Journal of Current Medical Research and Opinion
Received 08-03-2024 | Revised 09-03-2024 | Accepted 29-03-2024 | Published Online 31-03-2024

DOI: https://doi.org/10.52845/CMRO/2024/7-3-5 ISSN (O) 2589-8779 | (P) 2589-8760
CMRO 07 (03), 2196-2201 (2024)
Original Research

Use of DNA in the Forensic Identification of Charred Remains of Victims of Fire Disaster: Our Lagos Experience

Gbeneo[1,2] TJ, Fadeyibi[1] I.O, Adesina[1] A.A, Omosebi[1] D.T, Ajani[1] A.O, Buari[1]. A.F, Osinubi[1] O.O,

[1]Plastic & Reconstructive Surgery Unit, University of Port Harcourt Teaching Hospital, Port Harcourt, Nigeria.
[2]Department of Plastic Surgery, Lagos State University Teaching Hospital Ikeja, Nigeria.
Correspondence: Dr Tombari Gbeneol.

Abstract:

When identifying remains of humans in forensic medicine, it is the practice to compare the genetic profile of the deceased person's remains with reference samples of related individuals, typically parents. Here we describe, for the first time, the identification of adults' remains using a sample of reference of the subject's charred remains.

Materials and methods: 12 body bags containing remains of victims were subjected to analysis, short tandem repeat (STR) DNA analysis was performed on femur, blood and iliopsoas muscle samples of remains, DNA analysis of reference samples were also done. The matching was then performed for each on a 3500 Applied Biosystem Genetic Analyser to give the results.

Result: Table 1 shows the short tandem repeats samples (in base pairs) obtained at various genetic loci D2S44, D4S139, D5S110 and D10S28 from the biological samples of one of the 9 victims. A total of nine victims were identified from the 12 body bags that were brought, crosspacking of the body parts was observed, bodies of the nine victims were positively identified.

Conclusion: In the absence of medical records, STR DNA analysis is used in DNA profiling and compare with other profile in a data base to identify potential matches, determine familial relationships and identify human remains in disaster situations or mass graves.

Keyword: DNA, forensic medicine, genetic loci, STR DNA

Introduction:

Tragically, fire disasters occur throughout the world. Identifying victims of fire disasters remains a challenging part of disaster management because of the fires damaging effects on the body, which frequently result in minimal physical evidence.[1.] Identification of human remains is required for humanitarian reasons and has legal implications, as revealed by Baldino and colleagues[2], when the charred remains of the victims were finally identified, this might result to gradual peace of mind and solace as it resolves the riddle and ends the search for their victims. This might be crucial in situations when there is doubt about the validity of a specific death, such as in disasters with mass casualties.

Legal ramifications might range from little things like a will settlement to great issues as criminal prosecution in homicide cases[3]. Forensic and catastrophe research goals require precise and thorough data collecting, which also requires identification[3]. Scientific, investigative, and humanitarian interests have all continued to be piqued by the devastating fire disaster episodes and their aftermath[3,4,5,6] While fire can be useful to humans when used constructively, when it is out of control, it can be disastrously harmful to humans. Fire disasters continue to be a leading cause of unintended harm and death in homes; with inhalational injuries accounting for most mortalities rather than the primary burns injury[3,4,5]. Research indicates that 80% of fire fatalities are caused by smoke inhalation, with burn victims making up only 20% of the total[4].

Robino and colleagues[5] have stated that fire disasters have persisted as a significant public health issue in Lagos and throughout Nigeria. In the majority of fire disaster cases, victims experience severe burns and are rendered virtually unrecognizable. In these cases, family members are left to untold hardship and huge financial burden. DNA methods can be employed to identify the victims. Lagos State has experienced a fair number of fire disasters, with many victims suffering burns so severe that the only ways to identify them are frequently through dental records, jewellery, personal property, and other carry on documents like ID cards. In October 1996, there was a fire outbreak at a petroleum pipeline, resulting in the recovery of approximately 200 scorched bodies.

The Ikeja bomb blast on January 27, 2002, was the most recently tragic incident. It resulted in a large-scale fire outbreak that affected a heavily populated region of Ikeja, with an estimated casualty count of over 1000.

The aim of this study is to describe the identification procedures involved in DNA and to describe the benefits of using genetic information for charred victims of burn natural catastrophes.

Materials and methods:

12 body bags containing remains of victims were subjected to analysis, short tandem repeat (STR) DNA analysis was performed on femur, blood and iliopsoas muscle samples of remains, DNA analysis of reference samples were also done. The matching was then performed for each on a 3500 Applied Biosystem Genetic Analyser to give the results.

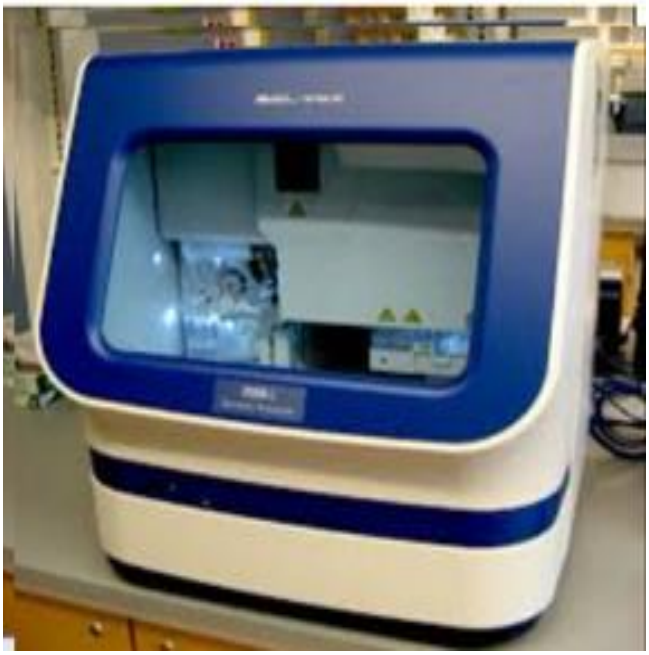

Figure 1.1 Applied Biosystems 3500xl Genetic Analyzer

A STR analysis, a useful method in molecular biology, compare specific loci on DNA from two or more samples, a short tandem repeat, a microsatellite, of a unit of 2 - 13 nucleotides repeated hundreds of times in a row on the DNA strand, STR analysis measures the exact number of repeating units, Differs from restriction fragment length polymorphism analysis (RFLP); does not cut the DNA with restriction enzymes, probes attached to desired regions on DNA, polymerase chain reaction then discovers lengths of short tandem repeats, the Promega Powerplex Fusion 6C kit was used to amplify DNA using polymerase chain reaction (PCR). The thirteen FBI-specified core loci (D3S1358, D13S317, D16S539, D18S51, CSF1PO, TH01, Vwa, D21S11, D7S8820, D5S818, TPOX, D8S1179, and FGA) and the seven FBI-specified expanded core loci (D12S39, D19S433, and FGA) were covered. Male-specific markers DYS391, DYS576, DYS570, Promega Powerplex Fusion 6C kit, D22S1045, Penta D, Penta E, SE33, and sex marker Amelogenin.

DNA amplification was done with polymerase chain reaction (PCR) using Promega Powerplex Fusion 6C kit, covering: thirteen FBI-specified core loci (D3S1358, D13S317, D16S539, D18S51, CSF1PO, TH01, Vwa, D21S11, D7S8820, D5S818, TPOX, D8S1179, and FGA), seven FBI-specified expanded core loci (D12S39, D19S433, D22S1045, Penta D, Penta E, SE33 and sex marker Amelogenin, and male-specific markers DYS391, DYS576, DYS570

Figure 1.2: Promega Powerplex Fusion 6C kit

Samples were analyzed on a 3500 Applied Biosystems Genetic Analyzer –capillary electrophoresis device. Promega Buccal Swab Solution Method on buccal swab specimens obtained from relatives of victims. The DNA amplification was done using Polymerase Chain reaction with Promega Powerplex Fusion 6C kit as done on victim's samples. Samples were analyzed on a 3500 Applied Biosystems Genetic Analyzer. Positive and negative controls in each stage of analysis were performed, Profile matching between the unidentified remains and the families of relatives was performed with the Small Pond software, a computerized DNA profile matching system. All matches were verified manually.

Figure 1.3: DNA analysis of unidentified remains

DNA extraction was done using an organic DNA extraction method, DNA quantification was done using Qiagen's investigator quantiplex Kit

Among the specimens are those from the iliopsoas, femur, urine, muscle, and buccal swab.

The selection of family members from whom to obtain specimens, including parents, siblings, sisters, and siblings.

Table 1.1: Disaster victim identification (Summary Table)

S/N	AGENCY CASE NO	LSDFC VICTIM'S SAMPLE CASE NO	LSDFC REF.(FAMILY MEMBER' SAMPLE) CASE NO)	VICTIM BELONGS TO THIS FAMILY	PRIMARY POINT OF CONTACT	CONTACT NUMBER
1	OTE/009/2018	2018-021-09	2018F-013	OOA FJA	FJA	
2	OTE/004/2018	2018F-021-04	2018F-014	OBA OF	OF	
3	OTE/002/2018 OTE/10B/2018 OTE/01C/2018	2018F- 21-02 2018F-21-10B 2018F-21-10C	2018F-015	MIO	MIO	
4	OTE/OO8/2018	2018F-021-08	2018F-016	EMD	EMD	

Table 1.4: Disaster Victim identification Summary table II

S/N	AGENCY CASE NO	LSDFC VICTIM'S SAMPLE CASE NO	LSDFC REF. (FAMILY MEMBER' SAMPLE) CASE NO	VICTIM BELONGS TO THIS FAMILY	PRIMARY POINT OF CONTACT	CONTACT NUMBER
5	OTE/OO1/ 2018	2018F-021-01	2018F-017	JE	JE	
6	OTE/005/2 018	2018F-021-05	2018F-018	TO JO	JO	
7	OTE/003/2 018	2018F-021-03	2018F-019	OC IO	IO	
8	OTE/OO6/ 2018 OTE/010A/ 2018	2018F-021-06 2018F-021-10A	2018F-020	OS	OS	
9	NONEX	NONE	2018F-022	NOT APPLICABL E	SAA	

Discussion

A fire incidence in Lagos State, Nigeria, has destroyed fathers, mothers, and children in a number of homes. Fires are so destructive because they start with any form of spark in the presence of some inflammable materials. The results of our study on the use of DNA in the forensic identification of burned remains of victims of fire disasters in Lagos State, Nigeria, showed that the bodies of the victims had been positively identified with the help of the following samples: iliopsoas, femur, vitreous humour, urine, muscle, and buccal swab specimens collected from victims' cousins, that had been used in a number of testing kits and processes; such as the Promega Powerflex Fusion 6C kit and the utilized Biosystems 3500xl Genetic Analyzer. The DNA amplification was carried out using Polymerase Chain Reaction, which was used in conjunction with Promega Powerplay Fusion.

The victim's samples were subjected to a 6C kit, an organic DNA extraction method was employed for DNA extraction, and Qiagen's Investigator Quantiplex Kit was utilized for DNA quantification. These results are consistent with related research conducted by Robino and associates[5]; in their investigation, a DNA profile was acquired using three deciduous teeth. From just one tooth, an entire DNA profile was acquired. This literature reported on the effectiveness of DNA typing from teeth exposed to a variety of experimental settings, including exposure to fire,[7,8] treatment with acids, and so on. Furthermore, analysis has been done on the impact of the lengths of the postmortem and post-extraction periods on the extraction of genetic profiles from the teeth[9,10].

It is noteworthy that the conclusion of this case depended heavily on the mother's choice to hide several teeth from her kid. Teeth can serve as an alternate source of reference DNA for the identification of individuals in situations such as mass disasters or criminal cases, hence it is important to support this and related practices[11]. For this aim, additional samples including blood spots, hair, and buccal swabs may also be taken into consideration. one may readily find instructions on the Internet for gathering and preserving them, along with the materials needed, even in a home environment. But in this regard, one needs to exercise extreme caution, show great sensitivity, and respect the traditions and convictions of a certain community or person.

Even though DNA profiling is a crucial component of identifying human remains, a number of variables, including a lack of extracted DNA or sample degradation in cases of poor preservation, can impact on the analysis's findings. Under such

circumstances, a multidisciplinary strategy that takes into account the use of other disciplines such as odontology and forensic anthropology may be required[12].

Disasters that cause fatalities can occasionally happen in places where the victims are unknown. In these cases, the bodies of some of the victims may have undergone significant morphological distortions that make it difficult to identify their remains. These kinds of bodies are frequently interred as unknown, particularly in poor nations. Facilities are accessible in wealthy nations with good medical records[11].

There are resources accessible to help identify these victims. Four forms of identity are legally valid in numerous countries, according to Raffone and colleagues[12]: visual recognition, dental identity, fingerprint instance, and DNA typing. Since most of these procedures are readily unavailable in Nigeria, the bodies of people killed in large-scale accidents are frequently buried in mass graves under the name "unidentified." In recent years, a DNA mapping facility was developed in Lagos, Nigeria. The recent Otedola Fore-Bridge Fire Disaster's dead victims' remains were positively identified using this facility. The processes used in these victims' identified are the subject of this paper. On September 27, 2017, the forensic division of the Pathology Department of LASUTH formally opened as a DNA Laboratory. One can get results in less than an hour. As at 2017 it was the first and only one in Nigeria. It is the first state-owned DNA and forensic center in West Africa. The Otedola victims' case was the first of its kind to be brought to the department's attention, and it was particularly difficult and urgent. Recently centers like Intercontinental Diagnostic Centre-,Port Harcourt Rivers State has a PCR Polymerase Chain Reaction and a Forensic Laboratory.

Result:

Table 1 shows the short tandem repeats samples (in base pairs) obtained at various genetic loci D2S44, D4S139, D5S110 and D10S28 from the biological samples of one of the 9 victims. A total of nine victims were identified from the 12 body bags that were brought, crosspacking of the body parts was observed, bodies of the nine victims were positively identified.

Conclusion:

In the absence of medical records, STR DNA analysis is used in DNA profiling and compare with other profile in a data base to identify potential matches, determine familial relationships and identify human remains in disaster situations or mass graves.

References:

1. National Commission on the Future of DNA Evidence. "Using DNA to Solve Cold Cases" (pdf). U.S. Department of Justice.(2002)
2. Baldino G., Mondello C., Sapienza D., Stassi C., Asmundo A., Gualniera P., Vanin S., Ventura Spagnolo E. Multidisciplinary forensic approach in "complex" bodies: Systematic review and procedural proposal. Diagnostics. 2023;13:310. doi: 10.3390/diagnostics13020310.
3. Schwark T1, Heinrich A, Preusse-Prange A, Von Wurmb-Schwark N. Reliable genetic identification of burnt human remains. Forensic Sci. Int. Genet. 2011;5(5):393-9.
4. Muhamamd S, Manzoor H, Muhammad AS, Rukhsana PZ, Muhammad I. Successful DNA Profiling for Identification of burnt Families from their bones using AmpFℓSTR Identifier Plus Kit. Adv.life sci. 2016 ;3(2):59-62.
5. Robino C., Pazzi M., Di Vella G., Martinelli D., Mazzola L., Ricci U., Testi R., Vincenti M. Evaluation of DNA typing as a positive identification method for soft and hard tissues immersed in strong acids. Leg. Med. 2015;17:569–575. doi: 10.1016/j.legalmed.2015.07.004.
6. Ozano-Peral D., Rubio L., Santos I., Gaitán M.J., Viguera E., Martín-de-Las-Heras S. DNA degradation in human teeth exposed to thermal stress. *Sci. Rep.* 2021;11:12118. doi: 10.1038/s41598-021-91505-8.
7. Garriga J.A., Ubelaker D.H., Zapico S.C. Evaluation of macroscopic changes and the

efficiency of DNA profiling from burnt teeth. Sci. Justice. 2016;56:437–442. doi: 10.1016/j.scijus.2016.06.006

8. Lozano-Peral D., Rubio L., Santos I., Gaitán M.J., Viguera E., Martín-de-Las-Heras S. DNA degradation in human teeth exposed to thermal stress. Sci. Rep. 2021;11:12118. doi: 10.1038/s41598-021-91505-8.
9. Raimann P.E., Picanço J.B., Silva D.S., Albuquerque T.C., Paludo F.J., Alho C.S. Procedures to recover DNA from pre-molar and molar teeth of decomposed cadavers with different post-mortem intervals. Arch. Oral Biol. 2012;57:1459–1466. doi: 10.1016/j.archoralbio.2012.08.
10. Higgins D., Rohrlach A.B., Kaidonis J., Townsend G., Austin J.J. Differential nuclear and mitochondrial DNA preservation in post-mortem teeth with implications for forensic and ancient DNA studies. PLoS ONE. 2015;10:e0126935. doi: 10.1371/journal.pone.0126935.
11. Vij N., Kochhar G.K., Chachra S., Kaur T. Dentistry to the rescue of missing children: A review. J. Forensic Dent. Sci. 2016;8:7–12.
12. Raffone C., Baeta M., Lambacher N., Granizo-Rodríguez E., Etxeberria F., de Pancorbo M.M. Intrinsic and extrinsic factors that may influence DNA preservation in skeletal remains: A review. Forensic Sci. Int. 2021;325:110859. doi: 10.1016/j.forsciint.2021.110859