Forensic Science

Forensic science in criminal investigation and trials is mainly concerned with materials and indirectly through materials with men, places and time.

Materials are identified and compared with the process of forensic science. They established the presence or absence of a link between the crime, the criminal, the victim, the place and the time of occurrence.

When a crime has been committed and evidence is collected at the scene, scientists analyze it, arrive at scientific results and give expert court testimony about their findings.

Forensic science can be used to:

- Prove elements of a crime
- Verify or discredit victim or suspect statements
- Identify decedents or suspects
- Establish a connection to a crime or crime scene

Need of forensic Science

There is urgent and widespread need for the application of forensic science in the criminal justice delivery system. The present day scenario of crime Investigation and prosecution of criminals, in India is a sad sight. A large percentage of the trials, in heinous crimes ultimately, end in acquittals.

The need for the application of science in the dissemination of justice is pressing. Many factors, including the following are responsible for the same.

1. Social Change
2. Anonymity
3. Technical Knowledge
4. Wide Field
5. Better Evidence
6. Alternatives

In a nutshell, forensic science has become indispensable in the dissemination of justice because of the failure of the old order, reliability of its tools and techniques and the ever-availability of the wherewithals of its assistance. It has to be utilised on a much larger scale that it is being used in our criminal justice system today, if it is to serve society effectively.

Functions

Forensic science provide answer to the following question:

Has a crime committed?

Consider the case of the recovery of a dead body that could be natural accidental or it could be homicidal forensic science by asserting the nature of death establishes the existence or absence of Corpus Delhi seat it is true for non death crime also

How and when was the crime committed?

The examination of the Corpus Delicti, the evidentiary clues and of the scene of crime can possibly indicate the modus operandi and the time when it was committed.

Who committed the crime?

Forensic science established The Identity of the culprit through: personal clues like fingerprint, footprints, blood drops, hair and the like.

Objects left by him at the scene and with the victim or carried from the seen and from the victim.

Further, Forensic science help the criminal justice system:

1. Provide leads to the investigation.
2. Establishes whether the scene is real or fake.
3. Locates hidden clues, correct clues, and also proper samples for comparison.
4. Establishes sequence of events.
5. Verify is the prosecution version the defence version and find the correct version. Saves the innocent accused by de-linking him with the clues, with the victim or with the scene of crime.
6. Identify the victim in cases of putrefaction or mutilation of the body.
7. Identifies the correct crime weapon.

Principles

The laws and principles of all the sciences from the base of forensic science. In addition, it has developed its own principles.

Laws of individuality

Every object, natural or man-made, has an individuality, which is not duplicated in any other object. It is unique. Neither the nature has duplicated itself, nor men can.

The law of individuality is of fundamental importance in forensic science Anything and everything involved in a crime, has individuality. Thus the culprit is unique, his modus operandi is unique, his weapon of offence is unique, scene of crime is unique, evidentiary clues, left over or picked up by the culprit, are unique. We have just to identify the uniqueness to link the crime with the criminal.

Principal of Exchange

'Whenever two entities come in contact, their is exchange of traces mutually'. This is the principal or law of exchange. The French scientist, at Edmond Locard, first enunciated it. It is also known as Locard's principle.

According to the principle, when the criminal and/ for his instrument of crime come in contact with the victim or the objects surrounding him, they leave traces. Likewise, the criminals and/or his instrument pick up traces from the same contact. Thus, a mutual exchange of traces takes place between the criminal, the victim and the object involved in the crime.

Law of Progressive Change

'Everything changes with the passage of time'

In other words nothing is permanent-immutable or invariable. The rate of change varies tremendously with different objects.

The impact of the law on forensic science is immense.

The criminals undergo progressive changes. If he is not apprehended in time, he become un recognizable except perhaps through his fingerprints, bone fractures or other characteristic of permanent like body fluids which contain body cells which have unique DNA profile.

Principles of Comparison

'Only the likes can be compared'

It is the principle of comparison. It emphasises the necessity of providing like samples and specimens for comparison.

Principles of Analysis

'The analysis can be no better than the sample analysed'.

Improper sampling and contamination render the best analysis useless. The principal emphasizes the necessity of correct sampling and correct packing for the effective use of experts.

Law of Probability

All identification, definite or indefinite, are made, consciously or and unconsciously, on the basis of probability.

Facts Do Not Lie

'Facts do not lie, man can and do'. Hence the importance of circumstantial evidence vis-a-vis oral evidence. The orall testimony of the witness is modified by auto-suggestion, external influence, suggestions, descriptions and opinions of other rationalization. Oral evidence, therefore, is coloured, whereas material evidence is free from these infirmities.

Forensic Toxicology

Forensic Toxicology is the study of the presence of toxic substance inside a body and the effect that they had on the individual. It encompasses methods and procedures from various disciplines such as analytical and clinical chemistry, and pharmacology to aid in the medical and legal investigation of death due to poisoning or drugs. This branch of forensic science is of prime importance in road accidents, poisoning, and sexual violence.

Forensic Chemistry

Forensic chemists analyze non-biological trace evidence found at crime scenes in order to identify unknown materials and match samples to known substances. They also analyze drugs/controlled substances taken from scenes and people in order to identify and sometimes quantify these materials.

Forensic Toxicology

Forensic toxicology is the use of toxicology and disciplines such as analytical chemistry, pharmacology and clinical chemistry to aid medical or legal investigation of death, poisoning, and drug use.

Difference between Forensic Toxicology and Forensic Chemistry

Forensic Chemistry relates to the identification of a chemical substance submitted and results applied to the court of law. Forensic Toxicology relates to the identification of the chemical found in the biological fluid from the body or breath and applied to the court of law. Forensic chemistry is the application of chemistry and its subfield, forensic toxicology, in a legal setting.

Importance of Forensic Toxicology

As part of a team investigating a crime, a forensic toxicologist will isolate and identify any substances in the body that may have contributed to the crime, such as: Alcohol. Illegal or prescription drugs.

Types of Toxicology

1. Analytical toxicology,
2. Applied toxicology,
3. Clinical toxicology,
4. Veterinary toxicology,
5. Forensic toxicology,
6. Environment toxicology, and
7. Industrial toxicology.

Divisions of Forensic Toxicology

1. Analytical Toxicology,
2. Urinalysis,
3. Drink,
4. Drug Driving, and
5. Hair Drug Testing

Disciplines of Forensic Toxicology

The field of forensic toxicology involves three main sub-disciplines:

1. postmortem forensic toxicology.
2. human performance toxicology, and
3. forensic drug testing.

All of these sub-disciplines measure substances in biological matrices for a given purpose.

Finger Prints

The identification of criminal through fingerprints was the first important breakthrough in the scientific investigation of crime. As usual, the Judiciary and the public word took some time to believe in the utility of fingerprint as a scientific aid. The same is now recognized throughout the world.

The fingerprints as evidence are important because of the following features of the fingerprint

they are unique

- they are permanent
- they are universal
- they are inimitable
- they are classiffiable
- they are frequently available in crime situations, as a evidence

Nature

Palmar surfaces of the hands and of the soles of the feet have friction ridges. The ridges are the raised portions of skin between furrows on either side. They are also known as papillary or epidermal ridges. The ridges flows in various directions giving rise to innumerable patterns.

The richest have small pores, which exude perspiration. It is spread all over the surface. The evaporation of the perspiration concentrates its non-volatile constituents, notably, the common salt, fats and the albumins. Whenever the epidermis comes in contact with a surface, they are left thereon in small quantities. The deposits take the pattern of the ridges. The mark is latent letter due to a visible print. The rough and the fibrous surfaces do not give decipherable patterns. The

prints are visible when the surface of the hand is smeared with colored powder or liquids. The mark may be distinct impression if the receiving surface is pliable such as butter, dust, putty, wet paint, mud, wet clay, kneaded flour, any semi-solid substance or warm wax.

Classification

1. Arches
2. Loops
3. Whorls
4. Composites
5. Accidentals
6. Individuality features

Location

1. Reconstruct
2. Leave
3. Preserves
4. Avoid Inhaling
5. Photographs
6. Routes
7. Vehicles

Scene of Occurrence

1. Bathrooms
2. Utensils
3. Leftover Objects
4. Documents
5. Dead Bodies
6. Search

Firearms

The use of firearm in criminal offences is of frequent occurrence. In fact the figure prominently in most of the heaviest crimes like murders, dacoities, robberies, assassinations and mob violence and also in police encounters and firings. The firearm evidence, therefore, is important in criminal investigation and trials.

It is however, necessary that the link between the evidence and the culprit is properly established. The firearm recovered from the culprit, which fired the fatal bullet or the cartridge case recovered from the scene, should be proved to be in the possession of the accused at the time when the crime was commited.

The firearm evidence helps to:

1. Decide whether the given incidence is a case of murder, accident, killing in self defence or suicide.
2. Determine the sequence of events.
3. Verify versions.
4. Established the number of directions, directions, ranges and the number of firearms.
5. Distinguish between real and fake incidence.
6. Assertion whether the injury fatal or nonfatal.

Nature

A firearm is device to hurl a projectile or projectiles. The force is supplied by the creation and expansion of gases usually from the burning of powder charge. In air Rifles and pistols the motive force is given to projectiles by the expansion of compressed air.

According to Indian arms act, of firearm means arm of any description, designed or adapted to discharge a projectile or projectiles of any kind by the action of any explosive or other forms of energy and includes:

1. Artillery, hand grenades, riot pistols or weapons of any kind designed or adapted for the discharge of any noxious liquid, gas or other such things.
2. Accessories for any such firearms designed or adapted to diminish the noise or flash caused by the firing thereof.

3. Part of the and machinery for manufacturing fire are and cut platform and appliances for mounting transporting and servicing artillery.

Those firearms which can be easily handled, carried and operated by a single person are called ‘small arms’. They include hand guns, (pistols and revolvers) which are fired from the shoulder arms which are fired from the shoulders (shotguns, rifle and muskets) and other firearm like machine and submachine guns. The letter are automatic and fire a large number of rounds in a short time.

The firearms which are commonly met with, in crime situations, in India are:

1. Shotguns
2. Pistols
3. Revolvers

5. Rifles
6. Sub-machineguns
7. Machine guns
8. Muzzle Loaders
9. Improvised firearms.

There are ample variations of the firearms in each category.

The most commonly used weapon are 12 bore shotguns and improvised firearms.

Hand Writing

Handwriting is an individual characteristic. This means that handwriting is unique for each person. Each person has their own style. Handwriting analysts say that people could have a few writing characteristics that are the same but the likelihood of having any more than that is impossible.

Identification of handwriting is the most important branch of questioned documents. The following types of identification are required:

Signature

Are the signatures genuine or forged?
Are the signatures in the hand of the victim?
Are the signatures in the hand of the suspect?
Are the signature traced?
Are the signature disguised?
Are the signature transplanted?

Holograph

The document written and signed by one person is called a holograph. The question asked are:

Is the document a holograph

Is it written by the suspect or by the victim?

Anonymous letters

The questions asked about the anonymous or pseudonymous letters are:

Where has the letter emanated from?

What is the occupation of the writer?

What is the educational calibre of the water?

Alterations

Where the changes made at the time of writing the document or were they made later?

Are the changes in the hand of original writer?

Are the changes in the hand of the suspect or in the hand of the victim?

Figures and mark

Figures, hand printing, block lettering, marks may be the questioned writing in some cases.

Typescript

Problems of typewritten questioned documents are equally varied:

Is the given document typed on a particular typewriter?

Is the given document typed on a particular typewriter?

What is the make and model of typewriter?

Was the document typed on one or more than one typewriters?

Are there any additions, alterations or substitutions to the original text?

Writing Materials

In the writing of a document, paper, ink, pen, pencil, blotting paper, carbon paper and erasers are used. Sometimes the materials prove useful.

Mechanical Match

The comparison of seals, stamps, punches, torn papers pieces, carbon copies, printing blocks, perforations, stubs, water marks, punched numbers, embossed marks and trade marks is sometimes required. It involves techniques and principles which are used in the examination of tool marks and matching of broken and severed parts of various articles.

Burnt Documents

Burnt document require restoration of the writing. If currency notes are involved, it may be necessary to estimate the amount. If Currency notes are of one denomination only, it is easier to do it.

Miscellaneous

- **Erasures**
- **Indented writing**
- **Sequence of stroke**
- **Gum, adhesive and sealing wax**

Forensic Aspects of Arson and Explosion

An explosive is any substance which on receiving an impulse undergoes rapid changes – decomposes and emits energy in the form of pressure, light, heat, and confers kinetic energy to materials, including decomposition products, which come in contact with the expanding gases. The decomposition and conversion to other substance(s) is extremly rapid and self sustained.

Arson and explosion investigation is the process of analyzing the charring and chemical residue (if any is left) on the debris found at the crime scene to perform the following tasks:

- Determine whether the event was accidental or intentional.
- Identify relevant chemicals found at crime scene.
- Reconstruct how the arson or explosion was started.

Fire accelerants and explosive powders often evaporate within hours or days of the event. Investigators perform the following tasks at the crime scene:

- Locate the origin of the fire or explosion.
- In the case of fire, look for devices and containers used to ignite and/or spread the fire.
- In the case of explosion, look for detonating mechanism and use dogs or a vapor detector to find residue.
- Look for accidental causes as well as evidence of foul play.
- Make notes, draw sketches, and take photos of the evidence.
- Pack evidence in airtight containers to prevent evaporation of residues.

Classification

- According to Speed
  - Deflagrating Explosives
  - Detonating Explosives
- **According to Sensitivity**
  - Primary Explosives
  - Secondary Explosives
- **Industrial Explosives**
- **Water Explosives**
- **Explosive Emulsion**
- **Military Explosives**
- **Pyrotechnics**
- **Propellants**
- **Aerosol Explosive Mixture**
- **Nuclear Explosive**

DNA Testing

DNA stands for DNA stands for **deoxyribonucleic acid**, sometimes called "the **molecule of life**," as almost all organisms have their genetic material codified as DNA.

- It is the hereditary material found in all living organisms.
- It contains the genetic instructions for the development and functioning of an organism.
- These instructions are passed from one generation to the next generation.

DNA profiling is a **forensic** technique in **criminal** investigations, comparing **criminal** suspects' profiles to **DNA** evidence so as to assess the likelihood of their involvement in the crime. It is also used in parentage **testing**, to establish immigration eligibility, and in genealogical and medical research.

Steps in processing of DNA

The DNA testing process is comprised of **four main steps**, including extraction, quantitation, amplification, and capillary electrophoresis. How long does forensic.

DNA testing take 24-72 hours

Most genetic tests take 24-72 hours but the time taken for DNA to go from crime scene to identification can span as long as 14 days. By the time that the results are back, the suspects often have been released

Evidentiary Clue Materials

- Blood
- Bloodstains
- Semen
- Hair
- Saliva Stains
- Body Tissues and Organs
- Post-mortem samples
- Foetal materials
- Blood samples in paternity cases

- Liquid Blood
- Liquid blood at the scene

NARCO-ANALYSIS

Narco-analysis has become one of the most popular techniques of crime detection.

It is a kind of psychotherapy which is conducted on a person by inducing by bringing that individual into semi-sleep with the help of scientific drugs.

In this test, the subject's self-consciousness is allowed to sink down by making intrusion to his nervous system. In such a state an attempt is made to extract information in form of clues about the crime as under the influence of drugs it becomes extremely difficult for the subject to lie.

Narco-analysis is a form of psychotherapy and an effective aid to scientific interrogation. It is a process whereby a subject is put to sleep, or into a state of half consciousness by means of dosage of scientific drugs and then interrogated while in a reverie.

Procedure for the Narco Analysis Test

Drugs used for the tests are commonly known as Truth Serum. Generally, thedrug called "Barbiturates" or "Sodium Pentothal" is used for conducting narco-analysis test. It is also known by the name of "Penthol Sodium" or' Thiopental"or "Thiopentone".

Important things involved in the tests are:

(i) Video recording

(ii) Tape recorder

(iii) Disposable syringe

(iv) Distilled water

(v) Prescribed truth drug.

Every test is video graphed.

Dosage of Truth Serum

(i) The dose depends upon the suspect's sex, age, health and physical and mental condition.

(ii) In normal condition 3gm of Truth drugs of barbiturate class like sodium pentothal, sodium Amytal etc. is required for the test.

(iii) 3gm of the drug is dissolved in 3000ml of distilled water. When the mixture (solution) becomes ready it is administered intravenously along with 10% of dextrose on interval of 3 hours to the suspect accused.

Presence of Authorities

At the time of performing test, presence of following person is necessary:

(i) Physician

(ii) Neurologist

(iii) Cardiologist

(iv) Anesthetist

(v) Lawyer

In criminal justice system it is used for investigation purposes. Narco analysis test should be used only in the cases where large interest of society is involved. Narco analysis is usually used in cases of terrorism, crimes that are well organised, serial killings, in cases where no evidence is available etc.

There are two categories of -suspects who undergo Narco analysis test:

1. Where suspect willingly volunteers and co-operates with the interrogator.
2. Where suspect is forced to change the test under court orders.

The advantage of Narco analysis is that this technique is helpful in saving the innocents from prosecution and eliminating the use of third degree method. In addition, 45 it has been used as a time saving device in criminal cases with the help of Narco analysis by a trained and skilled psychiatrist.

Forensic Medicine

Forensic medicine deals with offenses against the person or patient. Practitioners of forensic medicine assist in medical-legal investigations by offering expert opinions to help legally authorized individuals understand the medical implications of pathological examinations, including postmortem examinations (autopsies) of bodies, tissues, organs, and laboratory specimens. They offer expert scientific opinions on the cause and time of death.

Clinical forensic medicine refers to that branch of medicine that involves an interaction among law, judiciary, and police officials, generally involving living persons.

Branches of Forensic Medicine

Forensic Pathology

Forensic pathology deals with the study of the cause and manner of death by examination of a dead body during the medico legal investigation of criminal law and civil law cases in some jurisdictions.

Clinical Forensic Medicine

Clinical forensic medicine refers to a branch of forensic medicine that involves an evaluation and interpretation of injuries and illness in living individuals.

Forensic Toxicology

Forensic toxicology is an interdisciplinary field applying the methods of analytical chemistry, pharmacology, and toxicology to the analysis and interpretation of drugs and chemicals in biological samples for legal purposes.

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Forensic Serology

Forensic serology, also known as Science of Forensic Material Evidence or Forensic Physical Evidence, is the application of biology to law enforcement.

Forensic Psychiatry

Forensic psychiatry involves both psychology and psychiatry science in relation to the law and legal system. It studies, evaluates, and identifies mentally-

Forensic Anthropology

Forensic anthropology is the application of the science of physical anthropology and human osteology (the study of the human skeleton) in criminal cases where the victim's remains are decomposed, burned, mutilated, or otherwise unrecognizable.

Medico-legal Evidence

A medical practitioner will have to frequently give medical evidence to prove the innocence or guilt of the accused, or to authenticate or disprove a criminal charge of assault, rape or murder brought against an individual. Medical evidence consists of doctor's report of the examination, reports of the chemical examiner and serologist, and the doctor's oral evidence.

Meaning

Medical evidence given before a Court of Law is of two forms –

- documentary
- oral

The documentary evidence is the evidence presented by the doctor, i.e.,

- a medical certificate including the physical and mental state of a person
- a medico-legal report
- a dying declaration

In the documented evidence, first the physical injuries are taken into consideration. In case of rape, more particularly ano-genital injuries as well as extra injuries (injuries on rest of the body) are examined properly. In other cases, only the victim is examined. In rape case, both the victim and the accused are examined. In case of victim, in the medical examination, age of the victim, marks of violence on the body, blood stains, virginity, depth of the injury, such factors are taken into consideration. The emotional state is also examined. The victim may be in depressive

or maniac state. The intellectual state of the victim may have been hampered. She may be suffering from illusions, hallucinations, sometimes her behavior may have become psychopathic.

The mental state of the accused is also examined. Because sometimes it may happen that the accused wants to prove himself as an insane person, which he may not be. He may be pretending to get exempted from the punishment.

The samples and specimens are collected from body or clothing, including –

1. Seminal fluids
2. Head hair, public hair
3. Blood examination
4. Debris
5. Bones

Purpose of Medico-legal Evidence

The purpose of Medico-legal evidence is to aid the investigation and prosecution of an accused. With the help of medico-legal evidence, in case of rape, it would be possible to determine whether a sexual activity occurred or not. The sexual assault or rape occurred or not can be understood with the help of medical examination only. When the accused is examined or when more than one suspect are examined, it becomes easy to identify the assailant. Though the law may not take into consideration how much resistance was there on the part of the victim. However, to understand whether the consent of the victim was given or not, the use of force of the accused or resistance by the victim can be established in the medico-legal evidence. More particularly, in case of drug related violence, the medical evidence can be used to indicate an inability to consent due to the influence of alcohol and drugs.

Types of cases labeled as Medico-legal

The following cases are to be considered as "medico-legal" and due police notifications in all these cases must be done. Where there is death /injury/debility/infirmity due to:

1. Poisoning
2. Injury with sharp object/fire-arms.
3. Tetanus.
4. Burns
5. Drowning
6. Death on the operation table or immediate postoperative death.
7. Death injury in a woman within 7 years of marriage.
8. Conditions which require notification as per the laws for the time being in force.
9. Any other conditions where there is a suspicion of some foul play.
10. Where the cause of death is not certain.

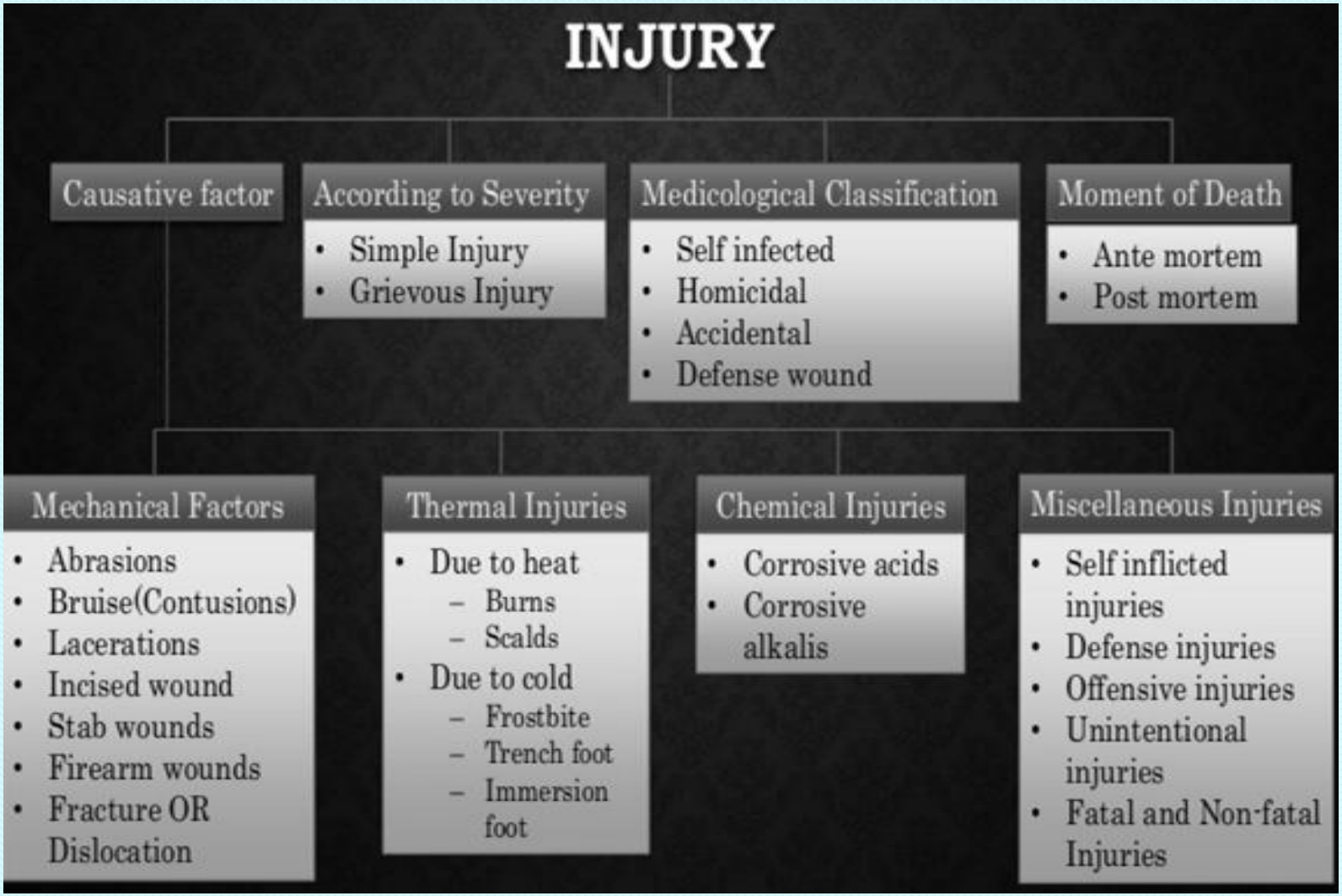
Wound

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 .

'Wound' and 'injury' are used interchangeably, and are used to describe tissue damage caused by;

- blunt force trauma (punching, kicking, beating, biting, being hit by a vehicle, falling from a height etc);
- sharp force trauma (stabbing etc);
- ballistic trauma (from firearms and blast trauma from explosives); and
- from another injurious agent, such as burns from electricity or chemicals etc.


INJURY
Causative factor
According to Severity
• Simple Injury
• Grievous Injury
Medicological Classification
• Self infected
• Homicidal
• Accidental
• Defense wound
Moment of Death
• Ante mortem
• Post mortem
Mechanical Factors
• Abrasions
• Bruise(Contusions)
• Lacerations
• Incised wound
• Stab wounds
• Firearm wounds
• Fracture OR Dislocation
Thermal Injuries
• Due to heat
– Burns
– Scalds
• Due to cold
– Frostbite
– Trench foot
– Immersion foot
Chemical Injuries
• Corrosive acids
• Corrosive alkalis
Miscellaneous Injuries
• Self inflicted injuries
• Defense injuries
• Offensive injuries
• Unintentional injuries
• Fatal and Non-fatal Injuries

In all injuries/ wound related cases the total number or wounds should be recorded and each would in carefully measured and it's characteristics described with photography. A blunt force injury comes from impact with a blunt object or something with no sharp edges.

Forensic expert determine the direction of impact, the type of object that caused it and how often the contact was made, often they're made by blows from a hammer or axe head. Bite marks are also a form of crushing wounds. With a knife or incised wounds the crime scene investigator must make a distinction between cut and stab or puncture wounds and among different types of piercing implements such as an ice pick or small knife. Most knives have a flat edge and a sharp edge which can be seen in the wound angels. Some wounds are defensive such as cuts made on the palms or fingers of a victim's hands. Some time cuts are associated with suicidal gestures are known as hesitation wounds as the person attempts to inflict self-damage.

As with all instances of a firearms offence that results in an injury, measurements are taken along with photographs to aid in the identification of the weapon used, it is necessary for a Forensic expert. Powder residue samples are taken and if the victim dies as a result of their gunshot wound, the round is removed for ballistic analysis from the corpse at the autopsy stage. The forensic scientists and investigating officer scour the crime scene looking not only for the weapon involved as they are sometimes disposed of but also for spent shell casings and/or loose rounds that were fired but did not hit their intended targets and imbedded themselves in nearby walls, doors or the ground.