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NAIL INJURIES MARK ON HUMAN SKIN : A REVIEW

Forensic Science

Kavita Dwivedi Research scholar,Department of Forensic Science,SHUATS,Allahabad, Utter Pradesh, India

Lav Kesharwani* Assistant Professor, Department of Forensic Science,SHUATS,Allahabad, Utter Pradesh, India *Corresponding Author

ABSTRACT

Human identification is the mainstay of civilization. Crime recognition by nail marks pattern is new. Nail marks may be found at number of crime scenes. Nail injuries marks by human is one of the complicated and demanding part of forensic medicine. The individuality of human identification allows the (forensic experts) to reach to strong opinion of association in cases of identification and nail injuries analysis. In the cases of physical assault having nail injuries the anatomy and physiology of skin and the position of victim affect the detail and the shape of nail injuries mark. Nail injuries marks have the level of forensic value necessary to identify just one individual. Advanced techniques using digital overlays have been suggested. The issues with in the nail mark analysis are discussed in the paper.

KEYWORDS

Assault, Injuries, Nail Marks, Nail Abrasions,

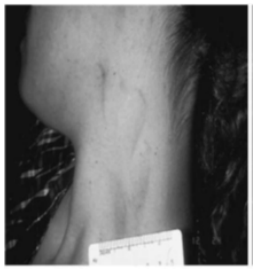
1. Introduction

The skin is one of the largest organs of the human body (Goldsmith 1990)[4]. The total body surface of the skin varies from 0.2 m 2 in a full-term newborn to around 2 m 2 in an adult (Patient.co.uk 2007).[2] The skin weighs about 15% of the total body weight. It is also the most accessible organ of the human being and plays an important role in the communication between human beings. It is soft to allow movement, but tough enough to resist breaking or tearing. It varies in texture and thickness from one part of the body to the next. It consists of two main layers .The epidermis - The epidermis is the compact, firm, and elastic outer layer of the skin. The epidermis protects the body against external in fluences. Because of its elasticity, the epidermis is not easily damaged in blunt-force trauma or crushing (Langlois andGresham 1991) [5].The dermis ,which is composed of three types of tissue that are present throughout the dermis: collagen, elastic tissue, and reticular fibers.The epidermis refers to the surface layer and is made of several sheets of skin cells. The dermis lies underneath and consists of elastic fibres (elastin), for suppleness, and protein fibres (collagen) for strength. Sebaceous glands, hair follicles, nerves and blood vessels are found in the dermis.

Forensic Onychology (Greek word, Onuks = nail, Logia = study of) is the subject which deals with study of fingernails and toenails for better administration of justice in the court of law. Nails are important tissues for human identification, employing morphological traits as well as bio-molecular information for individualization or direct comparison.[21]An injury is define as any harm, whatever illegally caused to any person in body, mind, reputation or property as per Indian Panel Code (Sec. 44). In forensic science, the injuries/wounds are produced by physical violence, which break of the natural continuity of any of the tissues of the living body. Trauma is explained as an injury to the body caused by physical, mechanical or chemical factors, which may result in wounds or possible complications. The medical purposes, violence refers to either behaviour that result in injury or to the injury itself. This violence may result in both psychological and physical trauma[22]. The two broad categories of skin wounds include abrasions and incised wounds. Abrasion is defined as a superficial injury on superficial layers of epithelium or on mucus membrane, caused by a hard blunt and rough object. It is frictional injury. This type of wound damages only the epidermis (uppermost skin layer), and should not therefore bleed. However, abrasions do usually extend into the dermis causing slight bleeding. Abrasions are commonly caused by a 'glancing' impact across the surface of the skin, but if the force is directed vertically down onto the skin surface it may be termed a 'crush' injury. These wounds are seen where an object has struck the skin (eg a blow from a fist), or where the injured person has fallen onto a rough surface, such as Skin abrasion being very superficial in nature, is always treated as simple in nature. On many occasions, forensic pathologists as well as the casualty medical officers give least importance to skin abrasions as those are seldom responsible for causing death. We are reporting a case wherein the victim of a road traffic accident died due to complication of one small skin abrasion. Skin abrasions is almost always treated as simple in nature because they do not bleed much and heals easily within few days even without any treatment. It is a fact that no one will like to seek medical/surgical aid for an abrasion unless it is large in size or causing pain. The clinician also may not feel it necessary to give antibiotic cover and vaccination against tetanus to patients having a small abrasion, unless complicated. Most of the forensic pathologists do not document each and every abrasion (except nail scratch abrasion resulting from throttling or forceful sexual assault) when those are too many or very few in number as those are not responsible for the fatality[10]. Violence is a leading cause of preventable injury world wide. Violence has physical , phychological, social and economic impacts. Sexual violence has a profound impact on physical and mental health. As well as causing physical injury it is associated with an increased risk of range of sexual and reproductive health problems with both immediate and long term consequences. Death following sexual violence may be as result of suicide. But now pattern of crime has been changed by many ways. As now crime is done to hide another crime. Sexual violence apart from being a dehumanizing act is an unlawful intrusion on the right of privacy and sanctity of female. It is serious blow to her supreme honor and offends her supreme honor and offends her self-esteem and dignity. It degrades and humiliates the victim and where the victim is help less innocent child or minor, it leaves behind a traumatic experience. When sexual assault is alleged, the presence of bruising on the victim may help support the victim's account and give an indication of the degree of violence that was used. For example- grip marks or “defense” injuries may be present on the upper arms and forearms, whereas bruising on the thighs and the inner sides of the knees may occur as the victim's legs are forcibly pulled apart.

Nail marks plays an important role in personal identification in forensic case works. Nail marks can be recorded in violent crimes such as sexual violence, child abuse cases. The arrangement of human nail injury pattern are individuals. Fingernail marks are superficially incised curvilinear abrasions, occurring singly or in sets. [3]

In rare cases, all four fingers will mark the skin in a single pattern. Fingernail marks are rarely associated with the assailant's hands, but commonly associated with the victim's own fingers, as she struggles to pry the assailant's grasp off her neck. (Fig-01)



Finger touch pad contusions are caused by the assailant's grasp. The thumb generates more pressure than the other fingers, so singular thumb impression contusions are found more often than contusions showing the complete hand grasp.

Ligature abrasions follow a predictable pattern of horizontal circumscription about the neck; distinguishable from the marks left by suicidal hanging, where a suspension point causes the ligature furrow to rise toward one ear. The scene investigation may be useful in identifying strangulation assaults, based on blood spatter and ligatures. Rarely, the latent fingerprints of the assailant may be recovered from the skin of the victim's neck of research interest, it may be possible to actually recover the assailant's skin cells from the victim's injured neck, and DNA-type the recovered cells to the suspect. Nail abrasions caused by the victim are usually found horizontally placed, where as those caused by the assailant fingernails are often vertically/obliquely placed. The nail abrasions caused by the fingernails of the assailant often do not correspond to their shape i.e. cresentic. (seeFig-02&03)




The ability to appropriately assess, document, and interpret injuries that have been sustained is a key part of the work of any forensic physician or forensic pathologist. Crimes of violence are increasing throughout the world. Nonjudicial assault, such as torture, has also become more widely recognized. It has been suggested that the definition of physical injury in the forensic medical context should be "damage to any part of the body due to the deliberate or accidental application of mechanical or other traumatic agent". Mechanism of Mechanical Injuries- These are injuries which follow the principles of mechanics Caused by either moving object or weapon (Counterforce is inertia of the body) or movement of the body itself (Counter-force I rigidity of the surface. Impact Energy transferred to tissue. Some energy spent in moving of body Causes compression / traction strain or combination, on the tissue Shearing strain produced Causes Force alteration of shape of tissue. Biomechanical properties of tissue- Different tissues have different strengths and weaknesses -skin is elastic and more resistant than underlying tissues (Bruise > Laceration). -blood vessels more resistant to compression than stretching. -bone more resistant to bending than to torsion. -hollow or fluid-filled organs sensitive to compression. -brain (semi-fluid) more resistant to direct impact than rotational impact (--> shearing of nerve fibres). -bone and joint may transmit force to a weak point.[3].Finger touch pad contusions are caused by the assailant's grasp. The thumb generates more pressure than the other fingers, so singular thumb impression contusions are found more often than contusions showing the complete hand grasp. Ligature abrasions follow a predictable pattern of horizontal circumscription about the neck. The common scenario for homicidal strangulation is that the individual is found dead, often reported by the assailant, with a vague history of substance abuse or depression. There being no externally-evident injury, the body is taken for autopsy with a suspicion of drug overdose, and the injury of strangulation is not found until the neck dissection is carried out at autopsy, ordinarily at the end of the case. Therefore, photographs and trace evidence collections are not made[16]

1. Methodology

A literature search of journal articles and academic texts detailing finger nail marks injuries were undertaken to provide an overview of research in the disciplines of forensic medicine, forensic pathology, forensic jurisprudence and forensic anthropology.[10,21] Papers were distributed into key areas :(forensic medicine and documenting assault data) and clinical medicine (literature documenting hospital and medical colleges studies that had some inclusion of victim individuals. Victims were defined as individuals who have been assaulted , usually very soon after the incident or later following complications from those injuries for the purpose of this review, only studies addressing victim individuals were included.

2. Result and discussion

The problem of sexual violence against women and female children is very serious and vast in nature. Due to the complexities related to commission of crime, criminal investigation and varied nature of various criminal acts it cannot be possible to describe every related aspect in depth. A medical officer rendering his services in a government setup mainly in remote and rural areas has to perform administrative and clinical work in addition to examination of such and other medico-legal cases. Soft tissue injuries (contusion abrasion, laceration) were the most common type of injuries seen in both assault and self harm victims. Assault cases were deals in casualty department for primary treatment purpose, doing medico-legal work and for certification purpose. The injury certificate is issued on the request of investigating police officials and it will be important evidence in court of law.[21] Assessment and interpretation of injury depends on a good history, an appropriate physical examination and recording the findings contemporaneously, clearly, and unambiguously. Such documentation (whether notes, body charts, or computer records) may be reviewed by other doctors, legal advisers, and the courts. Based on the queries generally faced by casualty medical officer, the present work is aimed to study the medico-legal aspect of clinical medico-legal cases in casualty with special reference to assault cases[20]. Abrasion can be classified on 3 main basis-On the basis of shape/size, On the basis of pressure/ weapon, On the basis of observation.Abrasions are usually seen in accidents and assaults. Suicidal abrasions are rare. Abrasions have to be differentiated from erosion of skin produced by ants. Excoriations of the skin by excreta. Pressure sores. In manual strangulation, small, crescent-shaped abrasions caused by the fingernails of the victim or assailant may be the only signs visible on the neck. A victim resisting a sexual or other attack may claw at her assailant and leave linear parallel abrasions on the assailant's face. Some abrasions may be contaminated with foreign material, such as dirt or glass, which may have important medicolegal significance. The woman is carefully examined for evidence of recent injury, such as grazes, bruises and scratches and an estimate made of the timing of the injuries. Hair combings and cuttings are taken. Her injuries are described in writing and drawn with measurements on a body chart. Manner of injury may be known from its distribution: In throttling, curved abrasions due to finger-nails are found on the neck. In smothering, abrasions may be seen around the mouth and nose. In sexual assaults, abrasions may be found on the breasts, genitals, inside of the thighs and around the anus. Abrasions on the face or body of the assailant indicate a struggle.Nail abrasion phenomenon – Nail abrasion phenomenon is based on four main categories- Defensive phenomenon, Offensive phenomenon, Accidental phenomenon, 55Natural phenomenon. Biomechanical properties of tissue - Different tissues have different strengths and weaknesses -skin is elastic and more resistant than underlying tissues (Bruise > Laceration). -blood vessels more resistant to compression than stretching. -bone more resistant to bending than to torsion. -hollow or fluid-filled organs sensitive to compression. -brain (semi-fluid) more resistant to direct impact than rotational impact (--> shearing of nerve fibres). -bone and joint may transmit force to a weak point preference of arms/hands and ventral trunk – sparing of areas very sensitive to pain such as lips, eyes or nipples – symmetry – no defence or fixing injuries – multiple superficial scratches or cuts – grouped and/or parallel injuries – signs of repeated self-inflicted injuries – lack of blunt trauma – lack of corresponding clothing defects.Injuries simulating abrasion- Injuries those simulates abrasion are as follows,-Dermatitis, Exflorating dermatitis, Different skin disesase ,Derma erosion.

Keeping in consideration the need of analysis of nail injuries marks on human skin, there are few authors who have shared their thoughts and given their contribution in this related field which has briefly described below:-

Strasmann (1910) described common features of self-inflicted wounds intended to simulate a bodily crime such as superficiality and localisation at the anterior aspect. B. Karger (1997) proposed that self-inflicted injuries intended to simulate a criminal offence are reported. Typical characteristics of self-infliction such as superficiality, localisation at the anterior aspect, parallel course or avoidance of areas with high sensitivity to pain are substantiated by most of the cases analysed. However, the majority of cases also comprised atypical features including large hematomas of the extremities, a gaping cut wound, lip laceration, hematoma of the eyelids, concussion of the brain, large burn injuries and signs of bonding. Therefore, atypical injuries, which are either found in isolation or in combination with typical injury patterns, cannot exclude self-infliction. Initially, most "victims" did not intend to report the matter to the police but the persons whose affection was to be obtained made the report. Psychopathological motivations are predominant but rational motives

such as attempted insurance fraud also occur. Perper JA and sobel MN(1981) found the clever solution to the problem of identifying fingernail markings was accomplished by means of forensic pathology and odontology. This approach was required to develop techniques for constructing the impression of the fingernail used in strangulation of a victim. The illustrations show how this rare type of evidence was processed so as to match the fingernails of the suspect to the marks on the skin of the victim's neck. Willot and Allard (1982; also, Allard, 1997) found that the probability of finding sperm from vaginal swabs declined substantially after 24 hours. Healey et al. (1998) proposed that Interventions with perpetrators based solely on individual models (e.g. psychotherapy, anger management or substance abuse treatment) have raised concerns that the interpersonal and cultural context of violence and its functional nature, is ignored, and that the violent and controlling behavior itself not directly confronted or addressed, and may even be exonerated, or tolerated until the perceived underlying problem is resolved. Anger management approaches may also implicitly ascribe responsibility for the violence to the victim. Walker (1999) studied that social factors such as acceptance of domestic violence, low social status of women, oppressive political structures, oppressive fundamental religious beliefs that devalue women, civil conflicts, and the existence of states of war continue contribute to the existing prevalence rates of domestic violence in other countries. Weiss (2000) studied that abusive relationships tend to follow a cyclical pattern. The changes between the various stages presented are subtle, and vary depending on the relationship and the nature of the abuse. In the beginning phase of the abusive relationship, some type of abuse occurs. This can be physical, sexual, or emotional, however, most often it is subtle and in the form of verbal insults or accusations. Tjaden & Thoennes (2000) studied that every year in America, between 1.5 and 3.6 million women are raped or physically, assaulted by an intimate partner. With multiple assaults per individual, adds up to approximately 4 to 6 trillion intimate partner physical and sexual assaults every year. Domestic violence is defined as rape, assault and stalking perpetuated by current and former dates, spouses 'and 'cohabitating patterns. Dean A Hawley et al. (2001) discussed about 300 cases of alleged strangulation assault, submitted for misdemeanor prosecution by the San Diego City Attorney's Office, led to a search for medical evidence that would be useful to prosecute these cases. The injuries identified in these non-fatal cases are similar to injuries found in fatal domestic violence strangulation assaults. Strack GB et al. (2001) also discussed about three hundred strangulation cases, submitted for misdemeanor prosecution to the San Diego City Attorney's Office, were evaluated to determine the signs and symptoms of attempted strangulation that could be used to corroborate the victim's allegation of being "choked" for purposes of prosecution. The study reveals that a lack of training may have caused police and prosecutors to overlook symptoms of strangulation or to rely too heavily on the visible signs of strangulation. Because most victims of strangulation had no visible injuries or their injuries were too minor to photograph, opportunities for higher level criminal prosecution were missed.[15]Moore E et al. (2002) found that 38% of individuals have DNA from someone other than themselves under their fingernails and several cases submitted to the FSS have produced a DNA match between the complainant and the assailant from the material recovered from the fingernails. Therefore, fingernail samples should be obtained from the complainant if the circumstances of the offense suggest that trace material may be present; for example, if there has been a struggle or if the details of the assault are uncertain and the forensic practitioner, in observing the complainant's hands, notices material of interest under or on the surface of the nails. They should also be considered if a fingernail broke during the offense and the broken section may be recovered from the scene. Sugar et al. (2004) studied that genital injury findings were more likely when there was physical or verbal resistance, when there was rectal penetration, when there were nongenital injuries, when victims were post-menopausal and when the examination took place within 24 hours of the assault.[17].Walker et al. (2005) studied that the prevalence of sexual victimization, it is shown that although more females are sexually victimized than males, the rate of sexual assault amongst males is still a notable problem. However, very few male rapes or sexual assaults appear on police files or other official records, due to the fact that only a minority of male victims ever report their assault to the authorities. Dr. S. Khaja, et al. (2007) observed that autopsy surgeons, often observed that the nail abrasions produced over the neck of victims in manual strangulation are almost straight and do not resemble the shape of nails, which are semi-circular/cresentic. A study is undertaken to know the reason for the same. During the study it is observed that the skin gets stretched while the assailant is applying pressure and only then nails produce indentations. Once the pressure is removed the stretched skin reverts back to its original position. Thus the semicircular indentations caused over the stretched skin appear straight after the skin regains its original position[18]. K Nagarja Rao (2008) discussed about the case series of self-injurious behavior (SIB) encountered in a General Hospital setting has been described. Limitations of current definition of SIB are explained. SIB is not a single clinical entity and it occurs in various psychiatric syndromes with wide range of psychopathology. Based on clinical criteria, a classification of SIB into three groups has been proposed viz 1) Mild and isolated form, 2) Moderately severe and repetitive form, and 3) Very severe and isolated form. Psychodynamic, cognitive and neurochemical explanations of SIB have been reviewed. Frustration, aggression and impulsivity appearing in helpless situation appear to be a common script across most of these models of explanations. Severity of injury seems to be determined by severity of psychopathology. Site of injury appear to have symbolic significance for a particular patient. Understanding some of these clinic psychopathological issues helps in management of these cases. Dr S. S. Sandhu(2009) proposed that mechanical injuries in form of abrasions are important injuries present in various types of police informed as well as medico-legal cases such as accidents and assault cases. Color of abrasions and its other associated features gives us clue about the approximate range of time since accident or assault. In this study, injured person coming/brought to the emergency wing for medico-legal examination were studied for changes in appearance with passage of time. Gingras et al. (2009) found the probability of finding DNA evidence dropped dramatically two days after the assault.Krohn et al. (2010) concluded that with the requisite technical background knowledge, injuries can be photographically recorded to forensic standards during patient care. The importance of clinical forensic examination has been demonstrated in numerous publications. By the time these examinations take place, however, the injuries will usually already have been attended to as avoiding detrimental health outcomes for the patient has priority. Also, a lot of forensic assessments of injuries and their possible consequences are done on reviewing the clinical and, if available, radiological documentation in the patient's record.Boisclair et al.(2010) studied that, although jewellery-related injuries are relatively infrequent, some can cause severe injuries that could compromise patients' health. As a primary prevention strategy, doctors and health professionals working with children should make parents and caregivers aware of the possibility of trauma in children wearing or playing with jewellery, especially in the zero- to four-year-old group requiring closer supervision. Specific anticipatory guidance concerning piercing may be helpful to adolescents. Mukesh sharma et al. (2011) proposed that penetrating injuries of the body are most commonly the result of injury/wounds and are often associated with a range of potentially life threatening injuries. In every physical assault, no matter it led to death or not, the attacker had produced/left different types of marks in the victim's body that could be helpful to reconstruct the crime scene and guide to determine the cause of death. In the present study, we have demonstrated some examples of injuries/wounds found of the victim's body with illustrative photos. These provide a proper and useful data for the forensic crime scene investigators. Saurabh Chattopadhyay and Biswajit Sukul (2012) examined that defence wounds in homicidal victims is of immense importance to the autopsy surgeon. Based on the presence of such injuries it can be opined that the victim was conscious, could comprehend the attack and provided resistance during the assault. The type of injury sustained also gives an idea regarding the weapon of offence. Out of the 189 homicidal deaths during the 5-year period of study, defence wounds were noted in 90 cases. Most of the wounds were sustained by males in the age group of 30–44 years. Incised wounds (52.2%) were the most common type of defence wounds followed by chop wounds and abrasions. In 70% of cases the injuries were on one side of the body, the left side being more common. The forearm and the hand were the most affected parts. A careful and thorough examination is necessary to rule out fabricated wounds being misinterpreted as defence wounds. Pragnesh Parmar (2012) introduced that Forensic Onychology is the subject which deals with study of fingernails and toenails for better administration of justice in the court of law. Identification means determination of individuality of a person. Nails are important tissues for human identification. One of the major advantages of utilizing nail is that, in comparison with other tissues, sample size and sampling process can be considered relatively non invasive and non destructive and yet each nail retains a discrete record of detailed information on genetic inheritance, drug use, pathology, diet and location history as well as exposure to explosives residues or other pollutants. In contrast to soft tissues, nails survive relatively well in the decomposition

environment.[21] Shrikant Sidram Shinge (2013) proposed that Sexual offences are the most heinous crimes against women. During examination of an accused of alleged sexual assault preservation of evidences is an important task. In India, owing to poor collection of medical evidences, conviction rate of accused is low. This study aims at recording results of medical examination and knowing injury patterns of alleged sexual assault accused along with preserving proper medico-legal evidence. We concluded that most of the accused were young unmarried males from the age group 21-30 years. Fifty six percent accused were friend and 29.2% were known to the victim. Only about a fifth of them were presented for examination on the day of incident itself and none of them had evidence of any struggle injuries. D M Twomey et al. (2014) discussed about the abrasion injuries result in damage only to the surface layer of skin and can result in player discomfort and changes in performance. The perceived fear of abrasion injuries on artificial turf playing surfaces has significantly affected the adoption of these surfaces, particularly in sports that involve frequent player-surface interactions. The underreporting of abrasion injuries due to how time-loss injuries are defined and the lack of validity of the current abrasion measurement device highlight the need for more research to understand fully the incidence and nature of abrasions on artificial turf playing surfaces and the effect of these injuries on playing behaviour. Improved reporting of abrasion injuries and a more biofidelic test device could assist in both the development of abrasion-related injury prevention strategies and in dispelling players' negative perceptions of abrasions on artificial turf. Zawa S et al. (2015) observed that cortisol level in fingernails may reflect the hormone's cumulative production over a long period, but the notions have not been fully established. In this study, we investigated the association of cortisol in fingernails with cortisol accumulation over a long period (hair cortisol) and over a relatively short period (salivary cortisol). The cortisol level in fingernail samples may be useful in the investigation of the link between psychosocial stress and health.[24] H. R. Thube et al. (2015) studied that Assault was the main crime since long back from history. The present study was conducted in accident and emergency Department of Grant Medical College and Sir JJ Hospital located in south Mumbai over the period of two years from October 2011 to September 2013. Total 1288 cases of assault observed out of which 1100 were male (85.4%) and 188 were female (14.6%). The age group which was maximally affected in case of male and female was same i.e. 21-30 year. In males majority of injuries were simple in nature 803 (73%). While in females no grievous injury noted. Most commonly body part involved in assault was head face and neck 959 (47.92%). The commonest injury in male victim was lacerations 543 (49.4%).The weapon of assault in male victims was hard and blunt object in maximum 51.4% while in females 45.2% were body parts such as fist and kicks. Out of 272 grievous injuries the 31.2% injuries were caused by hard and blunt weapons. Thorough examination and interpretation of injury is of vital medico-legal importance and plays crucial role for judiciary to deal with interpersonal violence.[25]

3. Conclusion

This review demonstrates that literature providing the level of nail injuries mark pattern detail a forensic medicine expert requires in order to provide an interpretation of the victims of assault cases. As according to locards principle when two things correlate exchange of matter takes place. The positive confirmation of crime using unique traits and characteristics of the nail injuries mark is the cornerstone of forensic science. One of the most intriguing complex and sometimes controversial challenges in forensic medicine is the recognition, interpretation, collection and preservation of nail injury marks pattern and their correlation with crime. Nail injury mark distortion through skin elasticity and anatomical location and body positioning is recurring problem.

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