SPIT 20

IRAL of SUCCESS

The discovery of DNA fingerprinting two decades ago revolutionised crime detection, says Dr Andrei Semikhodskii

Next year, will mark the 20th anniversary of the first use of DNA testing in the criminal justice system. It was in 1986, when a DNA fingerprinting technique was developed by Alec Jeffreys (now Sir Alec), a young professor of genetics in Leicester University, who used it to solve the infamous Enderby murder case. The criminal justice system now relies heavily on DNA-based evidence.

All over the world, thousands of perpetrators have been convicted of various crimes with the help of DNA evidence, and hundreds wrongfully convicted people have been exonerated. DNA analysis has become an indispensable police tool in fighting crime, as it allows unambiguous identification of the criminal by traces of biological material left at the crime scene and the acquittal of innocent suspects, based on DNA evidence.

Threefold uses

DNA testing has three major applications for forensic studies - identification of missing persons; identification of victims of wars, accidents and natural disasters; and crime investigation.

Out of all criminal cases when DNA was used as evidence, two out of three involve sexual assault. The rest are cases dealing with burglary, murder and other types of violent crime. Annually, more than 20,000 forensic DNA tests are performed in the UK alone. The UK's National Criminal DNA Database (NDNAD) currently contains more than 2.5m samples from suspected individuals and convicted criminals, as well as in excess of 250,000 crime scene samples. Every week more than 300 crime scene samples are matched to the suspect and the convicted criminals' database.

Blood, semen and saliva

The most common samples collected at crime scenes are blood, semen and saliva, although virtually any biological material or objects handled by a perpetrator can be DNA tested. Items of clothing, furniture and other items which may have traces of DNA are now routinely used for obtaining DNA evidence. Modern technology is so sensitive that it allows identification of a person by analysing DNA collected from a fingerprint left on the surface of an object, or from a single hair left at a crime scene.

When a crime scene sample or a sample from a suspect is analysed, a DNA profile is produced. A DNA profile is a digitalised representation of an individual's genotype with respect to the DNA markers tested. In the UK all crime scene DNA profiles together with those of all suspects and arrestees for any recordable offence are deposited into the NDNAD. UK Police use the NDNAD as an investigative tool to help solving a wide range of crimes including murder, rape, sexual assault, robbery, terrorism, burglary and arson and have almost doubled their clearance rate for volume crimes, such as house burglary and motor vehicle offences. As each new DNA profile from a suspect is added to the database, it is checked against all deposited crime scene DNA profiles. When a new crime scene profile is added, it is checked against DNA profiles of all suspected individuals, as well as against other crime scene DNA profile sample records. Since its inception in 1995, the NDNAD has matched more than 200,000 crime scene samples to suspects, and more than 20,000 crime scene samples to other crime scenes.

Despite the wide spread belief among criminal lawyers and barristers, DNA evidence is not an assailable proof of guilt. A DNA match between a suspect and a crime scene does not automatically guarantee a conviction. Although very strong, DNA evidence is just another piece of evidence and on its own, is often not enough to convict someone of a particular crime. It must always be taken in conjunction with other pieces of evidence and the weight of DNA evidence is impossible to estimate without taking into account the circumstances of the case. Even when a strong match between a defendant and a crime scene sample is presented by the prosecution, non-DNA evidence may be pointing to someone else as the real perpetrator of the crime. This "other" evidence can decrease the weight of DNA evidence and increase the chances of successful defence.

Since their introduction into forensic science, DNA typing methods have been strenuously attacked in court. There are several pitfalls in the way DNA evidence is obtained or/and interpreted which can be used to develop a successful defence strategy. As when dealing with other types of evidence, it can be built around two major points - evidence admissibility and evidence interpretation issues, as well as some case-specific issues.

Issues of DNA evidence admissibility relate to the origin of DNA samples, their transfer from the crime scene to the analysing laboratory (chain-of-custody) and the laboratory practice and technology, used for analysing the samples.

Chain-of-custody issues are of paramount importance for DNA evidence admission. At the crime scene biological material is collected by a forensic team, which then pass it onto another police force and so on until it reaches the destination laboratory which can be hundreds of miles away. It is important to be sure that the samples analysed are those that have been collected at the scene. This puts additional emphasis on the way crime scene samples are collected, recorded and stored.

The process of transporting the samples from the crime scene to the laboratory has to be meticulously documented and under no circumstances whatsoever should evidence be left unattended. It is important that the defence scrutinise the way biological evidence was collected and transported – in cases of any major mistakes, the DNA evidence may be successfully challenged and prevented from being admitted.

Contamination

There is a chance that the police force forensic team who collected the biological material and/or the technical staff who analysed it could have inadvertently contaminated the samples with their own DNA, or with DNA from another crime scene they have previously attended. In the UK, there is a database of the forensic police force involved in sample collection at crime scenes to exclude them from the list of suspects. The defence have to make sure that the people who collected the biological evidence have indeed being included in the police exclusion database. There is also a possibility that people who attended the crime scene before the police or police force who attended the crime scene before the samples were collected, could have also contaminated the evidence. If proven, any such incidents may dramatically reduce the power of DNA evidence or even invalidate the results.

When presenting DNA results, prosecution often claims very low probabilities of random match. In such circumstances, laboratory errors should also be taken into account by the defence. There are two main types of laboratory errors which may affect obtaining and interpreting DNA results – errors of methodology and errors which result from bad laboratory practice. DNA testing involves many steps and tracking of samples is paramount in order to be able to match the samples with correct results. Various sophisticated laboratory information management and quality control systems are used to make sure that the breakdown in the tracking process never happens, but nevertheless, there are documented instances when it was observed.

One in every hundred forensic tests performed on the DNA of suspected criminals may give a false result due to laboratory errors.

According to a recent report, DNA data presented in court is always supported by various statistical indices. In criminal cases, the aim of DNA evidence is to establish beyond reasonable doubt that a match between a crime scene sample and the suspect is a real match and not due to chance. In many cases it is not as straight forward as it seems. When calculating the match, various assumptions are taken into account. Most of them deal with the structure of human populations and are based on theoretical models rather than real-life situations – the differences between the two can dramatically affect the interpretation of DNA results. If one of these assumptions is not true or can be interpreted in another way, the calculations could be severely compromised.

In addition, crime scene samples are commonly a mixture of DNA from a number of donors, some of whom may be unknown, which greatly complicates interpretation of the results. Evaluation of mixtures is complex and can be done is several ways, each of which requires sophisticated statistical approaches. Often, the results are not unambiguous and are open to conflicting interpretations.

All in the family

The family and cultural background of a person whose DNA matches that recovered from the crime scene also has to be taken into account. If the suspect has a sibling, they both may have identical DNA profiles and the sibling instead of the accused, may be the real perpetrator of the crime. If the suspect comes from a community where close relative marriages are common, the chances of finding another individual with the same profile will be significantly higher in this type of population, and this will affect the interpretation of the data.

Specifics of each case have to be taken into account when attacking DNA evidence. Could it be that a relative of the defendant committed the crime or is it possible that the DNA evidence was left long before or after the particular crime was committed? One of the most common case-specific challenges to DNA evidence deals with DNA typing methodology. Here, the defence may suggest that although DNA testing is reliable in theory critical mistakes were made in testing (sample switches, contamination, deviations from laboratory protocols, misinterpretation of results, etc), which may invalidate the findings. With this strategy, typically the technical expertise of a particular laboratory or analyst is criticised.

In short, the discovery of DNA fingerprinting two decades ago truly revolutionised the legal profession. ❖