



Research Article

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Innovative Forensic Techniques In Crime Detection: An Appraisal

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Introduction:

Existence of crime in the society can be traced back to the time of arrival of Adam on this planet. The Bible and the Quran give vivid example of first crime committed by one son of Adam and can be said that crime was present from time immemorial. Similarly, the investigation and detection of crime begun in the same age as of crime. With the advancement of science and technology, the criminals have adopted new methods and techniques for committing offence, but science and scientific techniques also help the investigators significantly in their effort to nab the criminals or real culprits. The Forensic Science is one of those modern disciplines which is now extensively used in identification of criminals and unearthing the crime. It is very challenging, charming, dynamic branch of exiting science¹ which is now applied by almost all the investigators all around the world. With the growth and development of the society, the nature of the crime has been also changing and diversifying. Modern criminals are vastly using the science and technology in the commission of the crime of which the cyber crime is glaring example. Today, the guardians of law heavily depend upon various advance technologies of science to help them in crusade against crime. There have been various advancements in forensic science that has specially been welcomed in criminal investigation².

The application of advance science which embraces all techniques like photography, Ballistic, Physics, Biology, Chemistry, Toxicology,

Narcotics, DNA Profiling, Brain Fingerprinting, Narco-Analysis, etc in criminal law is commonly understood as the use of forensic science in the field of law. The main functions of forensic science are the detection, collection, packing, transportation and analysis of physical evidencandbiological material etc.

DNA Profiling:

One of the latest growing and most reliable modern scientific techniques of investigation in forensic science is DNA profiling of a criminal. DNA is the abbreviation of the term, “**Deoxyribose Nucleic Acid**” which is an organic substance found in every living cell and which gives an individual genetic blue print, which is almost unique. DNA can be obtained from a wide variety of sources found in human being like, blood, semen, bone, saliva etc³.

DNA was first discovered by Fredrick Micscher in the year 1869. Sir Alec J. Jeffery discovered the use of DNA in forensic analysis in 1984 in England and it was first used in the famous **Endurby case**⁴ wherein two girls were raped and murdered by Colin Pitchfork. Since then scientists have developed various techniques like Restriction Fragment Length Polymerase (RFLP)⁵ and later another technique was developed which is known as Polymerase Chain Reaction⁶ Technique (PCR). PCR had advantages over RFLP as it takes lesser number of samples and replicates them in manifolds. It is quicker and cost effective. It also enabled to analyze highly degraded samples and therefore it is the most widely followed method of DNA profiling.

DNA tests are highly effective because every human being’s DNA is unique except the twins. The probability of DNA being same is one in three billion. And it is credible because it cannot be tampered with. DNA test can be used in various cases in order to establish parentage of a child, identify mutilated dead bodies and identifying the criminals etc.

DNA Phenotyping:

Another innovation in DNA related technology is DNA phenotyping, which is relatively recent arrival in forensic science, and some critics question how useful it will be because of its inaccuracy in drawing the exact facial appearance of a person. However, it is undoubtedly a very helpful technique in criminal investigation, because it is a process of predicting an organism’s phenotype using only genetics information collected from genotyping or DNA sequencing also known as molecular photo fitting. By way of background, human physical appearance is the product of complex interaction among multiple genes, gene segments. Simply put, just as DNA guides orchids towards their complex appearance, it is also largely responsible for human appearance. Of course, an individual’s appearance is affected by the

environmental factors like nutrition, exposure or toxic material in the environment, rather than genetic makeup alone. One need only consider the striking similarity of identical twins, even those raised in dramatically different environment, to appreciate the powerful influence of DNA on human appearance⁷. It can predict a person physical appearance and biogeography ancestry which can play a leading role in the identification of the culprits. The facial composites it produces are predictions from genetics, not photographs. The drawback of this technique is that many aspects of a person's appearance are not encoded in DNA and thus can never be unearthed from it, like whether someone has a beard, or dyed hair.

STR-Analysis:

Short tandem repeat technology, which in short also known as STR technology is used to evaluate specific regions which is also called loci⁸ within nuclear DNA and it is most useful method in molecular biology to compare specific DNA from two or more than two samples. STR is a microsatellite in the sense and it consists of a unit of two to thirteen nucleotides repeated hundreds of times in a row of the DNA strand. The Federal Bureau of Investigation (FBI) uses a standard set of 13 specific STR regions for CODIS⁹. CODIS is a software program that operates local, state, and national databases of DNA profiles from convicted offenders, unsolved crime scene evidence, and missing persons. STR analysis is very much perfect in the identification of criminals because the odd that two individuals will have the probability of matching the similar 13-loci DNA profile is about one in a billion.

Mitochondrial DNA Analysis:

Although most DNA is packaged in chromosomes within the nucleus, mitochondria also have a small amount of their own DNA and this genetic material is known as Mitochondrial DNA or mtDNA.¹⁰ Mitochondrial DNA analysis (mtDNA) is to be used to examine the DNA from samples only in those cases where DNA cannot be analyzed by RFLP or STR. mtDNA analysis uses DNA extracted from another cellular organelle called a mitochondrion. Biological samples like as hair, bones, and teeth cannot be analyzed with STR and RFLP, they can be analyzed with mtDNA. At present time mtDNA is proving very helpful asset to the Criminal Justice System in solving the crime mysteries and in the investigation of those unresolved cases that have gone unsolved for many years.

All offspring have the same mitochondrial DNA as of their mothers. This is because the mitochondrion of each new embryo comes from the mother's egg cell. The father's sperm contributes only nuclear DNA. Comparing the mtDNA profile of unidentified remains with the profile of a potential maternal relative can be an important technique in missing-person investigation.

Y-Chromosome-Analysis:

Y-Chromosome analysis is a useful technique for analyzing DNA that can be linked in one sense to studying male DNA surnames inherited in uni-parental manner through paternal side into all male offspring.¹¹ Males surnames are passed down from one generation to another and continue on through sons which is a simplistic representation of Y-Chromosomes. A son inherits a y chromosome from his biological father and X Chromosome from his biological mother. Conversely, a female is inherits an X Chromosome from his biological mother and an X Chromosome from his biological father these chromosomes as they are inherited overtime through males in a familial line. This type of DNA analysis has important ramifications for scientists and investigators wishing to investigate the family or parental ties among

the male members. Hence, Y chromosomes specific STRs have prove as important tool in a male-specific forensic testing and thus can be utilized to prove relationship in paternity testing, sexual assault cases, historical evidence, missing person identification and helpful in evolutionary study to perform phylogenetic analysis.¹²

Additionally, Y-STR technique is also use in the investigation of those sexual offence, the sample of which consist of a mixture of body fluids from different individual and detection of male fraction in male/Female mixture without differential DNA extraction. However, the darker side is that Y-STRs are useful when only distant relation on the parental side is present as donor of reference genetic material.¹³

Paternity:

The *raison d'être* under the Indian Evidence Act, 1872, is against the illegitimization¹⁴ of a child and the public policy is that no child should suffer due to lapses on the part of their parents. It is well established that when certain fact is considered as conclusive proof of another fact, the judiciary generally disables the party in disrupting such proof.¹⁵ The only exception occurs when the party is able to show that there was no access to the other party when the conception could have taken place. Whenever paternity is contested, the burden of proof is on the party pleading negative.¹⁶

In the famous case of *Gautam Kundu v West Bengal*¹⁷ the apex court has laid down certain note-worthy guidelines regarding DNA test and their admissibility in the parentage case.

1. The courts in India cannot order blood test as a matter of course.
2. Whenever application is made for such prayer in order to have roving enquiry, the prayer of blood test cannot be entertained.
3. There must be strong prima facie case in which the husband must have established non-access in order to dispel the presumption arising under section 112 of Indian Evidence Act, 1872,
4. The court should carefully examine as to what would be the consequence of ordering the blood test.
5. No one can be compelled to give blood sample for analysis.

In case of *Kanti Devi v Poshi Ram*¹⁸ the Supreme Court held that even a DNA test that indicated that the person is not the father of the child would not be enough to rebut the conclusiveness of marriage as proof of legitimacy of child.

Section 125 of the Code of Criminal Procedure code, 1973 laid down that the natural and fundamental duty of a man is to maintain his legally wedded wife, children and parents so long as they are unable to maintain themselves.

The famous *9/11 in U.S.A* attack left none in any doubt about the great capacity and capability of the criminals of that era found their modus operandi used in the commission of such crime. Hence an urgent need for modification of the crime investigation process and tools were felt. The development of DNA is a welcome step and it has become more and more reliable instrument. Unlike civil paternity case, Indian courts have accepted the role of DNA in criminal paternity case. Likewise in *Rajiv Gandhi Murder Case*¹⁹, the DNA samples of alleged assassin Dhanu were compared with her relatives, which gave conclusive proof about her being involved in the gruesome attack. Similarly in the famous *Tandoor murder case*, the DNA samples of the victim Naina Sahni were compared with that of her parents to establish her identity. In the case of *Rohit Agrawal v Narayan Dutt Tiwari*²⁰, on the basis of DNA Profiling it was held by the court that Narayan Dutt Tiwari is the biological father of Rohit Agrawal.

Recently, in the landmark judgment of **Nandlal Wasudeo Badwaik v. Lata Nandlal Badwaik**²¹ the apex court of India has for the very first time recognized the admissibility of DNA test in the determination of paternity and thus, disallows the maintenance to the daughter who was not the biological daughter of the petitioner.

Narco-Analysis Test:

The Narco-Analysis test is one of the scientific tests used to nab the criminal and in the modern time this test has become crucial to identify the accused and suspects when all the other tests failed to identify them. Narco-Analysis is a process whereby a subject is put to sleep or into a semi-somnolent state by means of chemical injection and then interrogated while in this dream-like state, or the process of injecting a 'truth serum' (drug) into an accused or suspect to induce, semi-consciousness, and then interrogating the accused or suspect of crime. This process has been utilized to enhance the memory of a witness. In 1922, Robert House, a Texas-based Obstetrician thought that a similar technique may be used to interrogate the suspects in criminal investigation. This led Robert House to conclude that a person under the effect of scopolamine cannot lie, as there is no reason or power to think. His idea and experiment gained a lot of limelight and attention and thus led to the introduction of Narco-Analysis in criminal investigation. During the process of Narco-Analysis test a person has no power to think due to the effect of drugs which are injected into him. His idea and experiment gained a lot of limelight and attention and thus led to the introduction of Narco-Analysis in criminal investigation. Narco-Analysis has witnessed a mixed response from the judiciary, ranging from outright disapproval to reluctant and latent encouragement.

However, due to the subjective nature of this Narco-Analysis test, it is severely criticized by the jurist as violative of the inherent fundamental right of a person that he shall not be compelled to be a witness against himself.²² But despite of all the objections against the Narco-Analysis test, one must have to concede its indispensable need in the detection of felonious crimes like terrorist activities and acts of sabotage.

Polygraph Test:

The psychological stress evaluator, the polygraph or any "lie detection" device can not detect deception per se. Rather, such a machine records a reaction to a given situation, most commonly a question and answer session.²³ Polygraph tests have been traced back to the time of Lombroso²⁴, who experimented with the machine that measured blood pressure and pulse rate to examine the truthfulness of the statement and honesty of suspected persons in the crime. His device was called a hydrosphygmograph. Later on William Marston and John Larson further developed it. The theory behind the polygraph test is that when a subject is lying in answer to a question he/she will produce physiological responses which are different from those which arise in the normal course and these responses are measured by the examiner through the help of some machines. In this manner on the basis of the graph so built of such responses where the statement is concocted or lied, an accused can be nabbed and crucial evidence may be collected against him. Lie detection relies on the basic principle: an individual undergoing stress will exhibit certain involuntary reactions caused by such stress.²⁵

Fingerprints:

Although fingerprints have been used by crime investigators for more than a century, they remain one of the most required pieces of evidence. All human beings are born with a characteristic set of ridges on the fingertips. The ridges, which are rich in sweat pores, form a pattern that remains fixed for life. Even if the skin is removed, the same pattern will be evident when the skin regenerates. It is the

unique pattern made by these ridges that motivates the police to record people's fingerprints. Fingerprint identification has become without question the most trusted type of forensic evidence in criminal trials. Judges and juries have shown themselves readily willing to believe that no two fingerprints are alike and that fingerprint examiners can reliably trace "latent prints", fragments of fingerprints patterns found at the crime scene, to one and only one person.²⁶

Fingerprints are not the only incriminating patterns that a criminal may leave behind. Investigation for identifying a suspect on the basis of his lip prints is also gaining importance these days. Cheiloscopy²⁷ is the forensic investigation technique that deals with identification of human beings based on lip traces. Lip prints are frequently found on glasses. Footprints and the soil left on the print may match those found in a search of an accused person's premises. Tire tracks, bite marks, toe prints, and prints left by bare feet may also provide useful evidence. In cases where the identity of a victim is difficult because of tissue decomposition or death caused by explosions or extremely forceful collisions, a victim's teeth may be used for comparison with the dental records of missing people. Every coin has two sides. Every technology or knowledge created can be used or misused by the user. But that cannot be used as a ground to reject development of the knowledge.

Brain fingerprinting:

Brain fingerprinting is yet another innovative computer-based technology to identify the perpetrator of a crime with scientific accuracy by measuring brain-wave responses to crime-relevant words or pictures presented on a computer screen. Brain fingerprinting has proven 100% accurate in over 120 tests, including tests on FBI agents²⁸, tests for a US intelligence agency and for the US Navy, and tests on real-life situations including misdemeanor crimes.

Brain fingerprinting is based on the finding that the brain generates a unique brain wave pattern when a person encounters a well-known incentive. Use of functional magnetic resonance imaging in lie detection derives from studies suggesting that persons asked to lie show different patterns of brain activity than they do when being truthful.

Ballistic Fingerprinting:

Ballistic fingerprinting is one of the important branches of Forensic Science. It is another type of evidence. In ballistic fingerprinting the distinctive marking left on ammunition as a result of its use in a specific weapon. During the late 15th Century gun maker found that the addition of a groove to the inner surface of a gun barrel improved the accuracy of bullets fired from the gun. Bullets fired from a gun barrel. The pattern of scratches on the bullet matches those in the gun barrel. A gun barrel with seven helical grooves, for example, results in a pattern of seven scratches on a bullet fired from the gun. Since rifling patterns tend to differ from weapon to weapon, the patterns they produce on bullets fired from them tend to be distinctive, perhaps unique.²⁹

Binocular for identifying Dangerous gases:

It is a device, which is known as polychromatic, is being developed to spot and identify gases from two miles away when attached to binoculars. The system works by identifying the holographic signature of gases using infrared light to build up a 3-dimensional pattern of the composition of the gas. Within the binocular, a small hologram is programmed to mimic the chemical signature of any gas and by comparing it with the light from the gas, the two can be matched to identify the gas. The process takes less than a millisecond and can be used to simultaneously identify a number of gases. To identify the chemical weapon, the soldier can use it mainly for military and defense purposes. Fireman can also use it for the assessment of burning factories, houses and buildings. It may also be used for checking cars

exhaust fumes in future. This device can suitably be adapted for preventive forensic application.³⁰

Psycholinguistic profile

It is a profile of a criminal based upon his written and spoken words and texts used by criminal. Competent Forensic Psychologist can draw a fairly accurate descriptions of the possible criminal from the written or spoken (or both) words.³¹

Criminal Profiling

It is criminal's profiling based on his action and behavior. His acts, behavior, mannerism and expression are used to construct his profile. Criminal profiling is typically used when offender's identity is unknown and the serious criminal offences such as murder, sexual assault etc. There are two main direction of criminal profiling: the profiling of a criminal's personal characteristic and geographical profiling. A criminal profile is a part that describe the investigatively relevant and probative characteristics of the offender responsible for a particular crime or a series of crimes related crimes..... offenders characteristics includes any attributes that the examiner ascribes specifically to the unknown person or persons is responsible for the commission of particular criminal acts, including those that are physical, psychological, social, geographical or relational.³²

Forensic Acoustics- Speaker identification

Like variation in the face, fingerprint, and other biological parameters are discernible from one person to another, the voice also differs from one person to another. Voice analysis is essentially a sound spectrograph based technique, which is used to compare the recorded voice of an unknown individual to a known recorded voice sample of a suspected kidnapper, extortionist, terrorist, and others who communicate their intent to commit violent acts. The theory that explains the radiated acoustics in terms of the vocal mechanism that produces them is called the acoustic theory of speech production, or source filter theory. It was developed by the Swedish scientist Gunnar Fant....³³

Conclusion:

To conclude, modern forensic science techniques are playing pivotal role for the investigators to trace out the roots of crime by using even a slightest clue which could be recovered from the crime scene whether biological or non biological physical nature. It can be beneficial in two ways, first, to prove the guilt of the accused, and, second, to prove and established the innocence of innocents. Particularly, DNA profiling of an accused person can be of huge importance because by maintaining the database of the diaspora of the given locality, samples or clues recovered from the scene of the crime can be easily compared and matched. DNA test is the sole reliable scientific test which can accurately determine the paternity of a child and can be established the links between the persons, whom are related by blood, be of immense utility in tracing out the sexual offences and murder. Though the polygraph and psychological stress evaluator are not beyond the errors but can be crucial in the investigation of specific nature of cases, for example terrorist attacks. However, even in United States of America these scientific evidence is not so easily admissible because of the probability of obtaining them by way of contaminated resources, hence, violative of Fifth Amendment to the US Constitution. In India also Indian courts are so far, reluctant to admit them at once because of their uncertain nature and violative of constitutional provision.

But, despite of this, at least these forensic scientific techniques and methods undoubtedly are of great assistance to the police and other crime investigators, if not so valuable before the court of the law for

proving a fact. All is needed for their admissibility is certainty and surety of a definite accurate result with least flaws in the devices used for collecting such evidence. As the nature and modus operandi of criminals have drastically changed, it is high time that both legislature and judiciary should come forward and formulate the strategies and policy by way of legislations and hallmark verdicts of general and specific importance for a given region, if not of universal application, for admitting beyond any reasonable doubt the forensic and other scientific evidence.

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