1.9 Hair Evaluations

1.9.1

The purpose of a hair evaluation is to determine the investigative value and suitability for subsequent DNA analysis. Typically, DNA analysis is conducted on all appropriate non-hair evidence prior to any hair evaluations being conducted, even when hair examinations are requested. Before proceeding with hair evaluations, carefully consider the potential value of information that may be gleaned from this evaluation.

Hair evidence differs in many respects from other types of physical evidence commonly encountered in a crime laboratory. One major difference is the variety in characteristics that exist among the hairs from a single body region of any one person. Hair analysis can provide valuable investigative information, however, DNA technology offers a greater ability to discriminate or individualize hairs. For this reason DNA testing for either nuclear DNA or mitochondrial DNA is the recommended method for individualization of human hair. Individualization by detailed comparative microscopic hair analysis will not be conducted. Hair analysis will be limited to screening hairs by observing gross physical characteristics through macroscopic and/or microscopic evaluations to the extent the item can be described to the level of a human hair and its suitability for further DNA testing.

1.9.2 Instrumentation Available

Stereomicroscope
Binocular Microscope

1.9.3 Hair Evaluation Procedure

1.9.3.1 Macroscopic and Microscopic Evaluations

1.9.3.1.1

Macroscopic evaluations are those observations made by the unaided eye. A variety of observations may be facilitated by varying the lighting conditions and/or background colorations.

1.9.3.1.2

Microscopic evaluations are those observations made by using a magnifying instrument. A variety of observations may be facilitated by varying the lighting conditions and/or background colorations. In addition, preparing mounted slides (dry-mount, water, cedar oil, etc.) may also be necessary.

1.9.3.1.3

All gross physical characteristics may be observed by using either macroscopic, microscopic, or a combination of both methodologies.

1.9.3.2 Characteristics for Observations

The following is a list of characteristics that can be observed and documented in routine evaluation of hairs. Any observations of characteristics outside this list shall not be allowed according to this manual.

The minimum number of characteristics documented will be determined based on the case specifics and the nature of the evidence itself.

Color (hue and intensity) - The general coloration of the hair can be noted, along with a description of the general intensity of such color. (i.e. light blonde, dark brown, black, etc.)

Shaft Form - The shaft form is the general shape of the hair that can be noted throughout the length of the shaft. (i.e. straight, wavy, curly, kinky, etc.)

Shaft Length - The length of the shaft is an approximate measurement of the length of the hair (i.e. two inches, ten centimeters, etc.) or a range of lengths for multiple hairs. (i.e. two inches to six inches, six inches to eight inches with the majority at the longer end of the range, etc.)

Shaft Thickness (Texture) - The thickness of the shaft reflects the overall texture of the hair. (i.e. fine, medium, coarse, etc.)

Proximal End (Root) - The presence or absence of root material should be noted. If deemed probative, the general condition of the root material should also be noted. (i.e. shed, pulled, skin tag, sheathing of root, extreme damage to root, apparent blood/tissue observed, etc.). The root phase may be noted by following the definitions listed below:

Anagen Phase- A hair that is actively growing and where the root is securely attached to the follicle

Catagen Phase- A hair in transition from the Anagen to the Telogen phase.

Telogen Phase- A hair that is in a resting phase and where the root is mature and has little to no adhesion to the follicle.

1.9.3.2.6

Medulla- The medulla is the central core of cells that may be present in the hair. While the medulla is not a gross physical characteristic of hair, its evaluation can aid in the determination of human or non-human origin.

1.9.3.3 Human and non-Human Hairs Determination

A number of features that are visible with both the unaided eye and with the stereoscope may differentiate between human and non-human hairs. Features that remain unclear may be aided by the use of a binocular microscope and mounting of the hair. The features listed below may aide in the determination of human and non-human hairs:

Non-Human Hair Feature	Human Hair Feature
May exhibit color banding (distinct color changes along the hair shaft)	Untreated human hair generally is more uniform in color
Pigmentation may be so dense that hair is opaque	Pigmentation seldom results in an opaque hair
Pigmentation may extend into the root in a heavy quantity	Roots are more often translucent (unless Anagen Phase)
Root shape may appear tapered, wine-glass shaped, or have a shape atypical of human	Root is "club-shaped" for many hairs or appear ribbon-like for Anagen Phase-doesn't typically appear tapered or thin
Full hair length may be short with tapered distal end	Short human head hairs will often exhibit cut, blunt, broken, or split ends-typically not tapered
May exhibit a subtle widening of the hair shaft just prior to the tapered distal end	Typically will not exhibit a widening of the hair just prior to a tapered distal end
Hair form may exhibit a regular wave or sine wave appearance	Hairs may be wavy or curly but typically not in a regular sine wave pattern
Scales may be prominent and protrude away from the hair shaft	Scales are generally flat
Medulla may be distinctly patterned	Medulla is amorphous when present
Medulla is generally >1/3 of the hair shaft	Medulla is generally <1/3 of hair shaft

1.9.3.4 Condition of Root/Determination of Nuclear DNA Potential

Human hair, after a period of active growth, will go into a resting stage. The appearance of a hair root will depend on the phase the hair was in when it was removed. Decaying hair roots will also show certain features that are unique to that condition.

The purpose of characterizing the condition of the root is to determine whether or not the hair is a candidate for nuclear DNA analysis or may need to be outsourced for potential mitochondrial DNA analysis.

Roots that are identified in the telogen phase may not be successful with nuclear DNA analysis and anagen and/or catagen roots should be prioritized over telogen roots for nuclear DNA testing. The unaided eye or use of a stereoscope may be sufficient for characterizing the root structure. It is acceptable to utilize the binocular microscope and hair mounting to aid in the root phase determination.

Root Phase	Characteristics
Anagen Root	This is a root that has been removed while it was in the actively growing stage. Often a tissue tag may be present at the end of the root and/or a thin, clear, colorless layer of tissue will be present around the root and up the shaft a short length. Trace amounts of blood may also be observed as a reddish material deposited on the root. The root shape may be club shaped or appear elongated or ribbon-like due to its adhesion to the follicle. **Caution:** A root that is removed during the growing phase may lack tissue, tissue/follicular tag or blood.
Catagen Root	This is a root that is not securely attached to the follicle but is still part of the germ and dermal papilla. The roots may show some distortion when removed and overall the characteristics may appear in between the telogen and anagen roots. Tissue may be attached. This type of hair is not encountered frequently.
Telogen Root	This is a mature root that is typically club or bulbous shaped and does not have a thin, clear, colorless layer of tissue around the root and up the shaft a short length. The root appears "bald". *Caution: Telogen roots from flesh body areas (pubic/facial regions) may show follicular tags.*
Putrid Root	This is a root that has begun the decomposition process. It may appear black with transmitted light or bright with reflected light due to air spaces created by degradation and is often found just above the tip of the root. The root itself may also look tapered. Putrid roots are an indication that the donor was deceased.
Absent Root (Hair Fragment)	There is not root present, having been cut or broken off.

A human hair in telogen phase, or that does not have a root, may be considered for mitochondrial testing by an outside laboratory. It is generally required that the hair be a minimum of 2 centimeters in length, but a small length may be considered if the hair is of suitable quality.

1.9.4 Conclusions

All conclusions that are drawn based on the gross physical characteristics observed must have documented observations and/or notes to support those conclusions. Generally, the only conclusions that may be drawn in a laboratory report include:

Differentiation between a hair, fiber or other material.

If it is a hair, differentiation between human and non-human hair.

If it is a human hair, differentiation between the root phases and a determination of its suitability for subsequent nuclear DNA testing.

Comparison between unknown human hairs and reference hairs will not be conducted.

1.9.6 References

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