



B160 The Utility of Y-STR Analysis in Casework

Kelly Bowie, MSc*, Roger Frappier, MSc, and Jonathan Newman, BSc, Centre of Forensic Sciences, 25 Grosvenor Street, Toronto, ON M7A 2G8, Canada

The goal of this presentation is to present to the forensic community the Centre's guidelines for Y STR testing and highlight successful casework examples where Y STR analysis has proved to be a very valuable forensic tool.

This presentation will impact the forensic community and/or humanity by providing guidelines for when to employ Y-STR testing in casework; potential for standardizing use of Y-STR methodology in casework where sample is potentially limiting.

The CFS utilizes the PowerPlex[®] Y (Promega Corporation) multiplex system that allows for the characterization of 12 STR loci on the Y chromosome. Validation of the PowerPlex[®] Y DNA typing system for use in forensic casework at the CFS was previously included as part of a collaborative inter-laboratory study (Krenke et al., Forensic Science International 148 (2005) 1-14) that demonstrated this system to be highly robust, sensitive and precise. Experience shows that a full Y chromosome STR profile was generated when as little as 31 pg of DNA was amplified. With respect to mixtures of female and male DNA, a full male Y STR profile was generated with a 10,000-fold excess of female DNA in the sample. To date, a male-specific quantitation system has not been implemented, and as such, an estimate of the amount of male DNA present in a sample is determined, whenever possible, based on the ratio of female to male DNA observed in the autosomal STR results.

The Y-STR testing service that was implemented in casework at the CFS in April of 2005 is largely designed to assist with three main case types: homicides, sexual assaults and familial analysis (*i.e.* criminal paternity cases). The CFS guidelines that have been developed with respect to which sample types are amenable to Y-STR testing include the following:

- Case history and results (body fluid identification &/or autosomal STR results) that indicate the possibility of a male source that has not been fully elucidated by autosomal testing.
- Autosomal analysis that indicates a mixture of DNA is present where a major component can be readily determined, while the gender of the minor component or the number of individuals contributing to the minor component is in question.
- Paternity cases with a male child.
- Comparison samples that require testing for the purpose of addressing the possibility of a familial relationship to the perpetrator.

It is imperative that the interpretation of Y-STR profiles and the reporting of their significance reflect the case history at hand and the hypothesis being tested. Equally important is the need for the scientist to draw upon their training and experience. The evolution of the above guidelines is, in turn, a reflection of the laboratory's collective experience with the PowerPlex[®] Y system in conjunction with a hypothesis-based testing approach. To date, approximately three quarters of cases forwarded for Y-STR analysis at the CFS have been sexual assaults and testing has proven to be a valuable tool in circumstances where the amount of male DNA present in the sample is often negligible relative to the amount of female DNA. In the majority of sexual assault cases that were subjected to Y-STR testing at the Centre, the purpose was to assist in developing a Y-STR profile suitable for comparison to known samples, as previous attempts to generate a male DNA profile with autosomal STRs were unsuccessful. In some of these cases, a full male Y chromosome profile was obtained, thereby providing valuable evidence that could assist in identifying the perpetrator, where none had existed previously. Y-STR testing has also been utilized to specifically address an assumption made upon which the interpretation of autosomal STR results was based. In one example, a mixture of DNA from at least three individuals, including at least one male, was obtained from a semen stain in the crotch of a pair of underwear and a 9-locus STR DNA profile was determined based on the assumption of a single minor male contributor to the mixture. In this case, subsequent Y-STR analysis supported this assumption. Y-STR analysis has also proved useful in addressing the possibility that particular persons of interest may be biologically related to the perpetrator of a crime. In specific cases, the number of alleles shared between the crime scene DNA profile and a particular known individual was indicative of a familial relationship. Y-STR testing was undertaken in order to assist in determining whether a male relative of the known individual could be excluded as being the perpetrator.

Overall, to date, use of the PowerPlex[®] Y system in casework at the Centre has proven to be an invaluable tool and has assisted countless investigations. Future work will focus on implementing a method of quantitating male DNA, such that more informed decisions can be made with respect to proceeding with autosomal or Y-STR analysis.

Y-STRs, Hypothesis-Based Testing, Casework