EXPERIENCES WITH A COMPUTERISED DATABASE OF DNA PROFILES IN FORENSIC CASEWORK

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INTRODUCTION

DNA profiling using single locus probes D1S7 (MS1),D7S21 (MS31), D12S11 (MS43A) and D2S44 (YNH24) has been used in casework at the Metropolitan Police Forensic Science Laboratory since November 1988. In this time approximately 1200 cases have been profiled including more than 2800 blood samples from different individuals. As the Laboratory had considerable experience in using computerised databases of conventional bloodgroups for intelligence purposes, it was a natural progression to continue this with DNA profiles. This was one of the factors that influenced our choice of single locus probes instead of a multi locus system as SLP results are relatively easy to store in numerical form and can be easily searched using a computerised database.

DESCRIPTION

A set of autoradiographs from all four probes is prepared wherever possible and the bands in each track measured using a video scanner system developed at the Laboratory (Catterick and Russell 1991) which calculates the band weight values automatically. The results from all unsolved cases, which consist mostly of profiles from semen in sexual assaults, together with profiles from individuals are entered on the index. As each record is added it is automatically compared against all the others enabling links to be made between crimes committed by the same individual and also between crimes and possible suspects.

ARRANGEMENT OF THE INDEX

The index is stored on a Prime 550 minicomputer in the form of a single file containing DNA records. Each record gives details of a single individual or crime stain. Fields within the record contain information such as name ,sex, racial type, gel reference of the original result and the band weights detected.

SEARCH WINDOW

Since there is slight variability in the results obtained when a sample is repeatedly profiled it is not possible to search for direct matches between records as was the case with the index of conventional blood group results. Instead a search window approach has been adopted. The window is applied to each of the band values of the suspect profile and then any record with bands falling within the window is selected from the database. Absence of bands in either the suspect or searched record will not cause the record to be excluded. This is important as the situation can occur where a full profile is obtained from a suspect's blood sample and only a partial profile is obtained from the crime stain.

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The search window was initially set at +/- 10% of the band weight. This was an arbitrary decision and it was known from the data relating to the standard deviation of repeated samples that it was an extremely conservative value.It would include many profiles that were similar, rather than just exact matches, to avoid the possibility of missing a linked case or suspect.

As the index expanded the number of false matches that were produced, due to the large window, increased especially if a complete set of band sizes from four probes was not available.

The present window varies in size in a non-linear manner. An equation has been derived that calculates the molecular weight of points 1mm either side of the band position. These values together with an extra factor which ensures that they are conservative at all times now form the window. This has proved successful and it has reduced the number of false matches to a lower level.

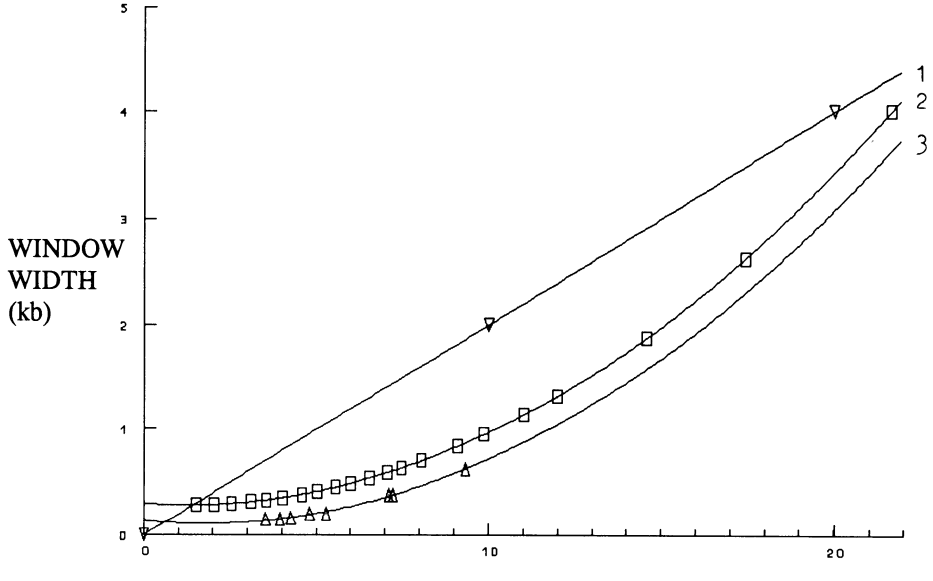

Fig 1. Plot of search window widths vs molecular weight

1) +/- 10% of band weight.
2) Present search window.
3) +/- 3 standard deviations obtained from genomic control (100 replicates).

The +/- 10% window can be seen to be excessively conservative in the low molecular weight regions.

RESULTS

The index has been fully operational since January 1990 and in that time has produced the following results:

Links between crime scenes (no suspect)	6
Links between crime scenes and suspect	7

All of these are links that would otherwise have escaped detection. Many other links between cases and suspects have been suggested by police officers or scientists who have seen similarities in modus operandi or the description of the suspect. These have later been confirmed by DNA profiling.

DISCUSSION

The ability to analyse data produced by a DNA profiling laboratory in this manner can be extremely rewarding. Without any additional DNA tests it is possible to detect unsolved series of crimes and nominate suspects to the police for unsolved crimes.

The DNA index program also produces population frequency data for 6 different racial groups. This automatic procedure has enabled us to build up one of the largest reference collections of DNA profiles in the world.

The legal and ethical status of such a system is likely to differ between countries. In The United Kingdom, data from DNA tests can be stored on computer providing it is on an officially registered system. However in cases where a match is obtained between an unsolved crime and a previous offender the police would normally have to obtain a fresh blood sample for comparison. Any reference to a suspects previous involvement in crimes (such as the presence of his profile on the index) could make the evidence inadmissible.

An index system restricts the freedom of a laboratory to make radical changes such as the use of different probes since much valuable information on previous offenders and crimes will become useless if those probes are no longer performed. As many of the criminals are recidivists it is vital that we are still able to recognise their profiles several years later when they are released from prison.

FUTURE DEVELOPMENTS

We are currently investigating the use of a more advanced computer search program that has been developed at CRSE Aldermaston which uses a Bayesian Likelihood Ratio method. Cooperation between the Metropolitan Police Laboratory and the other United Kingdom laboratories is already well under way to establish a national database.

It will also be necessary in the near future for bodies such as The European DNA Profiling Group (EDNAP) to develop a strategy for PCR technology in order that the compatibility that has been achieved with SLP methods is not to be lost when new techniques are introduced.

Reference: Catterick.T & Russell J.R.(1991). The development of a video scanner for forensic DNA autoradiographs.Lab Microcomputer 91.p105

4 Conventional Systems