DNA fingerprinting with simple repetitive oligonucleotide probes in forensic medicine

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INTRODUCTION

DNA technology in forensic medicine (determination of the origin of biological materials and of consanguinity) has advanced dramatically over the last five years. Individual-specific fingerprints in man can be obtained using oligonucleotide probes specific for simple repetitive DNA sequences (Ali et al. 1986, Schäfer et al. 1988, Nürnberg et al. 1989). Simple repetitive DNA sequences consist of short, tandemly repeated sequence motives. They are spread all over the human chromosomes, i.e. in intergenic spacers and introns; they show extensive polymorphism (Epplen 1988, Epplen et al. 1989). The simple repetitive DNA elements do not exert any sequence dependent function. They do neither contribute to the phenotype nor to the behaviour in man. Therefore the only information obtained concerns the individual-specific hybridization pattern of an individual.

The most informative DNA fingerprints for paternity testing in man, including stains from blood clots, sperm traces and epithelial cells were obtained with the simple triplet repeat probe $(GTG)_5$ or its complement $(CAC)_5$. This is a highly discriminating probe which allows to differentiate all individuals in the 4 to 25 kilobase range of DNA fragments (Schäfer et al. 1988, Zischler et al. 1989). DNA fingerprints obtained by $(GACA)_4$ were also informative albeit showing less bands, allocated in the short fragment range (Roewer et al. 1989). This oligonucleotide probe can therefore be used even in partially degraded DNA.
In the following cases the $(GTG)_5$ probe was tested for its informativity by comparing the patterns from blood with those of sperm traces and epithelial tissues. Furthermore the method was also applied to identify parts of dead bodies of unknown origin.

METHOD

The DNA was isolated from peripheral blood, blood clots, muscle tissues, epithelial cells from mucosal smears and sperm, following modified protocols of Kunkel et al. (1977) and Bär (1988). The method for oligonucleotide fingerprinting has been described by Ali et al. (1986). DNA was digested by the restriction enzymes Hinf I and Alu I and electrophorezed in 0.7 % agarose gels in TBE buffer; the gels were dried and hybridized with the $(GTG)_5$ probe.

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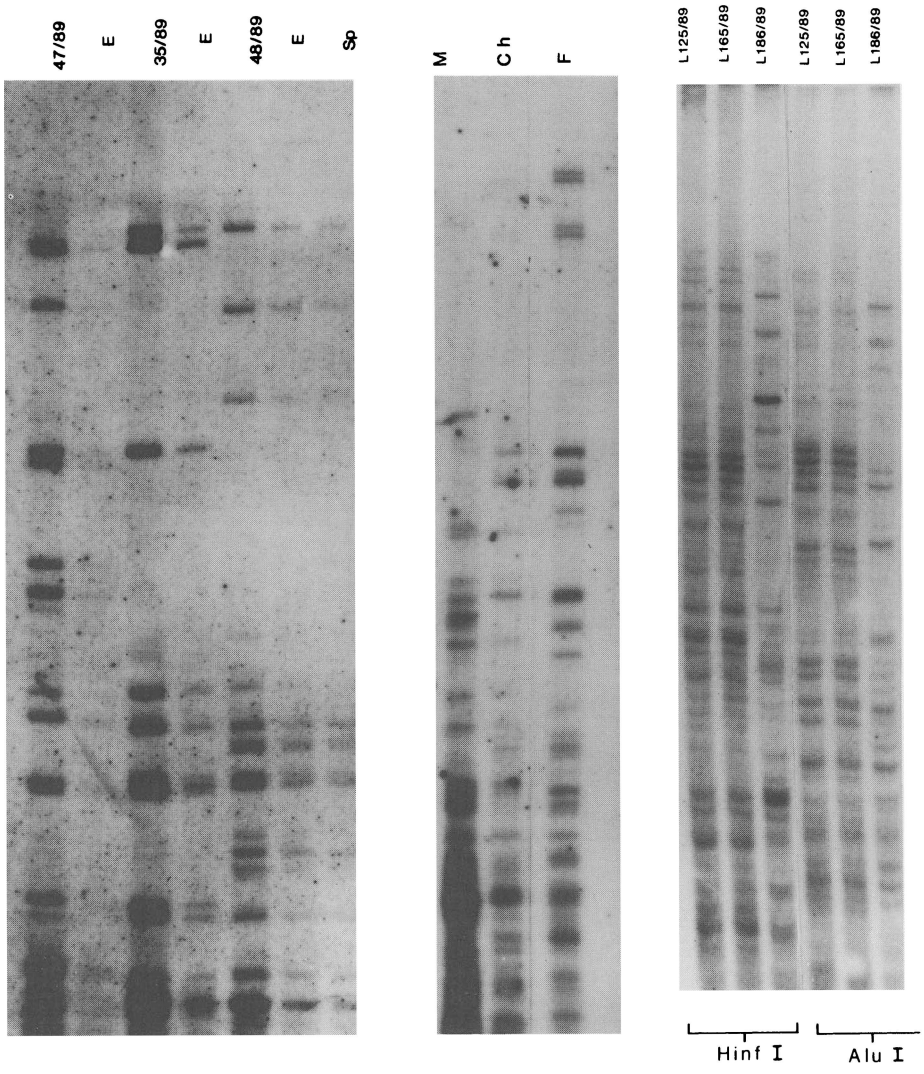

Figure 1: $(GTG)_5$ fingerprints of three persons. DNA obtained from different tissues (numbers=blood, E=epithelial cells from mucosa, Sp=sperm), digestion by Hinf I.

Figure 2: $(GTG)_5$ fingerprints of parents and their child. DNA obtained from blood, digestion by Hinf I. (M=mother, Ch=child, F=father).

Figure 3: $(GTG)_5$ fingerprints of 3 pieces of dead bodies. Digestion by Hinf I and Alu I. Piece L 125/89 and L 165/89 showing an identical pattern. L 186/89 does not belong to the same corpse.

RESULTS

Using different biological materials the analyses of the $(GTG)_5$ fingerprints show identical patterns in all tissues from the same person, but different patterns between different persons. This was confirmed in more than 10 cases, one example of which is shown in figure 1. An example of paternity testing is demonstrated in figure 2. The DNA isolated from a blood clot of a child was compared to the oligonucleotide fingerprint of his parents. Clearly the child is the biological offspring of this couple since all its bands can either be referred to as maternal or paternal. In addition DNA fingerprints were generated from three pieces of dead bodies (all muscle tissues) which were found independently at different times and locations in a lake. The oligonucleotide probe $(GTG)_5$ proved that two of the pieces belonged to one body, while the third one (L 186/89) could be excluded (figure 3).

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