A REVIEW ON DNA PROFILING IN FORENSIC DENTISTRY

ABSTRACT:

Forensic Odontology is the emerging field in dentistry. The significance of forensic dentistry, with little remaining has led the investigators to move on with the molecular biological techniques. In crime investigations many cases fails due to the lack of source and evidence, in such case DNA analysis can provide a base for identification of age and gender of the person. In such a way DNA profiling gained popularity among the field investigators. Pulp or tooth sample are resistant to environmental assaults such as, incineration, mutilation and decomposition which can be an excellent source of DNA material. This method can be applied in mass disaster where the fragments of the tooth are available for disaster victim identification.

KEY WORDS: Forensic Odontology, DNA profiling, disaster, mutation

INTRODUCTION

Forensic Odontology is a branch of dentistry which deals with proper handling and examination of dental evidence, evaluation, and presentation of dental findings in the interest ofjustice(Goldman1985).Forensic Odontologyplays an important role in identifying the victims of crime and disaster. It has always been a key source in man-made and natural disaster especially in case of mass casualties. It also plays an important role in age and gender identification. Some of the most important methods used for investigation with teeth as a source are visual method, microscopic method, and recently many advanced technologies have been employed. Among them DNA profiling has gained popularity due to its genetic confirmation.(1,2)

DNA PROFILING

In the field of modern molecular biology, differenttechniqueshave led to major evolution in dentistry. Among those, DNA plays a major role. DNA profiling is also known as DNA fingerprinting or DNA typing, invented by Sir.Alec Jeffreys in the year1984.In failure of conventional methodsdue to various environmental assaults such as trauma, heat, decomposition etc. DNA method can be more reliable. The source of DNA is usually protected by epithelial, connective tissue and muscular tissues were asdental pulp is protected by enamel, dentin, and cementum. (3,4,1)

HISTORY OF DNA PROFILING

DNA profiling is one of the greatest discoveries in the late 20thcentury.AlecJeffrey's in UKfound out heritable patterns with multi -locus probe, which was according to the size of the sequence, named as variable number of tandem repeats (TR) and short tandem repeats (STR). (5,6)

Table 1: HISTORY OF DNA PROFILING

DNA – Isolated from Dental Pulp	Schwartz et al., 1991
Sex identification- Genomic dot blot hybridization for	Potsch et al., 1992

DNA extracted from an unerupted preserved 3rd molar	Sweet., 1995
Conducted PCR after incinerating the extracted pulp at different temperatures.	Tsuchimochi et al., 2002
PCR amplification -stronger in pulp than cementum and dentin.	Malaver and Yunis et al., 2003
Microarray in SNP (Single nucleotide polymorphism)	Li et al., 2006
Massive parallel sequencing	Tucker et al., 2009

VARIOUS SOURCES OF DNA:

Tooth as a source in DNA profiling:

Tooth is proved to be the best source to extract DNA, as it is most resistant of all body tissue, and can alsobe preserved for a longer period. Also, tooth is most resistant to adverse conditions such as humidity, high temperature etc. without causing any damage to the DNA.(7)

Saliva as a source in DNA profiling:

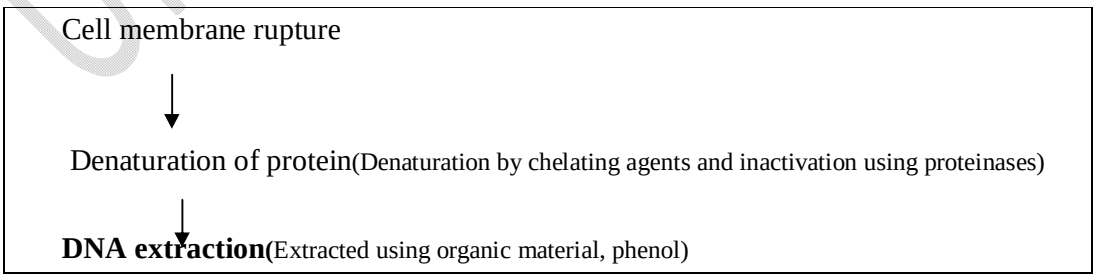
In the crime investigation, saliva samples can be collected from the deposits on the skin due to biting, licking or kissing. Various proteins, blood groups and enzymes can be analysed using this saliva that can be compared with the suspect. But, it has certain drawbacks such as less concentration in the material, immediate washing of the wound, contamination with blood, etc.

PRINCIPLES OF DNA PROFILING/ FINGER PRINTING

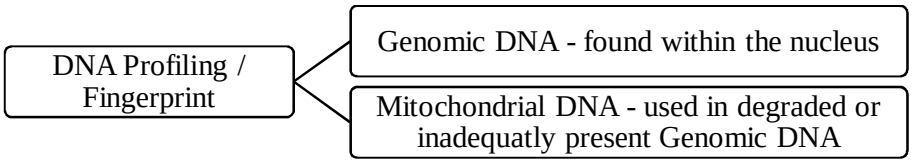
The gene coding for a particular protein is usually found to have 95% non-coding DNA and 2-5% of coding DNA, out of which the junk DNA is usually found to be present in the form of single copy or multiple copies. The variation in the pattern which is usually detected by a probe form,isthe basis of DNA profiling system (8, 2)

STAGES IN DNA EXTRACTION DURING DNA TYPING (Flow chart 1)

The DNA can be usually obtained from the tooth from the following steps.



TYPES OF DNA USED IN DNA FINGERPRINTING



METHODS USED IN DNA FINGERPRINTING

A successful analysis of the genetic makeup can be made by proper DNA isolation and proper quantification. Hence there are various set of methods that are followed.

1. Restriction fragment in length polymorphism method (RFLP)
2. Analysis of Y chromosome
3. Single nucleotide polymorphism (SNP)
4. Polymerase chain reaction (PCR)
5. Short tandem repeat (STR) TYPING
6. Analysis of mitochondrial DNA (mtDNA)(8, 9)

RESTRICTION FRAGMENT IN LENGTH POLYMORPHISM METHOD (RFLP)

A DNA sample which is collected is fragmentedusing restriction endo-nucleases enzymes named as molecular scissors. These enzymeshelp to cut DNA sites without the tandem repeats. As aresultvariablenumbers of tandem repeats are produced, which are then separated using gel electrophoresis. A radioactive probe is then used to analyse the DNA fragments.

ANALYSIS OF THE Y-CHROMOSOME

Y chromosome analysis plays an important role in analysing biological evidence, especially useful in tracing relationship among males, as Y chromosomes are the genetic markers which are passed directly from the father to son.The main criterion of Y chromosome ishalo typing that includes exclusion of the male suspects from the crime scene, which gives a lead in the investigation. (3, 4, 9)

SINGLE NUCLEOTIDE POLYMORPHISM (SNP)

Any variations in the genome as result of insertions or deletions at single positions are known as single nucleotide polymorphism (SNP). SNP are the emerging markers in the field of forensic medicine. They have an upper hand as they are abundant in human genome and has lower mutation rate.

POLYMERASE CHAIN REACTION (PCR)

PCR is one of the most commonly used techniques in DNA profiling. One of the main significance of PCR is that it is used to amplify the amount of DNA present. Amplification of the original DNA can be done, through standard Polymerase chainreaction which runs through 30 cycles for a couple of hours.DNA primers and special enzymes are used for thereaction. (7,8)

ANALYSIS OF MITOCHONDRIAL DNA

It is one of the most expensive techniques as it involves direct sequencing of nitrogenous base. Mitochondrial DNA is usually used when the sample lacks nucleus. Analysis of the mtDNA can be done by obtaining high molecular weight DNA from the teeth. It is a beneficial tool for identification of the missing person by comparing with the maternal relative.

USE OF DNA PROFILING IN FOENSIC DENTISTRY

Biometric identification is one of the tools used for age identification in forensic science. Due to several conditions such as fire and skeletonization, there are difficulties in identification using biometrics. Asteeth have distinctive characteristics and high resistance it plays an excellent source of DNA especially when there is a failure in the conventional method. (10)

DRAWBACKS WITH DNA PROFILING

Even though DNA profiling is considered to be one of the major important tool in Forensic Odontology to solve mysterious cases, DNA profiling has been a matter of question because of its several disadvantages.

The victim cannot be identified in several cases due to the following issues:

- Degradation in case of prolonged exposure to heat and light, samples handled by inexperiencedtechnician, instrumental error, incorrect database, and identical twins.
- DNA can be easily implanted at the site of crime.

DNA DATABASE OR DNA DATA BANK

The idea behindDNA profiling in human identification is the comparison of victim's or suspect's DNA with that of DNA database. Hence it is important to have a proper DNA data collection.

There is lack of DNA collection due to various reasons, out of which the most common issues areprivacy issues and in developing countries DNA profiling is notmuchin common use. (6, 9)

PRIVACY - A MATTER OF CONTROVERSY

As DNA analysis is most likely to invade one's own personal information it is considered as invasion of privacy. It gives sensitive information of an individual such as hereditary disease, physical state and ethnic background leading to racial discrimination.

TRACE DNA

Trace DNA also known as the touch DNA is considered to be one of the major drawbacks in DNA profiling technology. Trace DNA are DNA which is obtained from the biological material transferred from a donor to a person during the physical contact. Coincidental matches such as chimera shows a major drawback in DNA profiling.(10)

CONCLUSION

Forensic Odontology, especially DNA profiling is an upcoming branch of dentistry. A tooth plays valuable evidence when no other samples are available in crimescenes. Further advancement in DNA profiling can reduce the time factor for the identification of the deceased. Even though DNA profiling has a positive impact in the justice system, there are several disadvantages also. DNA is anunique characteristic feature of every individual, but due to several man-made errors makes it unreliable.

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