

Crime Scene Investigations of Forensic DNA-Analyses

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Abstract

In Switzerland, burglaries rank as the top mass crime according to forensic DNA analysis. In the Swiss DNA database, almost one-third of the DNA trace profiles are connected to burglaries. However, it is unknown if the DNA sampled during the collection of prospective DNA traces within a person's home during a burglary came from the culprit or from a resident of that home. Crime scene investigators typically do not gather reference samples from all the homeowners due to the high frequency of burglaries for administrative and financial reasons. As a result, it must be considered that there is a significant likelihood that a DNA profile from someone who was allowed to be at the crime scene will ultimately be transmitted to a DNA database for comparison. As far as we know, no research has been done to determine the proportion of these non-perpetrator profiles that end up in DNA databases. We gathered reference samples from locals who had recently experienced house invasions to help answer this question. We are able to demonstrate that the bulk of the DNA samples gathered during burglary investigations belong to the inhabitants by contrasting the profiles created from these reference samples with the profiles created from trace DNA. We further demonstrate that trace DNA collection in the vicinity of the break and entry area, in particular window and door glasses, is most promising for sampling perpetrator instead of inhabitant DNA, despite the small number of cases included in the study, likely due to a crime decline caused by the pandemic.

Keywords: Forensic genetics • Crime scene • Sampling.

Introduction

Burglaries are a serious sort of property crime, with the impact being heightened by the sense of insecurity left among the victims. They typically involve a combination of property destruction, trespassing, and theft. Burglaries are the most common crime investigated with forensic genetics in Switzerland and possibly many other nations. With 24,010 reported cases in Switzerland in 2020 (or nearly 9% of all registered property crimes), it is a common sort of crime against property. On the other hand, compared to other high-volume crimes like fraud, burglaries are particularly well-suited for DNA traces collection. "Touch" DNA traces from burglaries and burglary attempts make up more than 50% of the total number of traces studied in the department for forensic molecular biology of the Institute of Forensic Medicine, where the current study was undertaken.

Given the length of time spent within a home, it is reasonable to assume that the majority of DNA traces found there came from the residents in question. To prevent having their profiles determined from DNA traces gathered at the crime scene forwarded to the Swiss DNA database for comparison via CODIS, we rarely obtain reference samples from locals despite the high number of instances. Routine reference swab sampling from all residents would incur astronomical financial and administrative expenditures, assuming an average of 2-3 people per family or even more for workspaces, when considering burglaries in commercial environments.

However, failing to take into account the fact that many resident profiles end up being registered in CODIS as traces profiles leads to the following issues: (A) By presenting unreliable evidence, the police run the risk of

derailing investigations. The actual case described below could be used as an illustration of this particular issue: Three males attacked a man and a woman who were living together. A DNA combination with a female and a male component was extracted from the woman's jacket and transmitted to CODIS. Cross-checking all samples from the same case revealed that the feminine component belonged to the female victim. However, there were profile matches with DNA traces from two burglaries for the male component. Therefore, the police opened an investigation into the assault's male victim. The investigation was started based on inadmissible evidence provided by two random and unrelated DNA matches, which could have been avoided by taking reference samples [1]. The Bern Cantonal High Court, however, disallowed the use of all the evidence acquired in this instance. The case became a cold one as a result of the verdict, which prevented the attackers from being brought to justice. (a) The absence of a previous exclusion may discourage crime victims from calling the police. Once someone becomes a victim themselves, they may be reluctant to call the authorities due to the possibility of being connected to a former crime or a youthful vice, such as spraying illegal graffiti. In Switzerland, trace DNA sampling is legal when property damage results in monetary losses of more than 10,000 CHF, which can be easily attained through graffiti spraying. We may envision a 16-year-old graffiti sprayer who becomes a victim of a more serious crime but chooses not to call the police out of concern that his past or present spraying actions might be discovered by the police due to accidental DNA matches. (c) An exaggerated database results. Normally, DNA trace profiles left behind by residents won't produce any matches in forensic databases, at least not with profiles of those who have been found guilty. As a result, the traces will continue to be stored in the database for years and produce potential matches with recently added suspect profiles or trace profiles from other instances. DNA combination profiles frequently produce potential matches that the submitting lab must confirm. The "candidate match" is then evaluated by the lab to determine if it is a true match (or "HIT") or not. Most verifications for mixture profiles yield "NO HIT" conclusions. The database should be cleaned up of profiles from criminally sanctioned individuals because controlling such candidate matches takes time and could be an error source.

We anticipate that a significant portion of the DNA trace profiles generated in burglary investigations will be from the residents based on controlled research on DNA transfer and persistence [2,3]. However, it is unknown how many of the profiles in real-world case studies are from locals. Because access is more limited in private homes than it is in stores or other commercial settings, we concentrated on burglaries there to gain an idea of those numbers. Prior

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to sending them for comparison into the Swiss DNA database, we gathered the reference samples from the locals and compared them to the DNA profiles created from the traces found at the murder scene.

Methods

The Bern Cantonal Police conducted a sample for crime scene traces in burglaries in accordance with standard procedure. Individual police officers at the scene independently determined where DNA from the perpetrator would be anticipated and obtained samples in accordance. Using a Qubit fluorometer, DNA from buccal swabs was measured (Thermo Fisher, Waltham, MA, USA). The AmpFISTR® NGM Select Express™ and PowerPlex® ESI17 Fast kits from Thermo Fisher, Waltham, MA, USA, were used to create DNA profiles in a 12.5 L reaction volume (Promega, Madison, WI, USA). Using the PrepFiler Express™ Kit and the AutoMateExpress™ instrument, DNA from trace samples was extracted with an elution volume of 50 L, in accordance with our usual lab practise for swabs from touched surfaces [4]. Using a 7500 RT PCR System and Thermo Fisher's Quantifiler® HP Kit, DNA was quantified using Real-Time PCR (qPCR).

Results

The samples were divided into three groups: (a) movable things, such as jewellery or keys; (b) samples obtained near the offender's entry, such as a door or window. (A) furniture, such as handles from cupboards or pieces of furniture that had been moved by the offenders. Approximately 65% of the samples were collected close to the entry. Subcategories were further created for the samples near the entry. The majority of them (n=46) were gathered from broken or broken glass in windows.

From 48 traces, we were able to create DNA profiles that could be submitted to CODIS, which represents an overall success rate of 33%. Only around 30% of traces collected near the entry produced CODIS-suitable profiles, compared to 70% and 50%, respectively, of samples taken from portable and furniture, respectively.

Conclusion

Less than 10% of all other traces led to unknown, and thus potentially suspect, profiles, but more than 70% of all profiles generated from window glass in the area of the break-in were caused by unknown individuals. In order to generate investigative leads, traces from (broken) windows should be given priority in crime scene sampling. The collection of reference samples should at the very least be taken into consideration for traces that weren't obtained from window glass in order to reduce the inclusion of DNA profiles coming from crime scene authorised individuals in CODIS.

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