B136 Significance of Detecting Foreign Sources of DNA Under Fingernails

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The goal of this presentation is to provide the forensic community with a better foundation on which to base opinions with respect to DNA fingernail evidence in casework.

This presentation will impact the forensic community and/or humanity by providing the forensic community with data to validate their opinion regarding DNA evidence from fingernail samples in courts of law.

Scientists at the Centre of Forensic Sciences (CFS) routinely examine DNA results from fingernail scrapings and clippings in casework. Fingernails are useful in forensic science as they can often be used to generate a DNA profile from the donor and any additional sources. Foreign DNA beneath the fingernails can arise due to the transfer of skin cells or body fluids as a result of intimate physical contact. While the ability to detect foreign DNA profiles from fingernails has been demonstrated, their evidentiary significance is afforded little attention in the literature.

Fingernail related items are submitted to the CFS for DNA testing in one of two ways: scrapings or clippings. If the debris underneath the fingernails has been scraped with a wooden applicator stick prior to submission to the laboratory, then all of the scraped debris and the end of the stick are subjected to DNA analysis. In cases where clippings have been provided, the undersides of the fingernails are swabbed at the laboratory prior to DNA analysis. Special attention is given to fingernail clippings with blood staining; for these samples the blood, usually originating from the fingernail donor, is swabbed separately from the remainder of the underside of the fingernails. Experience is that this approach aids in the detection of foreign DNA by separating out samples likely to contain very high amounts of the donor's DNA.

A study performed at the CFS, involving staff of the laboratory and students from a local University, was undertaken to determine the prevalence of foreign DNA underneath the fingernails of individuals who share work or household environments. A total of 39 participants provided 78 samples (from the left and right hands) for DNA analysis by scraping under their fingernails with a wooden applicator stick. Of these samples, only 12% yielded a second source of DNA. When these were further categorized into samples where a significant foreign DNA profile was detected (DNA results for at least 4 STR loci) then the number dropped to only 4%. Further investigation determined that the foreign source of DNA could not be attributed to fellow members of the household or work environment, unless intimate physical contact had occurred. These results suggested that casual contact between individuals is not likely to result in the deposition of a second source of DNA beneath the fingernails.

The CFS maintains a database to track DNA results from fingernail related items in casework. Since February 2003 the data from 95 cases have been analyzed (a total of 187 samples). Homicides (67%) and sexual assaults (26%) comprised the majority of cases with fingernail related items. The majority (76%) of samples were submitted as clippings, while 22% were submitted as fingernail scrapings, and 2% contained both clippings and scrapings. Of the samples from fingernail clippings, 34% yielded a foreign source of DNA, while 58% contained only DNA from the fingernail donor, and 8% yielded insufficient or no DNA for analysis. Of the samples of fingernail scrapings, 29% yielded a foreign source of DNA, 40% contained only the fingernail donor's DNA, and 31% yielded insufficient or no DNA for analysis.

The results indicate that the likelihood of detecting a foreign source of DNA on fingernail clippings is greater than in scrapings. This may be a result of the CFS method of sampling any blood separately on clippings to prevent the "swamping out" of a foreign source of DNA with the donor's DNA during PCR. The data also suggest that fingernail samples can yield useful investigative information when the case history warrants their examination. However in casework, fingernail evidence is only examined if the case history suggests an expectation of finding a foreign source of DNA. Therefore one would expect a much higher prevalence of foreign DNA relative to the controlled study.

Additional experimental data regarding both the prevalence and persistence of foreign DNA profiles beneath fingernails under a variety of conditions will be presented. It is expected that this data and research will provide the forensic community with a strong foundation on which to base opinion evidence in courts of law pertaining to the relevance of fingernail findings in casework.

Fingernail Clippings, Fingernail Scrapings, DNA

 ** Presenting Author*