



DNA FINGERPRINTING - AN OVERVIEW

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ABSTRACT

DNA Profiling has proved to be a boon for forensic medicine. It is an accurate and well established scientific technique used for disaster victim identification, investigation of crimes, identification of missing persons and human remains, and for medical research purposes. Most of the countries have proposed appropriate laws within the framework of their respective constitutions and other legal frameworks for the safe use of this method. DNA Fingerprinting plays a remarkable role in Paternity testing. DNA is the catalyst required for generational transference of heritable unit. The morphology of DNA is quite pliable, within the nucleus of each cell resides a similar copy of the individual's genetic material, DNA. The coding regions of the genomic DNA are called as genes. DNA or the short tandem repeats are dispersed throughout the human genome and occur on an average of every 10,000 nucleotides. Microsatellite markers are distinguished as the most powerful genetic marker. Collection, preservation and handling together constitute an integral part of DNA fingerprinting analysis. Before DNA fingerprinting came into existence, battery of blood groups and enzyme markers were used to look into the status of Paternity.

KEYWORDS: DNA Fingerprinting, DNA Profiling, Short tandem repeat (STR), STR loci.

INTRODUCTION

DNA fingerprinting is emerging to be of great significance in the establishment of the paternity of an individual. Professor Sir Alec Jeffreys was one of the first to discover the inherited variation in the human DNA.^[1] He discovered the minisatellite region, which was isolated and used as a probe to investigate human DNA. It was found that the minisatellite probe result was a complex pattern of bands for each individual, and was detecting a large number of hypervariable regions in the human DNA. These regions were interrelated, and each band represented one of the hypervariable DNA regions. Further refinement and sequencing led to recognition of unique identification pattern for every individual namely a 'DNA Fingerprint.'^[2]

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DNA fingerprinting can be used for a variety of reasons in the field of forensic, some of them are mentioned in **Table 01.**

Table 01. Different Uses of DNA Fingerprinting

Paternity testing
Individual Identification
Identification of carcass of tissues
Tracking of blood relatives
Crime Scenes and Investigations
Detection of somatic mutations or cancers
Pathogen Identification
Sex Determination
Determination of Loci controlling quantitative traits or disease resistance
To study the Genetic Structure and biodiversity of wild population
Medical Research

DNA is the catalyst required for generational transference of heritable unit. The coding regions of the genomic DNA are called as genes. DNA or the short tandem repeats are dispersed throughout the human genome and occur on an average of every 10,000 nucleotides. Microsatellite markers are distinguished as the most powerful genetic marker. Collection, preservation and handling together constitute an integral part of DNA fingerprinting analysis.^[3] These procedures are technically demanding and the laboratory personnel are fallible, however, these issues can be circumvented with proper protocols, guidelines and rigorous oversight.^[4]

A study conducted in Pakistan proposed that ForeStatistics is a highly accurate windows-based software program which has DNA statistical calculations, DNA profile management and its matching. Probability for single-source profiles, combined probability of inclusion for mixed profiles, paternity index of a disputed child in duo, trio cases or when the alleged father is related to mother or biological father and relationship in cases of grandparents/grandchild avuncular relation can be estimated by the software. It has a great utility in the field of Forensic DNA analysis and can help DNA scientists in performing various DNA related statistics.^[5]

According to a recent study which was conducted to assess the usefulness of various combinations of autosomal STR marker sets (19 STR marker sets were analysed on 200 central Indian populations and 20 paternity cases) for their superior use in the central Indian population for forensic and paternity applications, it was found that Population-specific STR marker sets are found convenient in forensic and paternity applications. It is seen to be of benefit in database generation as well. It is envisaged that Penta E, Penta D, and SE33 markers will be included in the list of core STR loci in the central Indian population.^[6]

Another study was conducted in Mestizo and Amerindian populations from Mexico, where in order to assess the effectiveness of non-CODIS genetic markers in forensic and paternity tests, the genetic composition of six mini short tandem repeats-mini-STRs (D1S1656,

D2S441, D6S1043, D10S1248, D12S391, D22S1045) and the microsatellite SE33 were studied. The results from the study indicated that this set of loci is suitable to genetically identify individuals in the Mexican population, supporting its potency in human identification casework.^[7]

Indian Scenario

The Department of Biotechnology, in the year 2016, introduced a draft Bill. The purpose of the bill "The Use and Regulation of DNA-Based Technology in Civil and Criminal Proceedings, Identification of Missing Persons and Human Remains Bill, 2016" was to overcome the shortcomings in the existing legal provisions with regard to identification of individuals for specified purposes such as victims of disasters, missing persons, etc. Further, the draft bill was forwarded to the Law Commission of India on 27 September 2016, for re-evaluation.

After reviewing the draft bill, the commission came to the conclusion that merely amending the Code of Criminal Procedure, 1973, may not serve the purpose. Furthermore, to avoid the misuse and have a check on the proper working of human DNA profiling, it should be regulated by a law with

- 1) well delineated standards.
- 2) quality controls.
- 3) quality assurance systems to ensure the credibility of the DNA testing.

The Law Commission while revising the draft Bill also made a conscious attempt to keep the concerns raised by the Courts in account. For the DNA testing centers, it is necessary to abide by the guidelines, rules and standards mentioned in the Bill.

After thorough examination of the draft, the Commission took into consideration the various aspects of DNA profiling and the deprivation of appropriate regulatory mechanism for the use, retention and removal of body substances, DNA samples and DNA profiles. The draft Bill was substantially modified and renamed as "The DNA-Based Technology (Use and Regulation) Bill, 2017". The modified bill might act as a helping hand in promoting the establishment of uniform practices in

various laboratories involved in DNA technology and profiling.

Recently in August 2021, during the hearing of a divorce case filed by the husband, when the petitioner demanded DNA testing of his daughter to check the legitimacy of the child, the lower court allowed his plea which was upheld by the High Court. However, the Supreme Court quashed the order to check the legitimacy of the child using DNA test. The reason stated by the SC behind this judgement was that in the absence of primary evidence by the respondent in the case of Adultery, the conduct of DNA test to check the legitimacy, which is the secondary evidence, is not necessary and ought not be passed. The bench suggested both the parties to go for a divorce settlement rather than raising the issue of adultery, legitimacy and DNA testing again in the lower court.

Errors of DNA Fingerprinting

Discrepancies in court cases between biological proof and legal proof can be caused by various factors. Some of them are listed below.

1. Sample contamination
2. Faulty preparation procedures
3. Mistakes in interpretation of results
4. Privacy Concerns
5. Lack of expertise
6. Low template DNA
7. Touch DNA
8. Ecological Impacts - influence of diverse environmental factors, nicking of the whole DNA can occur.
9. Instrumental Error
10. Hacking of the DNA Database

DNA evidence is completely conclusive if the samples have not been contaminated, the advancement in molecular genetics has decreased contamination of samples to great extent. Permitting the trained person to enlighten the public about DNA reliability and authorizing new technologies which show acceptance towards common people, making of standardized tools and technologies of DNA typing can prove to be beneficial.^[8]

CONCLUSION

DNA Profiling involves various legal and ethical issues; concerns and apprehension regarding the same exists in the mind of the common man. Misuse of DNA profiling and technology, which unless protected, may result in the disclosure of personal information of an individual, such as health related data capable of being misused by persons having prejudicial interests, which in return might adversely affect the privacy of the person.

Techniques indulging with biological identification, can be sophisticated & precise, yet are considered as ineffective means for establishing identity, whether of individual personhood, as in the case of paternity, or national make-up. They are incorporated as supplemental

methods into complex legal, social, and cultural decision making around families. The menace of the shadow of the criminal law is an unequivocal instrument to discourse the delicacy of the hurdles that arise in the context of posthumous paternity testing of retained tissue.

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