

Comparative Analysis of Human Hair from Different Regions of The Male Body: An Evaluation

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Abstract—This study presents a comparative analysis of human hair from various regions of the male body, focusing on differences in hair morphology. This research experiment involved the collection of hair samples from multiple body regions and subsequent microscopic examination. Results revealed distinct variations in hair tip, shaft and root sizes and shapes across different body areas, shedding light on potential physiological and evolutionary implications. Understanding these differences could contribute to fields such as forensic science, dermatology, and evolutionary biology.

Index Terms—Hair morphology, Forensic biology, Evolutionary biology, Terminal hairs

I. INTRODUCTION

Hair samples are essential in forensic analysis, providing vital information for identifying suspects or victims. Due to their resilience and ease of transfer, hairs are frequently examined in crime scenes. Analyzing hair can yield valuable details for investigations and crime scene reconstruction. The success of microscopic hair comparisons in forensics relies on multiple factors, including the right equipment and methods. It is advisable to conduct a microscopic assessment before proceeding with DNA analysis.

Hair: The hair originates from the papilla and, apart from that specific point, is composed of dead, cornified cells. It is comprised of a shaft that protrudes above the skin and a root that is embedded within the skin. Keratin, melanin, and trace amounts of metallic elements are the fundamental components of hair.

These elements are either accumulated during hair growth or absorbed from the external environment.

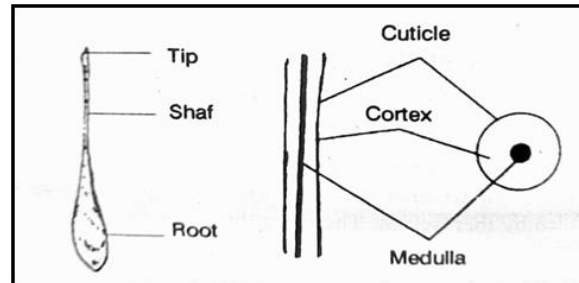


Figure 1: Outer & Inner Structure of Hair

- Cuticle - The protective scale structure on the outer surface of the hair.
- Cortex - The central part of the hair shaft.
- Medulla - A cellular column that runs through the core of the hair.

Hair Morphology: Hair is an extension of the skin that emerges from a structure called the hair follicle. The length of a hair spans from its root or bulb within the follicle, through the shaft, and ends at the tip. The shaft, consisting of the cuticle, cortex, and medulla layers, is meticulously examined by forensic scientists.

Hair Evidence: On average, humans lose around 100 head hairs every day. Since hair can easily be transferred through physical contact, it is often used as forensic evidence to establish connections between individuals, such as a victim and a suspect, or individuals and a crime scene. This type of evidence is particularly valuable in violent crimes where physical contact is likely, such as sexual assault, homicide, and aggravated assault. Crimes that are less likely to

involve physical contact, like armed robbery, would typically involve collecting clothing or other items that may have picked up hair, which could be used to identify suspects.

Terminal hair: Terminal hair refers to the dark, thick hair that covers various parts of your body, including your scalp, face, armpits, and pubic region. It serves multiple purposes, such as regulating your body temperature, protecting your skin from the sun's rays, and preventing germs and debris from entering your body. In individuals assigned female at birth, terminal hair covers approximately 30% of the body's surface, while in individuals assigned male at birth, it covers about 90% of the body's surface.

II. MATERIALS AND METHODOLOGY

Materials:

1. Compound Light Microscope
2. Glass slide
3. Coverslip
4. Mobile Camera
5. Hair Samples

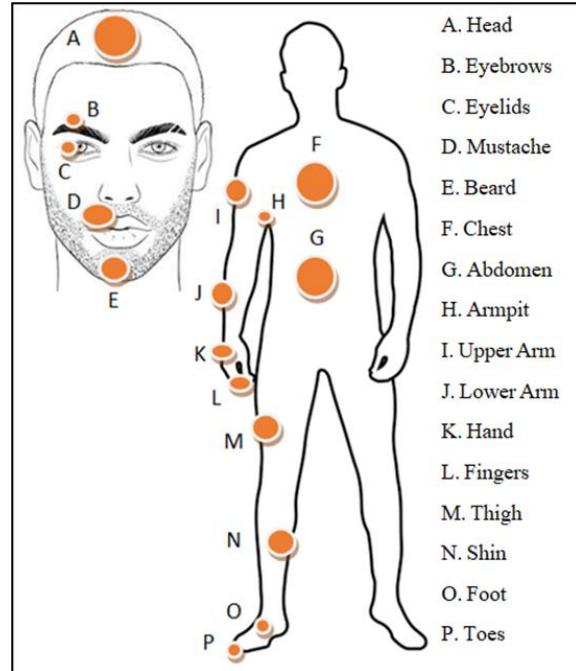


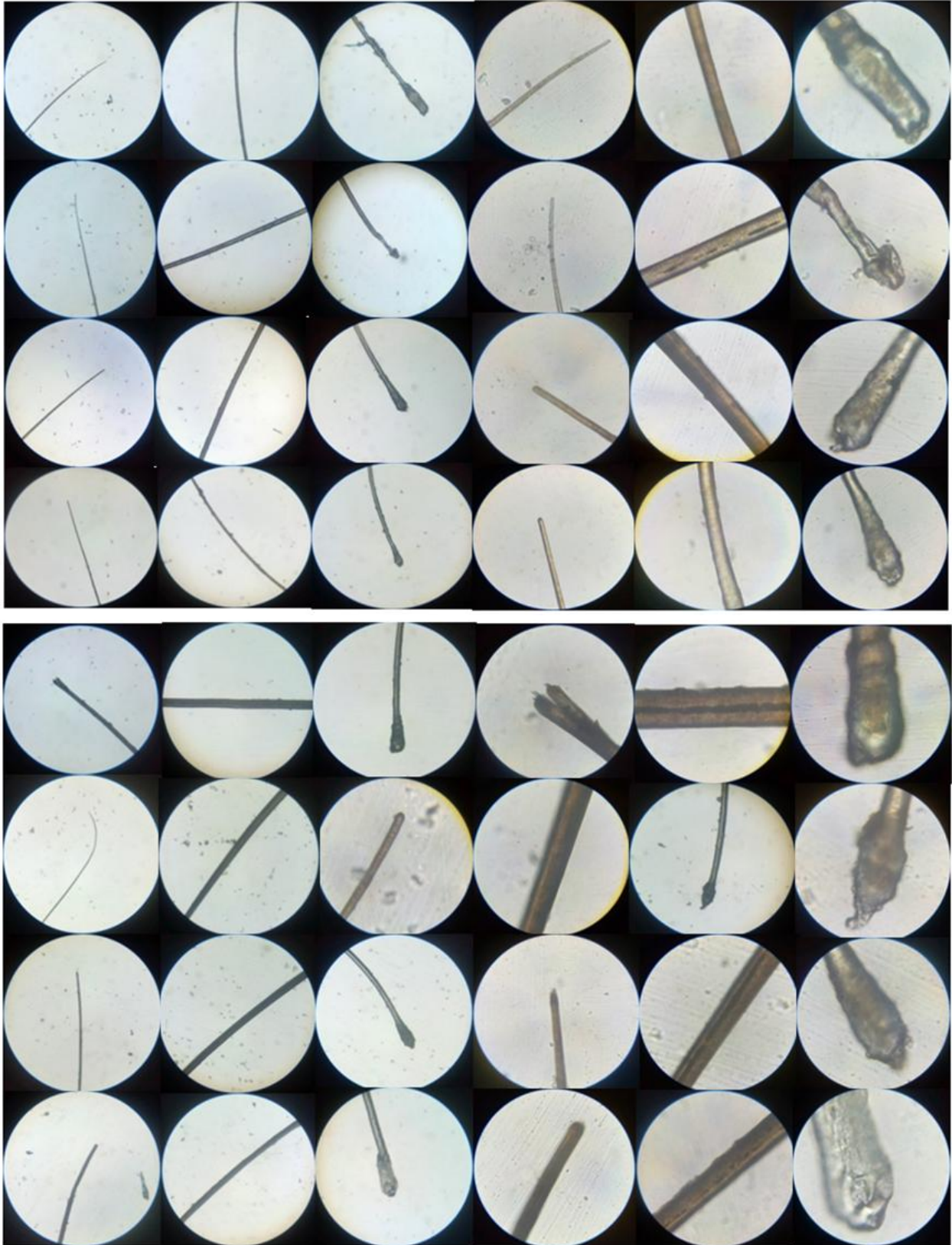
Figure 2: Locations of human hair on human body

Hair samples were collected from various regions of the male body (Fig.2). My own body became the subject for hair sample collection. Each sample was carefully plucked to ensure intact hair roots. Samples were then prepared for microscopic examination by mounting on glass slides with cover slip. A compound light microscope was used to observe hair tip, shaft/stem, and root at 10X and 40X magnifications. Hair tip, shaft and root morphology, including shape, size, and distribution of features such as medulla and cortex was analyzed and compared across different body regions. Then all photographs were taken as shown below.

Photographs: Tip, Shaft, Root (From left to right) with 10X and 40X Magnification



[In terms of rows - A. Head, B. Eyebrows, C. Eyelids, D. Mustache, E. Beard, F. Chest, G. Abdomen, H. Armpit]



[In terms of rows - I. Upper Arm, J. Lower Arm, K. Hand, L. Fingers, M. Thigh, N. Shin, O. Foot, P. Toes]

III. OBSERVATIONS

3.1 Tip:

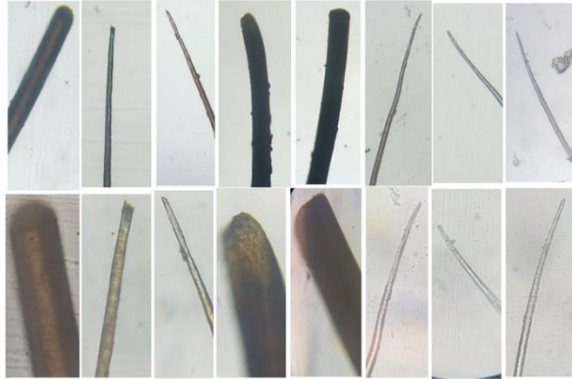


Figure 3 (A to H) →

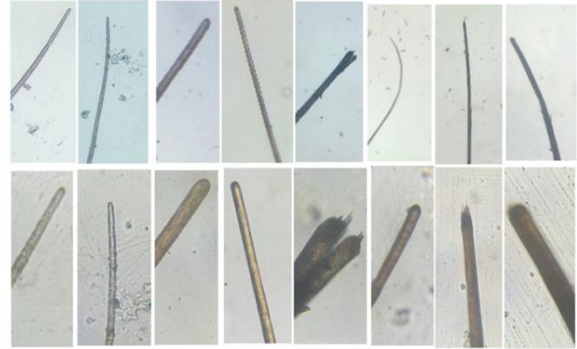


Figure 4 (I to P) →

General observations on Tip of hair from Fig.3 and Fig.4 – A: Semi-circular, thicker; B: Spiny, thinner; C: pointed tip end; D: blunt shape, thick, dense; E: flattened, thicker; F: more pointed, thin; G: small, pointed, transparent; H: pointed, transparent; I: small & semi-circular, straight; J: pointed, thin; K: semi-circular, thick; L: semi-circular, straight; M: split into two; N: semi-circular at end; O: spiny, irregular end; P: semi-circular, thick

3.2 Shaft:



Figure 5 (A to H) →

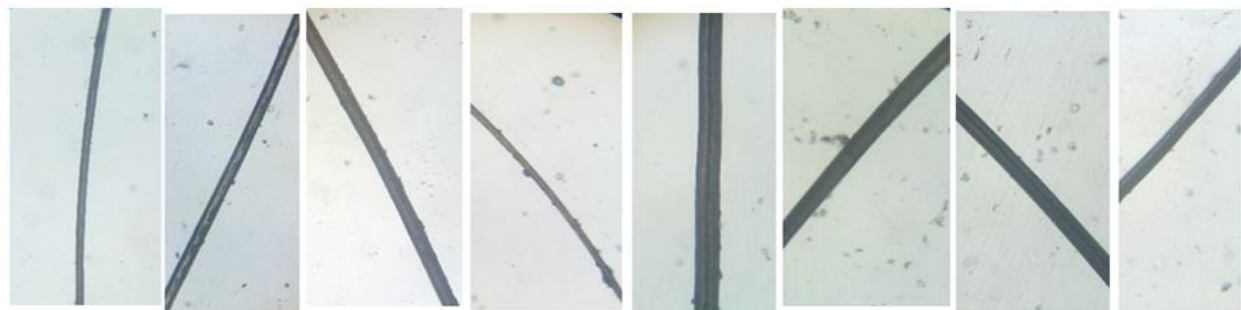
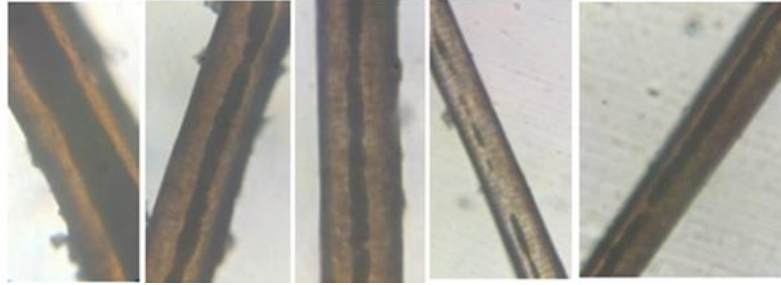


Figure 6 (I to P) →

From Fig 5 and 6 - The Shaft of D and E show larger size & broad diameter; the shaft of I and L shows smaller size & narrow diameter; and other shafts shows medium to large size & diameter. D, H, M, J, O shows some differences in presence of medulla which is shown in below (D: Continuous and thick, H: Continuous and thin, M: Continuous and narrow, J: More fragmented and thinner, O: Interrupted and thin)



D→H→M→J→O→

3.3 Root:

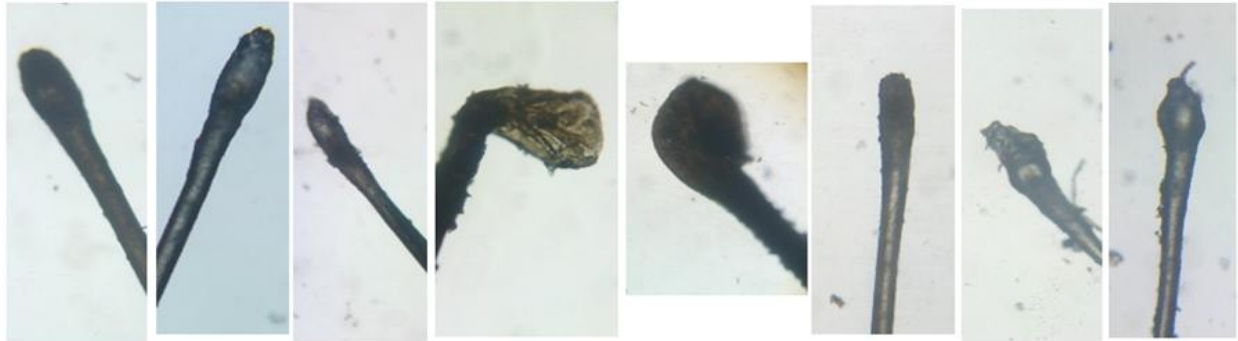


Figure 7 (A to H) →

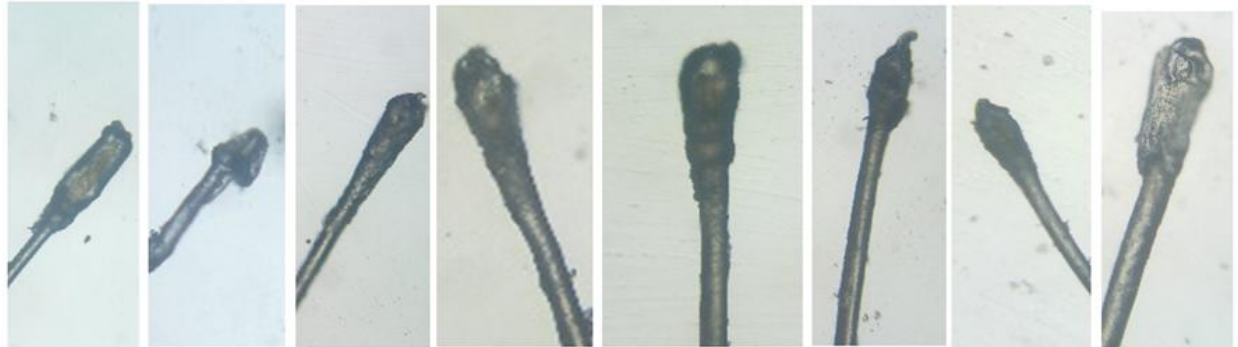
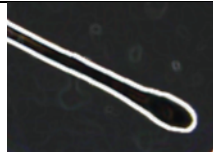
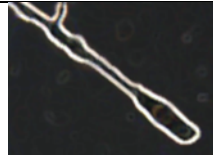
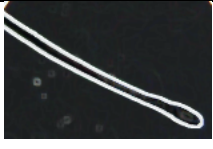

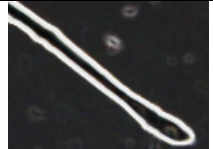






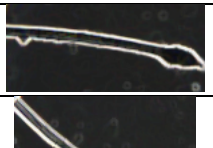


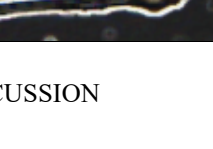
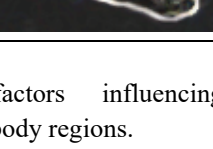


Figure 8 (I to P) →

From Fig.7 and 8, the root bulb of hair from D, E, G, H, I, J, N, P shows the comparative features in the form of different shapes and structures such as H-bean shaped, I-blade like structure, J-triangle shaped, N-appears as tail, etc. Others root shows cotton beard like appearance.

3.3.1 Diagrammatic Representation of Hair Root

Regions	Outline of Hair Root	Regions	Outline of Hair Root
A. Head		I. Upper Arm	

B. Eyebrow		J. Lower Arm	
C. Eyelid		K. Hand	
D. Mustache		L. Finger	
E. Beard		M. Thigh	
F. Chest		N. Shin	
G. Abdomen		O. Foot	
H. Armpit		F. Toe	

IV. RESULTS AND DISCUSSION

The microscopic analysis revealed significant variations in hair root morphology among different body regions. Hairs of eyebrows and eyelids displayed thinner, small, spiny and pointed tip. Hairs of head, beard and mustache showed thick, semi-circular tip. The tip of chest, abdomen and armpit showed transparent nature. The Shaft of beard and mustache shows larger size and broad diameter, where as hairs of arms shows smaller size & narrow diameter. Hairs of mustache, armpit and foot sometimes may show presence of medulla. Scalp hair exhibited well-defined, elongated oval-shaped root. In contrast, hair from the arms, and legs displayed shorter, more irregularly shaped roots. These findings highlight the diversity of human hair across body regions and suggest potential physiological and functional adaptations. Understanding these variations, further research is needed to elucidate the underlying genetic

and environmental factors influencing hair morphology in different body regions.

V. CONCLUSION

In conclusion, this study has provided valuable insights into the comparative analysis of human hair from different regions of the male body. Through the simple microscopic examination, significant variations in hair root morphology across various body areas were observed. The distinct differences observed in hair root shapes, hair sizes and structural characteristics. These findings highlighting the need for further research to fully understand the genetic, physiological, and environmental factors influencing hair morphology.

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