiome composition to find any indicators of habits and lifestyle of individuals. Their study result showed the presence of an oral core microbiome and the existence of microbial signatures associated with certain grouping conditions like Smoking Habits and Age. Concluded microbiome composition has significant implications for forensic investigations for which the ability to differentiate amongst individuals is essential.
- Sundstrom K, et al. [15] done a study to investigate the shared bacterial communities among family members and adult children. They found that high level of similarities was observed as related to mothers versus fathers. But over particular period of time similarity in oral microbiome between parent-child pairs seem to weaken. With these results they concluded that this approach was suitable for a relatedness study of multigenerational salivary bacteria microbiomes [15]. Now a day's in top GDP countries machine learning and deep learning are used in the field of dentistry [16].

Conclusion

Saliva obtained in the crime scene can be used to identify a culprit or it can also be used to identify a victim. Forensic microbiology is still a complicated process which requires

lot of trails and it also has lot of technical difficulties. Lot of studies are required to standardise the methods to identify salivary microbiome with the help of Artificial intelligence. With the advancement in detecting salivary microbiome. It can give better solution in the field of forensics.

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