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DNA Profiling: A Forensic Study

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Abstract: DNA profiling is a widely used techniques to identify two different humans at a genetic level. It is used to determine the blood relation of two individuals, to trace any diseases and at crime scenes to catch the suspect. Each and every person has a different DNA which makes the person unique. For DNA profiling, a drop of blood or root of the hair or skin scrapings or a mouth swab is generally used. This technique was developed by Alec Jeffreys in 1985. In this review paper we will have a look at the technique used in DNA profiling for forensic study.

Index Terms - Forensic science, DNA profiling, southern blotting technique.

I. INTRODUCTION

Professor Sir Alec Jefferys started his research in Amsterdam on a different topic of how to find single copies of human genes. In 1977, he moved to Leicester where he began his research using molecular biology techniques to look at human genetics. His research led him to discover techniques that involved the use of enzymes to target short DNA sequences and cut the genome into pieces. In 1978, he was the first scientist to describe single nucleotide polymorphism. Later he focused his research on tandem repeat DNA.

The major breakthrough of DNA Profiling came when Professor Jefferys was working on a different project. This was where he with the help of his team were looking at myoglobin genes in humans. They identified the myoglobin gene in grey seals as they produced a lot of myoglobin. Later they used the seal's myoglobin to isolate the human's corresponding gene by using a minisatellite until a core was found. On 10th September, 1984, at Jefferys' lab in the University of Leicester (UK), the x-ray blot was developed. In the beginning, it was rejected as it was a complete mess. However, when it was looked at again in more depth, Professor Jeffery discovered that there were patterns present. This led to the development of the DNA profiling technique.

DNA profiling is used to identify criminals from blood stain or hair samples which are available at the crime scene. DNA can be analysed from the blood, skin and bone marrow of a person. It is then digested with the help of restriction enzymes and the segments are analysed with the help of probes and southern blotting technique. In India, for DNA profiling Centre of Cell and Molecular Biology (CCMB) Hyderabad have the advance laboratory to conducted the procedure [9, 10].

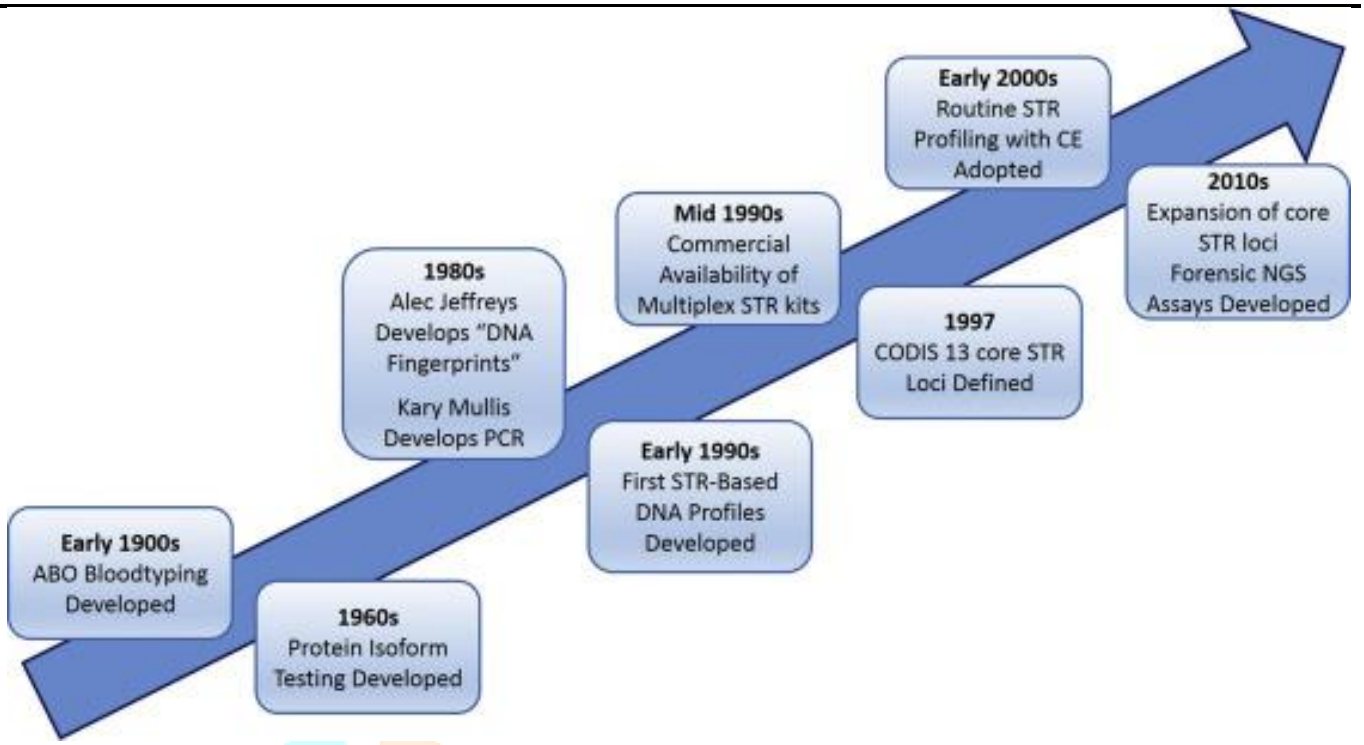

Figure 1: History of DNA profiling

II. TECHNIQUE AND STEPS IN DNA PROFILING

1. DNA profiling is based on Southern Blotting which is used to detect specific genes.
2. The cell sample is taken from the individual by a doctor.
3. The fragments of DNA are extracted from the cells using a centrifuge.
4. Polymerase Chain Reaction (PCR) is used to make many copies of the extracted DNA. DNA is cut into small fragments with restriction enzymes.
5. Later the DNA fragments are separated according to their size by agarose gel electrophoresis and transferred to membrane filter. By doing this, an exact replica of the DNA fragments is made on the agarose gel.
6. The membrane filter of the agarose gel is incubated with a cloned DNA fragment. It is also marked with radioactive label or a stained florescent dye and can be visualized under ultraviolet radiations.
7. The pattern of DNA bands on the autoradiograph helps us to identify a particular gene in the body.
8. A gene probe is used to test a sequence that is highly repeated many times within human genome or minisatellite sequence.
9. Every individual carries a different number of these repeated sequences in the DNA fragment and they lie side by side on the chromosome. They are called Variable Number Tandem Repeats (VNTRs).
10. When genomic DNA is digested using a restriction enzyme, it is then analyzed by Southern blotting. A DNA pattern of their VNTRs is seen.
11. VNTRs are spread over the genome. They are made up of a variable number of end to end duplications of identical and abnormal identical sequences of 2 – 80 base pairs each.
12. Two individuals will not have the same DNA profile except in the case of identical twins [2, 4, 6, 7, 8].

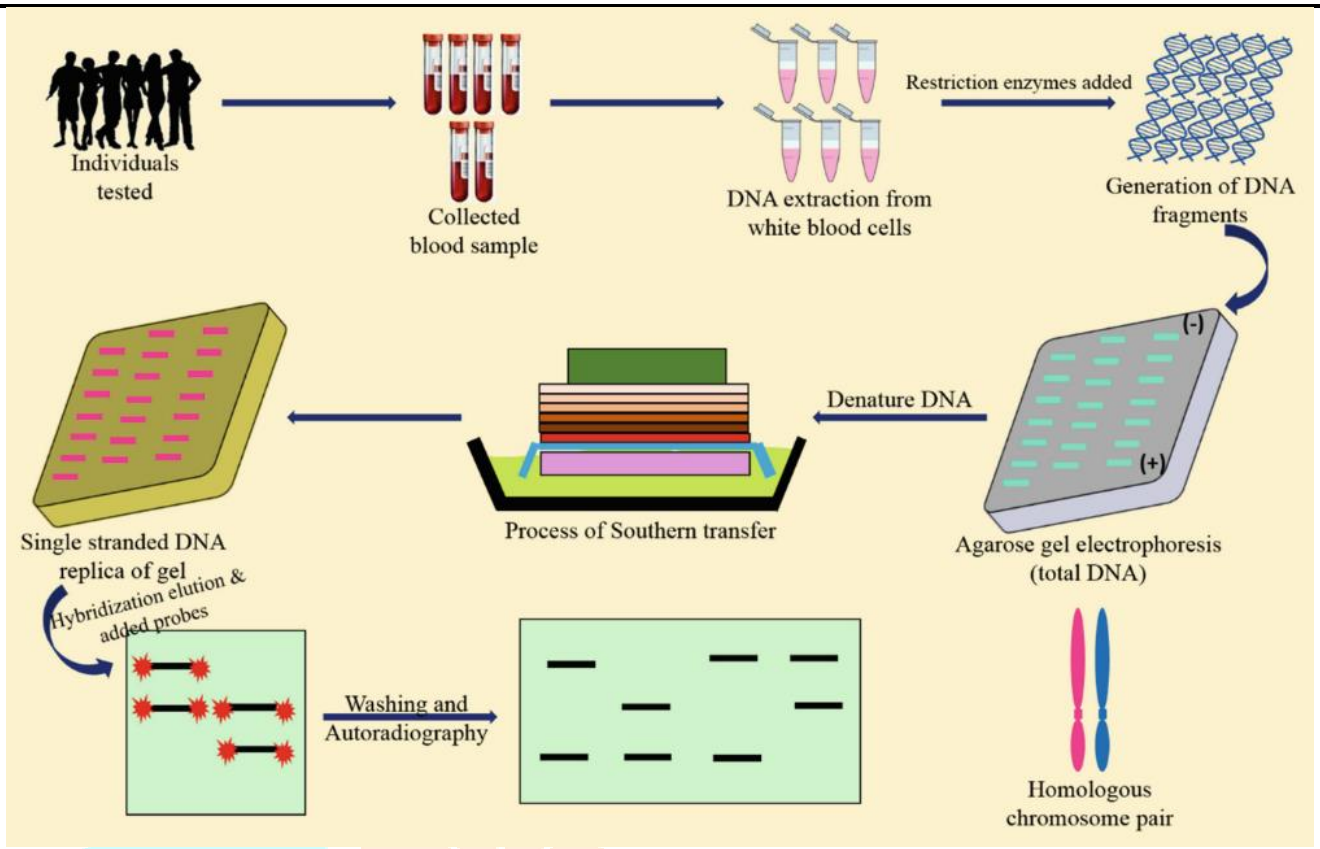

Figure 2: Steps of DNA Profiling

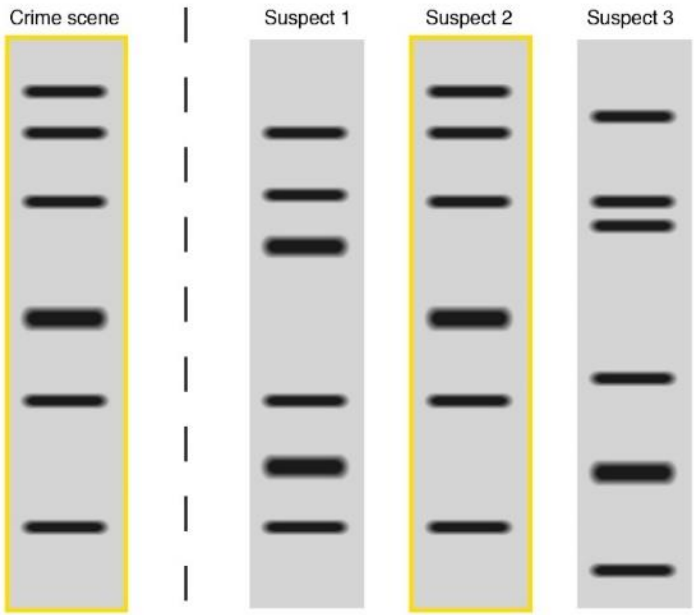

Figure 3: Detection of similar DNA characteristics

III. ADVANTAGES OF DNA PROFILING

1. Accurate, affordable and reliable technique
2. Less time required
3. Advanced technology used
4. It can be performed at any age [1, 3]

IV. DISADVANTAGES OF DNA PROFILING

1. DNA samples can easily get contaminated
2. Results need to be interpreted by a professional only
3. Multiple runs needed for each sample
4. Ethical issues may arise such as leaking of individual's person information [1, 3]

V. APPLICATIONS OF DNA PROFILING

1. To find out genetic defects
2. To identify siblings or twins or paternity or maternity
3. To identify suspects in crime
4. To understand historical migrations [1]

VI. CONCLUSION

In sum, research needs to be done to maximize the advantages and minimize the disadvantage as there are a lot of applications of DNA profiling and a wide future scope. DNA profiling can be summed up using the below flowchart [5, 11].

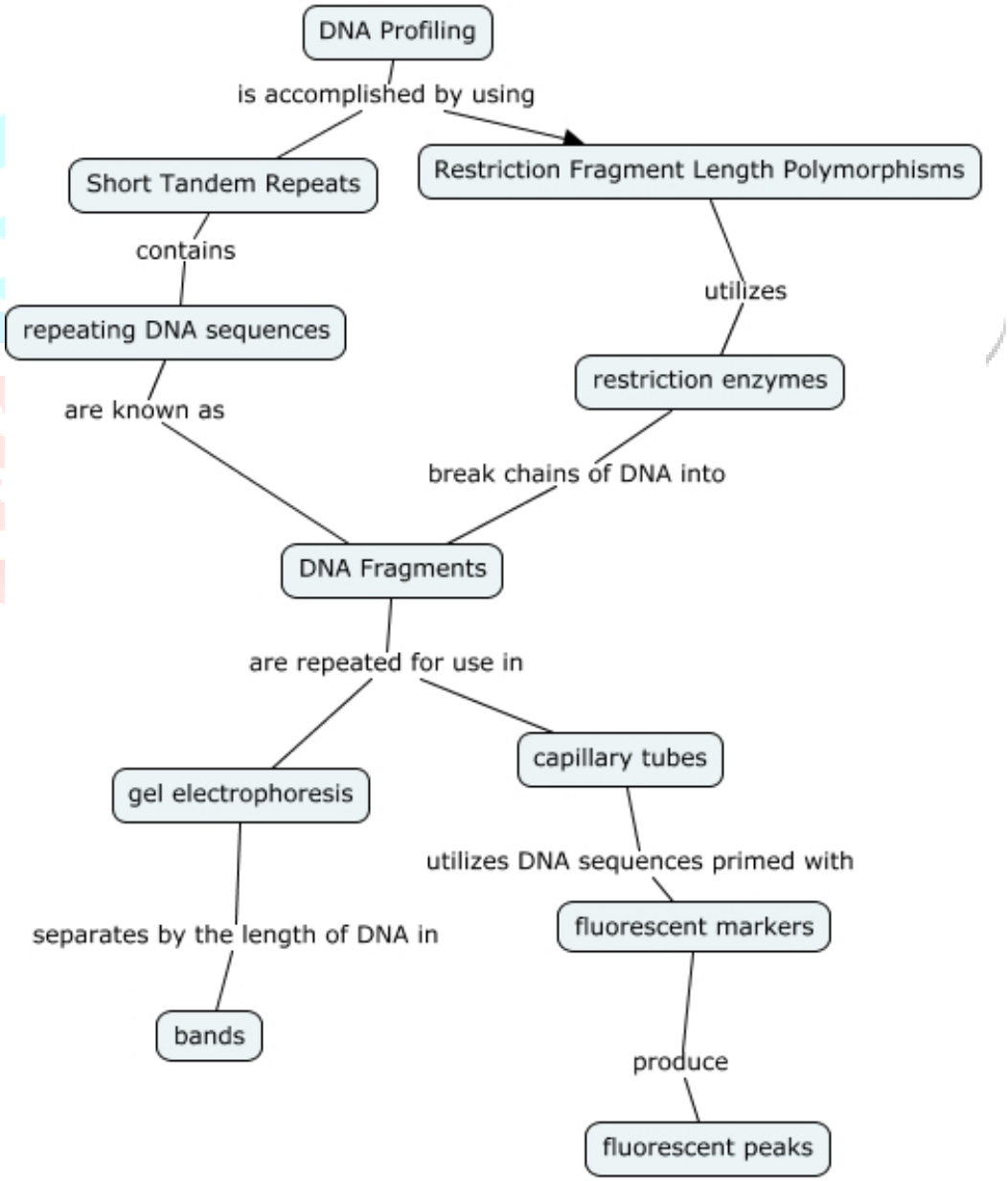

Figure 4: How DNA Profiling can be accomplished

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