Evaluation of a vacuum-swab protocol for recovering epithelial cells from handled evidentiary samples

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After attending this presentation, attendees will be able to implement a cost-effective and efficient collection technique for the recovery of epithelial cells from handled forensic samples.

This presentation will impact the forensic science community by introducing an efficient collection technique for the recovery of touch DNA from forensic samples. This vacuum-swab technique can easily be implemented into current forensic laboratories without the need of purchasing expensive equipment.

Handled evidence, such as clothing, firearms, and tools, are frequently submitted to forensic biology laboratories for Short Tandem Repeat (STR) typing. This has resulted in a growing need for a cost-effective and efficient collection technique for recovering biological material from handled items of evidence. Due to the limited quantities of DNA that can be left behind on handled objects, it is essential that the recovery method employed provides the maximum possible percent recovery of epithelial cells and therefore the greatest chance of generating a quality genetic profile. Current recovery techniques used to collect epithelial cells include the double-swab method, the tape-lift method, and the scraping method. On hard, non-porous surfaces, the double-swab technique has been shown to be the most effective. In a comparison using filter paper, single-swab, and double-swab techniques, the double-swab technique yielded the greatest quantity of DNA. The use of adhesive tape has been shown to be the most effective on porous samples, yet recovered only 55% or less of the donor's genetic profile. An additional collection method using a vacuum apparatus has been shown to produce promising results from porous items of evidence. This system sprays a buffer on to the surface of an item of evidence while simultaneously suctioning from the surface, thus collecting cellular material in a large volume of buffer; however, this necessitates the use of an additional filtration step to collect cellular material for DNA extraction. The current study evaluated these DNA recovery techniques in comparison to an alternative vacuum-swab technique to determine the optimum method of collecting epithelial cells from porous substrates.

Buccal cells were collected from a single donor and deposited on fabric at varying concentrations and allowed to dry. For the double-swab method, a swab moistened with 2% Sodium Dodecyl Sulfate (SDS) was first passed over the surface of the fabric ensuring maximum contact between the swab and surface. A second dry swab was then passed over the fabric and combined with the initial swab for extraction. For the tape-lift method, water-soluble tape was firmly pressed against the surface of the fabric and directly added to tubes for extraction. For the scrapping method, a scalpel blade was passed over the fabric held at an angle to recover cellular material on the surface of the fabric. The vacuum-swab technique used a sterile glass tube with a cotton plug attached to a rough pump vacuum apparatus. All samples were quantified and then amplified at 16 polymorphic loci and analyzed using

capillary electrophoresis. Quantitative values were compared for each method and resulting genetic profiles were assessed to ensure no allelic drop-in or sample contamination.

Equal volumes of liquid buccal cell slurry were extracted with samples that had the same volume deposited on fabric prior to collection. This was used to calculate a theoretical DNA quantity deposited on the fabric swatches and, therefore, the percent recovery of each collection protocol. Significant differences were found among the four methods of recovery ($p \leq 0.001$). The double-swab and scraping methods showed the poorest percent recovery, while the tape-lift and vacuum-swab methods showed the best percent recovery. At each concentration assessed, the tape-lift and vacuum-swab methods collected on average two to five times greater DNA concentrations, respectively. Amplification results demonstrated the absence of contamination in all cases. This data illustrate that the vacuum-swab and tape-lift collection protocols employed can enhance the quantity of recovered DNA from handled items and, therefore, are best suited for use in forensic biology laboratories for submitted porous evidence types.