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Is Hair Reliable Forensic Evidence?

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Editorial

In 2009, the U.S. National Academy of Sciences published a report on the status of forensic science, identifying what they found to be disciplines of forensic science that lacked appropriate scientific basis. Those areas of forensic science, including fingerprints, firearms examination, crime scene reconstruction, bloodstain pattern interpretation, hair comparisons, odontology, and others, were characterized as subjective and lacking standardized procedures, proper validation, and error rate calculation. More recently, the FBI identified 2,500 cases that require review after finding experts of microscopic hair comparison overstated the value of evidence. A study to date showed that in 257 cases, 95% of those reviewed, examiners testified to "near certainty" of matches or unfounded statistics. At the time of the announcement many suggested elimination of this "flawed" technique. Recently, NIST and DOJ have established the national Commission on Forensic Science and subcommittees to review current standards and practice in various forensic disciplines, including methods for the examination of human hair.

A quick look at the nature of hair analysis and its value may help to clarify the issue. Analysis of hair has been a scientific technique that has been used in a number of situations for more than a century. An experienced forensic hair examiner can answer conclusively many questions that may arise in a civil or criminal case: Is the material a hair or fiber? Is the hair human or from some other animal? Other questions that may be addressed include: If human, what biogeographical ("racial") origin is indicated by the hair? What was the somatic origin? What was the method of removal of the hair? At what growth phase was the hair when it was removed? Are the hairs chemically treated? What is the appearance of the hair tip and possible cutting mechanism if the tip is altered? There is little dispute that the answers to these questions may significantly affect an investigation and may provide important forensic information.

After the initial examination of hairs, it is possible to conduct a microscopical comparison of an evidence hair with those from a known source. This process involves a painstaking examination of a relatively large number of hairs from the known source, noting the range of variation for each of a number of characteristics within and among the hairs. Only after this extensive study of the known sample should the questioned (evidence) hair be examined and compared side by side against the known specimens. Significantly, this microscopical comparison can eliminate a person as a source of the hair, which provides important exculpatory evidence. When the questioned evidence sample demonstrates characteristics within the range of the known sample, that hair can be stated to be "similar to" or "consistent with" the known hairs. It is not possible for hairs to provide a positive means of individualization; a scientist will never say that the hairs "match." Thus, the microscopical examination and comparison of hairs does have great value as a useful, preliminary step in the individualization of a sample, especially when a clump or large quantity of hairs is involved.

Historical efforts based on serological methods to individualize hairs after microscopical comparison were successful in some instances providing approaches to ABO typing, sex determination and isoenzyme typing of hairs. Today, if microscopic comparison includes an individual, STR DNA analysis of root tissue present may result in individualization as with DNA testing of other biological material. If sufficient root tissue is not available, mitochondrial DNA (mtDNA) analysis of the hair shaft may be conducted. While mtDNA testing is less individualizing because mitochondria are inherited through the maternal line, such analysis may provide exclusion or an inclusion associated with a statistical significance. Studies have shown that approximately 10-13% of human hairs found to be microscopically similar to a known sample are eliminated by mtDNA testing.

Several scientists have attempted to provide probabilities associated with a positive microscopical hair comparison alone. The approaches suggested offer little more than an "average" or "estimate" of the random match probability. The fact that no statistical significance can be associated with a positive hair comparison leads some to question its validity, and others to question whether such hair comparison testimony is too prejudicial to present to a jury.

The FBI review showed that individual examiners often overstated the significance of that evidence; one individual even testified that the "odds were 10 million to one" that hair strands could originate from someone other than the accused. However, a well-trained scientist who has remained objective, who thoroughly examines the hairs, and who understands the limitations of the testing will never make such statements. It appears that the problem lies not in the science of hair analysis, but in us. As long as there are individuals who are willing to go beyond the boundaries of the science itself to make the positive comparison of hair with no subsequent DNA analysis more individualizing, damage to the criminal justice system will continue. National standards for evidence analysis will not necessarily stop such misrepresentation of the significance of scientific findings. We forensic scientists must to the best of our ability be vigilant and prevent misinformation and incorrect conclusions from being touted as valid within the justice community.