B100 Separating DNA Mixtures by Computer to Identify and Convict a Serial Rapist

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After attending this presentation, attendees will understand some principles of using probabilistic genotyping separation of complex DNA mixtures to investigate serial crime, calculate match statistics, prepare for trial, establish genotyping reliability, and present computer results in court.

This presentation will impact the forensic science community by providing a case example of using sophisticated computer technology that resolves complex forensic evidence in order to simplify human understanding and the communication of statistical support.

In July and August of 2013, a masked man broke into four separate Bakersfield, CA, homes and assaulted nine women and children. Three women were raped and one child was molested. The police recovered biological evidence from three of the crime scenes.

The Kern Regional Crime Laboratory (KRCL) took 37 swabs and cuttings from garments, blankets, apartment surfaces, skin, body cavities, telephones, and zip ties. In October of 2013, KRCL tested these biological items with Identifiler® Plus to generate Short Tandem Repeat (STR) data. The items were largely low-level DNA mixtures of three or four people. Human review of this data was generally uninformative; however, one of the zip ties (found in the road outside a victim's apartment) was a DNA mixture with a clear major contributor. This major donor led to a Combined DNA Index System (CODIS) profile that identified gang member Billy Ray Johnson.

Mixture separation and comparison were performed on all 37 evidence items using TrueAllele® Casework probabilistic genotyping technology. The company and KRCL independently conducted this mixture interpretation, each using their own in-house computer.

In October, the company interpreted the 37 evidence items by computer, separating the mixtures into genotypes. Parallel processing permitted all the computer analyses to proceed simultaneously. Once the 11 reference samples became available, computer comparison between separated evidence and reference genotypes yielded match statistics that indicated inclusion or exclusion. The technology linked eight mixture items (purse strap, phone, phone cord, two pants, shirt, bathtub handle, and zip tie) to Johnson. The computer showed the mixtures also contained DNA from victims and other people, consistent with their statements. The company sent their case report on these findings to the Kern County District Attorney's office. A grand jury heard the DNA and other evidence in December of 2013. They indicted Johnson on 25 counts, and he was arrested.

Separately, the KRCL conducted an independent in-house TrueAllele analysis of the DNA mixture data. Their match statistics agreed with the company's results. The concordant inclusionary statistics ranged from hundreds to hundreds of quintillions, depending on DNA quantity.

At the 2015 trial, expert witnesses from the company and KRCL testified about their match results. Each group had independently calculated match statistics, arriving at the same conclusions regarding the individuals who had contributed their DNA to the crime scene evidence. The computer had dissected the mixtures to show who was (and wasn't) associated with each item.

The jury was informed about computer interpretation of DNA mixtures and viewed a PowerPoint® presentation that explained how a computer separates mixture data into contributor genotypes. Comparing a mixed evidence genotype that had been subjected to contributor separation by the computer with the reference genotypes, relative to a population genotype, visually clarified the match statistic. Using published validation studies, the expert witnesses established interpretation reliability and could give false positive rates for their statistical conclusions. The cross-examination was respectful of the science.

On April 21, a Bakersfield jury convicted Billy Ray Johnson of 24 (out of 26) felony charges. On May 19, the serial rapist was sentenced to life in prison without the possibility of parole plus 423 years. Computer technology had successfully analyzed otherwise "inconclusive" DNA evidence, helping to secure criminal justice and ensure public safety.

A case study will be presented in probabilistic genotyping as an example of the processing and presentation of complex mixture results. Familiarity with this approach will help criminalists obtain statistical results from low-level DNA mixtures containing three or more people and assist in explaining their findings in court.

DNA Mixture, Probabilistic Genotyping, Serial Rape

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