

CLOSING CASES WITH A SINGLE SNP ARRAY: INTEGRATED GENETIC GENEALOGY, DNA PHENOTYPING, AND KINSHIP ANALYSES

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Genetic genealogy (GG) is poised to revolutionize forensic investigations by generating leads as to the possible identity of an unknown victim or offender. Unlike traditional familial searching using STRs, GG uses genome-wide autosomal SNPs to detect distant relatives in public databases of consenting participants. Genetic matches (individuals who share large amounts of DNA with the unknown subject) serve as clues to inform traditional genealogy research. First, family trees of the matches are constructed back to the set of possible common ancestors using online genealogy databases, newspaper archives, obituaries, and other public records, after which descendancy research is employed to enumerate the possible identities of the unknown subject.

While extraordinarily powerful on its own, GG can be performed much more efficiently by combining it with other advanced DNA analyses that can help narrow down the possible identities to just one or a few. Critically, this full suite of advanced DNA analyses can be conducted from a single sample of only 1 ng of forensic DNA using microarray genotyping, which conserves sample and saves time.

First, the autosomal SNPs are used to attempt to identify the unknown subject through genetic genealogy, aided by inferred mitochondrial and/or Y-chromosome haplogroups. DNA phenotyping can be applied to the same autosomal SNP data to predict the unknown subject's ancestry and physical appearance traits, such as pigmentation and face shape, which can help include or exclude branches of the family tree to narrow down the scope of possible identities. Finally, if genealogy and phenotyping do not lead to a single individual but, instead, to an extended family group, one-to-one kinship testing, effective even at large genetic distances, can be performed using DNA collected from cooperative family members to zero in on the correct branch of the family tree.

In this presentation, we will illustrate how this suite of SNP technologies is actively being used to solve decades-old cold cases. As the only group to have worked on hundreds of cases using these advanced technologies, we will present case studies and statistics on the potential solve rate for violent crimes using this methodology.