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Forensic Identification Through Non-Biometric Markers: A Case Series on the Role of Personal Belongings and Body Modifications

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ABSTRACT

Background: The identification of unknown deceased individuals is a core responsibility in forensic medicine. While biometric methods such as fingerprinting, DNA analysis, and dental comparison are the gold standard, they are frequently unavailable in resource-limited settings or when biological material is compromised. Non-biometric markers, including personal jewelry, clothing, tattoos, and cultural physical characteristics—often represent the only immediately available identification tool.

Objective: To document and analyze the forensic utility of non-biometric markers in the identification of unknown deceased individuals through a case series.

Methods: A retrospective descriptive case series of six medicolegal cases referred for autopsy or examination at a tertiary-care institution in northern India. Cases were selected on the basis that identity was established through non-biometric markers. Standard medicolegal autopsy protocols were followed.

Results: Identity was established or critically advanced through: engraved jewelry (Case 1); distinctive prescription spectacles (Case 2); a name- and address-bearing forearm tattoo (Case 3); a recognizable clothing fragment corroborated by CCTV evidence (Case 4); a name-bearing forearm tattoo on a decapitated body (Case 5); and cultural markers (circumcision, beard grooming) guiding post-mortem management of an unidentified migrant (Case 6).

Conclusion: Non-biometric markers continue to play a vital and, in many contexts, indispensable role in forensic identification. Systematic documentation of these markers during scene examination and autopsy is essential. Forensic practitioners should be trained in their recognition and evidential significance, and standardized documentation protocols should be developed and adopted.

Keywords: forensic identification; non-biometric markers; tattoos; personal belongings; clothing; skeletal remains; trauma; cultural markers; circumcision; medicolegal autopsy

INTRODUCTION: The identification of unknown deceased individuals is one of the most fundamental duties in forensic medicine, with profound implications for medico-legal case resolution, criminal investigation, and the dignity and rights of the deceased and their families (1, 2). Establishing identity is indispensable for legal proceedings, inheritance claims, closure for relatives, and the accurate recording of death statistics. In mass-casualty scenarios, armed conflict, and natural disasters, the challenge of identifying the dead is magnified considerably (3).

Contemporary forensic practice relies on a hierarchy of identification methods. Primary methods that yield positive identification—include fingerprint analysis, comparative dental examination, and DNA profiling. Secondary and tertiary methods incorporate anthropological assessment, medical history, and circumstantial evidence such as personal effects and clothing (4). Biometric systems, including iris recognition and facial reconstruction, have further expanded the forensic toolkit (5). However, these approaches share a common set of prerequisites: they require intact or minimally degraded biological material, appropriate technical infrastructure, and databases against which to compare finding conditions that cannot always be guaranteed in the field (3, 4).

In resource-limited healthcare settings, peripheral hospitals, or situations involving advanced decomposition, severe traumatic injury, or skeletal remains, the immediate application of primary identification methods may not be feasible. Moreover, in contexts involving undocumented migrant workers, socially marginalized individuals, or those with no prior contact with law enforcement, biological reference samples for comparison may simply not exist (6). In such scenarios, non-biometric markers—personal belongings, clothing, jewelry, tattoos, scars, and culturally embedded physical characteristics—assume a disproportionate investigative importance, often providing the critical initial lead that enables subsequent confirmatory identification (7, 8).

The forensic value of body modifications, including tattoos, has been increasingly recognized in the literature. Tattoos are permanent, resistant to moderate decomposition, and frequently contain personally identifying information such as names, dates of birth, or addresses (9, 10). Similarly, clothing and personal accessories, although subject to degradation, can carry distinctive features—

engravings, customization, prescriptions—that render them uniquely attributable to an individual (11). Cultural and religious markers, such as circumcision, grooming practices, or specific jewelry styles, may further assist in narrowing the field of possible identities and ensuring culturally respectful post-mortem management (12).

Despite the acknowledged utility of these non-biometric markers, their systematic documentation and analysis in forensic literature remains limited relative to biometric methods. This paper presents a case series of six forensic identification scenarios encountered in routine medicolegal practice in northern India, each of which demonstrates a distinct non-biometric marker as the primary or corroborative means of establishing identity. The cases collectively illustrate the practical significance of meticulous scene documentation, thorough external examination, and forensic awareness of culturally embedded physical characteristics.

MATERIALS AND METHODS:

This paper presents a retrospective descriptive case series of six medicolegal cases referred for autopsy or examination at a tertiary-care institution in northern India. Cases were selected purposively on the basis that identity was established, at least in part, through non-biometric markers. Standard medicolegal autopsy protocols were followed in all cases in accordance with institutional guidelines. The non-biometric markers identified in each case were documented photographically and recorded in the official post-mortem report. Patient confidentiality has been maintained; identifying information has been anonymized or withheld where appropriate. No ethical approval was required for this retrospective descriptive series under applicable institutional guidelines.

CASE REPORTS

Case 1: Silver Bracelet Facilitating Identification Following a Road Traffic Accident

A severely disfigured body recovered from the scene of a high-energy road traffic collision involving a heavy goods vehicle. Blunt force trauma had rendered the face and upper torso entirely unrecognizable, precluding any form of visual or facial identification. At the time of mortuary reception, the examining duty doctor systematically documented all externally visible artefacts and personal effects. A silver bracelet (*Kada*), worn on the left wrist, bore an engraved

inscription containing two names—one male and one female (Figure 1). The bracelet was noted as personalized and non-commercially generic.

The findings were communicated to the investigating police officers, who cross-referenced the names against local missing persons reports filed within the preceding 24 hours. A match was identified: a woman had filed a missing person's report shortly before the recovery of the body, reporting her husband missing after failing to return from a journey. The family confirmed the bracelet as belonging to the deceased, and the body was formally identified and released. This case underscores the investigative value of personalized jewelry as a first-contact identification marker and highlights the importance of routine documentation of personal effects at the scene and at mortuary reception.

Case 2: Spectacles Leading to the Identification of Partially Skeletonized Remains

Partially skeletonized human remains were discovered in a drainage channel in a rural village, approximately two weeks following the disappearance of a local resident with a documented history of epilepsy. Due to the advanced state of decomposition and skeletonization, soft-tissue examination was not possible, and facial identification was precluded. A pair of thick-lensed, distinctively framed spectacles was recovered near the skull (Figure 2).

The spectacles were presented to the missing person's family, who provided unequivocal identification of the item as belonging to their relative, noting the distinctive frame style and the high-power prescription lenses characteristic of the individual's severe visual impairment. Osteological analysis conducted during autopsy confirmed findings consistent with the reported age range and biological sex of the missing individual. The case illustrates how prescription spectacles—particularly those with a distinctive appearance or high dioptre correction—may function as reliable personal identifiers even in advanced decomposition scenarios. The temporal and geographical context further corroborated the identification.

Case 3: Forearm Tattoo Enabling Identification of a Disoriented Elderly Woman

An elderly woman was found in a severely disoriented and injured state near a rural railway station, having apparently been left behind following disembarkation from a moving train. She was unable to communicate effectively owing to a significant language barrier and presented with no identity

documentation. Initial attempts at identification through verbal history were unsuccessful.

During clinical examination, a tattoo was noted on the anterior aspect of the right forearm (Figure 3). The tattoo bore her given name, her husband's name, and a partial residential address—a cultural practice observed in certain communities of the Indian subcontinent as a form of personal identification, particularly among elderly individuals. The information was communicated to the local police, who used the address details to contact the relevant district authority. The woman's family was located and her identity confirmed. This case illustrates the dual forensic and humanitarian value of culturally embedded tattoos: they serve not only in post-mortem identification but equally in locating the relatives of living, incapacitated individuals.

Case 4: Torn Shirt Fragment as the Decisive Identifier in a Skeletonized Body

A fully skeletonized body with disarticulation of the skull, mandible, and multiple long bones was recovered from a roadside ditch in a rural area. The advanced state of decomposition rendered biological identification methods impractical in the immediate term. The only potential identifier was a torn fragment of fabric—a red, black, and white checked shirt pattern—adherent to residual soft-tissue remnants surrounding the thoracic vertebral column (Figure 4).

Investigators pursued a parallel investigative line, reviewing closed-circuit television (CCTV) footage from a nearby industrial facility. Footage obtained from approximately one month prior to the discovery of the remains depicted an individual whose clothing—a shirt of identical pattern and coloration—matched the fragment recovered at the scene. The footage further showed the individual's bicycle falling into the ditch in question. Family members subsequently confirmed the identification based on their recognition of the shirt. This case demonstrates the forensic value of even severely degraded clothing fragments when combined with contextual investigative evidence and highlights the utility of CCTV footage as a corroborative tool in scene-based forensic investigation.

Case 5: Forearm Tattoo Enabling Identification of a Decapitated Body

A male individual was found deceased on a railway track. The head had been completely severed and subsequently crushed by train wheels, rendering the craniofacial region entirely

unsuitable for identification purposes. No identity documents were found at the scene, and the body bore no other immediately apparent identifying features.

Systematic external examination of the body revealed a distinct tattoo on the upper right forearm bearing the deceased's own given name (Figure 5). The tattoo was noted in the post-mortem report and communicated to the investigating authorities. When family members were contacted following a missing persons enquiry, they confirmed the presence of such a tattoo on their relative, and corroborated circumstantial evidence—including the location of the incident relative to the deceased's known movements—further supported the identification. This case reaffirms the particular value of name-bearing tattoos in severe trauma scenarios in which craniofacial identification is not possible, and the importance of conducting a thorough, systematic external examination regardless of the apparent cause of death.

Case 6: Cultural and Physical Markers Guiding Post-Mortem Management of an Unidentified Migrant

An unidentified young adult male, presumed on circumstantial grounds to be a migrant worker, was brought for medicolegal autopsy following a railway accident. No identity documents, religious symbols, or jewelry were present on the body. Tattoos were absent. In the absence of any conventional identifying markers, careful external examination was conducted with particular attention to physical and cultural indicators.

External examination revealed a beard with a trimmed moustache and circumcised external genitalia (Figure 6). While neither circumcision nor beard grooming is exclusively diagnostic of any single religious group, the combination of these findings—in the context of the complete absence of markers typical of the regional majority religious community—raised substantive concern regarding the appropriateness of default cremation as the standard method of body disposal practiced in the region.

Cremation was suspended pending further enquiry. A religious scholar was consulted, who advised that, based on the totality of cultural and physical findings, burial consistent with Islamic tradition was most appropriate. The body was subsequently interred accordingly. Several days later, family members came forward and confirmed the identity of the deceased, along with his religious affiliation, validating the decision made based on physical and cultural

examination. This case highlights the forensic and ethical significance of cultural markers in post-mortem management decisions, particularly in the context of migrant and unidentified populations (12, 13).

DISCUSSION: This case series illustrates the breadth and practical significance of non-biometric markers in forensic identification. Across diverse scenarios—ranging from a severely traumatized body to a skeletonized corpse, and from a living, incapacitated individual to a culturally unidentified migrant—non-biometric markers served either as the primary means of establishing identity or as the critical first investigative lead. While these markers have traditionally been regarded as secondary or corroborative, the present cases demonstrate that in real-world forensic practice they are frequently the only immediately available tools, and their systematic documentation is therefore of paramount importance (6, 7).

Jewelry and Personal Accessories: Jewelry and personal accessories represent a well-recognized category of non-biometric forensic identifiers. While generic items of jewelry may offer limited discriminatory power, personalized or engraved pieces—as in Case 1—effectively function as portable records of personal relationships and identity. Starkie et al. (11) have demonstrated that trans-dermal artefacts, including jewelry, can retain their identifying characteristics even through advanced stages of decomposition. Maclennan's forensic jewelry analysis work has further systematized the examination of jewelry in death investigation, identifying manufacturing marks, wear patterns, and personalization as key discriminating features (6). The forensic examiner should document not only the type and material of jewelry found on or near the deceased, but also any inscriptions, hallmarks, repair evidence, or customization.

Tattoos and Body Modifications: Tattoos occupy a particularly important role among non-biometric forensic identifiers by virtue of their permanence, their resistance to moderate post-mortem degradation, and their frequent incorporation of personally identifying information. Kulshreshtha and Mondal (8) have provided a comprehensive review of acquired body marks—including tattoos, scars, and branding—as forensic identification tools, noting that name-bearing tattoos are especially valuable in scenarios of severe craniofacial trauma or decapitation, as demonstrated in Cases 3 and 5 of the present series. Byard (10) further notes that tattoos can

persist through stages of decomposition that would render most soft-tissue features unidentifiable and may even be visible on mummified or macerated skin following careful preparation. The location, dimensions, color, style, and content of tattoos should all be documented during post-mortem examination, and images should be retained in the case record.

Clothing and Fabric Remnants: Clothing retains forensic value even in conditions of advanced decomposition or skeletonization. Warrier and Kanchan (7) have emphasized that clothing not only provides potential information for identification but may also carry trace evidence relevant to the manner and cause of death, including bloodstain patterns, fibre transfer, and contact residues. In Case 4, the persistence of a recognizable fabric fragment through skeletonization, in conjunction with CCTV footage, provided the only viable identification pathway. The importance of systematic documentation of clothing at the scene—including pattern, color, manufacturer's labels, and any modifications or repairs—cannot be overstated. Even fragmented or heavily degraded items may retain diagnostic features when examined carefully.

Cultural and Anthropological Markers: The use of cultural and anthropological markers in forensic identification and post-mortem management, as illustrated by Case 6, raises both practical and ethical considerations. Circumcision, while not pathognomonic of a specific religious identity, is highly prevalent in certain communities and, in combination with other grooming practices and the absence of counter indicating markers, may meaningfully inform decisions regarding the religious or cultural background of an unidentified individual (12, 13). Anwer et al. (13) have documented the cultural specificity of male circumcision practices in Muslim-majority settings, reinforcing its potential utility as a contextual marker. From an ethical standpoint, the forensic practitioner has a duty to ensure that the post-mortem management of an unidentified body is, to the greatest extent practicable, consistent with the cultural and religious values of the deceased. This duty is particularly salient in the context of migrant and refugee populations, who may be both unidentified and culturally distinct from the receiving community.

Limitations: Several important limitations of non-biometric identification must be

acknowledged. First, personal belongings and clothing may not be found with the body—they may have been displaced, removed, or stolen at or before the time of discovery. Second, although some items are unique to an individual, others (particularly generic clothing or common jewelry) may be insufficiently discriminatory to establish identity in isolation. Third, tattoos and other body modifications are subject to distortion through trauma, decomposition, and heat, and their interpretation may require specialist expertise (9). Fourth, cultural markers such as circumcision are population-level indicators rather than individual identifiers and must be interpreted within a broader investigative and contextual framework. Finally, and critically, identification based solely on non-biometric markers should be regarded as presumptive until corroborated by at least one additional line of evidence—whether biometric, contextual, or testimonial (3, 4).Implications for Forensic Practice: Notwithstanding these limitations, the consistent lesson of the present case series is that meticulous documentation—of scenes, of bodies, and of personal effects—creates investigative opportunities that would otherwise be lost. Forensic personnel, including autopsy technicians, first-responders, and emergency department staff, should be trained to recognize, preserve, and systematically record non-biometric markers as a matter of routine practice. The development of standardized documentation protocols incorporating non-biometric markers would strengthen the evidentiary value of these findings and facilitate their integration with biometric databases and missing persons registries. International standards, such as those published by Interpol for Disaster Victim Identification (DVI), already acknowledge the role of personal effects in the identification process; broader adoption of these frameworks in routine forensic practice would represent a meaningful step forward (3).

CONCLUSION: Non-biometric markers—encompassing personal jewelry, clothing, tattoos, personal belongings, and culturally embedded physical characteristics—continue to represent an indispensable component of the forensic identification toolkit, particularly in resource-limited settings, in cases involving severe trauma or advanced decomposition, and in populations with limited documentation or prior forensic engagement. The six cases presented in this series collectively demonstrate that

these markers are not merely adjunctive curiosities but may constitute the primary, and occasionally sole, evidence available for establishing or initiating the identification of an unknown deceased individual.

Forensic practitioners at all levels—from scene-attending officers to autopsy pathologists, must cultivate and maintain a systematic awareness of non-biometric markers and commit to their thorough documentation in every case. Investment in training, in standardized documentation protocols, and in the integration of non-biometric evidence with existing biometric and missing persons databases will enhance the efficiency, accuracy, and cultural sensitivity of the identification process, thereby fulfilling both the medicolegal mandate and the humanitarian duty that lie at the heart of forensic medicine.

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Table 1. *Summary of forensic cases identified through non-biometric markers.*

Case	Marker Type	Body Condition	Key Finding	Identifier	Outcome
1	Personal jewellery (Kada)	Severely crushed / unrecognisable	Engraved silver bracelet with two names	Spouse (missing person report)	Identity confirmed; body released
2	Personal belonging (spectacles)	Partial skeletonisation (2 weeks)	Thick-lensed framed spectacles near skull	Family members	Confirmed; osteological findings corroborated age and sex
3	Tattoo (name + address)	Injured; disoriented; alive	Name, husband's name, residential address on forearm	Police + family	Family located; patient reunited
4	Clothing (torn shirt)	Skeletonisation with disarticulation	Distinctive checked shirt adherent to soft tissue	CCTV footage + family	Identity confirmed; postmortem interval established
5	Tattoo (personal name)	Decapitation; head crushed	Name tattooed on upper right forearm	Family members	Confirmed via tattoo + location evidence
6	Cultural marker (circumcision + grooming)	Intact; unidentified migrant	Circumcised genitalia; trimmed beard with moustache	Religious scholar + family (post-burial)	Culturally appropriate burial; identity later confirmed

CASE 1





CASE 2



CASE 3



CASE 4



CASE 5



Case 6



