B110 The Development of a Dissolvable Swab for Increased Biospecimen Recovery

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After attending this presentation, attendees will understand existing forensic swab techniques and processes and the potential of a high-surface-area dissolvable swab to enhance biospecimen acquisition and subsequent recovery for forensic analysis.

This presentation will impact the forensic science community by discussing the increases in forensic competence as advances in material technologies are applied to biospecimen acquisition and processing for improving forensic analyses. Swab fiber technology with increased acquisition properties and complete specimen release through total swab dissolution allows for the collection of small amounts of cellular evidence while still producing robust Short Tandem Repeat (STR) profiling using standard methods.

Swabs are routinely used by crime scene investigators and forensic scientists for the collection of a wide range of evidence types for analysis. The most commonly used swab device for collection of biological specimens is the sterile cotton swab due to its ease of use, low cost, and ability to collect on multiple substrates such as wood, fabric, and metal. Although cotton swabs readily adsorb biological material, they exhibit low efficiency of DNA sample release. While material and manufacturing advances have resulted in a diversity of new forensic swab types and materials, sampling and extraction efficiency from these swabs varies significantly by substrate and sample type. The loss of biological material for downstream processing can be 40%-80% from merely the swab extraction process.

The primary objective of this study was to evaluate the effectiveness of high-surface-area, dissolvable, electrospun nanofibers on biospecimen capture and DNA recovery. Using prototype swabs made from sheets of electrospun biopolymeric material, experiments were conducted that evaluated adsorption of high and low volumes of biological material (wet and dried cells) from glass slides, and subsequent DNA extraction using commercially available forensic analysis kits. Both manual and automated DNA recovery was investigated. DNA extraction was conducted using the QIAGEN® QIAamp® DNA Mini Kit or the QIAGEN® EZ1 Robot. The Quantifiler® Human DNA Quantification Kit, in conjunction with an Applied Biosystems® 7500 Real-Time Polymerase Chain Reaction (PCR) instrument, was used to estimate the quantity of human DNA present in each sample. Following DNA quantification, STR typing was performed on all samples of DNA recovered from the dissolvable swabs using the GlobalFiler™ PCR Amplification Kit and analyzed using the GeneMapper™ ID-X software.

Dissolvable nanofiber swabs were shown to have excellent performance in cellular adsorption (99%) and in DNA extractions (82%). All DNA samples recovered from dissolvable electrospun swabs were also capable of producing full, high-quality STR profiles. The results of these experiments demonstrate the potential usefulness of high-surface-area, dissolvable, nanofiber swabs for both enhanced biospecimen capture and increased DNA recovery of biological evidence.

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