

Ear prints as Potential evidence in criminal investigation: A Review

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Abstract

When someone without permission does pre-intrusion activities like auditory surveillance close to a door or window and has oils and waxes on their auricles, the deposition of a latent ear print may take place. By using methods analogous to those used in fingerprint lifting processes, the visibility of this print can be increased. An earprint is a 2D representation of the auricle segments that have come into contact with a certain surface, similar to the impression left by a rubber stamp.

This study critically reviewed the efficacy of ear prints as a form of corroborative evidence and its significance in the realm of personal identification. Ear prints, in conjunction with other latent evidence, have the potential to be identified and gathered at the location of a criminal incident. The literature that has been examined exhibits promising advancements and a notable level of precision in the field of ear print development and identification, thereby emphasizing the necessity for further study.

Keywords: Latent ear print, trace evidence, powder method, Human ear

Introduction

An ear print refers to a bi-dimensional replication of the auricle segments that made contact with a specific surface, akin to the impression left by a rubber stamp. In contrast to the uniform print surfaces found on stamps, the auricle exhibits variations in elevation and flexibility due to its diverse morphological structures. Specific structures will therefore produce a noticeable indication, while others may not or only to a limited degree. The analysis of the relationship between morphological characteristics is dependent on their specific spatial coordinates and altitudes. Moreover, the variation in sebum production across various regions of the auricle may exert an impact.

Anatomical and Morphological Structure of Human Ear

The ear possesses a distinct anatomical arrangement akin to the facial region. As depicted in (Figure 1), the morphology of the ear is primarily influenced by the outer rim or helix, as well as the configuration of the lobe. Additionally, there exists an inner helix or antihelix that exhibits a general parallel alignment to the outer helix, but diverges into two separate branches at the uppermost point. The inner helix and the inferior branch of these two branches constitute the superior and lateral aspects of the concha, which is named after its resemblance to a shell. The inferior part of the concha anatomically

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connects with the highly recognizable intertragic notch. Additionally, it is important to observe the crus of helix, which refers to the point where the helix intersects with the lower branch of the antihelix. The anterior portion of the concha provides access to the external ear canal, also known as the acoustic or auditory meatus. The crux of the helix exhibits diverse morphologies and consistently produces an impression when an ear is pressed against a surface. The helix rim is the anatomical feature that determines the morphology of the external ear. The morphology of the rim exhibits significant variability. The initial or final point of unwinding varies among individuals.

The inside edges of the helix rim plays a crucial role in the identification process. The object may feature either notches or knobs and exhibit distinct angular characteristics..

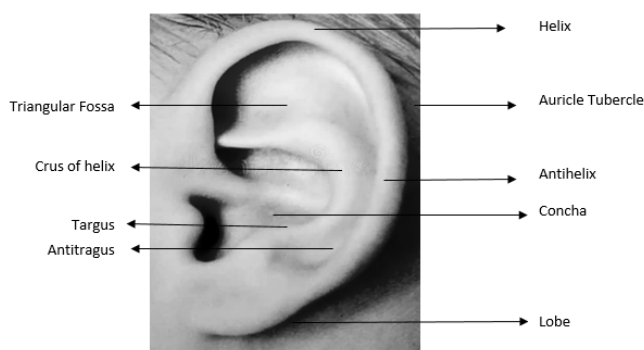


Figure 1: Parts of human ear

The ear prints commonly exhibit imprints of the helix, anthelix, tragus, and antitragus (figure 1). The latter two entities could potentially serve as an extension of the intertragic notch outline, or they may manifest as distinct patches. The anatomical structures known as the anthelix and antitragus frequently exhibit a connection, and occasionally a similar association can be observed between the anthelix and helix imprints. Moreover, the representation of a single morphological structure can be fragmented into one or multiple distinct patches. This is especially true for the impression of the helix.

Ear prints may contain features such as imprints of the earlobe, the crus helicis (part of it), and the crus superior anthelicis and/or crus inferior anthelicis. It is worth noting that a crus posterior anthelicis is not commonly found in the actual ear, and as a result,

its imprint is less frequently observed in earprints. A portion of the pre-auricular region is frequently depicted in a print, and appears to offer valuable insights as a result of distinctive skin folds in this region.

Ear prints in forensic investigations

Initially, a latent earprint discovered at a crime scene can be utilized to eliminate an individual as a potential suspect. It is necessary to ensure that the prints produced by a single ear do not exhibit significant variations that would prevent us from identifying them as originating from the same ear.

In the domain of forensic investigation, an alternative methodology can be employed to leverage earprints in scenarios where the presence of a suspect is absent. A latent print can undergo a comparative analysis against a database that contains prints collected from crime scenes. Each print in the database is linked to a particular case or potentially a suspect, determined by other evidence or a confession. A database can also incorporate control prints obtained from large groups of individuals, or a combination of both approaches. When utilizing earprints for the purpose of case linkage, it is crucial to acknowledge that the lack of substantial differences in prints created by a single ear, and the unlikely chance of two ears producing indistinguishable prints, are not acceptable circumstances. It should be noted that the auricle generally shows minimal alterations over a given period, allowing for the possibility of identifying a matching print from the same person at a different age in a database. The accurate processing of precise print dimensions is essential for determining the quantity of potential matches.

It is crucial to acknowledge that as time passes, a print stored in the database may become unidentifiable as a valid match due to a range of factors. However, it should be noted that the utilization of dimensions for initial categorization and limited association does not necessarily indicate that another individual is at risk of being implicated. The process of individualization is expected to depend on the identification and positioning of minute details, such as wrinkles, small raised areas on the skin, or other unique attributes, along with distinct irregularities or angles in the shape of imprinted features.

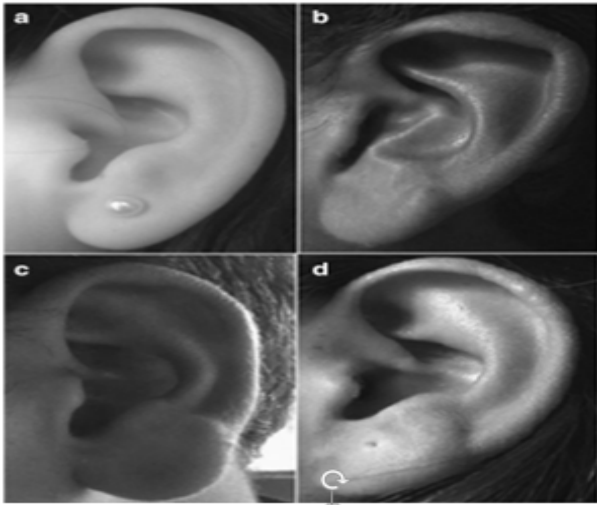


Figure 2: Different ear lobe structure: (a) Oval, (b) Triangular, (c) Rectangular, (d) Round

Courtesy: Krishan et al. Egyptian Journal of Forensic Sciences (2019) 9:6

Conclusion

Ear prints are commonly found as evidence in various crime scenes, particularly in cases involving burglaries. In contemporary forensic science, there is a growing emphasis on formerly regarded as unconventional traces, such as ear impressions¹. However, the application of ear print evidence has not been widely utilized in comparison to other forms of body trace evidence². The collection of biometric data from evidentiary material discovered at a crime scene is an essential element of the forensic process³. Previous studies have provided evidence supporting the practicality of employing ear biometrics due to the unique anatomical characteristics of the ear, which are expected to differ among individuals. Moreover, the measurements obtained from this anatomical analysis have demonstrated temporal consistency. Ear biometric identification is a viable and promising method, assuming its technical feasibility. This approach exhibits similarities to face recognition as it operates in a non-intrusive manner. Instead of relying on the complex process of extracting facial biometrics, ear biometrics can leverage more dependable and readily extractable biometric characteristics, similar to those present in fingerprints⁴. It is important to acknowledge that ear biometrics, although a recent addition to the growing field of biometrics, has already exhibited its efficacy and has the potential to

become a prominent biometric tool⁵.

Elevated features of the ear, such as helix, antihelix, antitragus, tragus, and inter-tragic notch; particularly the degree of antihelix curvature, are more easily impressed and identifiable on an ear print. The results support that ear prints may provide important clues to assist in establishing the identity of an individual if several morphological features are evaluated concurrently⁶. The distinctiveness of the human ear and its consequent usefulness for individual identification has been hypothesized. Currently, there is a lack of published data that definitively establishes the uniqueness and distinctiveness of each individual's ear, as well as the ability to conclusively identify an individual through ear comparison⁷. However, the work done by Chattopadhyay & Bhatia suggest that utilizing morphological examination to compare ears can serve as supportive evidence⁸.

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