International Congress Series 1239 (2003) 799–801

Use of low copy number DNA in forensic inference

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Abstract

Since January 1999, the Forensic Science Service has routinely carried out low copy number (LCN) DNA profiling in casework. To support this initiative, research has been carried out to discover the characteristics and limitations of LCN DNA by studying a series of well-defined evidence types, such as latent fingermarks, and by measuring the propensity of donors to deposit DNA onto objects that they have touched.

Keywords: Low copy number; Shedder; Enhanced fingerprints; Secondary transfer

1. Introduction

In 1997, Van Oorschot and Jones [1] reported that DNA profiles could be retrieved from the surface of items that had been handled only briefly. This led to an increase in the practice of swabbing items in regions that are likely to have been handled with a view to DNA profiling. Such items have included the interior of latex gloves, the grips and hafts of tools, drinking glasses and clothes [2–7]. In casework, the touched areas of an item often contain fingerprint detail and enhancement with light and/or chemicals is required. The effect of such treatments on the DNA within fingermarks has been explored [6,8–10]. However, any DNA result will have to be interpreted with caution as it has been demonstrated that secondary transfer of DNA can occur. It has been shown that one person's DNA can be transferred from an object to another individual [1]. Similar experiments carried out by other researchers [11] have not supported the observation of

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0531-5131/03
PII: S0531-5131(02)00484-3

secondary transfer. However, these authors reported that the potential for primary transfer varied considerably between individuals.

2. Primary transfer

In order to determine whether individuals vary in the amount of DNA that they leave behind on touching an object, simple experiments were carried out. It was demonstrated that some individuals (defined as good shedders) could deposit a full DNA profile after contact of only 10 s with an inert object, whereas others (defined as poor shedders) left very little DNA. It was also observed that even up to 2 h after hand-washing the poorer shedders deposited only partial profiles. These results were reproducible, which indicated that some individuals can naturally and consistently deposit more DNA than others.

Further studies into primary transfer involved examination of the DNA deposited on T-shirts worn by either a good or poor shedder for a period of 8 h. More DNA was recovered from the T-shirt worn by the good shedder and for both subjects the greatest amount of DNA was recovered from the outside front of the garment. A simulated assault (duration of 30 s) was also carried out; one individual grabbed the shoulder of the T-shirt worn by the second person. Sampling of the grabbed area of garment revealed that both profiles could be obtained and that the good shedder constituted the major component of the DNA mixture. In an experiment where a pair of knickers worn by a poor DNA shedder was pulled down swiftly by a good DNA shedder, effective targeting of the handled area allowed a partial profile from the good shedder to be detected.

3. Secondary transfer

It is also possible for one individual to transfer DNA that has originated from another person (secondary transfer). Initial experiments involved a good and poor DNA shedder shaking hands for a period of 1 min after which the poor shedder immediately gripped an inert object for 10 s. Consistently, where one particular pair of individuals was involved, the full profile of the good shedder was transferred to the object and that of the poor shedder could not be detected. The study was then repeated employing a time delay of 30 min between handshaking and object-holding. Mixed profiles were recovered from the object; full and partial profiles from the good and poor shedder, respectively. Analysis of mixture proportions revealed that approximately 70% of the total DNA was that of the good shedder; the individual who had not had any direct contact with the item.

4. Enhanced latent finger-marks

The effect of various finger-mark enhancement techniques on the recovery of DNA from latent marks were investigated. Enhancement chemicals including cyanoacrylate, aluminium powder, iodine, ninhydrin, metal deposition and physical developer were tested. In general, it was found that profiles could be obtained from marks after treatment

with all of the chemical enhancements tested. However, recovery values varied between 33% and 100% of donor DNA profile depending on the chemical employed. Additionally, it was determined that the best results were obtained when the time period between mark enhancement and DNA processing was less than 7 days. In a further study, approximately 70% of the donor profile was obtained from both taped and lifted aluminium powdered prints and from the powdered marks in situ.

The views expressed in this paper are not necessarily the policy of the FSS.

References

[1] R.A.H. Van Oorschot, M.K. Jones, DNA fingerprints from fingerprints, Nature 387 (1997) 767.
[2] M. Pizzamiglio, F. Donato, T. Floris, C. Bellino, P. Cappiello, G. Lago, L. Garofano, DNA typing on latex gloves, in: G.F. Sensabaugh, P.J. Lincoln, B. Olaisen (Eds.), Progress in Forensic Genetics, vol. 8, Elsevier, Amsterdam, Louisanne, New York, Oxford, 2000, pp. 504–507.
[3] R.A.H. Van Oorschot, I. Szepietowska, D.L. Scott, R.K. Weston, M.K. Jones, Retrieval of Genetic Profiles from touched objects. In: Proceedings of the 1st International Conference on Forensic Human Identification, 1999, pp. 1–8, http://www.fss.org.uk/172.19.16.14/forensic/conference/papers/genetic_profiles.htm.
[4] D.E.O. Van Hoofstat, D.L.D. DeForce, V. Brochez, I. De Pauw, K. Janssens, M. Mestdagh, R. Millecamps, E. Van Geldre, E.G. Van den Eeckhout, DNA typing of fingerprints and skin debris: sensitivity of capillary electrophoresis in forensic applications using multiplex PCR, Proceedings form the 2nd European Symposium of Human Identification, Promega, Innsbruck, Austria, 1998, pp. 131–137.
[5] P. Wiegand, M. Kleiber, DNA typing of epithelial cells, in: B. Olaisen, B. Brinkman, P.J. Lincoln (Eds.), Progress in Forensic Genetics, vol. 7, Elsevier, Amsterdam, Louisanne, New York, Oxford, 1998, pp. 165–167.
[6] P. Van Rentergeum, D. Leonard, C. De Greef, Use of latent fingerprints as a source of DNA for genetic identification, in: G.F. Sensabaugh, P.J. Lincoln, B. Olaisen (Eds.), Progress in Forensic Genetics, vol. 8, Elsevier, Amsterdam, Louisanne, New York, Oxford, 2000, pp. 501–503.
[7] M.M. Schulz, W. Reichert, A strategy for STR-analysis of cryptic epithelial cells on several textiles in practical casework, in: G.F. Sensabaugh, P.J. Lincoln, B. Olaisen (Eds.), Progress in Forensic Genetics, vol. 8, Elsevier, Amsterdam, Louisanne, New York, Oxford, 2000, pp. 514–516.
[8] D.E.O. Van Hoofstat, D.L.D. DeForce, I.P.H. De Pauw, E.G. Van Den Eeckhout, DNA typing of fingerprints using capillary electrophoresis: effect of dactyloscopic powders, Electrophoresis 20 (1999) 2870–2876.
[9] A. Zamir, C. Oz, B. Geller, Threat mail and forensic science: DNA profiling from items of evidence after treatment with DFO, J. Forensic Sci. 45 (2) (2000) 445–446.
[10] A. Zamir, E. Springer, B. Glattstein, Fingerprints and DNA: STR typing of DNA extracted from adhesive tape after processing for fingerprints, J. Forensic Sci. 45 (3) (2000) 687–688.
[11] C. Ladd, M.S. Adamowicz, M.T. Bourke, C.A. Scherczinger, H.C. Lee, A systematic analysis of secondary DNA transfer, J. Forensic Sci. 44 (6) (1999) 1270–1272.