

DNA extraction from lip cosmetics' prints: A Review

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ABSTRACT

Background: Persistent use of lip cosmetics makes them one of the most regular evidence in crime against females, with this concern, plenteous work has been done to differentiate various types of lip cosmetics on basis of their composition. However, the forensic and DNA perspective regarding the same remains unexplored to a huge extent.

Study: We looked at the DNA implications of lip stains as well as several ways for extracting DNA from lip cosmetic prints in this work.

Conclusion: We came to the conclusion that DNA profiles created from lip cosmetics imprints are extremely valuable in forensic examination for personal identification because they are regarded the most crucial type of transmission traces and are equivalent to finger-marks.

Keywords: lip prints; lip cosmetics; touch DNA; DNA profiling

INTRODUCTION

Any physical aspect can be used to link a suspect to a crime as the need for law enforcement to present sufficient physical evidence to identify a perpetrator at a crime scene develops. Establishing a person's identity is a very laborious task. Human identification based on biometrics has become increasingly prevalent in recent years. Humans can be identified on the basis of their physical traits without the use of any external keys in these methods. Individuals, living or deceased, are identified on the basis of the premise that each person is unique and that no two people are alike. Personal identity is becoming increasingly vital in criminal investigations and genetic research, not just in legal medicine. Trace evidence is taken into account for this reason as these are minute pieces of evidence that

can be overlooked by a perpetrator at a crime scene. DNA can then be processed from this evidence or rather say Touch DNA can be obtained from this evidence. DNA transferred from shed epithelial cells or any other material biological in nature from a donor to a recipient which may be an item or an individual during physical contact is defined as "Touch DNA." This sort of material is regarded as an important resource to investigators yet has a pivotal part in forensic lab work.

MATERIAL AND METHODS

This review is organized in two broad categories: integrants of lip prints and its forensic evidentiary value. We have collected the data from printed data as well as electronically available data in forms of research papers and literatures.

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Lip Prints

Lip prints, like fingerprints, footprints, and palm prints, are defined by the presence of lines and wrinkles. Dactyloscopic traces and Lip imprints have similar values. Lip imprints, like fingerprints and tooth prints (Bite marks), can be used to identify someone. Lip prints are one-of-a-kind and do not alter throughout a person's life. When the valleys and folds of the labial mucosa come in direct contact with a surface, they generate a lip print. Cheiloscropy is a technique used in forensic investigations that deals with the study, classification, analysis, and comparison of imprints of lip prints. Lip prints are frequently discovered in rapes, murders, and break-ins. Individual identification of humans is possible thanks to traces with clear lines and individual elements. They resemble other chemical and biological remnants in their appearance. The lips unite the facial skin, that is Para keratinized stratified squamous epithelium, towards the mucosa of the oral cavity, which is moist non-keratinized to Para keratinized stratified squamous epithelium¹. Different zones present in the lip of human are shown in Figure 1. Among these zones exists a vermilion zone, which is a convergent area of red-colored tissues. In forensic examination techniques, this vermilion zone is usually referred to as 'lips'. Lip prints are commonly found on drinking glasses, paper napkins, cigarette butts, duct tapes, or even on the skin of the person.

Lip impressions at the scene of the crime may adhere to the following:

1. Visible lip prints: Imprints that can be seen with the naked eye. They need not require any extra processing to be visualized.
2. Latent lip prints: Imprints that are not visible to human eyes. They need prior development for visualization.
3. Plastic lip prints: These prints are found on pliable substances i.e., Soap, wax, etc. These prints although visible to unaided eyes but sometimes need further development to visualize.

Cosmetics

Cosmetics are items designed to be applied on the body of a person to cleanse, enhance, or change their look². The most popular cosmetics are utilized on the lips. They have been used for at least 5000 years, and a significant number of women still describe them as a beauty enhancers³. There are many different kinds of lip cosmetics such as lipsticks, lip liners, lip balms, lip gloss, etc.⁴. Lipsticks are used to add color to the lips, but lip balms have shown to be effective in preventing dryness and healing chapped lips.

Because of this characteristic, lip cosmetics are one of the most commonly seen pieces of evidence in crimes against women. The mutual exchange theory put forward by Sir Edmond Locard states that whenever two substances come in touch, materials will be exchanged. When it comes to lip makeup, this idea is valid as well. Lip balms and lipsticks are lip cosmetics that are the simplest to get onto the criminal's possessions, especially in situations of sexual assault, kidnapping, and murder. This is a result of their widespread usage. The stains left behind by lip cosmetics are easily discoverable on items like glasses, cigarettes, mirrors, tissue papers, and in certain circumstances, even on an individual's skin. These stains are among the most crucial pieces of evidence found at each crime scene that may be used to directly connect the victim and her attacker.

Numerous studies have been conducted to evaluate and study different lip cosmetic kinds in terms of the color and composition using chromatographic and analytical methods. However, there are still many unresolved questions regarding the forensic and DNA components of the case.

Components of lip cosmetics

A specific combination of waxes, pigments, and oils are used to create a standard lipstick. Emollients, which are often substances like Lanolin, Shea butter, etc., are made from 41% to 79% of their composition. Beeswax,

polyethylene, and other structural agents (15–28%) are also used. It has a pigment content of 3–10%, a luster agent content of 0–10%, and a preservative and antioxidant content of 0.2–0.5%⁵. In order to improve the wearability of the lipstick and make it “kiss-proof,” some contemporary lipsticks contain water-insoluble colors, silicone resins, polydimethylsiloxane, and other ingredients. From the viewpoint of makeup durability, this would be quite useful. However, it is not a very healthy option because many lip cosmetics include heavy metals like Antimony, Lead, or Mercury coupled with other carcinogens like Castor oil, Formaldehyde, and other chemicals that are known to induce toxicity in the body when used frequently⁷.

History

- R. Fischer, an anthropologist, discovered the biological quirks of furrow networks in the reddish region of human lips in 1902.
- One of France’s top criminologists, Edmond Locard, invented the use of lip imprints for identification verification in 1932.
- In 1950, Le Moyne Snyder proposed expanding the use of lip impressions as identification documents. He provided a great example of how lip prints helped forensic investigators.
- Dr. Martins Santos developed a basic classification system for lip prints in 1960 and said that all of these lip characteristics can also be useful for identifying a person.
- To gather important information for later applications in forensics, Suzuki conducted a detailed investigation in 1967 that included the measurement of lips, rouge color, and application, as well as the extraction technique.
- In 1971, Suzuki and Tsuchihashi conducted research and created their classification system for lip impressions.
- In 1972, Mc Donnell studied the lip impressions of a set of identical twins and found that, save from their lip imprints, the twins seemed to be similar in all other respects.
- Cottone described cheiloscopy as one of the particular methods used for personal identification in his 1981 book ‘Outline of Forensic Dentistry.’
- Kasprzak conducted a 5-year research on 1500 persons in 1990 to explore the potential applicability of lip prints.
- In his 1981 book “Outline of Forensic Dentistry,” Cottone listed cheiloscopy as one of the specific procedures used for personal identification.
- In 1990, Kasprzak performed a five-year study with 1500 people to examine the possible use of lip prints.
- In the year 2000, Mercedes Alvarez Segu⁸ commissioned research in which persistent lipstick latent impressions were collected on numerous surfaces that would have gone unnoticed at a crime scene. The results revealed that identifiable lip imprints were being retrieved lasting 30 days.
- In 2001, a research by Laurence G. Webb et al.⁹ that used a few lip cosmetics that produced complete DNA profiles to analyze a variety of individual features was published.
- A research on the capacity to piece together important genetic information using lip impressions left on the skin as well as any potential lipstick interference with STR typing was published in 2009 by Barbaro A. et al.¹⁰

1. Lipstick lip prints as biological evidence

Lip prints were once restricted to cheiloscopy tests, which had a limited capacity for successfully identifying people based on the lines and wrinkles visible on lip traces. However, if there is wear and tear from stains, the admissibility of these prints as evidence in a court of law may be disputed. Lip cosmetic prints tend to transmit various cellular components along with the pigment

to whatever surface they come into contact to. According to several investigations, DNA can be successfully recovered from both highly and somewhat permeable surfaces, proving that DNA could be retrieved from old lip imprints. However, due to undetectable prints, this capability is not often used to its fullest extent⁸. Lip cosmetics not only make them noticeable but also simplify and streamline the detecting procedure. The development and production of “kiss-proof lipsticks” have led to an increase in the use of water- or oil-based makeup removers. These solutions make it simple to remove makeup without damaging your lips from vigorous rubbing. These makeup removers include cotton swabs, cleaning milk, Micellar water, and others. To remove the lipstick, these materials are placed over the wipes and pressed on the lips. If found at a crime scene, these wipes and swabs can have significant forensic importance.

Types of cellular material found in lip cosmetics print

The number of individuals interested in learning more about the cellular composition of surfaces a person has touched in any way has significantly increased since the launch of the Touch DNA idea. However, the DNA found in these samples is quite limited. According to research, some cellular elements together with pigments and wax may be transferred during physical contact between a victim and the offender, especially when any lip makeup is involved¹⁰.

It is possible to identify cell-free DNA in some instances, as well as nucleated, enucleated, fragmented, and corneocytes in lip prints. The outermost epidermal layer of the lips' nucleated cells, which can generate the most DNA, are anticipated to shed off¹¹. These prints may also contain saliva, more skin cells, and cells from the upper lip. Enucleated cells, similar to those found in fingerprints, can be detected in lip prints. Because saliva is transferred to the lips' outer layers during eating or licking, the nucleated

cells may be moved there⁹. *Factors affecting the amount of DNA deposit*

The quantity of cellular material and DNA deposits found in these prints depends on several variables. These variables include the type of lip product used, the person's health, whether or not they have eaten anything, the surface onto which the prints are transferred, etc¹². The major deciding factor for the amount of DNA deposited in every individual is their shedder status. It describes a person's propensity to transfer genetic material to surfaces and items they contact. Numerous studies have revealed that some people “shed” more DNA than others.^{13,14} Although it has been suggested that persons who routinely lose some DNA are either “excellent” shedders or “poor” shedders, There is proof that the amount of DNA that is deposited differs from person to person as well^{13,14,16}. It suggests that while some traits tend to have a consistent impact on a person's shedder status over time, situational factors including behavior, context, and involvement can also have an impact. The amount of DNA deposited in lipstick lip prints is also influenced by how long the cosmetic was worn.

According to a few studies, lip prints on glass slides may successfully and abundantly demonstrate the deposition of cellular material, ranging from 4 cells/mm² to 37 cells/mm² for the upper and lower lips, respectively¹⁷. However, depending on an individual's gender and shedder status, these statistics may vary¹⁶. These slides display a significant quantity of cell debris and cellular components devoid of nuclear material.

Transfer Of Foreign Materials

Contact with any alien or undesirable item has a major negative impact on the quality of cellular extracts. It is due to the exchange that will happen and might modify the outcomes of DNA profiling. The potential source of these foreign elements might be any sexual activity, before or after application, eating or drinking anything, applying or blending makeup with one's hands or nails, using a common product or applicator

that is used by several people, etc. If more than one makeup product, such as a moisturizer, foundation, or primer, is used before applying the lip product, the outcome may be altered. In these circumstances, the DNA profile may have a lower yield, several separate profiles, or mixed profiles¹⁸.

2. Extraction and DNA profiling from lip cosmetic's prints

Numerous scientists have worked for visualizing the latent lip prints by using the nucleic acid dye Diamond™ and examining them using a Dino-lite microscope. Its advantage is that the PCR processes are unaffected. Several kits, including Chelex¹⁸, the QuantiBlot kit, and the QIA fast PCR purification kit¹⁹, can carry out the process of DNA extraction and purification. AmpFISTR Profiler Plus™ PCR Amplification kits can be used for profiling. This aids in the study of the Amelogenin gene and nine STR loci. Analogous steps can be taken to examine the prints on samples of lip cosmetics. There may be certain artifacts that may be seen using a fluorescence microscope at particular wavelengths.

CONCLUSION

People of both genders use lip cosmetics extensively to accentuate their beauty worldwide. They are often employed, making them significant evidence in a court of law. There is disagreement among experts as to how much DNA could be extracted from the prints of lip cosmetics. It is simple to predict that the prints left behind during the transfer of lip cosmetics can be seen as a potential source of evidence carrying not only cheiloscopic but genetic value as well, given the emergence of novel concepts like Touch DNA and Trace DNA as well as prior works have been done on the successful extraction of genetic content from the lip imprints and even latent lip imprints. These prints can prove their competence from a forensic as well as legal perspective increasing the evidentiary value of these prints.

Conflict of Interest:

Authors declare no conflict of interest

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