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Unmasking the Truth: Crime scene to DNA Profiling in Forensic Identity Resolution: A Case Study

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Abstract

A severely burnt dead body was discovered in a cave-like area near Jaipur, Rajasthan (India), under suspicious circumstances. Physical evidence found at the crime scene initially suggested that the deceased might be a person named Ramcharan. However, his close friend Shambhu had also been reported missing around the same time, raising doubts about the true identity of the victim. Due to the extent of the burns, visual identification was not possible. To establish the identity, DNA profiling was conducted by comparing the genetic material from the body with reference samples from the parents of both Ramcharan and Shambhu. The analysis revealed a match with Shambhu's parents, confirming the body to be his. This case highlights the crucial role of DNA testing in forensic investigations, particularly when traditional identification methods are not viable.

Keyword: Burnt dead body, Crime scene, DNA profiling, Identification, Murder, Tooth

Introduction

The crime scene examination in the present case clearly indicated a planned murder case by a known person, and the initial evidence found at the crime scene pointed towards the deceased being Ramcharan. At the same time, Shambhu, a close friend of Ramcharan, was also reported missing, which caused deep concern for his family.

Due to the extensive burns on the body, visual identification was impossible. Shambhu's parents raised the possibility that the body could be that of their son. To resolve the uncertainty regarding the identity of the deceased, a DNA profiling test was performed. The profile generated from the tooth of the deceased was matched with that of the parents of both Ramcharan and Shambhu.

The DNA analysis of showed a match with Shambhu's parents, thereby confirming that the deceased was indeed Shambhu and not Ramcharan. This case highlights the critical role of DNA analysis in the accurate identification of bodies when physical recognition is not feasible.

Crime Scene Report:

The crime scene was examined by the investigation team, and a set of photographs was submitted along with this report. Evidence at the scene strongly suggested a planned murder committed by someone known to the victim.

The basis for treating the case as a homicide was the nature of the injuries found on the deceased: a horizontal incised wound on the neck and a blunt laceration on the head. No weapon was found at the

scene, nor was there any container that could have held an inflammable substance. Self-immolation was ruled out, as the victim had sustained a fatal neck injury prior to burning.

It is common in such cases for the body to be burned post-mortem either because the perpetrator was known to the victim or to obscure the victim's identity. In this case, the body was completely charred, making identification through physical characteristics impossible.

However, several unburnt pieces of evidence were found scattered near the body, all pointing towards the deceased being Ramcharan. Therefore, a DNA test was recommended for definitive identification.

Photographic documentation included:

Photograph 1: The overall crime scene location

Photograph 2: The burnt body lying on the floor of a cave-like area

Photograph 3: The incised throat wound

Photograph 4: A blood-stained stone recovered from the scene

Photograph 5: Ramcharan's mobile phone

Photographs 6 and 7: A slipper, a personal photograph, wallet, voter ID card, and other belongings believed to be Ramcharan's

All items recovered at the scene were identified by Ramcharan's parents as belonging to their son. Based on these findings, the crime scene report included a recommendation to conduct DNA testing to confirm the identity of the deceased.

However, before collecting DNA samples from the body at the mortuary, the parents of Shambhu—a friend of Ramcharan who had also gone missing on the same day—raised concerns that the deceased might be their son, Shambhu. In light of this, our team recommended conducting DNA tests for both sets of parents to compare with the DNA profile of the deceased and resolve the identity conclusively.

Laboratory Methodology

Samples Received:

The following samples related to the case were received in sealed condition for the purpose of identifying the deceased through DNA testing:

1. Blood sample of Shambhu's father
2. Blood sample of Shambhu's mother
3. Sample from the deceased (tooth selected)
4. Blood sample of Ramcharan's father
5. Blood sample of Ramcharan's mother

The blood samples from both sets of parents were collected on FTA cards. All the samples were subjected to DNA testing using the following procedures:

Processing of Blood Samples on FTA Cards:

The blood samples from Shambhu's father, Shambhu's mother, Ramcharan's father, and Ramcharan's mother were labelled as 1, 2, 4, and 5, respectively. A single 1.2 mm punch was taken from each FTA card using a Harris punch and mat and placed into 1.5 ml microcentrifuge tubes (MCTs) which were labelled accordingly (1, 2, 4, and 5).

Each FTA disc was washed using FTA purification reagent following the standard protocol recommended for FTA card processing. After washing and drying, the discs taken from FTA cards were directly subjected to PCR and fragment analysis.

Processing of Tooth of the Deceased

Isolation of DNA

Although multiple DNA isolation methods are available and well-documented for their efficacy [5], the magnetic bead-based technique was selected in this case due to its superior capability to purify DNA from compromised biological samples. The tooth of the deceased was chosen as the source material because of its unique anatomical properties like dense structure and protected location within the jawbone and it offers greater resistance to environmental degradation compared to bones, making teeth a preferred source for DNA profiling in criminal cases [3].

To minimize contamination risk, the tooth was thoroughly cleaned [7] and then pulverized into a fine powder. DNA was extracted from the powdered sample using automated DNA isolation system (Automate Express of Thermo Fisher Scientific, USA). This method offers significant advantages over traditional extraction techniques, including higher purity, efficiency, and automation. For the present case, t PrepFiler® BTA DNA Extraction Kit was employed, following the manufacturer's standardized methodology to ensure optimal yield and quality. To extract DNA pulverized tooth was transferred into a Lysate Tube. For lysis, PrepFiler® BTA Lysis Buffer, DTT, and Proteinase K were added in prescribed quantity. The mixture was incubated and the lysate was transferred to a new tube. DNA isolation was then carried out using the Automate Express instrument, following the standard protocol [8].

Quantitation of DNA

For quantitation of isolated DNA from the tooth, Real-Time PCR System (Thermo Fisher Scientific USA) was used. The DNA was quantified using the Quantifiler® Trio Kit following the manufacturer's standard protocol [11]. Results showed the presence of human male DNA in sufficient quantity (more than 1 ng)

DNA Amplification

PCR (Polymerase Chain Reaction) technology was utilized to amplify Short Tandem Repeat (STR) loci, which are highly polymorphic and serve as critical markers in forensic and paternity testing. Amplification was performed using the AmpFlSTR® Identifiler® Plus PCR Kit which is widely recognized for its sensitivity and reliability in forensic DNA analysis [1]. This kit targets 15 STRs loci and a Amelogenin locus, which is used for sex determination. The high variability of these STR loci among individuals enables precise identification and genetic relationship analysis.

All PCR procedures were conducted under rigorously controlled environmental conditions. Strict contamination prevention measures were maintained with regular surface decontamination ensuring the accuracy and integrity of amplification results.

DNA Fragment Analysis

Following amplification, STR amplicons were analyzed using capillary electrophoresis, a highly sensitive technique that separates DNA fragments based on size for precise allele determination. Analysis was performed on the ABI 3130XL Genetic Analyzer, a validated instrument widely used in forensic laboratories for high-resolution STR typing. The generated electropherograms were interpreted using GeneMapper ID-X® software, specifically designed for forensic DNA analysis [2]. 50 Relative Fluorescence Units (RFU) was applied during analysis. The software enables automated allele assignment to specific loci, offers detailed STR profile visualization, and supports comparative analysis across

reference and evidentiary samples. This facilitates the generation of comprehensive DNA profiles essential for establishing individual identity.

Result and Conclusion

The DNA analysis results are presented in **Table 1**. The alleles observed in the DNA profile obtained from the tooth are fully accounted for in the DNA profiles of Shambhu's parents, leading to the conclusion that the source of the tooth is their biological son. A detailed comparison confirming this complete match is provided in the Match Explanation column of **Table 2**.

In contrast, several alleles present in the DNA profile of the deceased's tooth are absent in the profiles of Ramcharan's parents, as detailed in the Match Explanation column of **Table 3**, thereby excluding them as the biological parents of the deceased.

Based on these findings, it can be conclusively determined that the deceased individual is the biological son of Shambhu's parents. This strongly supports the hypothesis of a premeditated homicide, in which the accused, Ramcharan, allegedly murdered Shambhu and attempted to mislead investigators by manipulating forensic evidence to misidentify the body as his own.

DNA profiling in thermally compromised tissues poses significant challenges due to the typically degraded nature of genetic material, which may hinder successful amplification of genetic markers. Furthermore, severely burnt bone samples are particularly prone to contamination by exogenous DNA, complicating the analysis.

Nonetheless, genetic fingerprinting remains a critical tool in the forensic identification of severely burnt human remains, which often present difficulties in routine forensic casework. In cases of extreme thermal damage—where soft tissues are completely destroyed—teeth serve as a highly reliable source of DNA due to their structural durability with protected anatomical position [3].

Success of DNA recovery is influenced by factors such as the intensity and duration of exposure to heat. For instance, a study [4] demonstrated the feasibility of obtaining reliable genetic profiles from human bones subjected to varying degrees of thermal damage, confirming that DNA-based identification is possible even in severely burnt remains. Additionally, successful identification of a severely burnt individual using the AmpFℓSTR® Identifiler® Plus Kit has been reported [6], wherein complete autosomal STR and Y-STR profiles were obtained. Other studies [9, 10] further support the capability to recover complete DNA profiles from burnt human remains, reinforcing the utility of modern DNA profiling techniques in such challenging forensic contexts.

Summary

DNA analysis confirmed that the tooth recovered from the deceased matched completely with the DNA profiles of Shambhu's parents, establishing the deceased as their biological son. In contrast, mismatches with the DNA profiles of Ramcharan's parents excluded them as the biological relatives. These findings support the conclusion that Ramcharan allegedly murdered Shambhu and attempted to misidentify the body as his own.

Despite the challenges posed by thermal degradation and contamination in burnt remains, teeth provided a reliable source for DNA extraction due to their protected anatomical structure. Studies and case evidence affirm that complete genetic profiles, including autosomal STR and Y-STR markers, can be successfully recovered from burnt samples using advanced kits like AmpFℓSTR® Identifiler® Plus, highlighting the effectiveness of DNA testing in forensic cases requiring identification.

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Table 1: AmpFlSTR® Identifiler® plus Allelic data analysis

Locus	Father of Shambhu	Mother of Shambhu	Tooth of deceased	Father of Ramcharan	Mother of Ramcharan
D8S1179	13,14	13,13	13,13	13,13	14,14
D21S11	31.2,32.2	29,33.2	32.2,33.2	29,32.2	28,31.2
D7S820	11,12	12,12	12,12	12,12	11,12
CSF1PO	10,12	11,12	11,12	10,10	10,12
D3S1358	15,18	16,18	15,16	16,18	18,18
THO1	9,9	9,9	9,9	9,9	7,7
D13S317	8,12	11,12	12,12	8,12	11,11
D16S539	12,13	11,13	11,12	9.9,13	9,12
D2S1338	18,25	20,23	18,23	18,23	23,25
D19S433	15,15	14,14.2	15,14.2	13,15	13,15
vWA	17,17	15,18	17,18	16,17	17,19
TPOX	8,9	11,11	8,11	8,8	9,9
D18S51	15,17	14,14	14,15	13,17	15,17
D5S818	9,12	12,12	12,12	9,12	11,12
FGA	20,23	23,25	20,25	23,23	21,23
Amelogenin	X, Y	X, X	X, Y	X, Y	X, X

Table 2: Match Explanation of DNA profiles of Tooth of Dead body and Parents of Shambhu

Locus	Father of Shambhu	Mother of Shambhu	Tooth of Dead body	Match Explanation
D8S1179	13,14	13,13	13,13	**13 from both parents**
D21S11	31.2,32.2	29,33.2	32.2,33.2	**32.2 from father, 33.2 from mother**
D7S820	11,12	12,12	12,12	**12 from both**
CSF1PO	10,12	11,12	11,12	**11 from mother, 12 from father**
D3S1358	15,18	16,18	15,16	**15 from father, 16 from mother**
THO1	9,9	9,9	9,9	**Both 9 from parents**
D13S317	8,12	11,12	12,12	**12 from both**
D16S539	12,13	11,13	11,12	**12 from father, 11 from mother**
D2S1338	18,25	20,23	18,23	**18 from father, 23 from mother**
D19S433	15,15	14,14.2	15,14.2	**15 from father, 14.2 from mother**
vWA	17,17	15,18	17,18	**17 from father, 18 from mother**
TPOX	8,9	11,11	8,11	**8 from father, 11 from mother**
D18S51	15,17	14,14	14,15	**15 from father, 14 from mother**
D5S818	9,12	12,12	12,12	**12 from father, 12from mother**
FGA	20,23	23,25	20,25	**20 from father, 25 from mother**
Amelogenin	X, Y	X, X	X, Y	**X from mother, Y from father**

Note: All 15 autosomal loci and Amelogenin match with Shambhu's parents. Hence, the source of tooth is the biological son of Shambhu's parents.

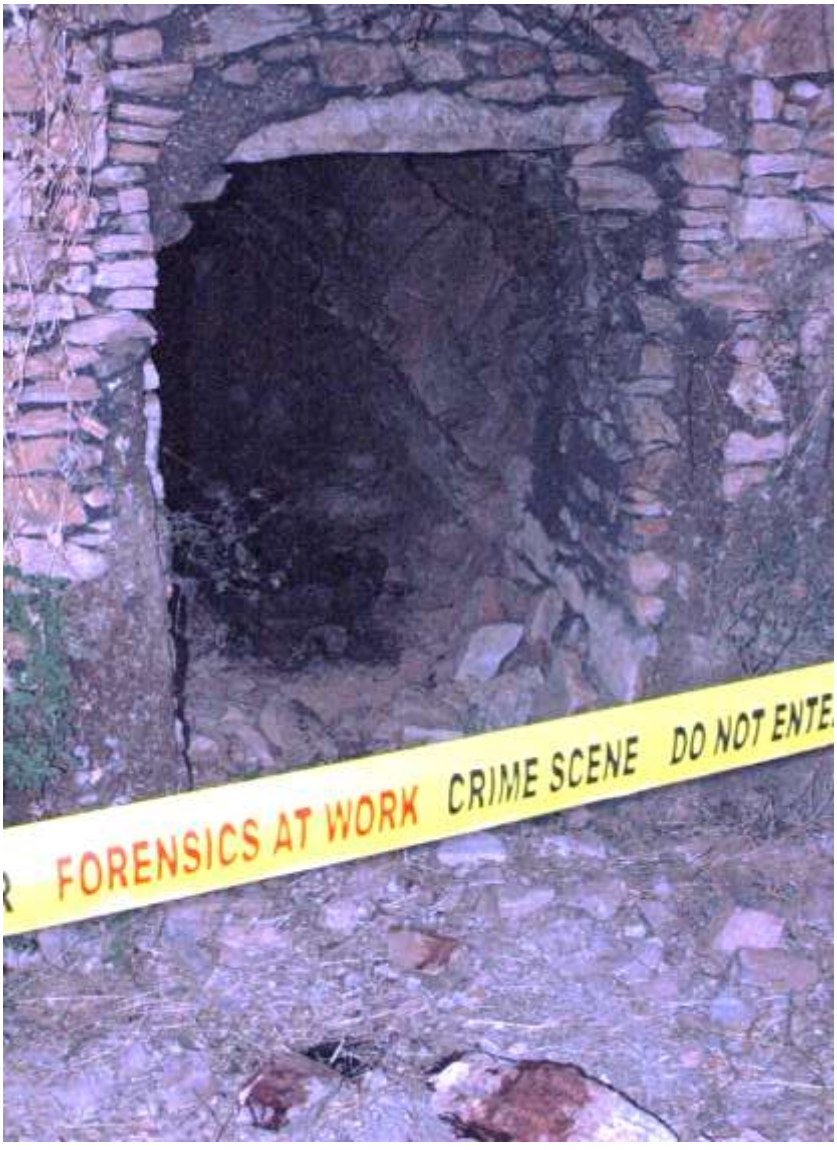
Table 3: Match Explanation of DNA profiles of Tooth of Dead body and Parents of Ramcharan

Locus	Tooth of Deceased	Father of Ramcharan	Mother of Ramcharan	Match Explanation
D8S1179	13,**13**	13,13	14,14	13 (ok), but no 2nd 13 or 14?
D21S11	32.2,**33.2**	29,32.2	28,31.2	33.2 not in either
D7S820	12,12	12,12	11,12	✓
CSF1PO	**11,**12	10,10	10,12	11 not from either
D3S1358	**15,**16	16,18	18,18	15 not from either
THO1	9,**9**	9,9	**7,7**	Only 9 from father

D13S317	12,**12**	8,12	11,11	Only 12 from father
D16S539	**11**,12	**9.9,13**	**9,12**	11 not from either
D2S1338	18,23	18,23	23,25	✓
D19S433	15,**14.2**	13,15	13,15	14.2 not from either
vWA	17,**18**	16,17	17,19	18 not from either
TPOX	8,**11**	8,8	9,9	11 not from either
D18S51	**14**,15	13,17	15,17	14 not from either
D5S818	12,12	9,12	11,12	✓
FGA	**20,25**	23,23	21,23	20,25 not in either
Amylogenic	X, Y	X, Y	X, X	✓

Note: Only 4 loci match out of 15 loci. Many alleles are not present in Ramcharan's parents. Hence, the source of tooth cannot be the biological son of Ramcharan's parents.

Photograph 1: The crime Scene-Location



Photograph 2: The Dead body

Photograph 3: Cut throat Injury

Photograph 4: Blood-stained Stone recovered from crime scene

Photograph 5: mobile of Ramcharan

Photograph 6: Slipper of Ramcharan (identified by his parents)

Photograph 7: Showing voter ID and other evidences related to Ramcharan