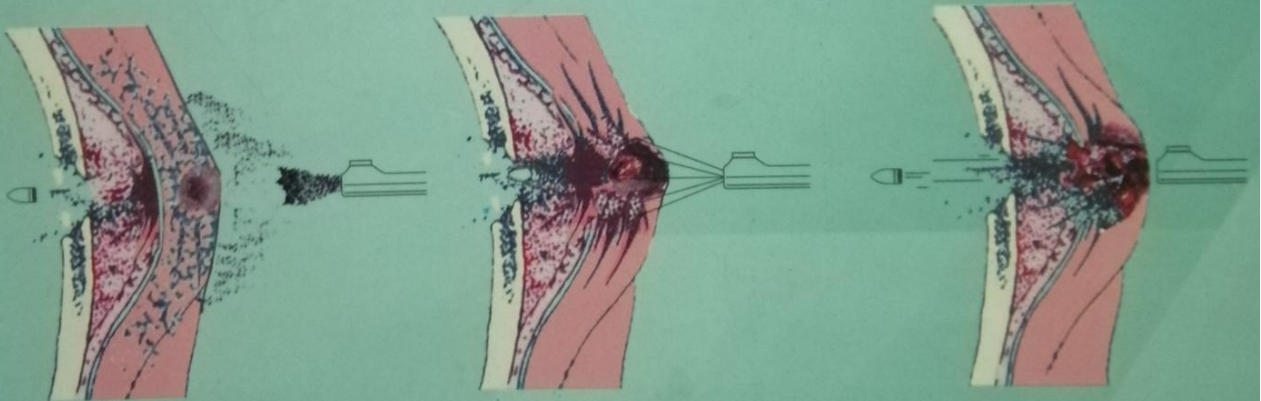


Second Edition

# Principles & Practice of Forensic Medicine



Nasib R. Awan

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## 1. Forensic Medicine

**System of selecting a subject** for professional medical practice after basic medical qualification did not exist during earliest period, because quantum of medical knowledge was limited and also public was not conscious about health and their rights. It was an era of simple medical graduates. He was responsible for all the needs of his patient i.e. medical examination prescribing/applying medicine, investigating illness if required and issuing medical certificate of health status for administrative purposes. Separate prescribed teaching syllabus of under-graduates of medicine and dentistry is modern concept and there are now many subjects, each having an epithet (name) for its recognitions.

**Naming subject started** during the course of medical practice, when medical knowledge was extremely limited and only one mother subject by the name “*medicine*” selected for all patient’s needs. After passage of reasonable time along with improvement in understanding of medical treatment and also appreciation of difference skills of application of medical treatment, a second mother subject by the name “*surgery*” got introduced. Further on at the various stages of advancement of medical knowledge about vital body systems and individual body organs, which continued to expand and properly understood, there arose the necessity of re-allocation of medical knowledge into separate and manageable compartments to grant them new epithets for each like “*Cardio-vascular medicine/surgery*” and “*Ophthalmology*”. Subjects have also been created and named uniting knowledge of two allied or related subjects adding adjective to one of them to identify their relationship like “*Pediatric medicine/surgery*” and “*Forensic medicine*”.

Besides naming another change in medical practice that has taking place is that initially all patient’s needs were the responsibility of medical practitioner holding basic medical qualification. He was all powerful. Specialization in specific subjects has completely revolutionized the situation. Defined specialists have come to take care of patients’ needs. Now we have treating physician, operating surgeon, investigating pathologist/radiologist and certifying medical examiner who hold specific medical qualification; in addition to basic medical

qualification. Standard of provision of medical treatment and certifications have much improved.

**Forensic Medicine**, also alternately called **Medical Jurisprudence** is the granted epithet. Forensic is for *Law*, Jurisprudence is for *philosophy of Law* and their addition with word *medicine* constructs the name, also indicating relationship between both subjects i.e. law and medicine. Both epithets are now considered synonymous and are interpreted to include identical matters. English and European named it as *forensic medicine* and *legal medicine* and Americans as *forensic pathology*.

Relationship of subject of Law and Medicine with administration of justice is very old, intimate and also unique. Both are learned and progressive since antiquity and have been serving human beings directly as “client” and “patient”, but separately within confines of respective environment i.e. Law Chamber and Hospital. While in professional relationship, both specialize on the problems brought by client and patient and try to find solution or remedy after knowing truth, a “**common goal**”. Achieving goal depends upon proper understanding of the problem, which some time may become difficult especially when it has arisen simultaneously from one experience. Example is a case of divorce in a court of law, where wife claims husband to be impotent and husband his wife suffering from veganism. It can easily be resolved by proper medical opinion/advice about state of health of both wife and husband. Both lawyer and medical practitioner thus should dependent on each other for sack of administration of justice. (Fig 1.1)

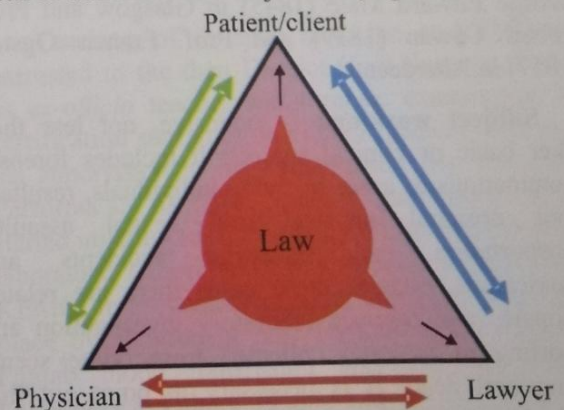


Fig 1.1: Law-Medicine relationship

As regards definition, importance and status of the subject of forensic medicine, it is defined as, “a **subject that deals with application of principles of medical knowledge to purposes of law and furthering of justice**”. Its importance is due to its public service necessity, which has since been acknowledged by law in connection with administration of justice. Status of forensic medicine in its own right as an independent subject of medical curriculum is because of exclusive prerogative of forensic certification, as no other branch of medicine teaches it. It is for this reason it has been included as

an essential and examination subject in syllabi of both Law and Medicine.

Graduates of both law and medicine learn this subject at their respective institutions and qualify university examinations to finally join professional practice. Rapid increase of knowledge in medicine is utilized by law enforcement agencies as well as courts of law to resolve complicated medico-legal issues. It has granted forensic medicine a pivotal position and it acts like a cross-road or bridge for interaction between both disciplines, where they update themselves. During professional life later, this relationship becomes unending. (Fig 1.2)

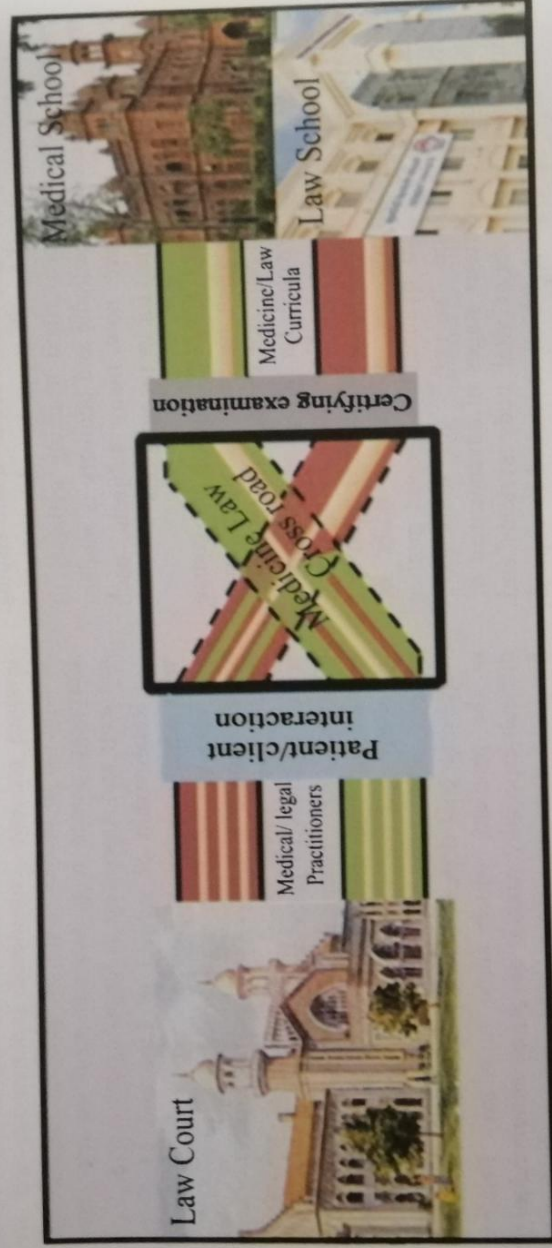


Fig 1.2: Law Medicine pathway

First Chair of Medical Jurisprudence and Medical Police was created with royal patronage in U.K. way back in 1807, followed by Prof. John Gordon Smith (1832). Other Chairs established later were Prof. George Edward Male (1845) in Glasgow and Prof. Robert Cowan (1839) and Prof. Francis Ogston (1857) in Aberdeen.

**Subject workload** is extensive, not less than other basic or clinical subject. It includes forensic examinations of cases of living individuals, resultant from criminal physical and sexual assaults, transportation and industrial accidents and intoxication. Besides these cases there are related autopsies and forensic laboratory investigation and reporting of material collected from crime scene, living and dead. It is necessary to point out that forensic examination and certification is a difficult

task of much higher responsibility than routine clinical examination, having its own specific approach, technique and procedure.

**General belief about forensic medicine** is merely a forensic aspect of medicine, requiring simple common sense for its interpretation is neither correct nor quit fit this pattern. Prof. Sidney Smith, University of Edinburgh (1928-1953) emphasized that medical knowledge and a stock of common sense are not sufficient themselves for understanding of medico-legal problems, which are presented to law enforcement agencies and law courts. They are of very specific nature and differ entirely from clinical cases with which practitioners of medicine have generally to deal with.

**Comparing clinical practice with forensic medicine practice** indicates that they differ in their

examination objectives. In medical practice, all facilities for medical treatment i.e. in and out-patients, investigating laboratory including radiology services are situated in the same building. Laboratory specimens are either sent to laboratory or technician from laboratory goes to the wards to collect them. Interest of both is same; to have results quickly with no chance of substitution except an error of labeling. In contrast, places for forensic examination including autopsy and collection of samples are situated miles apart from forensic laboratory. Further there are two opposing parties in a case and both desire and try to obtain forensic certificate in their favor. To achieve this objective, they may distort history of allegation and also make attempts to substitute or adulterate samples. Forensic Medical Examiner has to entertain *low threshold of suspicion*, while evaluating history of allegation, adopt necessary precautions during collection, packing and dispatch of samples to forensic laboratory and maintains *chain of custody* of forensic samples, following strictly legal dictates in this respect. (Table 1.1)

**Table 1.1:**

*Legal dictates for forensic medical examination*

- Only authorized medical examiner to undertake forensic medical examination
- Expressed written consent of examinee, a prerequisite
- Verification of examinee's personal identity essential
- Who, how much and to whom fee of medical examination paid be recorded for transparency
- On whose behalf i.e. examinee's, police or law court forensic medical examination undertaken
- Choice of sampling, its collection, preservation and dispatch to laboratory undertaken by medical examiner him-self or at least under his personal supervision
- All required investigations documented in medical certificate
- Samples collected in impervious glass containers and sealed before dispatch\*
- Ensures seals are intact at the time of receipt of samples in laboratory
- Before and after receipt samples kept in freezing temperature \*\*
- Processing of sample undertaken in turn without delay
- Results of investigation sent back to examining forensic medical examiner by name under sealed cover

\* To avoid addition or substitution

\*\* To prevent decomposition of biological material and eventually negative results

Another point of difference is that forensic practice unlike clinical practice extends beyond hospital into the premises of Court of Law in continuation of forensic certification to help furthering of justice. Nature of duties performed in hospital and Court of Law though are equally responsible, yet different in concept. During later stage, Forensic Medical Examiner has to on oath *present, interpret, authenticate and even justify* all recorded findings and opinion already expressed in medical certificate as factual and true. There is no such thing in clinical practice.

**Courses of studies** in forensic medicine for medical undergraduates traditionally contained pathologic-anatomy and forensic-toxicology. Prof. John Gradwohl, while accepting them as firm pillars did not agree to such a narrow definition. He pointed out that forensic medical examinations are concerned with medico-legal issues that are referred and contained in prescribed laws dealing with offences against the person or brought before the court of law for decision. He stressed that knowledge of related legislation, administrative regulations as they impinge upon medicine and other related basic matters about law courts, legal procedure and court evidence are also necessary.

Teaching of forensic medicine and practice of forensic certification along with related laboratory investigations for purposes of enforcement of law were introduced in Indian-subcontinent by English much later after its colonization. They also brought allopathic medicine, educational and judicial system and laid foundation of Lahore Medical College, later named King Edward Medical College (KEMC) in 1860 and eleven year later Punjab University in 1871.

Teaching of forensic medicine at KEMC was entrusted to the then District Civil Surgeon, Lahore as *ex-officio* teacher and forensic examination and certification started by his junior medical staff under his supervision at his office using two elementary Performa's. Modified partial laboratory system started utilizing service at Punjab Chemical Examiner laboratory, Lahore and a few teaching departments at KEMC. Improvement of inherited system has taken place by addition of new institutions like Director, Punjab blood transfusion and Forensic Science Laboratory at Lahore. (Table 1.2)

**Table 1.2:**

Name of institutions, places and allocated work

Name	Place	Allocated duty
Services introduced by English Punjab Chemical Examiner, Anatomist, Punjab government (Additional duty)	Lahore	Forensic Toxicology and semen analysis
Bacteriologist, Punjab government (Additional duty)	Prof of Anatomy, K.E. Medical College, Lahore	Forensic Anatomy
Entomologist, Punjab government (Additional duty)	Prof of Bacteriology, K.E. Medical College, Lahore	Forensic Bacteriology
Serologist, Federal government	Prof of Entomology College of Community Medicine, Lahore	Forensic Entomology
Services added after establishment of Pakistan	Karachi (now abolished)	Forensic Serology
Director Punjab blood transfusion	Lahore	Forensic Serology
Director Punjab forensic science laboratory	Lahore	Forensic toxicology, semen analysis and DNA testing

Above systems continued even after partition till 1995, when first independent Department of Forensic Medicine staffed by qualified specialists and technically equipped was established at KEMC, Lahore. Now all public and private sector medical colleges have departments of forensic medicine.

**Forensic medical certification** is important public duty undertaken for administration of justice through law enforcement agencies including police and law courts. It is an essential duty linked with related police station and court jurisdiction. This duty can neither be referred to other medical facility without permission of higher authorities nor its examination delayed at authorized center. Transportation outside to other medical facility is even inadvisable, because of chances for loss of vital evidence during transit, call of nature, cleansing of parts especially in sexual assaults. Further findings in trauma cases with lapse of time get masked due to onset of repair or infection in the injured part and decomposition of the corpse.

All Provincial Governments in the country are duty bound to provide these services at public sector hospitals from Rural Health Center to Tehsil, District and Tertiary Teaching Hospital like provision of treatment facilities for medical, surgical and other patients. But facilities provided in public sector hospitals are substandard and inadequate. Medical certification of living criminal trauma, intoxication, sexual assaults and related autopsies of dead are undertaken by most joiner general duty Medical Officers without specific training or qualification. Premises where work is undertaken lack basic logistics like examination/autopsy table, mortuary freezer for storing corpse and some places

especially in rural area or even without electricity and water supply.

Forensic medical certificate and its preparation are like issuing legal tender. It is a technical exercise requiring serial division of work for much detailer elucidation of findings during forensic examination, investigation, incorporation of results and additionally includes other related information surrounding the case. Findings both positive as well as negative should be documented for information of requesting forum i.e. administrative authority, law enforcement and law courts. Purpose of examination, on whose behalf it is performed and how much fee received are to be mentioned in the medical certificate for transparency.

Medical certificate should neither omit any finding nor include non-existent one. It is the most comprehensive document about state of health of the examinee whether healthy or diseased and is based exclusively upon medical facts observed during medical examination. Besides physical and mental status of examinee; other details such as description of worn clothes along with any change in them like torn or stained and other special characteristic such as trace evidence of hair in cloths are included in the medical certificate. Its preparation is both art and science requiring proper attention and concentration of mind. Medical procedures should be carried out with dignity, decorum and efficiency. Job requires neatness and precision and must reflect respect for human being, who may be a victim of physical aggression, sexual assault or even an accused and finally concluded with opinion of medical examiner at the time of examination. Beside, legal and moral considerations, duty may become arduous, while

examining decomposing dead and endangers safety of the workers.

**Scope of forensic medical certification** has not both been understood and appreciated, nor any worthwhile attention paid. It is adversely affecting administration of justice, which is an absolute necessity. What is recommended that architecturally-designed centers having **medico-legal clinic** for examination of living forensic cases, **forensic autopsy suite** for conduction of autopsies should be provided at medical facilities where such examinations are undertaken? Further, **laboratory system** at least one in each province for investigation of material collected from crime scene, living and dead victims should be established as centralized service.

**Forensic laboratory examination** is of diverse nature and requires elaborate services. Depending upon resources and expertise of country, two systems have been developed:

- **Full laboratory system**
- **Partial laboratory system**

*Full laboratory system* is superior to partial laboratory system being more efficient and provides services under one roof. Minimum divisions of moderate center are Forensic Biology, Toxicology and Histopathology. Highly developed center may have additional sections of Forensic Anatomy and Biochemistry. Further, there is additional advantage of coordination among specialists while certifying forensic findings in the consolidated form. Such an approach avoids both error and delay.

*Partial laboratory system* is rather an out dated concept, in which various working divisions are scattered in the province they serve.

Staff and equipment in both systems, of course, will depend upon type of services rendered, population served, crime index, proficiency standards, policy of storing of exhibits and general awareness of the public of their rights.

Building should have areas for registration and receipt of the specimens, stores for chemicals and reagents, technical working space for customized laboratory, library and offices of the staff, kitchen and utility services areas like toilets. Principle of design of building is that registration should be near the main entrance to facilitate receipt of specimens and other related information pertaining to the case without interfering with other sections. Unauthorized

public should be discouraged and not allowed entering. Location of stores and medical record should be away from the entrance and they should have window reinforced with iron bars. Their size would depend upon the workload and the policy of storing.

Security of facility and its arrangements are of paramount importance. First line of defense should include high boundary wall, complete absence of trees in the adjacent area of the buildings and other provision against fire. Second line of defense against theft is combination of strong bolts and unbreakable locking system.

Laboratory and instrument room should have adequate outside illumination and air conditioning should be efficient because modern instrument are more sensitive than personnel. Most of these equipment function in a very narrow range of humidity and temperature. Instrument room and chemical store should be placed away from each other to avoid contamination. Library, conference room and kitchen should also be located away from the working area. Placement of customized laboratories in relation to other services requires the advice of highly trained staff and the task is extremely technical.

Forensic examinations and related laboratory work in other countries are undertaken by trained and qualified staff. Forensic certification of living in England is done by qualified police surgeons. Forensic autopsies either performed by academic staff of Department of Forensic Medicine or designated pathologists of National Health Service at fully equipped judicial mortuaries. In Europe, especially France, Germany and Spain, medico-legal autopsies are conducted jointly by two specialty qualified experts under most favorable conditions. In U.S.A., forensic certifications are catered by qualified medical examiners at extensively equipped centers having additional legal authority to make spot investigation of circumstantial aspects of the case.

*Prof. G. Forbes* recommended merger of medico-legal certification and laboratory services and be located at Teaching Department of Forensic medicine in larger city. Arrangements should be developed to provide three major services besides teaching duties:

- Medico-legal Clinic
- Forensic Autopsy Suite
- Laboratory Services



Minimum essential support facilities for medico-legal clinic are forensic radiology, psychiatry and odontology. Laboratory services should cater for forensic anatomy, histopathology, toxicology and serology. Forensic autopsy suite essential services are freezers for storage of corpses, with a public viewing area. Additional facilities will be an exhibit museum, lecture rooms, public relation services and waiting area.

According to him, it will benefit all concerned. General public will have standard medico-legal certification provided by qualified manpower and also to the satisfaction of Law Courts. In return the teaching institution will have access to all categories of human teaching material so essential for teaching and training of both undergraduates and postgraduates and also for research. An additional benefit will be an appellant forum of senior and highly qualified staff. (Fig 1.3)

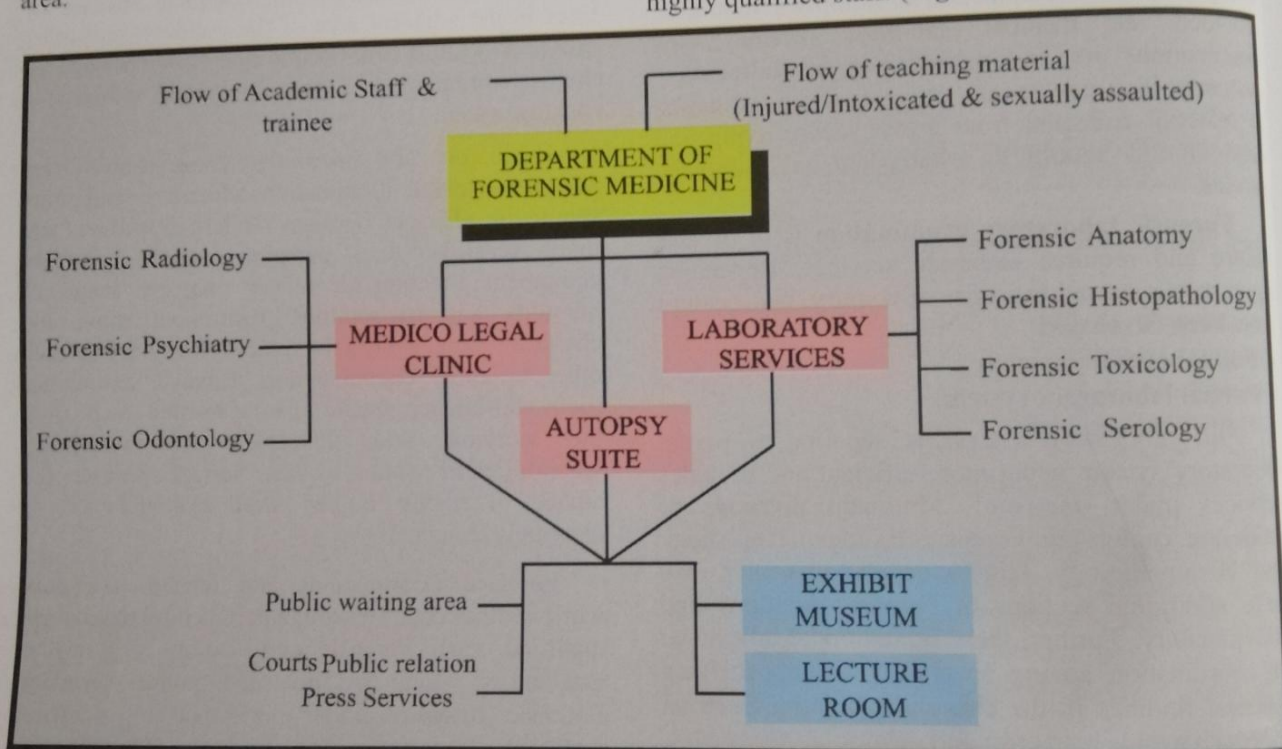


Fig 1.3: Facilities of Department of Forensic Medicine

## 2. Law, Courts of Law and Court Evidence

**Law** is an elusive term defying a comprehensive definition. In its broadest sense it means any rule of action and in this context it is applied indiscriminately to all kinds of actions whether animate or inanimate, rational or irrational. These range from scientific laws, rule of game, international laws ad infinitum. In a narrower sense and confined to human actions, however, it can be defined as a rule established by authority, society or custom based on reason as quoted, "*Law is nothing but reason and that what is not reason is not law*". Only those systems of laws, which pertain to humans, will briefly be described and discussed as we are limiting ourselves to the latter sense.

**Sources and types of laws** on the basis of its *sources* and *types* as applicable to human behavior are of two categories i.e. **common & statute law** and **civil & criminal law**.

*Common law* is an unwritten, generally accepted and applied system of law based on conduct decisions, usage and customs. The community in which we live controls conduct of an individual. Over centuries, therefore, a body of general and particular customs grew up which was and still is enforced by judges in the courts. The usefulness of common law is its universal applicability.

*Statute law* is body of law, which is enacted by the legislative body of a representative government or decreed by a ruler. In the former case it is known as an Act and in the latter an Ordinance. It is the written and the codified law of a country. The statute laws yield to changes introduced by amendments of legislature, decree of a military despot or foreign invader. Examples are that *English* after occupation of the Indian Subcontinent gave their laws and military despots introduced Ordinances like **Shariat Ordinances 1988**.

After enactment of the statute law, it is notified in Extra-Ordinary Gazette of the Government and later published in a booklet form. In its printed form, like any other book, it consists of a title, a preamble, parts, chapters, sections and schedule. A title, preamble and section are, however, the essential ingredients and form parts of every statute.

*Civil law* is that law, which deals with the rights of citizens in a particular state as distinguished from criminal law. It provides remedies for personal

grievances of individuals or group of individuals. It does not concern with the community as a whole. Issues arising from industry causing injury, intoxication or disease to worker, negligence during medical treatment causing damage to patient, matrimonial grievances of husband/wife and disputes between landlord/tenant are dealt under civil law. The damage to aggrieved party is compensated in terms of money.

*Criminal law* involves defining of crimes and laying their punishments. It exists for better Government of persons within the state. It includes offences against the law. Prohibition of certain act or omission is total. It is to be observed by all. Its contravention is punishable with fine, imprisonment or death. The purpose of criminal law is to safeguard the interests of the community and maintains a proper order and peace in the society. (Fig 2.1)

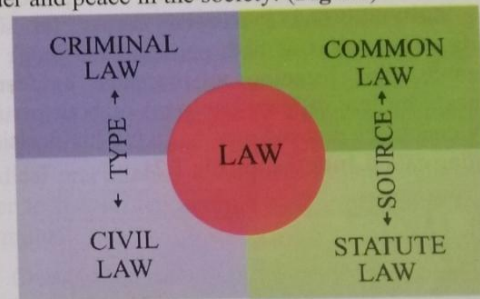


Fig 2.1: Sources and types of Law

Pakistan is an Islamic Republic and it has been strongly felt that criminal portion of inherited *English laws* pertaining to offences against the person, education and practice of economic policies are not in conformity with the Islamic principles. These laws need amendment, hence **Shariat Ordinance 1988**.

*Shariat Ordinance 1988* basis is Islamic faith that sovereignty over entire universe belongs to Almighty Allah alone and exercise of authority by the people must be within the limits prescribed by Him. All Muslim residents in the country therefore, should adopt their lives in individual capacity and in collective spheres in accordance with the teachings of Islam as set out in *Holy Quran* and *Sunnah*. This principle is basis of creation of Pakistan and included in Objective Resolution 1940 and Constitution of Islamic Republic of Pakistan. Shariat has been declared by state as supreme source of law and grand norms of guidance for policy and law making.

## Law, Courts of Law and Court Evidence

Since enactment of Shariat Ordinance 1988, whenever a question should arise before a court of law that existing law is repugnant to Shariat, it shall refer the matter to Shariat Court for decision on the issue. Law further provides for appointments of qualified Aalim well versed with Islamic Shariat as judge, Mufties for guidance and interpretation of Islamic Jurisprudence in Supreme and High Courts and establishment of the following:

- Islamic Ideology Council
- Federal Judicial Academy
- Economic and Education Commissions

**Court of law** is a specifically established place where aggrieved people bring cases to seek remedies against a defaulter or an aggressor for decision. There are two types of courts of law namely *Civil* and *Criminal* presided over by a judge. When an individual is accused of breaking a contract or criminal law, the complaint is brought for trial before respective court. It is supported in work by a **Reader** who maintains dates of hearing of cases, a **Typist** who records the evidence in writing when presented before the court and a **Record keeper** for safe custody of case files of both parties. Civil judge or Magistrate after listening to presented evidence, arguments by law officers (lawyers) of both parties finally concludes proceedings by giving his decision in writing called **Judgment**. (Fig 2.2)

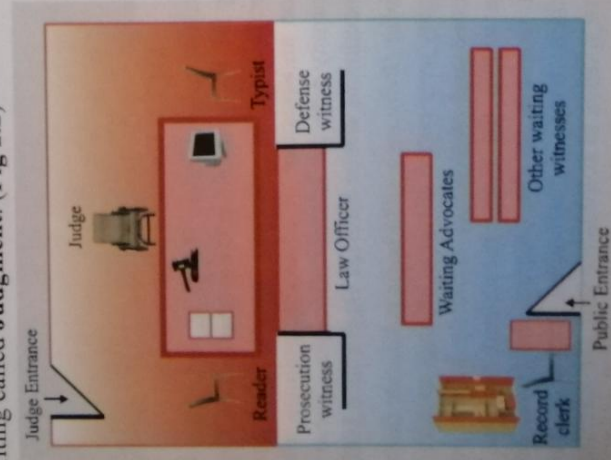


Fig 2.2: Layout of typical Courtroom  
Civil and criminal courts have three levels; courts of first, second and third instance.

Courts of first instance have small jurisdiction consisting of an illaqa. There are many in a district, depending upon crime index and area population. They are presided over by either Civil Judges or Magistrates and hear cases of ordinary nature.

Courts of second instance are above those of first instance. They have larger jurisdiction spread over whole district, hear cases, which are more serious and presided over by District/Session Judges. Additionally they hear appeals against decisions of courts below them.<sup>1st</sup>

Courts of third instance are High Courts, the highest in a Province. They are presided over by either a single Judge or a bench consisting of two or more Judges. They have both civil and criminal jurisdictions and hear mainly appeals against decisions of courts lower to it them. (Fig 2.3)

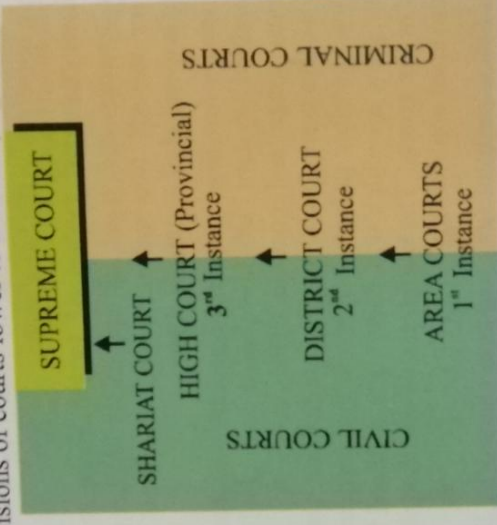


Fig 2.3: Organization of law Courts

Registered Medical Practitioner is mostly summoned by Courts of Magistrates and District/Session Judges and very rarely High Courts. He goes there to give evidence concerning medical examination conducted by him. It is an important duty in connection with furthering of justice. Before entering court room, he should appreciate the atmosphere of court, which is quite different from that of the hospital. It is tense and highly disciplined, but respectful. He should remember that he will be asked to come to witness box to present evidence. His evidence generally comprises of medical facts and opinion recorded by him in medical certificate issued to of victim of an assault having injuries or accused causing them. He is also required to answer a question raised by prosecution, defense and court about his medical observations and opinion.

Careful appraisal of situation of court room atmosphere points to fact that task of court attendance is of immense importance, but different from one that is undertaken in hospital. Further, it is emphasized that the powers of the court to call a witness including Registered Medical Practitioner to attend the court of law for purposes of giving evidence are enormous. There are many ways and such call should never be refused. (Table 2.1)

**Table 2.1:**

*Powers and ways to call witness*

<i>Summons</i>	Must be obeyed and not refused. If ineffective
<i>First call</i>	Witness arrested and produced in the court
<i>Warrants to arrest*</i>	Aggressive way to compel court attendance
<i>Second call</i>	
<i>Written proclamation/ Execution of bond**</i>	
<i>Third call</i>	

\*, \*\* embarrassing for Registered Medical Practitioner, not adopted by court

**Court evidence** is fact/facts in an issue, which a witness knows through perceiving it by his own senses of vision, hearing, smell, taste and touch. It is presented after taking **oath, in person and orally** for acceptance of court of law. Besides, **written evidence** either hand written or mechanically printed is also admissible in the court of law for its inspection. Hospital notes including treatment chart and results of medical investigation can be received in court evidence. Medical publications can also be presented before the medical practitioner to authenticate medical opinion. Written notes may be **primary or secondary**:

**Primary** means and includes original and if it consists of several parts, each of its part.

**Secondary** means and includes certified copy made from original by any process that ensures accuracy.

Court evidence is of three types; **direct or circumstantial evidence and opinion of an expert.**

**Direct evidence** proves the existence or nonexistence of a fact in an issue that a witness knows. Car accident hitting a victim while crossing road, the evidence of eye witness where and how the victim was hit falls in this category.

**Circumstantial evidence** tends to prove a fact by process of inference i.e. fact inferred from another fact. A dead person is lying on a road, close by broken wind screen pieces and car tyre marks offer circumstantial evidence of a road accident.

**Opinion of an expert** is conclusion upon technical matter observed by trained and qualified person in

respect of his specialty. Opinion of medical examiner about weapon of offence when based upon characteristics of wound comes in this category.

Printed material in a technical book is also a form of opinion that may be produced to represent the opinion of the author. Its acceptance is subject to the conditions that author is either dead or incapable of giving evidence and expense of summoning is unreasonable in the eyes of court of law.

**Purpose of court evidence** is to lay before the court of law entire what a witness knows about the case. He should not omit anything for any reason. It is presented within hearing of accused and judge. Requirement under the law is to convey to the court of the law everything truthfully with an opportunity to accused for cross-examination. It should be factual and relevant.

**Stages of court evidence** including medical practitioner's evidence are three: **Examination-in-chief, cross-examination and re examination.**

**Examination-in-chief** is first and main part and party who produces the witness conducts it. Facts deposed in this stage must be within the memory and recollection of witness. Only scientific witness like medical practitioner or ballistic expert is allowed to refer to his written notes. Leading questions are not permitted.

**Cross-examination** is second part, which is conducted by the party who defends the case. It is required to test credibility of the witness, accuracy of evidence and willful omission if any. Leading questions are allowed.

**Re-examination** is third stage providing an opportunity to rectify discrepancies that may occur due to cross-examination. Court may ask questions during any stage of examination to clarify the facts.

Evidence Act guides witnesses in respect of presentation of court evidence. It is a complex law, which has codified rules of English law with such modifications as were considered necessary by peculiar circumstances of our country. Occasionally during court proceeding, difficulty does arise for which principles of common law are adhered to. It prevents laxity in the admissibility of court evidence and introduces a more uniform rule of practice. Main principle for acceptance of court evidence is that it is relevant, confined to matter in an issue and the best evidence.

While in the witness box, he should adhere strictly to Evidence Act, which provides guidance in the presentation of court evidence. (Table 2.2)

**Table 2.2:**  
Guiding principles of presentation of medical evidence

- Be familiar with case and take record to court
- Speak briefly, clearly and in non-technical language
- When questioned, listen carefully before giving its answer
- Address the court as Sir. Court is generally sympathetic to medical witness
- Do not evade a question, admit lack of knowledge and there is no disgrace admitting it
- If not agree with a suggestion, disagree firmly, but politely
- Never attempt to comment on subject, which is outside sphere of competence
- Be impartial
- Read carefully page of book presented for opinion, note name of the author, edition of the book and only then offer comment
- Get permission of the court before leaving and ask travel expenses

### Medical Practitioner's Testimony

consists of two parts:

- First part comprises of observed fact noted in the medical certificate during medical examination about condition of an injury, intoxication, disease or health of examinee. Example of fact about injury is its number, their sites, sizes, shapes, condition of their margins and extent of hemorrhage.
- Second part is framed opinion or inference drawn by medical practitioner from above stated fact and taking the same case of injury would include weapon of causation; *sharp* or *blunt*, gravity of injury; *simple*, *serious* or *dangerous* and age of injury; *fresh* or *old*.

After completion of formality of court evidence and its acceptance by court of law, it is called **deposition**, which is of two types; **deposition and**

**Table 2.3:**  
Difference between dying declaration and dying deposition

Delay Declaration	Dying Deposition
1. Legal formality of oath is not necessary	1. Oath is an essential prerequisite
2. Recorded by any credible person including the attending medical practitioner	2. Only a justice of peace to record it
3. Presence of the accused is not necessary	3. Presence of accused is essential
4. A case of criminal homicide and circumstances of death subject of declaration	4. Recorded in any case when the witness is critically ill
5. Includes only the statement of the dying person	5. Includes the statement of the dying person and cross-examination by the accused
6. Read over to him and got signed if possible	6. Signature of the dying witness is necessary
7. After recording sent to illaqa magistrate sealed	7. Formality not necessary, being recorded by the justice of peace himself
8. Valid only after death of declarant	8. Remain valid even after the recovery of declarant

### dying deposition.

*Deposition* is statement of a witness given on oath in the court of law, taken down in writing in the presence and hearing of the accused and subsequently read over and signed by person making it and by the judge.

*Dying Deposition* is statement of a witness who is serious illness and is unable to come to the court of law to record his evidence. Court of law will go to him for this purpose. Conditions of deposition will be fulfilled at the place where the witness is lying, may it be his house or hospital.

**Hearsay Evidence** is an evidence of something, which the witness does not know for himself but has heard of it from somebody else. It is not admissible in the court of law except **dying declaration**.

*Dying declaration* is a statement of a dying victim of criminal assault, recorded by a credible person about "who assaulted the victim and other circumstances leading to his precarious condition that his death is imminent". Victim is the only eye witness and there is no time left to arrange a dying deposition.

Medical Practitioner in attendance and in-charge of such a patient would be the logical choice to record dying declaration. He should not shrink this legal duty. Being the best judge about physical health and mental condition of the victim ought to know what to do in such a situation.

Difference between dying declaration and dying deposition and condition of admissibility should not be forgotten. Victim being the only eye witness cannot be produced in the court of law after his death. Further, there is an assumption that impending death compels injured to speak the truth. (Table 2.3)

**Legal procedure** means legal proceedings conducted during a trial in the court of law, while the court is in session. Legal proceeding differs in civil and criminal courts. Civil court deals with breaking of contracts and there are always two parties for and against. Both parties bring witnesses to narrate and support allegations/assertions before the court of law. Duty to produce witness's rests on the party who makes the allegation, but onus of prove may shift from one party to the other during the course of proceedings. For example, in a case of divorce brought by wife for dissolution of marriage due to impotence of the husband has to prove non-consummation of marriage. If during trial her husband claims potency and makes an allegation that his wife suffers from veganism, the onus shall shift to him.

On the other hand, criminal court deals with accused guilty of a crime. State is prosecutor and its duty is to bring witnesses and also to prove commission of crime. It is done keeping in mind essential components affecting criminal responsibility, having two elements; **presumption and exception**:

*Presumption* is that everyone is responsible for his action, innocent until proved guilty and at the conclusion of criminal case, if court is in any reasonable doubt about allegation of commission of crime, the case shall be resolved in favor of the accused.

*Exception* negates criminal responsibility of the accused and is also three. They are immaturity, insanity or intoxication at the time of commission of crime. A child under the age of ten, an adult suffering from mental illness and an intoxicated individual are not considered competent to understand the nature and consequences of their action thus are not guilty. As regards intoxication, its intake must be without the knowledge or will of the accused. It means that the accused must not have acted voluntarily without external influence of force, drug or disease.

When the plea of insanity is raised by the defense during legal proceeding, the issue of criminal responsibility of the accused has to be resolved in accordance with **McNaughton's rule** originated in United Kingdom in 1843. (Table 2.4)

Both medical and legal authorities are in agreement that no test employed presently is perfect to resolve the issue of criminal responsibility. McNaughton's Rules has also been criticized as it

fails to exculpate those criminal acts, which are products of a truly disease of mind.

**Table 2.4:**

*Stipulations of McNaughton's rules*

Defendant has to prove that

- At the time of commission of crime, he was suffering from defect of reason
- Defect of reason was due to disease of mind
- Due to disease of mind;
  - i. He did not know nature and quality of his action
  - ii. If he did know nature and quality of his action, he did not know, was doing wrong

Americans have supplemented the McNaughton's Rules by '**Irresistible Impulse**' also known as '**Policeman at the shoulder**' meaning that the defendant, by reasons of disease of mind, would have acted as he did even had a policeman been standing at his side.

**Durham Rule** postulated in 1954 by the United States Court of Appeal has improved this situation and following it, an accused is not criminally responsible if his unlawful act is the product of mental disease. In contrast to the McNaughton's Rules, which takes into account the defendant's capacity to make moral judgment, the Durham Rule is based on purely medical concepts. In cases of defense plea of involuntary intoxication due to alcohol or other drug and mental immaturity of a child, medical evidence has only a probative value.

Plea of insanity, when raised in criminal cases as a defense during the course of proceedings may result in any of the three verdicts:

- *Unfit to plead*, applicable when the defendant was sane at the time of commission of crime but has subsequently become insane and thus not capable of defending himself. The court proceeding gets suspended till such time that defendant's sanity is restored.
- *Guilty but insane*, applicable when the defendant was insane at the time of commission of crime gets completely absolved of guilt and sent to mental hospital for his treatment.
- *Diminished responsibility* is applicable to defendant who is not absolved completely, but the severity of his sentence gets mitigated or reduced.

**Criminal Justice** revolves around two areas of interest to the medical practitioner; **substantive criminal law and legal definitions**:

Substantive criminal law deals with definition of a crime. Definition of crime always contains some mental element to manifest purpose or intent. Latin phrase **mens-rea** connotes evil or criminal intent, which is pre-requisite to guilt and thus a condition precedent to liability of the crime. Law does not punish evil thought and punishment is awarded for harmful result, which follows execution of the very criminal intention. In addition to mens-rea, there has

to be a following action that would indicate implementation of the criminal intention. Latin phrase **actus-reus** represents evil action. In the absence of either of the two, the crime cannot be considered as committed.

*Legal definitions, which are applicable to all cases, are given in. (Table 2.5)*

**Table 2.5:**

*General legal definitions*

Terms	Definition
<i>Judge</i>	A person who is officially designated or empowered by law to give, in any legal proceeding civil or criminal, a definitive judgment.
<i>Court of Justice Document</i>	A Judge or a body of judges who are empowered by law to act judicially alone or collectively. Any matter expressed or described upon any substance by means of letter, figures or marks, or by more than one of these means, which may be used, as evidence of that matter.
<i>Offence Oath</i>	A thing made punishable by Pakistan Penal Code A solemn affirmation specified by law, to be made before a public servant for the purpose of proof, whether in a court of justice or not.
<i>Injury Assault</i>	Any harm whatever illegally caused to any person, in body, mind, reputation or property. Whoever makes any gesture or any preparation intending or knowing it to be likely that such gesture or preparation will cause any person present to apprehend that he who makes that gesture or preparation is about to use criminal force to that person, is said to commit an assault. Mere words do not amount to an assault but the words which a person uses may give to his gesture or preparation such a meaning as may make those gestures or preparations amount to an assault.
<i>Good faith Complaint</i>	Anything done with due care and attention is said to be done in good faith. An oral or written allegation made to a magistrate to take action against a person who has committed an offence. This does not include a police
<i>Inquiry Investigation</i>	Any investigations undertaken for collection of evidence by police or anyone other than a magistrate, under the direction of the Code of Criminal Procedures
<i>Judicial proceeding Public prosecutor</i>	Any proceeding in the course of which evidence is or may be legally taken on oath Any person appointed under the law or his representative and any person conducting on behalf of the state in any High Court in exercise of its original criminal jurisdiction.
<i>Summons</i>	Written, signed and stamped directions of a court to a witness, accused or a juror to attend the court at the notified time, date and place.
<i>Warrant of arrest</i>	Written, signed and stamped authority to arrest a person, which shall remain in force till its execution or cancellation
<i>Bail</i>	A bond entered into, to ensure the appearance of an accused person at the time and place of trial
<i>Deposition</i>	A statement given on oath before a justice, taken down in writing, in the presence and hearing of the accused and subsequently read to and signed by the person making it and also the Justice.
<i>Affidavit (commissioner)</i>	A written statement given on oath before any person authorized to administer an oath (oath

### 3. Legal Aspects of Medical Practice

**Art of healing/Medical Practice** initially started a self-proclaimed profession with no concept of prior learning under supervision or control over it. There was also no sharing of one's skill or remedy with other healers. Everyone was free to join this business and adopt this art with two legal conditions of common law i.e. healer obtains consent of sick person before actual application of skill/remedy and is responsible for resultant damage (negligence).

**Shaping of medical practice** started around 13<sup>th</sup> century with introduction of certain period of training and its certification by an authority, but without supervisory control of defined professional body. Its earlier development revolved only around skills/remedies invented by natives of different countries like Ayurvedic medicine in India, Herbal and Acupuncture medicine in China and Unani Tib in Middle East and South Asia. With improved communication amongst nation for merchandize locally developed medicines/system traveled and got introduced other countries.

**Allopathic system of medical practice**, which is based upon proven scientific principles started sometimes later in Europe/United States. It is now the most modern system of medicine, which has replaced other systems of medicine and practiced all over the world. It has its own formally trained qualified and registered medical practitioners along with supportive nursing and paramedic services. Further medicine, isotope and implants used during its practice are vigorously tested both for effectiveness and safety before marketing and use. It has achieved unbelievable strides like increase in age span, extinction of infectious diseases, prevention and cure of many physical illnesses.

Introduction of sophisticated techniques like cloning and organ-transplantation have necessitated much stricter legal and ethical control. Laws have been streamlined to differentiate various type of medical practice, their qualification from each other and also laid regulations for protection of general public. As principally concerned with allopathic system of medicine, its related state laws should be discussed (**Table 3.1**)

**Table 3.1:**

*Relevant state laws*

- Allopathic system of medicine
- Medical treatment procedures
- Professional secrecy
- Medical documentation
- Medical ethics

**Allopathic system of medicine status**

law mainly is three and should be in the knowledge of registered medical practitioners of this system:

- **Pakistan Medical and Dental Council Ordinance 1962**
- **Allopathic medicine (Prevention of misuse) Act 1962**
- **Medical and Dental Degree Ordinance 1980**

*Pakistan Medical and Dental Council Ordinance 1962* has two specific objectives; to establish a statutory body consisting of registered medical and dental practitioners (RMP/RDP) called Pakistan medical and Dental council (PMDC) and to perform allocated duties. Besides, medical and dental members, there is one legal member, ex-judge of High or Supreme Court and nominated by Chief Justice. Members, either elected or nominated should be Pakistani and residing in the country to participate in meetings of the council. Term is five years, elect a President, an Executive Committee and also constitute Sub-committees (2 or 3) depending upon need to perform allocated duties.

Allocated duties of the council are performed through its President, assisted by Executive Committee and Sub-Committees and mainly are:

- **Maintenance of register of RMPs/RDPs**
- **Monitoring of standards of medical and dental proficiency**
- **Professional conduct scrutiny**

*Maintenance of register of RMPs/RDPs* involves its preparation and updating. Register contains names of all RMPs/RDPs, entered in two parts i.e. A and B and each further having two sections, 1 and 2. Duty is performed by Registrar of the council under supervision of President. All medical and dental practitioners, irrespective of their status, have to register and inform any change of place of duty or practice. Registration grants privileges and imposes obligations. Register is a public document within the



meaning of Evidence Act 1872 and is open to inspection by public. (Table 3.2)

Monitoring of standards of medical and dental proficiency is achieved by a three pronged strategy:

- (i) Prescribing eligibility criteria for appointment (qualification and teaching experience) of medical and dental teachers
- (ii) Evaluating medical and dental courses of studies for quantum, standard and duration

- (iii) Inspecting medical and dental institutions by teaching facilities and method of examinations

PMDC sends Inspection teams to medical and dental institutions periodically during years of studies and prepare recommendations for recognition of newly established institutions or withdrawal of recognition of already approved ones by Federal Government. (Fig 3.1)

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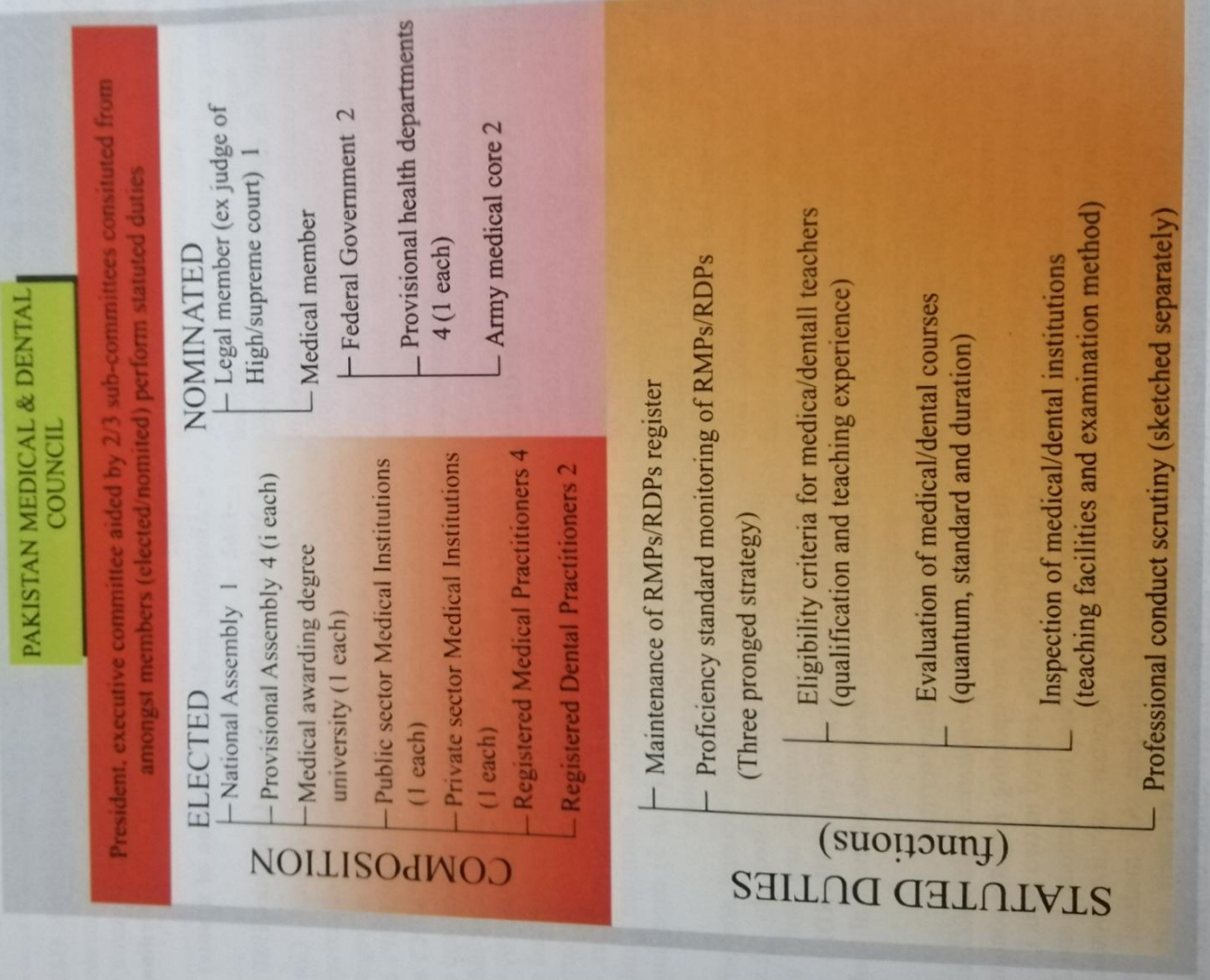


Fig 3.1: Constitution of Pakistan Medical and Dental Council

*Professional conduct scrutiny* of registered medical and dental practitioners is one of the responsibilities of the Council. **Disciplinary Committee** of the council exists to hold court of inquiry for this purpose. Proceedings start upon receipt of a complaint of **professional misconduct** during medical practice. A patient himself, Hospital Administrator and Court of Law after criminal conviction of medical practitioner approach Council for this purpose. Such references are addressed to the President of the Council, who asks explanation of concerned medical practitioner. If explanation is accepted, he declares the complaint as frivolous and

dismisses it. But if there is substance worth decision, complaint is forwarded by President to Disciplinary Committee for instituting a formal court of inquiry. At conclusion of court of inquiry RMP/RDP may receive either a warning with an advice to improve professional conduct, his name temporarily suspended for a period, if gravity of misconduct falls short of moral turpitude or removed permanently from the register, when charges against him are serious amounting to moral turpitude. His name is never removed arbitrarily. (Fig 3.2)

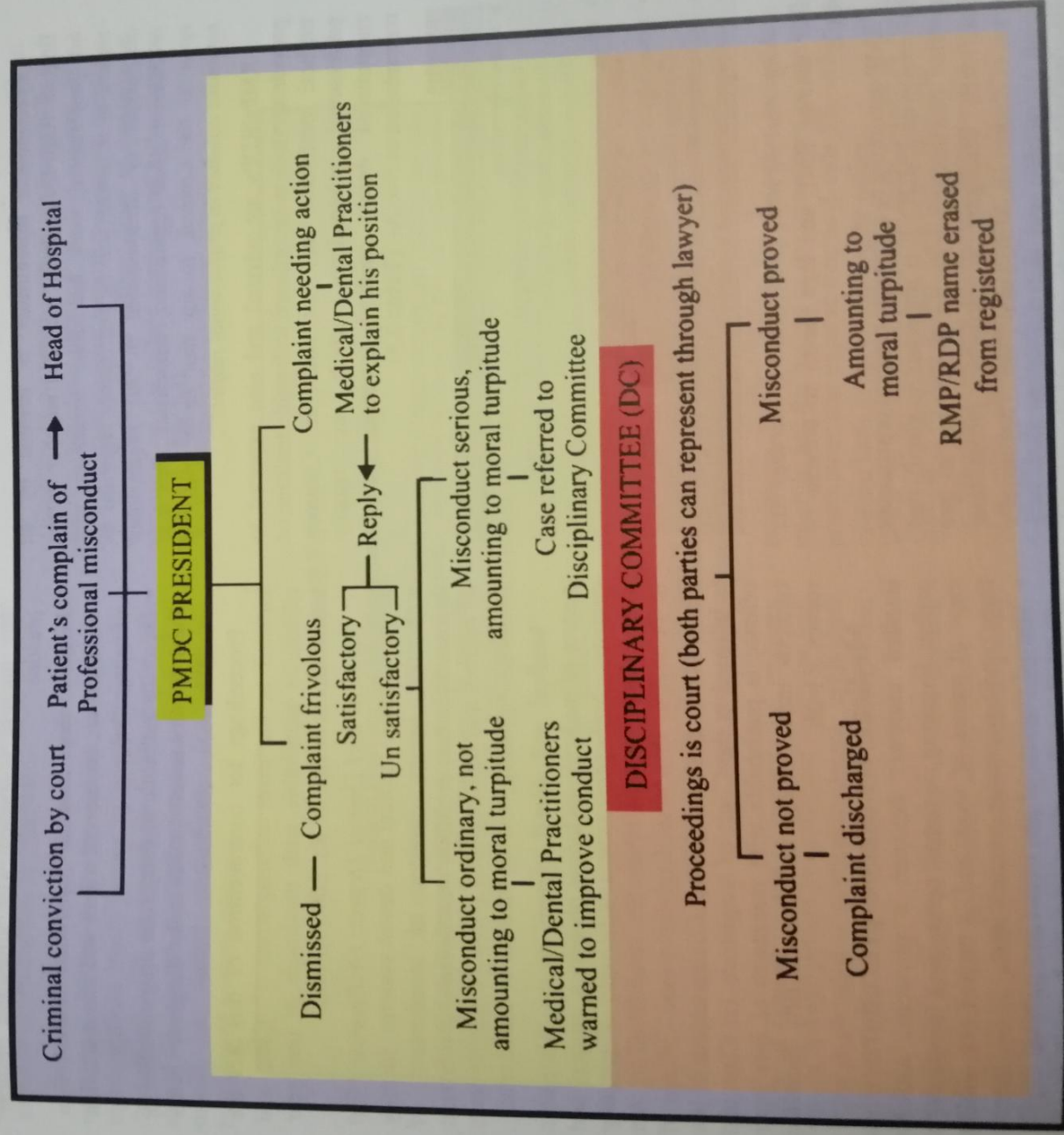


Fig 3.2: Flow chart of PMDC disciplinary proceeding

**Table 3.2:****Privileges and obligations of RMPs and RDPs****Privileges**

- Employment against job/establishment of an independent medical practice
- Issue medical certificate to patient for administrative and judicial purposes
- Charging of fee for rendered medical/dental services

**Obligations**

- Notification of change of address of practice or transfer within a period for 30 days of the change
- Not using any name, title, description or abbreviation indicating that he possesses additional qualification, which is not conferred on him.

**Professional misconduct** is defined by an English High Court Judge as, "If a member during his professional work has done something with regard to it, which will be reasonably regarded as disgraceful or dishonorable by his professional brethren of good repute and competency, then it is open to the Council, to say that he is guilty of infamous conduct in professional respect".

RMPs/RDPs are advised and also expected to provide services in accordance with noble tradition of medical profession and not abuse it. Common professional misconducts, which are usually encountered during medical practice, can be remembered as five As. (Table 3.3)

**Table 3.3:****Professional abuses during medical treatment**

- Abuse of privilege
  - Issuing false medical certificate
  - Prescribing drugs of addiction
  - Disclosing patient's secret
- Abuse of doctor-patient relationship
  - Indecent assault or adultery with patient
- Abuse of professional knowledge
  - Criminal abortion
- Associating with unqualified person
- Advertising for unreasonable gains

*Allopathic System (prevention of misuse) Act 1962* defines RMP and lays means to prevent its misuse.

RMP according to act means medical practitioner registered with PMDC. It is important to clarify that registered practitioners with the PMDC are of two types, each belonging to separate professional courses of studies i.e. MBBS and BDS. They acquire different knowledge and skill for which they seek registration with PMDC to be eligible for respective professional practice. Law not appreciating the

difference has prescribed single phrase "registered medical practitioner". Actually it should have been "registered medical practitioner/registered dental practitioner" so that both practitioners stand covered by enacted clause.

Misuse of Allopathic System under the act is directed that *no one other than RMP* shall use:

- *Word doctor* or any of its grammatical variations, cognate expressions or abbreviations to give an impression that he/she is entitled to practice allopathic medicine.
- *Medical degree or diploma* to give an impression that he/she is a qualified medical practitioner or for any purpose connected with allopathic medical practice.
- *Perform any surgical operation* other than circumcision, incision of a boil and administration of an injection.
- *Prescribe* antibiotic or dangerous drug specified in the drug rules enacted made under dangerous drugs act 1930.

Proceedings for contravention of this Act are initiated in the court of magistrate 1<sup>st</sup> Class and offence is punishable with maximum of one year imprisonment or fine of Rs. 2000/-or both.

*Medical and Dental Degree Ordinance 1980* define scientific medical and dental systems; identify authorities having powers of conferment of degrees/diplomas; prohibits unauthorized conferment of degrees and diplomas and prescribe punishments for falsely assuming or using medical or dental title.

Medical and dental system means Allopathic system of medicine including obstetrics, surgery and dentistry. Authorities vested with right of granting degree/diplomas are Universities established by Act of Federal or Provincial Legislature and College of Physicians Surgeons, Pakistan. Contravention of law is initiated in the Court of Magistrate 1st Class and offence is punishable with maximum of five years rigorous imprisonment and fine of fifty thousand rupees or both.

**Medical treatment procedure** is an **implied contract** between a physician and his patient, requiring no formal contracting formalities in view of nature of work and is carried out abiding three conditions under common law:

- **Mutual consent of physician and patient**
- **Obligations of parties (patient's & physician's)**
- **Compensation for physician's negligence**

*Mutual consent of physician and patient* means simultaneous consent of both, which is pre-requisite for start of medical treatment. A patient is not obliged to submit to medical treatment, except when the disease is contagious to other members of society. It is necessary for all kinds of medical procedures whether undertaken for diagnosis or physical treatment. Special procedures such as administration of anesthesia, fluid infusion including blood transfusion and surgical intervention require written consent. Patient's consent does not absolve medical practitioner from his duty of reasonable carefulness. Consent should be complete and freely expressed and may be **implied** and **expressed** depending upon situation i.e. emergency or otherwise.

*Implied consent* is applicable in cases of medical emergency. When a serious patient with profuse bleeding head injury comes to hospital emergency department, such circumstances imply that no time should be wasted in starting medical treatment. It should be started immediately condoning the formality of consent taking.

*Expressed consent* is taken from all other cases than medical emergency. Patient, being owner of his body, understands to what he is consenting. Consent should be *informed* and is generally given orally by the patient himself. Written consent is better for evidential purpose. Both forms are valid in the eyes of law. Protocol of written consent should have following spaces for:

- Name of consenting patient
- Type of medical treatment with its risks
- Name of physician/surgeon whom consent given
- Signatures of physician/surgeon and patient

**Blanket consent** is not valid in eyes of law. It means consent obtained from patient without explanation of purposed medical treatment/risks and patient's signature obtained on the consent form. Such improper consent form is used in our hospitals, which is presented to patient either at the time of admission or just before surgery and his signatures obtained. (Fig 3.3)

### Consent Form

(Name of Department of Medicine/Surgery, Name of Hospital, Lahore)

I, (name and CNIC number of the consentee), do hereby consent to (my own / relationship with the patient) operation of (name of the operation) under (type of anesthesia) anesthesia. I have been explained fully the nature, purpose and inherent risks involved in this Surgery and the type of anesthesia by Dr. (name of the doctor taking consent). No assurance has been given to me that any particular Surgeon will be performing the operation.

Signature/thumb impression of the Consentee \_\_\_\_\_  
Date \_\_\_\_\_

I, (name and CNIC number of doctor taking consent), confirm that all relevant details in respect of the above referred operation and anesthesia has been fully explained to the consentee who has signed this form in my presence.

Signature of the doctor taking consent \_\_\_\_\_  
Date \_\_\_\_\_

Fig 3.3: Recommended consent form for surgery

**Age of consent** is age of majority i.e. eighteen years. At this age patient has sufficient understanding to know implication of medical treatment. In children under this age, consent should be obtained from parents.

**Standard consent procedure** is that medical practitioner to tell his patient about nature of treatment and its possible implications including risks in simple language and only then gets his signature. Physician has marginal discretion in what to tell, especially when he honestly believes that to tell the whole is liable to impede or interfere with medical

treatment. The law leaves this question, as to how much to tell the patient to the conscience of medical practitioner and expects him to decide this question in good faith in the interest of the patient. When he withholds information from patient in good faith, he is advised to pass it on to his near relative.

**Modified consent procedure** occasionally has to be adopted, when patient is:

- Unable to consent
- Treatments involving organs of generation
- Newer surgical procedure

Unable to consent condition applies to under age, unconscious and mentally sick patients. Unto early 19<sup>th</sup> century mentally sick patients were considered moon-struck and called **lunatics** and **dangerous to society**. There was no concept of medical treatment and they were restrained in **lunatic asylum** in accordance with **Lunatic Asylum Act 1858**. Understanding of mental illness first necessitated replacement of Lunatic Asylum Act 1858 with **Mental Health Act 1912** and subsequent amendments substituted it with the latest **Mental Health Act 1973**, which described for the first time **mentally sick's admission procedure and his authority to consent**.

*Mentally sick's admission procedure and his authority to consent* depend upon his mental state and his family circumstances. They are three types:

- **Voluntary admission**
- **Temporary reception**
- **Reception order**

*Voluntary admission* is granted to mentally ill himself, who has proper insight into his condition and submits a written application to the administrator of mental hospital.

Admission is subject to the condition that his arrival be notified to two **mental hospital visitors** (MHV)\* within 24 hours of his arrival, one of whom is a Registered Medical Practitioner. Period of stay in mental hospital is open and if he desires to leave, is allowed subject to his satisfactory mental condition. Otherwise he will not be allowed to leave mental hospital for next 24 hours and during the period *temporary reception* be arranged.

\*MHV is a person of integrity, entrusted with the duty of guarding health and other interests such as food, sanitation, loading of the mentally sick during his stay in the hospital

Provincial Health Department notifies their names and number of such visitors depends upon the strength of the patients in a mental hospital i.e. small institution has three, one of whom is RMP and big hospital has more such visitors

MHV makes monthly inspection of the institution and record his findings in the Remark Book in respect of care and treatment given to the mentally sick patients by the staff of the institution for the information of the government so that remedial measure could be taken.

When a mentally sick patient accused/convicted of a crime is transferred from prison to a mental hospital, Inspector General of Prisons or other such authority

entrusted with this duty acts as MHV. He visits once in every six months to submit a report about mental status of such patient to higher authority.

*Temporary reception* is granted upon submitting a formal application on the prescribed form by a near relative having blood or marriage relation with mentally sick to administrator of mental hospital. Application should mention about mental condition of the patient and circumstances of the family necessitating admission into the mental hospital. It should be supported with two medical certificates issued by Registered Medical Practitioners, one of whom should not be his usual medical attendant. Medical certificates should indicate date of medical examination and whether medical examination had been conducted separately or in conjunction with each other. When medical examinations have been done separately, maximum interval between medical examinations should not be more than five days and recommendation remain valid only unto 14 days from the date of issue.

After receipt of formal application, administrator of the mental hospital accepts mentally sick and his reception notified to two MHV before expiry of the second day. Period of stay is six months and if by the expiry of this period, the patient has not recovered, he continues to remain in the mental hospital for another twenty-eight days during which a reception order shall be arranged.

*Reception order* is issued by court of area magistrate after submitting a written petition by a near relative having blood or marriage relations. Petition should indicate besides family circumstances necessitating admission, whether any such petition was made previously and was successful or not. Petition should also be supported with two medical certificates form two Registered Medical Practitioners, one of whom should be a government medical officer. In case one of the medical practitioners is related to mentally sick patient, this fact should be indicated in the medical certificate. Both medical examinations should have been done independently and separately. Medical certificates should also include symptoms and signs of insanity observed by the medical practitioners and other information's pertaining to the patient conveyed to medical practitioners by his relatives.

Petition on submission may either succeed to obtain a reception order or dismissed. When dismissed, reasons of dismissal have to be recorded by magistrate in writing. Further, reception order is

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generally subject to the condition that the relative is ready to pay the cost and maintenance of medical treatment in mental hospital and administrator is willing to receive him. Period of stay is generally not indicated in the order and patient cannot be discharged without the permission of the court.

Besides the above procedures of intake of mentally sick into mental hospital, a Station House Officer of a police station may arrest a wandering, dangerous or cruelly treated mentally sick, he should produce him before area magistrate, who orders his medical examination by authorized Government medical practitioner, who make other inquiries regarding whereabouts of his relatives and either hand over to his relatives who are ready to take care of him or in case of their non-availability authorizes his detention in mental hospital for a period of ten days. Maximum period of detention is thirty days with two more such detentions of ten days each to grant reasonable time to locate his relatives who can arrange proper admission procedure.

**Discharge of mentally sick** is permitted by mental hospital administrator/admitting judicial authority subject to the condition that he is fully recovered or his mental condition is such that he can be allowed to go out of the institution under the supervision and care of his family. Information of his discharge from the hospital is notified to MHV within 24 hours of his leaving of institution. He can also be sent home for smaller periods on an application of his relative to the administrator. Dangerous/unfit mentally sick cannot be discharged.

**Care of mentally sick** means physical care. It is under the supervision of MHV. *Maintenance of person and estate* of mentally sick is under the control of area **District Judge** vested with the power to institute an inquisition into the mental status of an individual alleged as mentally sick. If a petition succeeds, it results in the appointment of guardian for maintenance of his person and manager for the management of his estate. Appointees perform duties under overall control of **Collector, Provincial Government**. Relatives qualify for appointment as manager of the estate, but there is a restriction to appointment of legal heir as guardian.

*Treatments involving organs of generation* like contraception and artificial insemination additionally require consent of spouse. There are generally three situations:

- a) Prescribing of contraceptive pill to treat menstrual irregularities is permitted without permission of the husband.
- b) Insertion of intrauterine device should not be affected without husband's consent, but insertion in order to save a woman from pregnancy, in view of her weak health is considered justified. Insertion after age of majority in order to avoid pregnancy even with the consent of both husband and wife though legal yet would be unethical.
- c) Tube ligation surgery, when performed in good faith, to prevent transmission of hereditary diseases or to save life of the mother in view of disease in which pregnancy might endanger her life, is permitted.
- d) Artificial insemination is deposit of semen in vagina, cervical canal or uterus by instruments to bring about pregnancy unattained by sexual intercourse. Seminal fluid used for this purpose either may be obtained from husband (A.I.H.) or from a donor (A.I.D.). There is no legal or ethical complication whatsoever with A.I.H. Religious objection however exists with A.I.D., besides insoluble legal problem regarding legitimacy of the resulting child. While registering such a birth, it is usual to give the details of the father to avoid a charge of adultery subsequently against the women being pregnant by another man. Medical profession regards the practice of A.I.D. unethical and it should be strongly discouraged.

*Newer surgical procedure* like organ transplantation, everyone is entitled to consent for removal of organ regarding his own body before his death. Such authority, if given, should be passed on to Head of Hospital for safe custody where arrangements for organ transplantation exist. When an individual is dead and consent of the deceased is not available, consent of next of kin should be obtained. In no case should an organ be removed in an unaccompanied case.

Besides, there are situations in which medical treatment though essential, urgent and life saving, yet patient and his guardian are reluctant or unable to consent:

- Narcotic use prohibited by religious faith
- Blood transfusion objected by Jehovah's witness
- Limb amputation delayed or refused by patient's indecision or non-availability of guardian

In such situation medical practitioner should obtain advice of a senior colleague and enters in case notes and then proceeds with medical treatment.

**Documentation of consent** is an essential duty of medical practitioner. He should follow professional dictates in this respect while entering it in case files. He is advised to fully document adopted procedure and case circumstances and also obtained an endorsement of proposed treatment from a senior colleague before proceeding with the treatment. It secures his position against any subsequent complaint or a civil suit. (Fig 3.4)

**Obligations of parties (Patient & Physician):**

*Patient's obligations* are two, firstly to pay mutually agreed fee to physician. Medical practitioners in employment of an organization, Local Authority or Government are duty bound to provide medical treatment without charging of fee to its members. Secondly, to submit to legitimate command of physician as much as is professionally necessary.

From & by home			Which type	When taken	How taken	What documentation
(i) Patient	(i) Treating Practitioner	(i) Oral / written	Before	(i) Standard Procedure	(i) Consent form	
(ii) Relative (by Blood/marriage)	(ii) Investigating Practitioner	(ii) Implied / Expressed	(I) Medical Examination, (ii) Investigation (iii) Skill Application	(ii) Modified Procedure	(ii) Endorsement from senior	
(iii) Authority control patient	(iii) Operating Specialist	(iii) Blanket (Not recommended)			(iii) Placement of Papers in case file	

Fig 3.4: Type, sequence and medical practitioner's role in consent taking

The situation is very critical. Patient's history of illness contains secrets even the most guarded ones, physical examination grants physical excess to his body along with all sorts of manipulation even private parts and provision of medical treatment includes administration of poisonous/drug of addiction and surgical cutting.

*Physician's obligations* are also two, firstly to apply skill with the competence of his own claim i.e. ordinary or expert and secondly to exercise carefulness in work towards his patient. Medical treatment once started should continue and proceed uninterrupted till either full recovery, mutual termination, when medical practitioner refers the patient to another doctor and patient accepts it or death of the either party. Patient, however, can unilaterally discharge his physician when he is not satisfied with the medical treatment offered. (Fig. 3.5)

*Compensation for physician's negligence* is not condonable and no different from negligence of other artisans in the eyes of law. It is careless performance of professional work. Medical practitioner has a duty to conform to reasonable standard of carefulness, which should be exercised to avoid any fault leading to damage to patient's body. He is answerable and has to compensate his patient in terms of money. A personal belief that a particular treatment or technique is best is no defense, unless the belief is

based on reasonable ground. Further belief that a senior medical practitioner cannot be careless because he has many year of experience is not valid.

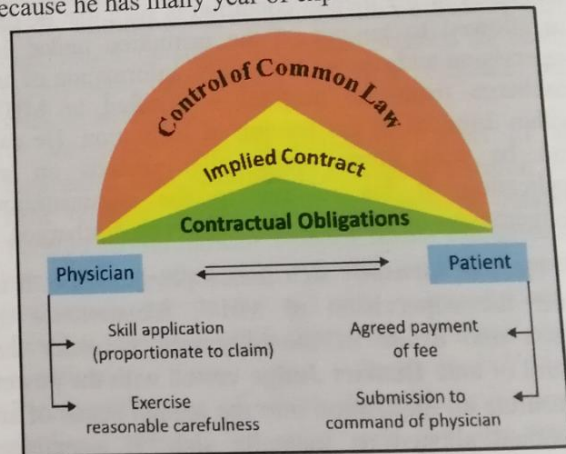


Fig 3.5: Contractual obligations of physician and patient and control of common law

It is necessary to point out that most of medical treatments are attended with risks and medical practitioners have to provide them in good faith in the interest of his patient. A reference to **iatrogenic disease**, the cause of which is supposedly physician is made here, as it pertains to practice of medicine. Side effects of medicines, complications during medical investigation and surgery are associated with medical treatment. They occur in spite of best efforts of the medical practitioner. Such situation should not

be included in many occasions patient fellow practitioner experienced misadventure answer in negative.

Medical mankind without professional learning that they not to be negligent.

So because also a practitioner who a hospital the value of professional medical quality quality which patient exercise in his medical practice.

be included in the list of professional negligence. On many occasions, a complication or even death of the patient follows in spite of best efforts of the medical practitioner who is properly qualified, skilful and experienced. Can such unsuccessful attempts or misadventure be called professional negligence? The answer in such cases definitely should be in the negative.

Medical science has conferred great benefits on mankind by taking risks. We can't take benefits without taking risks. Doctors, like most of other professionals, have to learn by experience and learning by experience is attended with risk. It means that there is no negligence during misadventure but not to take precautions subsequently, clearly would be negligence. A clear distinction between the negligence and misadventure must be made.

**Scope of medical negligence** is unending because of rapid inventions in medical science and also not limited to the conduct of the medical practitioner alone. It extends to other staff members who are working under his supervision, especially in a hospital setting where responsibilities are shared by the whole team. There are generally three situations of provision of medical treatment; by general duty medical practitioner holding basic medical qualification, specialist holding additional medical qualification over and above basic medical qualification and general duty medical practitioner when an expert is needed who is not available and patient has consented. Level of skill and competency expected in first case is that of an ordinary physician; in the second is of an expert having additional duty of remaining abreast with the latest advances peculiar to his field and in the third, if medical treatment ends in misadventure, it would not be considered doing of the medical practitioner. In other words, medical practitioner working in adverse circumstances should not be judged and labeled as negligent.

**Burden of proof** of medical negligence nearly always rests on the patient, except a specific situation covered by common law doctrine "*Res Ipsa Loquitur*" meaning thing speaks for it. This doctrine creates an inference that negligence has occurred and places responsibility on the medical practitioner to offset the inference, if he can. The burden of proof in such a case shifts from the patient to the medical practitioner to prove that he is not negligent. It is applicable, when a medical instrument, which does not ordinarily cause injury unless the controlling

medical practitioner is negligent and injures the patient. Examples encountered are:

- Live electric cattery left unattended, burns patient's skin.
- "On-position" anesthesia machine with gas plug connected with the patient, when left unattended over anaesthetizes the patient.
- Surgical instrument left in the abdomen of the patient during surgery to initiate foreign body reaction.

**Extend of damage** and intern punishment in law to medical practitioner in claims of medical negligence will legally depend upon, whether medical negligence is categorized as **civil** or **criminal negligence**:

*Civil negligence* results from lack of carefulness during medical treatment and common examples are extraction of a healthy tooth instead of diseased one; failure to X-ray a fractured bone and not to give anti-tetanus vaccine following an injury. Such cases are brought before a *civil court* for decision of award of compensation in terms of money. Damages are not limited to the physical injury alone. The patient is entitled to recover damages for physical injury, pain and mental suffering along with any loss of earning capacity associated with the injury. This is why the claims awarded by civil courts are generally very extensive. Besides, there are two other situations; **contributory negligence** and **negligence of the third party**.

*Contributory negligence* as the name indicates is that someone else has contributed in resultant negligence. It results when patient becomes negligent and does not carry out medical instructions properly. Good result of medical treatment depends upon the exercise of carefulness by both the medical doctor and his patient. Law is very particular about the situation and does not ignore the negligence of the patient in this respect.

*Negligence of third party* results by carelessness of supportive paramedical staff in a hospital situation, where responsibilities of medical treatment are shared between medical practitioner and such staff. It proportionally reduces the liability of compensation from medical practitioner and shifts to paramedical staff.

*Criminal negligence*, on the other hand, results from gross and wicked recklessness on the part of medical practitioner, who shows no regard for the



safety of patient's life and causes patient's death. Examples are:  
 (i) Over-anaesthetizing patient by an anesthesia addicted anesthetist solely to satisfy himself  
 (ii) Leaving patient unattended by surgeon after opening his abdomen to negotiate fee with his relatives.

Such an attitude on the part of medical practitioner would surely result in death of the patient and is not condonable. The law/state punishes the wrongdoer, who is charged with manslaughter under criminal law in criminal court for punishment. (Fig 3.6)

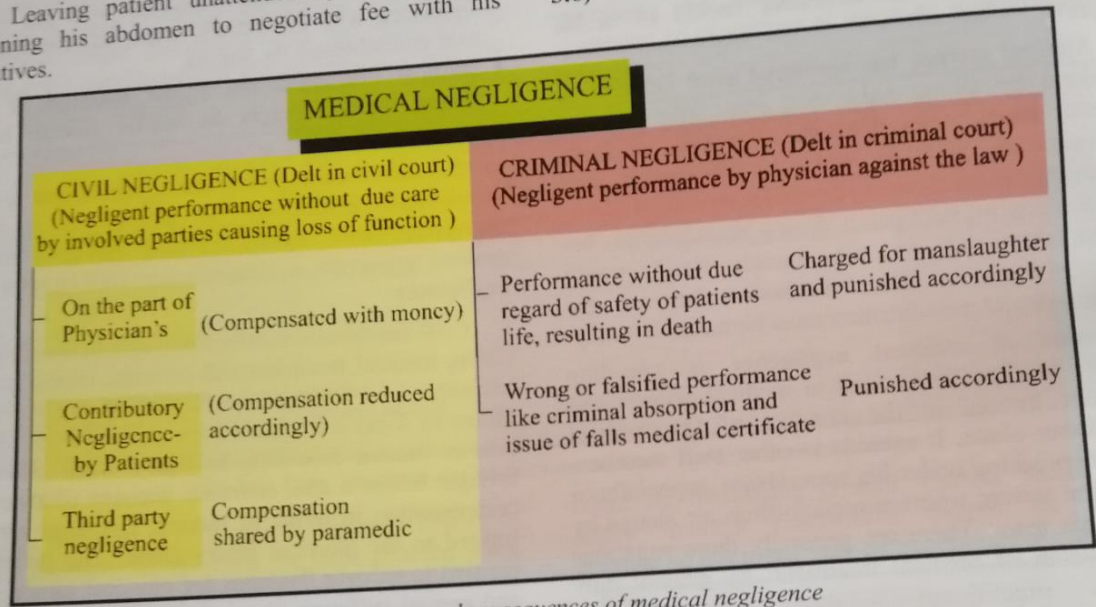


Fig 3.6: Types and consequences of medical negligence

Besides imposition of common law, provision of medical treatment is under-taken in accordance with noble traditions, accepted voluntarily by the medical profession and fall within the sphere of medical ethics.

**Professional secrecy** and its maintenance is an important ethical duty and also equally so in law. Patient's information about his disease received during medical practice due to doctor-patient relationship is a confidential communication between medical practitioner and his patient. It is a sacred trust and Hippocratic Oath affirms that medical practitioner will not divulge patient's secrets. It should be kept in secure place of the hospital away from public under direct control and supervision of medical practitioner.

Introduction and excessive use of computer and storage of patient's information in data bank for medical research has complicated medical practitioner's duty of preservation of patient's confidentiality. Courts so far have not commented upon its legal status. Professional bodies considered it justified.

Disclosure of patient's secrets by medical practitioner is a serious lapse and can lead to legal action against him in civil court as well as ethical action by disciplinary committee of PMDC. Courts have ruled that a medical practitioner has a common law duty of protecting confidentiality of patient's secrets in the context of doctor-patient relationship. But this is not absolute as the law also recognizes the propriety of careful disclosures to agencies, which qualifies to receive it for protection of the society.

**Privileged communication** is disclosure of patient's information to others having interest in it. In this context, doctor has a duty to disclose and it is considered justified in the eyes of law provided it is made in good faith in the course of legal duty with the precaution that the statement of disclosure is not malicious and the party receiving it has a duty to receive it. There are two type's disclosures under privilege communication; **qualified privilege** and **absolute privilege**. All notifications of birth, deaths and industrial, infectious or contagious diseases are examples of **qualified privilege**. Rationale of this disclosure is that the interest of the community is superior to that of an individual.

Another practitioner attendance v is compelled court. Cour has absol information privilege. (

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Another situation with which a medical practitioner may be confronted is during court attendance where disclosure of patient's information is compelled. Refusal may amount to contempt of court. Courts of law and parliament of the country has absolute authority to receive patient's information falling in the category of **absolute privilege**. (Fig 3.7)

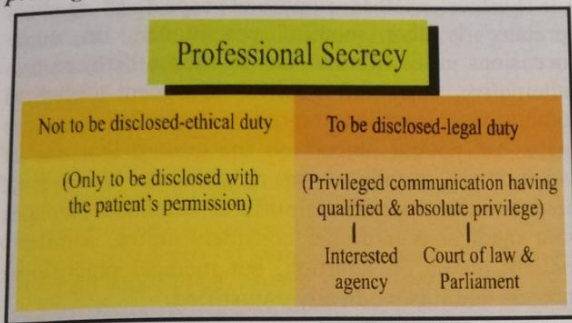


Fig 3.7: Principles governing professional secrecy

While appearing in the court of law to convey patient's information (condition) in cases of physical and sexual assaults or intoxication, medical practitioner should inform Justice of peace that he has a duty of professional secrecy towards patient's information and disclosure made.

**Medical documentation** is another highly important duty of medical practitioner during medical practice. Every country has some kind of system of preparation and proper documentation of medical record of patients for subsequent use. Important medical record to mention a few includes patients out/in-patient data registers, bed head folder of admitted patients, operation log register and patient's diseases abstract register. Each ought to have specific structure to fulfill the objective of its creation. All hospitals in a country should adopt them, so that state of health of population can finally be prepared for future planning. Situation in Pakistan is otherwise. Every hospital designs its own medical record documentation format. There is no standard protocol/design for guidance of medical students, fresh medical practitioners and statisticians. Further presence state of affairs is hurdle in linking countries data internationally.

Besides, the most common medical document in use during medical practice is **medical prescription**, **medical report**, **medical certificate** and **medical notification**. Each structurally consists of three portions. First and last portion is to fill-in personal

identity of patient and medical practitioner respectively. Central portion is meant for information/findings relevant to type of medical document in respect of patient.

**Medical prescription** is direction of medical practitioner, which is handed over to patient to send to pharmacist for dispensing medicine for use in the way indicated in it. It starts with letter "Rx.", which stands for the word **recipe**. It is followed serially as 1, 2 and 3 mentioning names of the medicines with their concentration and direction for use. At the end, medical practitioner signs and stamps the prescription bearing his name in capital letters, registration number and address.

It is necessary to point out that prescribing antibiotics and dangerous drugs is privilege only of registered medical practitioner by virtue of Allopathic system (prevention of Misuse) Act, 1962. Further, dangerous drug rules lay an additional duty of writing of **superscription**, stating repeat instruction of prescription for how many times. It should be written carefully and correctly, otherwise pharmacist may refuse to dispense the dangerous drug to the patient and he would be justified in doing so.

**Medical report** is prerogative of investigating medical practitioner like radiologist or pathologist. It starts with the phrase "This is to report..." and contains partial information limited to the purposed investigation like X-ray of patient's body part, a test of a material like bile, blood, urine or a biopsy from the patient's body. It is a small portion of patient's total condition only to gauge the level of his health or clinch diagnosis of the malady from which the patient is suspected of suffering. Medical report, being patient's confidential information, should be sent back to referring Medical Practitioner after enclosing it in an envelope.

**Medical certificate** preparation is the domain of formally notified medical examiner. It starts with the phrase "This is to certify..." It is complete and the most comprehensive information about state of physical health of an individual whether healthy or diseased. It is compiled after full physical examination of the body of the examinee and required investigations with their results to conclude finally with medical examiner's opinion regarding state of health or disease of the examinee at the time of examination.

The Most common examples of medical certificate are certificate for determination of age for

schooling, employment, marriage etc, sickness, temporary/permanent incapacitation after an injury.

Medical notification preparation is the responsibility of registered medical practitioners. It starts with the phrase "This is to notify..." It includes information about suspected diagnosis of infectious/contagious disease like cholera and leprosy and acute poisoning along with already administered medical treatment. Such cases require urgent hospitalization; it matters little whether diagnosis mentioned in the notification is correct or not.

Registered Medical Practitioner has a legal duty to notify infectious/contagious patients coming to their notice to authorities appointed by Municipal Medical Officer of Health.

Medical ethics is a subject of immense importance and its proper grasp requires understanding of word ethics.

Ethics is science or philosophy of morals dealing with general nature of morals and of specific moral choices to be made by an individual in his relationship with others. In another sense, ethics implies principles or standards governing the conduct of the member of a society. Frankena describes ethics as a part of field of philosophy and according to him; it is the study of morality, moral problem and moral judgment. It entails essentially an examination of what is right and what is wrong; what is virtuous and what is evil in the conduct of individuals and groups of individuals, emphasis being on what ought to be.

No man is an island unto himself. He is dependent on others and owes his existence to his relationship with others. He has to conduct himself in such a way, as he would like other to reciprocate. This is the essence of ethics. He will, throughout his life, come across situations when he will have to face ethical issues. These issues become more important in medical practice, because of special doctor-patient relationship, which exists between them. Situation is unique, but delicate and precarious. Physician has a privileged position having both skill and authority. Patient is at his mercy, helpless, dependent and vulnerable and in a state of complete surrender.

Physician behavior mostly consists of good manner and civilized behavior in the general sense. Besides, it includes peculiar issues of medical practice. (Table 3.4)

Table 3.4: Issues peculiar to medical treatment

- Patient's history of illness means knowing his secrets even most guarded ones.
- Medical examination means physical excess to patient's body even private parts with all sorts of manipulations
- Medical treatment means administration of poison/ drug of addiction and surgical cutting of patient's body.

Further another important aspect of medical practice is that medical practitioner, on many occasions in his lifetime, has to choose between two alternative lines of medical treatment. Medical practitioner prescribes morphine for relief of severe pain, but patient objects on the ground that use of narcotic is prohibited in religion. In a case of insurance compensation, sufferer demands damages that medical practitioner considers unjust. Similarly patient insists on abortion, but medical practitioner objects that it is medically unjustified.

These are only few examples of numerous situations, in which the interest of one party comes into conflict with the scruples of the other. Resolving such dilemma involves ethical consideration. Proper understanding of the principles of ethical conduct in medical practice is necessary for their application to a particular situation. At each step during these procedures, he may succumb to human temptations and failings ranging from blackmail, extortion of money to sexual exploitation.

Formidable is his unending authority are chances for him to out-step his moral obligation and invade the rights of his patients. No law can check his action, numerous of which fall outside official legislation. Only fear of God and scruples of his science can set the limitation.

Scope of medical ethics is not fixed into rigid boundaries and continues to widen with new inventions and developments. The most recent examples of advancement are introduction of practice of organ transplantation, artificial insemination and cloning. Each new invention creates new problems requiring laying of fresh ethical principles suited to new situation. Guidelines in this respect to codify and publicize information regarding ethical consideration emerging from newer problems, would be useful to keep in mind the following golden troika; adherence to scientific basis, impartial presentation of scientific findings and dedication to serving justice.

Hippocratic Oath sworn by Greek physicians is the oldest and well known code of

ethics to me will and I protection They make an unthinkable available to make know work for wrongs. N spirit and ethics. (T

Table 3.5: Translation

"I swear and all h to my ab stipulation to me as relieve h the same art, if th and th instruct and th stipula none c accora benefi delete anyon mann abort pract stone prac go in ever from wha in c oug tha thi an Bu be

ethics to medical persons. It contains promises of "I will and I will not" which are essential to the protection of the character of professional person. They make it clear that medical practitioner is neither an unthinking instrument of the client or employer, available to do things that they want nor willing to make knowledge and skill of the professional calling work for their interest irrespective of inherent wrongs. Majority of medical practitioners accept the spirit and abide by stipulations given in the code of ethics. (Table 3.5)

**Table 3.5:***Translation of Hippocratic Oath*

"I swear by Apollo the physician, Aesculapius and Health, and all heal, and all the gods and goddesses, that according to my ability and judgment I will keep this Oath and this stipulation to reckon him who taught me this Art equally dear to me as my parents, to share my substance with him, and relieve his necessities if required, to look upon his offspring in the same footing as my own brothers, and to teach them this art, if they shall wish to learn it, without fee or stipulation, and that by precept, lecture and every other mode of instruction. I will impart knowledge of the art to my own son, and those of my teachers and to disciples bound by a stipulation and oath according to the law of medicine, but to none other. I will follow the system of regimen which, according to my ability and judgment, I consider for the benefit of my patients, and abstain from whatever is deleterious and mischievous, I will give no deadly medicine to anyone if asked, nor suggest any such counsel, and in like manner I will not give to a woman a peccary to produce abortion. With purity and holiness I will pass my life and practice my Art. I will not cut persons laboring under the stone, but will leave this to be done by men who are practitioners of this work. Into whatever houses I enter, I will go into them for the benefit of the sick, and will abstain from every voluntary act of mischief and corruption, and, further, from the seduction of females or males, of freemen or slaves, whatever, in connection with my professional practice, or not in connection with it, I see or hear, in the life of men, which ought to be spoken of abroad, I will not divulge, as reckoning that all such should be kept secret. While I continue to keep this Oath un-violated, may it be granted to me to enjoy life and the practice of the Art, respected by all men, in all times. But should I trespass and violate this Oath, may the reverse be my lot."

Ethical Oath used to be pledged by all fresh entrants to the medical profession at their graduation ceremonies. Discontinuation of this practice resulted in gross transgression of medical ethics and intern disrepute to the medical profession. World Medical Association (WMA) in a conference in Geneva took cognizance of falling and deteriorating ethical standard; restated ethical oath in simple language and modern style known as **Declaration of Geneva** and recommended its adaptation at graduation ceremonies. With very slight modification Pakistan Medical and Dental Council Code of Medical Ethics is now based. (Table 3.6)

**Table 3.6:***Code of ethics of PMDC*

"In the name of Allah, Most Gracious and Merciful I solemnly pledge that I shall abide by the principles laid down in the Code of Medical Ethics of the Pakistan and Dental Council. I further make solemn declaration that:

I consecrate my life to the service of humanity.

I will give to my teacher the respect and gratitude which is their due.

I will practice my profession with conscience, dignity and fear God.

Health of any patient will be my first consideration.

I will respect the secrets, which are confined in me.

I will maintain by all the means in my power, the honor and the noble traditions of the medical profession.

My colleagues will be my brothers and sisters.

I will not permit consideration of religion, nationality, race, party politics, social standings to intervene between my duty and my patient.

I will maintain the utmost respect, for human life, from the time of conception: even under threat, and will not use my medical knowledge contrary to the laws of humanity.

I make these promises solemnly, free and upon my honor."

## CHAPTER 4

### Relationship between man and crime

is as old as him. Starting from initial stage of primitive man to final stage of civilized man, change occurred in three chronological stages:

- During *earliest first stage of primitive-man*, who was mightiest, followed own dictum, "might is right". When assaulted, exercised vengeance upon aggressor having no relation to harm suffered by him
- During *second stage of intermediary-man*, he shared power with next mightier and shifting retaliation having single scale of penalty i.e. life for life and an eye for eye
- During *last final stage of civilized-man*, who accepted proportionate role of responsibility of crime and penalty scale reduced accordingly

Human-being is believed as creation of All Mighty Allah, blessed with only one life spread from cradle to grave, having purpose/function to perform.

Life begins with conception within the womb of mother, proceeds uninterrupted passing through two defined periods; first pre-natal totally dependent upon mother and second post-natal totally independent of mother.

During life, an individual also passes through three biological phases of defined ages, which are important for purpose/function of life:

- **Proliferative phase**
- **Static phase**
- **Retregressive phase**

*Proliferative phase* is continuation of pre-natal period into post-natal period to the age of puberty at 13/15. This phase is period of growth and his body (parts and organs) conforms into normal shape and continuously increasing in size including height and also acquire three functional abilities i.e. physical, sexual and intellectual, which are interdependent on each other. After this age, an individual is considered as fully developed for purpose/function of life.

*Static phase* is from age of puberty to age of onset of regression at 45/50. During this phase, there occurs no biological change affecting shape, size (height) and functional abilities of human body and remains fit for purpose of life.

*Retregressive phase* is last age of onset of degeneration to that of senility. During this period, there occur decline in human body shape, size and

## 4. Medical aspects of Law

functional abilities, which continue till inevitable end point i.e. death.

First and third phases are comparatively less competent from second as regards purpose/function of life, thus have mitigation towards quality of actions and individual responsibility. (Fig.4.1)

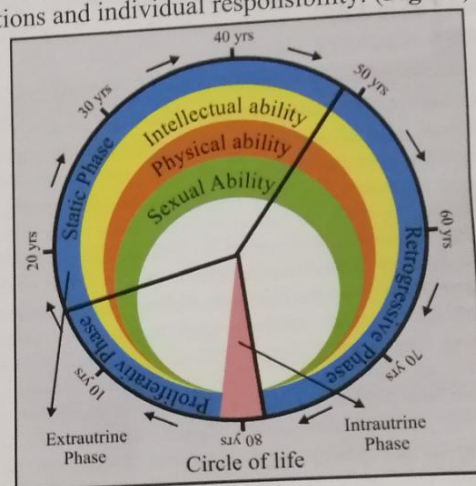


Fig 4.1: Phases of human body and their relationship to functional abilities

Jews, Christians and Muslims are unanimous that no one has any right to interfere into the purpose/function of life of other. This principle has been accepted and incorporated in criminal law codes. Criminal law while defining crime takes into consideration individual's age, gender, quality of his action and its consequences upon other. Such issues containing medical aspect of law are part of definition of crimes. Total list is extensive and going through them all is beyond the scope of this chapter. Some of them as examples are taken from criminal laws contained in Pakistan Penal code of offences against the person and are mentioned:

- Role of age, gender and potency/impotency especially in sexual offences
- Role of **mens-rea**, mental faculty manifesting purpose or intent of crime, also dependent upon being major/minor, intoxicated or suffering from mental illness
- Role of intoxicating (self/others) in Hadood ordinance,
- Role of wounding (self/others) and killing of fetus, self and others in Qisas & Diyat Ordinance

**Qisas & Diyat Ordinance 1991 and Hadood Ordinance 1976** has since been amended to bring them in conformity with the injunctions of Islam, thus reproduced.

*Qisas & Diyat Ordinance 1991* has replaced terms of murder with qatl and **injury** with **hurt** and also gave new classifications denoting specific meanings. Proper understanding of changes of injury/wound requires knowing the following:

- From medical point of view, any break in the body tissue, externally or internally is termed as wound or injury. Both words are synonymous in meaning and are a single pathological entity.
- Law also defines injury as any harm caused illegally to any person in body, mind, reputation or property.
- Law has not defined word *wound* so far and prefers to use the term *hurt* for it instead.

Besides, amended law provides compensation for criminal hurt for the first time in the country introducing new legal terms of **Arsh**, **Daman** and **Diyat**, in addition to **Qisas**. (Table 4.1) *Big Bro*

**Table 4.1:**

*Names of terms and their descriptions*

Names of terms	Description
<b>Arsh</b>	Compensation not is specified in law for causing hurt and payable by the offender to the victim or his heirs.
<b>Diyat</b>	Compensation specified in law for causing hurt payable to the heirs of the victim, by the offender.
<b>Daman</b>	Compensation not liable to Arsh and to be determined by the court for causing hurt and payable by offender to the victim or his heirs

**Hurt** is defined as and means causing of pain, harm, disease, infirmity, injury or impairing, disabling, dismembering any organ of the body or part thereof without causing death. It is typed on the basis of part of body involved and manner of infliction, each having further subtypes. (Tables 4.2 & Fig 4.2)

**Killing of human being** is a serious crime. It can occur during one's life from intra-uterine to extra-uterine unto the end point. Law divides killing into three types:

- Killing of human fetus, also called **miscarriage**
- Killing of self, also called **suicide**
- Killing of another human being, also called **homicide**.

**Killing of fetus** is evacuation of pregnant uterus. It may occur accidentally as spontaneous, induced therapeutically on medical grounds or by criminal means. Criminal miscarriage had been regarded as one of the most heinous crime in the early medico-legal codes. Therapeutic abortion, on the other hand, when performed in good faith for the sole purpose of saving life of mother used to be considered as the only justified reason for termination of pregnancy. The period of gestation is an important deciding factor. The attitude of society towards therapeutic abortion is changing dramatically.

**Table 4.2:**

*Classification of hurt*

Type	Subtype	Description and extent of damage
<i>Itlaf-i-Udw</i>	<i>Itlaf-i-Salahiyat-i-Udw</i>	Causing of <u>dismemberment, amputation, severement of any limb or organ of the body</u>
	<i>Shajjah</i>	Destroying or permanently impairing the <u>function or capacity of an organ</u> of the body or causing permanent disfigurement
<i>Jurh</i>	<i>Shajjah-i-Khafifah</i>	→ Hurt on the <u>head or face</u> which does not amount to <u>Itlaf-i-Udw</u> or <u>Itlaf-i-Salahiyat-i-Udw</u> .
	<i>Shajjah-i-Madiyah</i>	Hurt without <u>exposing of bone</u> .
	<i>Shajjah-i-Hashimah</i>	Exposing of bone without its fracture.
	<i>Shajjah-i-Munaqqilah</i>	Fracturing of bone without <u>displacement</u> .
	<i>Shajjah-i-Ammah</i>	Fracturing of bone with <u>displacement</u> .
	<i>Shajjah-i-Damighah</i>	Fracturing of bone and the wound touching the <u>membranes of brain</u> <i>meninges</i>
<i>Jurh</i>	<i>Jaifah</i>	Fracturing of bone with rupturing of the brain membranes.
	<i>Ghayr-Jaifah</i>	Hurt on part of the body other than the head and face bearing mark of wound which may be temporary or permanent.
	<i>Damiyah</i>	Hurt extending to the body cavity of the trunk.
	<i>Badiah</i>	Hurt not amounting to Jaifah.
	<i>Mutalahimah</i>	Rupturing of the <u>skin with bleeding</u> .
	<i>Mudihah</i>	Cutting of the <u>flash</u> without exposing the bone. ( <i>Sharp weapon</i> )
	<i>Hashimah</i>	Lacerating of <u>flesh</u> . ( <i>blunt weapon</i> )
	<i>Munaqqilah</i>	Exposing of <u>bone</u> .
	Fracturing of bone without displacing it.	
	Fracturing of <u>bone with its displacement</u> .	

*Jaifah* → body cavities  
*Ghair Jaifah* → U + L Limbs.

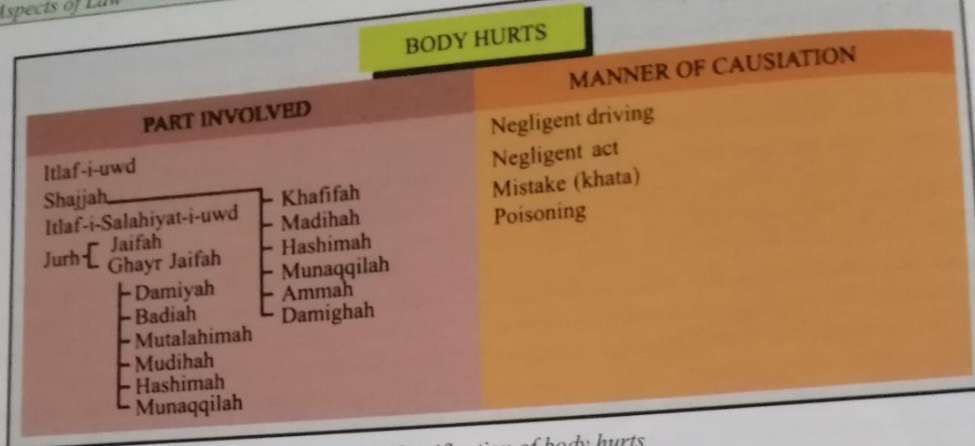


Fig 4.2: Classification of body hurts

Extent of provision of abortion services in the western countries is now considered as an index of community's stage of civilization.

Crime of **infanticide** exists in U.K having reduced punishment for a guilty mother only, compared to killing by another. Pakistan penal code is silent about it. Instead protects the new born child by prohibiting its secret burial or otherwise disposal whether dies before, during or after birth. Further, law after its conformity with Islamic principles now takes into consideration two stages of fetal gestation making the offence of miscarriage more serious, when done at a later stage of pregnancy.

In U.S.A. till 1973, the statute law had declared performance of criminal miscarriage unlawful. Decision of Supreme Court has radically changed it by new principles giving importance to three stages of fetal gestation and accepting the will of concerned individuals in this matter transferring authority to them. (Table 4.3)

Table 4.3:

*Period of gestation and authority for decision*

Period	Authority for decision
First, 13 week	Pregnant women and her physician
Second, onward to viability*	Physician, in the interest of pregnant woman's health **
Third, after viability	Physician, only to preserve pregnant woman's life

\* 28 weeks gestation (occasionally earlier as 24 weeks)

\*\* Taking into consideration her age, emotional health, family size and general well being

**Abortion Act 1976** of U.K has legalized performance of abortion, laying conditions for its as under:

- A person shall not be guilty of an offence under the law when a registered medical practitioner terminates a pregnancy, if two registered medical practitioners are of the opinion formed in good faith that
  - (i) Continuance of the pregnancy would involve risk to pregnant women's life or injury to her physical/mental health or her existing children greater than if the pregnancy were terminated
  - (ii) There is a substantial risk that if the child were born, it would suffer from such physical or mental abnormalities as to be seriously handicapped.
- Opinion of two registered medical practitioners shall not apply to the termination of a pregnancy by a registered medical practitioner in a case where
  - (i) He is of the opinion formed in good faith that the termination is immediately necessary to save the life or
  - (ii) Prevent grave permanent injury to the physical or mental health of the pregnant women.

**Killing of self** is an act of taking one's own life intentionally and voluntarily. Attempts have been divided into degrees explaining circumstances. (Table 4.4)

Table 4.4:

Category	Circumstances
Degree 1.	Deliberate (planned) - premeditated self murder
Degree 2.	Impulsive (unplanned) - under great provocation
Degree 3.	Accidental (intention to die is low) - person puts his life voluntarily into jeopardy.
Degree 4.	Circumstances of lack of capacity for intention - psychotic or intoxicated
Degree 5.	Self-destruction due to self-neglect - ignoring medical instruction
Degree 6.	Justifiable suicide - self-destruction due to terminal illness

Suicide is a complex phenomenon having medical, social, ethical and philosophical

implications. Christians and middle A later criminal Traditionally, every death e (homicide or

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implications. Under religion codes of Jews, Christians and Muslims, it is prohibited. Starting from middle Ages, society first used canonical and later criminal law in its fight against suicide. Traditionally, it was necessary to assign blame for every death either to God (natural death), or to man (homicide or suicide).

In U.K., it was designated as a special crime punishable by mutilation, sanction on place or manner of burial, forfeiture of property or censure of family. The last of penal statutes have since 1961 been repealed and suicide is no more a crime. In U.S.A., with the exception of some states, suicide was never a crime through statute, though it was considered as such under the common law. In Pakistan attempted suicide is a crime punished with imprisonment.

In most countries, it is now regarded less as a crime and more as an unfortunate consequence of mental illness and social disorganization, yet an undercurrent of social condemnation persists.

**Killing of another human being (Qatl)** is either **culpable** or **non-culpable**. *Culpable-homicide* deserves blame and according to law, has four types; **Qatl-i-Aind**, **Qatl-i-Shibh-i-Amd**, **Qatl-i-Khata** and **Qatl-bis-Sabab** and has taken cognizance of intention and circumstances surrounding culpable homicide. *Non-culpable*

*homicide* is without blame, further divided into **justifiable** and **excusable**.

**Euthanasia** is a special type of mercy killing of a human being, who is suffering from a painful and incurable disease. It is controversial killing and has not so far been taken cognizance by law courts being legal or illegal.

**Plato** first advocated the practice of euthanasia under Roman emperor. It is also claimed that in ancient Marseilles, authorities used to be approached to order euthanasia or direct medical authorities to stop medical treatment. There are examples in western world, in which parents and guardians approached law courts with the request to issue directive to the medical authorities to switch off the respirator because of vegetative state of the patient.

Pace of life now has picked so much during the last few decades that the values like time and money have taken over the idealistic value of reverence and veneration. Important question is whether the medical profession should be allowed to practice euthanasia independently in the interest of the patient or his family. It is a highly complicated issue and it will not be resolved in the near future, because of socio-cultural and religious traditions.

Euthanasia has recently been legalized in Australia but such a step is still considered unpleasant and unethical in most part of the world. (Table 4.5 & Fig 4.3)

**Table 4.5:**

*Types of killing and their description*

Type	Subtype	Description and extent of damage
A. Miscarage	Isqat-e-haml	Killing of human fetus by evacuation of pregnant uterus
	Isqat-e-janin	Killing of child whose organs has not been formed, without good faith for the purpose of saving life of the mother or providing necessary treatment
B. Suicide		Killing of child whose limbs or organs have been formed without good faith for the purpose of saving the life of the mother
		killing of self by an act of taking one's life voluntarily and intentionally
C. Homicide	<b>Culpable homicide</b>	Killing of a human being by another human being
		Killing of a human being having a blame
	Qatl-i-amd	Killing of specific human being or another with intention and knowledge of causing death.
	Qatl shibh-i-amd	Killing of human being with intention only to harm, but the death occurs which is unlikely.
	Qatl-i-khata	Killing of human being without intention to kill or harm, but death occurs by mistake of act or fact.
	Qatl bis-sabab	Killing of human being without intention to cause harm or death, but death occurs during the course of an unlawful act.
	<b>Non-culpable homicide</b>	Killing of human being without having a blame
Justifiable homicide	Killing of human being in pursuance of law. Example judicial hanging and killing by police during suppression of riots	
Excusable homicide	Killing of human being in excusable circumstances example death in self defense	



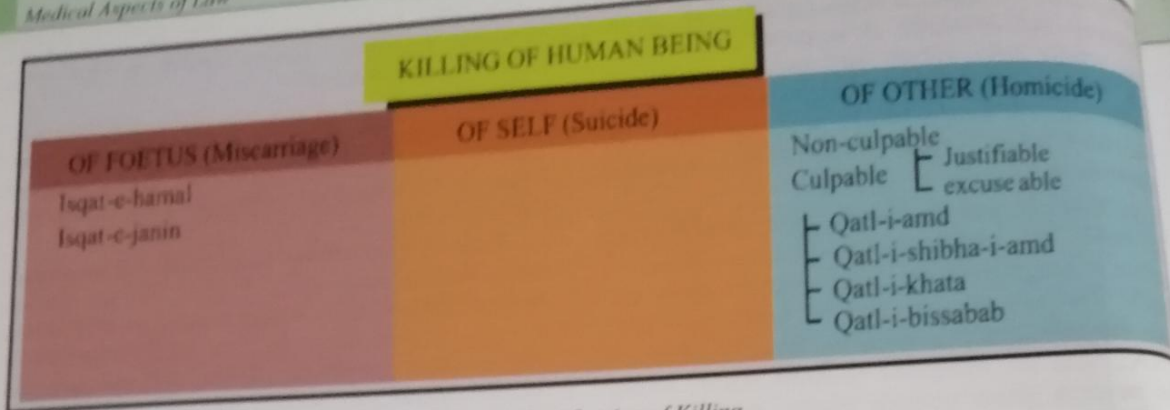


Fig: 4.3: Classification of Killing

Offence of rape has since been repealed, replaced with that of two offences of *Zina* and *Zina-bil-jabiar* and introducing different scales of punishments when committed by Muslims and individuals of other religion by enacting *Hadood ordinance 1976*. (Table 4.6)

Table 4.6:

Differentiation between zina and zina-bil-jabiar

Offence	Definition
<i>Zina</i>	Willful committing of sexual intercourse without being validly married to each other*
<i>Zina-bil-Jabar</i>	Committing of sexual intercourse with a woman or man** without being married, against will and consent of the victim*

\*Penetration constitutes sexual intercourse for offence of Zina.

\*\*When woman commits Zina-bil-Jabar

It has complicated the situation and its grasps require proper understanding of previous offence of rape, zina and zina-bil-jabar. Offence of rape was committed exclusively by a man with a woman against her will and consent. On the other hand offences of zina and zina-bil-jabar under the new law are willful committing of sexual intercourse by man as well as by woman, who are not validly married to each other, even with consent of partner and more heinous without consent of the partner. Punishment for Muslims, who are married and get involved, is severer and for this purpose terms of **Hadd** and **Muhsan** have been included:

- *Hadd* means punishment ordained by Holy Quran or Sunnah.
- *Muhsan* applicable to Muslim adult man and Muslim adult woman and means:

- A Muslim adult man and not insane, who has had sexual intercourse with Muslim adult woman and not insane, at the time he had sexual intercourse with her was married to her
- A Muslim adult woman and not insane, who has had sexual intercourse with a Muslim adult man, at the time she had sexual intercourse with him, was married to him.

Above stated is the current legal situation. Majority of the cases fall amongst normal healthy individuals and gets investigated in accordance with prevailing situation. But human sexual behavior during sexual intercourse is highly complicated and continues to remain confidential affair especially so when crime is involved. Besides, there is varied individual's requirement depending upon his mental disposition. Its relationship with sexual assault depends upon understanding and analysis of essential factors like **necessity of sexual indulgence, normal and socially accepted manner and abnormal and socially unacceptable behavior:**

- *Necessity of sexual indulgence* in both sexes is an intrinsic desire of variable intensity, which is compulsive and reparative. It must be fulfilled at intervals.
- *Normal and socially accepted manner* is difficult to define. In a medico-legal conference at Boston University, it was as decided that normal sexual activity may be defined as, "an adult's sexual expression with an adult of the opposite sex with mutual respect, tenderness and love." Socially accepted manner though varies at the individual level because of personal, traditional, racial and social differences amongst people, yet heterosexual

indulgence in **natural way** i.e. **sexual intercourse per vagina** is essential for procreation of the human race and is therefore, considered acceptable to fulfill this necessity. All religious codes accept these principles and all societies have legalized them under specific conditions of marriage and family laws. Marriage, therefore, has been accepted as the right way of having sexual intercourse with the partner of opposite sex. Sexual intercourse of normal type is the most important factor in a functioning marriage. Inability on the part of either spouse to consummate marriage enables the courts

to declare the marriage null. Consummation depends upon successful coitus.

- **Abnormal and socially unacceptable behavior** has not been a fully studied topic, being an extremely personal, private and confidential affair and there is a small percentage of people, who adopt **unnatural** or **perverted way**. No accurate statistical data is available. Unnatural sexual practices that are met in society involve both males as well as females. **Homosexuality** is on the top of the list. (Fig 4.4)

SEXUAL INDULGENCE (Of humans)		
NATURAL WAY (Per-vagina)	UNNATURAL WAY (Other way)	PERVERTED WAY
Marriage (After marriage) Zina (Unlawful, without marriage) Incest*	Sodomy (Per-anal cannal) Bestiality (Sex with animals) Lesbianism (sexual activity between women)	Sadism — Homosexuality Masochism — Voyeurism Paedophilia — Exhibitionism Trans-sexualism — Necrophilia Fetishism — Transvestism
*Sexual intercourse between blood relation		

Fig 4.4: Classification of Sexual practices

Besides, a very small percentage of persons, who due to their acute psychological need, transgress beyond usual sexual practice of foreplay and intercourse and become abnormally aggressive during the act. It may result in trauma to the partner and even death, which fortunately is rare. But when it does occur, creates sensation. This phenomenon should be recognized, because the catastrophe is the result of the complicated blend of many different sexual deviations with one type dominating over others. The most common combination is **sadomasochism**, **sadism** being primary and dominant trait. (Photo 4.1 & Table 4.7)



Photo 4.1: Death during aggressive sexual foreplay and intercourse

Table 4.7:

Sexual perversions with definitions

Perversion	Definition*
<b>Sadism</b>	Sexual pleasure from acts of cruelty to partner of opposite sex
<b>Masochism</b>	Sexual pleasure from pain/injury inflicted by partner of the opposite sex
<b>Homosexuality</b>	Sexual stimulation and gratification by partners of the same sex
<b>Lesbianism</b>	Sexual stimulation and gratification after consent between two females
<b>Transsexualism</b>	Desire to adopt the opposite sex
<b>Transvestism</b>	Sexual gratification derived by wearing dress of opposite sex
<b>Pedophilia</b>	Sexual love with prepubescent child
<b>Voyeurism</b>	Sexual gratification by looking at naked picture or body of the opposite sex
<b>Exhibitionism</b>	Sexual pleasure by exposing sex organs to the members of the opposite sex
<b>Bestiality</b>	Transference of object of sexuality from human beings to animals
<b>Necrophilia</b>	Desire to use dead body for sexual pleasure
<b>Fetishism</b>	Transference of sexuality object from human beings to belongings of opposite sex

\* To qualify as perversion, the desire should be morbid, taking precedence over desire for normal sexual intercourse

Sexual offenders, who are otherwise normal, but deteriorated morally, should be punished, rather severely to prevent illegal sexuality in the society.

**Marriage laws** have developed through ages starting with **common law union** to the present laws of marriage. Though there are international differences due to culture and religion, yet basic concept in the union of marriage is the same. Every society prescribes requirements of a good marriage, which are generally reflected in the customs. Essential criterion for a good marriage is that it should take place between a male and a female, both having appropriate ages and they should not have blood relation. These principles have been accepted by civilized societies. Pakistan is no exception. Important prevalent laws are:

- **Child Marriage Restraint Act 1929**
- **Dissolution of Muslim Marriage Act 1939**
- **Muslim Family Laws Ordinance 1961**

*Child Marriage Restraint Act 1929* is to protect children by prohibiting their marriages at an early age before the attainment of majority. The law prescribes punishment to parents or guardians who arrange or promote child marriage and further directs that once such a marriage occurs, it remains valid till the attainment of the puberty of the child.

*Dissolution of Muslim Marriage Act 1939* spells grounds for decree for dissolution of marriage amongst Muslims. Aggrieved party has to move the court of law for redress and place grounds for separation. The most important ground for dissolution of marriage is sexual deprivation of wife resulting from non availability of husband or his failure to perform sexual intercourse. (Table 4.8)

**Table 4.8:**

*List of grounds for the dissolution of marriage*

1. Husband's whereabouts unknown for four years
2. Husband's failure to provide maintenance for two years
3. Husband imprisoned for seven years
4. Husband's failure to perform marital obligations for three years
5. Husband's impotence since married
6. Husband suffering from insanity, leprosy or virulent venereal disease for two years.
7. Repudiation of marriage by wife after attainment of majority.
8. Husband's cruelty towards wife by way of:
  - (a) Physical or psychological violence
  - (b) Associating with women of ill repute
  - (c) Forcing her to lead immoral life
  - (d) Obstructing her from religious practices
  - (e) Disposing her property
  - (f) Not treating her equally in the presence of other wife/wives

*Muslim Family Law Ordinance 1961* is a recent law, which provides for registration of existing marriage. It further permits husband the privilege of second marriage on certain grounds such as sterility or physical infirmity for conjugal relations of existing wife. Insanity of existing wife is also a ground.

**Industrial worker compensation**, which involve use of large machines and chemicals having potential for causing injury to the body of worker. Similarly, toxic material may leak out into the environment affecting adversely the health of the worker and residents of the locally. Recognition of cause-effect relationship helps devise preventive measure for adoption in future and its medical certification serves the cause of justice to permit proportionate compensation to the worker.

**Common law torts**, laid principles to provide compensation to private individuals for losses suffered through conduct of others involving important issue of presence or absence of fault. (Table 4.9)

**Table 4.9:**

*Principles of common law torts*

1. Plaintiff\* has a right to be free from physical and mental injury
2. Defendant\*\* has a duty to the plaintiff to conform to a standard.
3. Breach of duty by the defendant.
4. Breach of duty resulting into damage to the plaintiff.
5. Determination of damage in terms of money

\* Party who sues in the court of law.

\*\*Person sued or accused in the court of law.

**Intentional torts**, on the other hand is criminal injury requiring action by the state in the form of punishment and **Negligence** without due regard for others safety resulting in injury is no more routinely applicable.

Modern laws of compensation of factory worker are based on the concept of **insurance** against injury to body or health of the worker and ensure prompt and proportionate cash benefits for any kind of worker's disability whether temporary or permanent caused due to accident. The permanent disability is further classed as total or partial.

Important laws, which are related with compensation to industrial worker, are **Workman's compensation Act 1923** with **compensation Rules 1961** and **Employee Social Security Ordinance 1965**.

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*Workman's Compensation Act 1923 with compensation Rules 1961* provides for compensation to the worker for any injury or disablement's occurring both due to accident and environment at place of work. An injured worker has two alternatives. He may either proceed under Workman's Compensation Act, or he may sue his

employer for damages in any civil court in which case he forfeits his rights under the Act. Injuries at the place of work resulting in total or partial permanent disablement (**Table 4.10**) or occupational disease (**Table 4.11**) have been enlisted in Schedules I and III respectively.

**Table 4.10:***List of injuries of permanent disablement*

Description of injuries	Percentage loss of earning capacity
<b>A. Permanent Total disablement</b>	
Loss at the level both hands or amputation at higher sites	100
Loss of one hand and one foot	100
Double amputation through leg or thigh or amputation through leg of one side and loss of the other foot	100
Loss of sight to such an extent as to render the victim unable to perform any work for which eyesight is essential	100
Very severe facial disfigurement	100
Absolute deafness	100
<b>B. Permanent partial disablement</b>	
<i>(i) Amputation cases -- Upper limbs (each limb)</i>	
Amputation through shoulder joint	90
Amputation below shoulder with stump less than 8 inches from tip of <i>acromion</i>	80
Amputation from 8 inches from the tip of <i>acromion</i> to less than 4 1/2 inch below the tip of <i>olecranon</i> is essential	70
Loss of hand or of the thumb and forefingers of one hand or amputation from 4 1/2 inch below the tip of <i>olecranon</i>	60
Loss of thumb	30
Loss of thumb and its metacarpal bones	40
Loss of forefingers of one hand	50
Loss of three fingers of one hand	30
Loss of two fingers of one hand	20
Loss of terminal phalynx of thumb	20
<i>(ii) Amputation cases -- Lower limbs (both limbs)</i>	
Amputation of both feet resulting in end-bearing stumps	90
Amputation through both feet proximal to <i>metatarsophalyngeal joint</i>	80
Loss of all toes of both feet through <i>metatarsophalyngeal joints</i>	40
Loss of all toes of both feet proximal to the proximal <i>interphalyngeal joint</i>	30
Loss of all toes of both feet distal to proximal <i>interphalyngeal joint</i>	20
<i>(iii) Amputation cases -- Lower limbs (each limb)</i>	
Amputation at hip	90
Amputation below hip with stump not exceeding 5 inches in length from the tip of greater trochanter	80
Amputation below hip with stump exceeding 5 inches in length from the tip of the greater trochanter	70
Amputation below mid-thigh to 3 1/2 inch below knee	60
Amputation below knee with stump exceeding 3/12 inch but not exceeding 5 inches	50
Amputation below knee with stump exceeding 5 inches	40
Amputation of one foot resulting in end-bearing stump	30
Amputation through one foot proximal to <i>metatarsophalyngeal joint</i>	30
Loss of all toes of one foot through <i>metatarsophalyngeal joint</i>	20
<b>C. Other injuries</b>	
Loss of one eye without complications, the other being normal	40
Loss of vision of one eye without complications or disfigurement of eye ball, the other being normal	30

Table 4.11:

Occupational diseases	Employment
Occupational diseases	Any employment involving:
Anthrax Employment	a) Handling of wool, hair, bristles or animal carcasses including hides, hoofs and horns
	b) Working with animals infected with anthrax
	c) Loading, unloading or transportation of merchandise
Compressed air illnesses	Any process carried on in compressed air
Leads	Any process involving the use of lead
Nitrous fumes	Any process involving the use of nitrous fumes
Phosphorus	Any process involving the use of phosphorus
Mercury	Any process involving the use of mercury
Benzene	Any process involving the use of benzene
Chrome	Any process involving the use of chrome
Arsenic	Any process involving the use of arsenic
Pathological manifestations due to	
Radium	Any process involving exposure to the action of radium
Radioactive substances	Any process involving exposure to the action of radioactive substances
X-rays	Any process involving exposure to the action of X-rays
Primary epitheliomatous cancer of skin	Any process involving the handling of tar, pitch, bitumen, mineral oil, paraffin or compounds of these substances
Silicosis	Any process involving the grinding, cleaning, fettling, casting and crushing of Stones

**Temporary disablement** means disablement of temporary nature, which reduces the earning capacity of a workman in employment in which he was engaged at the time of the accident

**Permanent disablement** means disablement which reduces his earning capacity in every employment which he was capable of undertaking at the time of accident: provided that every injury specified in the Schedule I shall be deemed to result in permanent partial disablement.

**Total disablement** means disablement whether of a temporary or permanent nature<sup>1</sup> as incapacitates a workman for all kinds of work, which he was capable of performing at the time of the accident. Permanent total disablement shall be deemed to result from:

- Permanent total loss of the sight of both eyes
- from any combination of injuries specified in Schedule I where aggregate percentage of the loss of earning capacity as specified in that Schedule against those injuries, amounts to one hundred per cent

*Employees Social Security Ordinance 1965* provides for the insurance of both employer and employee and the scope of benefits have been made more liberal extending them even to dependents of the worker. The disability has been equated to

inability to engage in any substantial gainful activity because of any medically determinate impairment. The state, employer and employee all pay contributions to the social security fund to be utilized for workers benefit, (Table 4.12) when earnings are stopped.

**Payment of the benefits** to the worker is through the Social Security Institution having a medical advisor, medical boards and many medical practitioners. It can safely be stated that introduction of social security laws has made extensive improvements in medico-legal matters concerning an industrial worker by replacing the ancient rule of Common law tort to most modern laws of Social Security. Legislation has replaced judicial decisions, which has permitted more satisfactory handling of medico-legal issues evolving from industrialized, urbanized and technologically advanced society of modern man. Improvements have made medical issues as principle concern from inception of insurance to payment of claims for disability or death. It means that medicine has moved from an inferior position to a superior position and further the authority to make decision in such cases involving medical issues has moved from lay courts to expert administrative agencies having medical specialists. It has also resulted in standardization of claims.

**Table 4.12:***Employment benefits of the worker*

<b>Benefit</b>	<b>Legal Definition</b>
Sickness Benefit	A secured person who is certified to be incapable of attending to his work on account of sickness shall be entitled to receive sickness benefit throughout the period of sickness.
Confinement	Labor resulting in the issue of a living child or labour after 26 weeks of pregnancy resulting in the issue of a child, whether alive or dead.
Maternity Benefit	A secured woman shall be entitled to receive maternity benefit as certified by a medical practitioner and such benefit shall be paid for all days on which she does not work for remuneration during a period of twelve weeks, of which not more than six weeks shall precede the expected date of confinement.
Disablement	Condition caused by an employment injury which has permanently reduced or is likely to reduce permanently a secured person's earning capacity. Disablement shall be minor when the loss of earning capacity is less than twenty percent, partial when the loss of earning capacity ranges from twenty one percent to sixty-one percent and total when the loss of earning capacity is in excess of sixty-six percent.
Injury Benefit	A secured person shall be entitled to receive injury benefit in respect of any day, other than the first three days, including the day on which, as a result of an employment injury, to be incapable of work, but for not more than one hundred and eighty days.
Disablement Pension	A secured person who sustains total or partial disablement shall be entitled, upon the expiration of his entitlement to injury benefit, to receive disablement pension, according to the degree of disablement determined.
Employment injury	Personal injury to a secured person caused by an accident or by such occupational disease arising out of and in the course of his employment.
Disablement Gratuity	(i) A secured person who sustains minor disablement shall be entitled to a disablement gratuity for different degrees of disablement as may be fixed by Government by notification, in consultation with the institution. (ii) Where a person receiving disablement pension ceases to suffer from total or partial disablement but continue to suffer from minor disablement he shall, on the termination of his disablement pension, be entitled to disablement gratuity under this section.
Death Grant	On the death of a secured person entitled to receive injury benefit, sickness benefit or medical care at the time of death, the surviving widows/widower/the person who provided for the funeral shall be entitled to a death grant equal to the daily rate if sickness benefit multiplied by thirty, but in no case less than five hundred rupees.

# CHAPTER 5

## 5. Personal identity

**Recognition of individuality** means

**personal identity**, Accepted particulars for this purpose are individual's father's name, age, sex, height, weight and residential address. **Proof of personal identity** is a legal requirement for all administrative purposes like admission into schools, colleges and universities and also for seeking employment, passport and driving or fire-arm license. In law enforcement, no complaint against another person is entertained and investigated by police without confirmation of accused and applicant's personal identity. Above stated particulars are routinely mentioned along with **two permanent identity marks** like scar or mole and it was considered sufficient. Introduction of computerized national identity card (**CNIC**) bearing facial photograph, signature or thumb impression of the holder has standardized method of personal identification.

Cases of personal identity during law enforcement investigation, which occasionally create problem are person without CNIC or willfully withhold unconscious victim of road accident and ascendant soldier. It may also become a problem in baby in maternity ward and rarely in a case of impersonation. Only choice or method left to establish personal identity in such cases is to prepare **written narrative** i.e. full description of person including possible identity clues related to him after careful and meticulous physical examination. Police till recently had been preparing written narrative of person's description basing it on conventional methods, though are based on sound footing, yet have no medical background.

- 1. Anthropometry, also called Bertillon's anthropometric system
- 2. Dactylography

→ Bertillon's anthropometric system named after its originator was criminal investigation assistant in France. He observed that after the age of 21, an individual ceases to increase in size and most of his measurements such as length/breadth of head, length of middle, index and little fingers and size of feet and toes could be used as clues to personal identity. According to him if 14 such measurements are collected, odd against any two persons having the same measurements is 1 to 286. His supporters

considered it almost an infallible method. Final method consisted of individual's descriptive data, which included color of skin, eyes and hair, shape of nose, ears, chin and identity mark on the body like mole, scar or tattoo, and 14 bodily measurements including standing and sitting heights. Method required extensive apparatus and time. (Fig. 5.1)



Fig. 5.1: Main sketches of Bertillon's anthropometric system

→ Dactylography is superior to the above method and is based on the study of patterns of ridges present on hand finger tips after taking of fingertip impressions, Chinese used thumbprint as an identity mark on seals many hundreds of years ago. In 1823, a Czechoslovakian physiologist **J.E. Purkinje** described them giving first classification. In 1885 **Henry Faulds**, Scottish physician recognized importance of skin ridges as an aid to personal identification and its possibility of using them in criminal investigation. In 1892, **Francis Galton** produced proper scientific work on the subject, which was later improved and elaborated by **Edward Henry**.

Personal identification from individual's fingerprints is a matter for fingerprint expert. Medical practitioner should have some knowledge of patterns of papillary ridges, which remain constant from birth to death and are not destroyed by desquamation of surface epithelium or by abrasive action of sandpaper. These ridges on fingertips form different patterns and expert study of fingertip pattern shows 150 ridge characteristics. It is the fingertip pattern and ridge characteristics, which are individual specific. So far there have been many classifications of fingertip patterns, but the most common and accepted classification includes four patterns i.e.

\*CLASSIFICATION OF FINGER-TIP PATTERNS:

arch or loop and composite may have of this method and their investigation fingerprint

**arch or tented arch, loop or twinned loop, whorl and composite.** A very low percentage of individuals may have an additional **accidental** pattern. **Accuracy** of this method is because of type of fingerprint patterns and their individual characteristics. Federal Bureau of Investigation in United States has over 30 million fingerprints on its files and none are alike. (Fig 5.2)

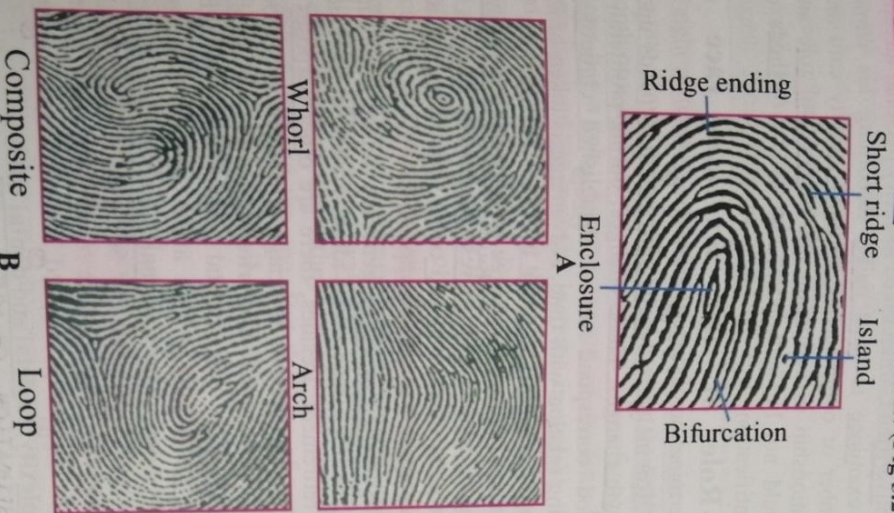


Fig 5.2: A. Papillary ridges' characteristics B. Four fingerprint patterns

In our country after an allegation of a crime and arrest of a person, prints of all five fingers are taken. **Thumbprint** is taken at the time of joining an employment and for issue of computerized identity card and passport. There are two methods of recording of fingerprints; plain and rolled, later is considered better.

Forensic medicine has since long been playing its role to resolve problems of police including determination of personal identity of unknown during investigation by law enforcement. Forensic medical

- examiner may be approached and requested for advice to help in like cases;
- Harden skin of hands of dead body due to postmortem drying has difficulty of recording of finger prints. Skin should be rendered soft by application of oil and fingerprint contour restored by injecting subcutaneous area bearing print with paraffin wax *extensive portions of skin + underlying fascia*
- In case of de-gloving of epithelium, as generally happens in early decomposition, it should be carefully separated from underlying tissues sparing print and then spread on a slide and preserved between two glass slides after air drying.
- Preservation of whole hand, five fingers or even fingertips is undertaken by cutting at proximal joints and cut-portions preserved either in saturated saline or rectified spirit in separate containers having a label mentioning hand, finger or fingertip whether of left or right side.
- Basic principle applicable for establishment of personal identity of fresh unknown cases and decomposed, mutilated or burnt human's remains is location and utilization of individual's personal identity clues and those of his belongings.

Human bodies though appear similar, yet some of its body parts such as face, hands and feet are individuals specific. Other personal identity parameters are related to anatomy, physiology, pathology and even genetics. (Table 5.1)

Table 5.1:	
<b>Personal identity parameters</b>	
<b>Whole body</b>	Age (height and weight) and sex
<b>Body parts</b>	(a) Face having specific shape of eyes, nose, lips, chin, cheeks, teeth, color of iris
	(b) Hands and feet bearing specific finger prints/tracings
<b>Anatomy</b>	(a) Primary at birth --no sex character
	(b) Secondary that appears later--sex characters and other degenerative changes like cataract/arous <u>senilis</u> in eyes
<b>Physiology</b>	Gait, tone of voice and manner of speech
<b>Pathology</b>	Diseases—eczema/calclified fibroid
<b>Genetics</b>	Blood groups and other morphological character like <u>Barr body</u>

Related findings collected during physical examination depend upon physical condition of dead body weather fresh or otherwise and circumstance surrounding the case. They are present within body as a whole, human remains and belongings. **Examples** of various characteristics clues within body are facial features, color of skin, height, weight or any special



finding like webbed fingers and others in belongings are wristwatch, spectacles and head cap. All have a role in personal identity.

→ **Compilation of personal identity data**

is a technical job, more suited to the medical personnel rather than police, being a part of descriptive protocol. Every case should be dealt carefully on its own merits, avoiding orthodox approach, as it prevents application of fresh knowledge. Problem may have to be discussed amongst involvement experts belonging to others specialties before starting work. **Coordinated approach is better.** There are two methods: **Subjective** and **Objective method.** \*METHODS: ↴

① → **Subjective method** is applicable in fresh unknown, unconscious and unaccompanied road accident victims. Other possible cases are highly putrefied and burnt bodies in which facial identification and fingerprinting is not possible. Fresh ones present no difficulty in preparation of descriptive protocol. Physical examination of remains of putrefied and burnt bodies including belongings is subjected to search to isolate various tissues like hair, nails, teeth and bones, which do not putrefy. These tissues are subjected to thorough wash to make them fit for physical inspection, microscopy and radiology for identification of their characteristics for matching. **Non-biological material** of interest in such cases is clothes and other belongings, which are subjected to physical inspection to note style of dress, identity marks of tailoring and laundry. During autopsy of fresh case, information may be very extensive and that of other during advanced putrefaction, gross mutilation and severe burns especially with parts missing, it is patchy and limited. Dried stains of blood and semen on clothes and other biological trace of human or animal origin that are not subjected to decomposition are extremely valuable to identify their sources of origin. It will be discussed as a separate topic under the heading of trace evidence.

② → **Objective method** is utilization of already collected data. It is analyzed to isolate individual's specific identity clue or character, which can act as a lead to personal identity. Exercise is based on the theory that a character having intimate association to a person, be it may in body of the person or his belongings, is sufficient to establish his identity. An example to illustrate this point is that the fattest, the shortest or the tallest boy/girl in a class does not

require additional clue or characteristics, even facial for his recognition.

→ **Third party method** used during forensic medical certification/autopsy is in-fact legal approach for identification of examinee. There is essentially two parties, medical examiner and examinee and relative/friend, when asked to verify personal identity of examinee is third party. Recording his name, number of computerized national identity card and relationship in certificate has no medical role and should not be included in the list of methods of identification.

→ **Role of age, sex and race** in determination of personal identity:

→ **Age** inclusive height and weight depends upon growth changes. These changes, during proliferative period correspond to an established chronology having relation with time. Advantage is taken of this record of events in order of time that age can be estimated with some degree of reasonable accuracy. Afterwards during retrogressive period, changes in most parts of the body do occur, but are erratic and **age estimation is only an approximation.**

Estimation of age is generally raised at the time of schooling, issue of an identity card, employment and retirement. Besides, there are other purposes of civil nature such as marriage and election for both voter and candidate and criminal nature like criminal responsibility and capital punishment including whipping. **Factors** which affect age are sex, race, nutrition and climate. Females end up in advance of males and it is generally seen that **puberty ensues much earlier in hot climate of the East.** Determination of age is mainly directed towards study of **body complexity, skeletal and dental data.**

\*ESTIMATION OF AGE:

① → **Body complexity** includes length, weight and morphological body:

\*HESS'S RULE: ↴

- **Length of fetus** during intrauterine period may be fixed with near mathematical accuracy by direct measurement by **Hess's Rule**. It states that squares of months of gestation give the length of fetus in centimeters upto fifth month and after words, number of months should be multiplied by five, which shall give length of fetus in centimeters. Later increase of length during extra-uterine period occurs at puberty in males at thirteen to fourteen years of age. Increases in length during extra-uterine period become erratic and the scale is neither regular nor reliable. (Table 5.2)

**Table 5.2:**

*Fetal length and morphological features at different ages*

Age	Length	Morphological
1 <sup>st</sup> month	1.25cm	Embryo formed showing limb buds
2 <sup>nd</sup> month	2.5cm	Head formed showing ears and hands
3 <sup>rd</sup> month	9 cm	Placenta formed, nails appearing
4 <sup>th</sup> month	15cm	Sex clear, hair appearing on head
5 <sup>th</sup> month	25cm	Weight 350-450g
6 <sup>th</sup> month	30cm	Weight 700-900g
7 <sup>th</sup> month	35cm	Weight 1.2-1.4kg
8 <sup>th</sup> month	40cm	Weight 1.5-2kg
9 <sup>th</sup> month	50cm	Weight 2.5-3.5 kg

• **Weight of fetus** is important. Fetus gains weight at the rate of one pound per month starting from fifth month onward and later appearance of ossification center has a role. **Average weight of the fetus at birth is about six pounds.** Increase in weight, till end of first year, is also at the rate of one pound per month. A child roughly doubles its weight in first six months and weight is three times at the end of first year. After this, rate of increase in weight also becomes erratic. However, the general tables of average lengths and average weights are available, indicating in a general way rate of growth. From forensic point of view, they are of little value as regards estimating the age. But they are of some use in indicating what is expected in a normal individual. (Table 5.3)

**Table 5.3:**

*Relation of age with heights and weights*

Age	Male		Female	
	Height (in feet)	Weight (in Kgs)	Height (in feet)	Weight (in Kgs)
1	2.5	8.4	2.3	8.2
2	2.8	15.0	2.7	11.5
3	3.1	15.5	2.10	14.5
4	3.1	16.7	3'0	16.3
5	3.4	18.2	3.3	17.5
6	3.7	20.0	3.6	19.0
7	3.10	22.5	3.8	21.5
8	3.11	25.0	3.10	23.5
9	4.1	27.5	4.0	25.0
10	4.3	30.5	4.2	28.0
11	4.5	32.5	4.4	30.5
12	4.7	35.0	4.6	34.5
13	4.9	37.5	4.8	39.5
14	4.11	41.5	4.11	43.5
15	5.2	46.5	5.1	48.2
16	5.4	54.0	5.2	51.5
17	5.6	59.0	5.3	52.5
18	5.7	62.0	5.3	55.0

① **Morphological changes** are developmental and retrogressive in nature.

a) **Developmental changes** during intra-uterine period are appearance of facial features, growth of nail, hair on head and eyelashes, differentiation of sex and descending of testis. During extra-uterine period the changes are appearance of fine hair in the pubic region, deepening of voice and enlargement of testes and penis takes place. These changes later are followed by appearance of hair in axillae and finally hair begins to appear on the face in male. **Appearance of fine hair in female is about one year earlier than male**, first appearing in the pubic region and then in axillae followed by enlargement of breasts. **A girl also starts to menstruate around thirteen years.** (3y)

b) **Retrogressive changes** take place in both sexes. They are not reliable and act only as pointers for age. These changes externally are:

- **Wrinkles** about eyes and in front of the ears around 30 to 35 years
- **Arcus-senilis** in eyes around cornea, which begins to develop at about forty years or later but seldom becomes circular and complete before the age of sixty years. However, **an arcus-juvenile** is also known to occur.
- **Hair color change** like graying occurs around forty years. Graying of pubic hair practically never occurs before fifty years.
- **Loss of elasticity and discoloration** of skin of buttocks and abdomen
- **Internal changes** are atrophy of the uterus, brown atrophy of the heart and calcification of laryngeal and costal cartilages generally occurs after forty years of age. All give some indication that the body is of an elderly person.

② → **Skeletal data** for determination of age requires examination of the bones. Human skeleton develops from a number of separate centers of ossification and their growth. Development of centers of ossification and bone growth is very complicated. Some idea of its complexity may be gaged from the fact that there are about **806 centers** of bone growth at eleventh prenatal week stage, at birth about **450** and adult skeleton has only **206 bones.**

With the exception of bones in skull, all other bones of the skeleton are **pre-formed in cartilage**, which takes on the characteristic shape of the bone-to-be and is, in very fact, the **matrix** within which ossification will occur. A typical long bone for

example tibia, will have three centers or principal loci of growth.

- Mid-portion, the shaft or diaphysis and
- Two end-positions; an upper or proximal and lower or distal, the epiphysis.

These three, one diaphysis and two epiphyses, are the growth loci of the tibia. At either end, between diaphysis and epiphysis, is a plate of hyaline cartilage, which is the diaphyseo-epiphyseal zone. It is here that growth actually occurs, and it is here that epiphyseal union occurs.

Histological examination of the ends of long bones in the earlier age and morphological examination of them at the later stage are the choices of examination for the determination of age. (Photo 5.1)

Reliable estimation of age is based on study of long bones of limbs (arm and shoulder, leg and hip) and skull bones including mandible. In long bones of limbs, appearance of primary centers of ossification and their growth with appearance of secondary

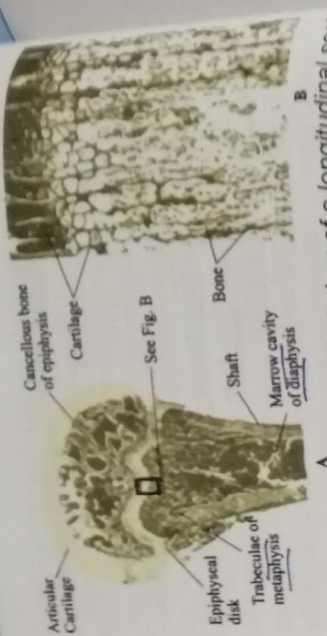


Photo: 5.1: Photomicrographical view of a longitudinal section through the upper end of a growing long bone showing diaphyseo-epiphyseal relationships A under low power and B under high power

centers of ossification and their growth and finally union of epiphysis with diaphysis is the index into the attainment of twenty-fifth year of age. (Fig. 5.3 to 5.6 & Photo.5.2) 25<sup>th</sup> y

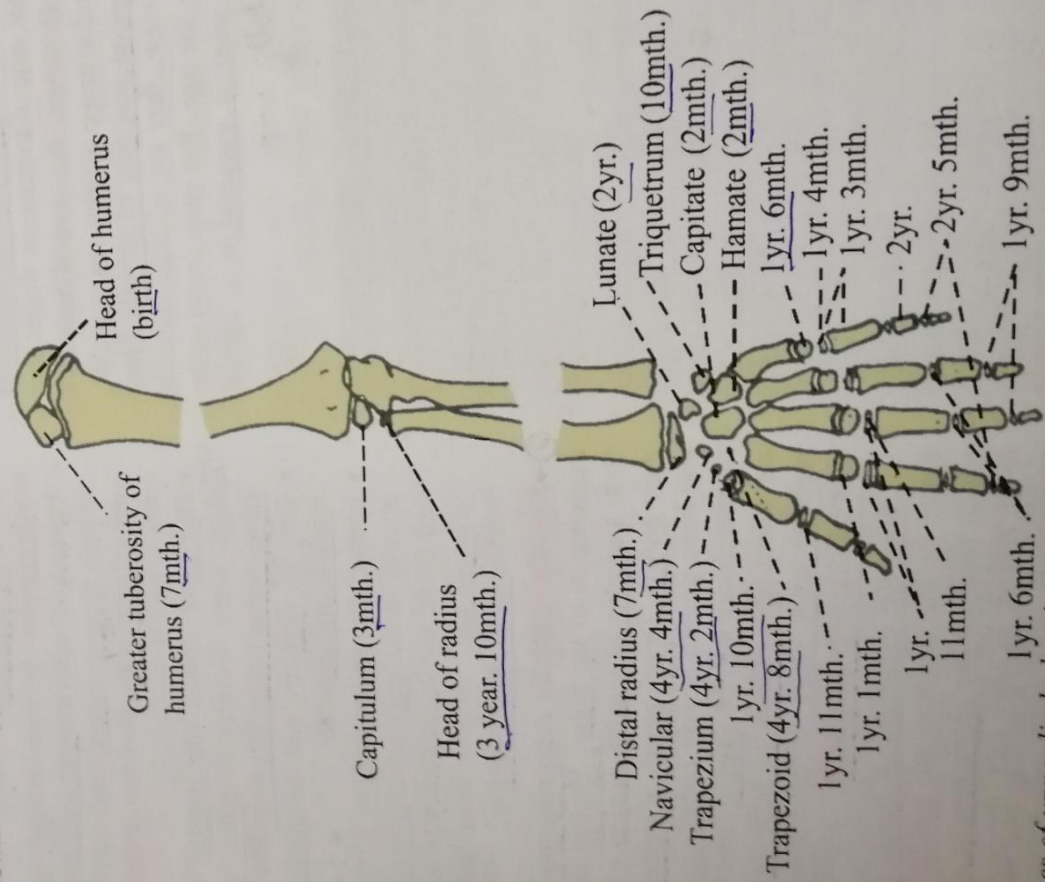


Fig 5.3: Bones of upper limb showing appearance of centers of ossification upto the age of five years.

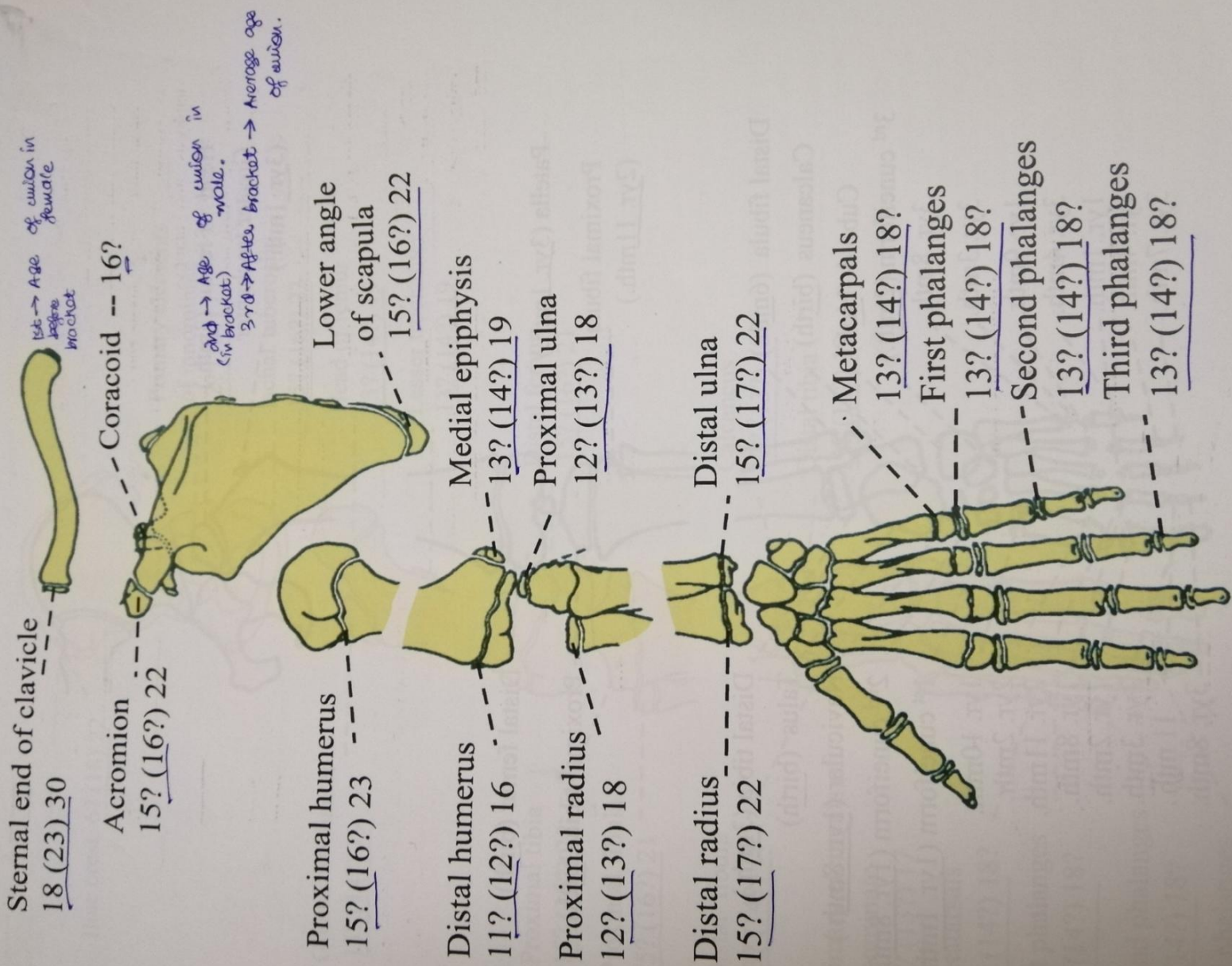


Fig 5.4: Bones of upper limb showing location and ages of unions of epiphyses. Of the three, earliest is age of union in female, second is age of union in male and next is average age of union

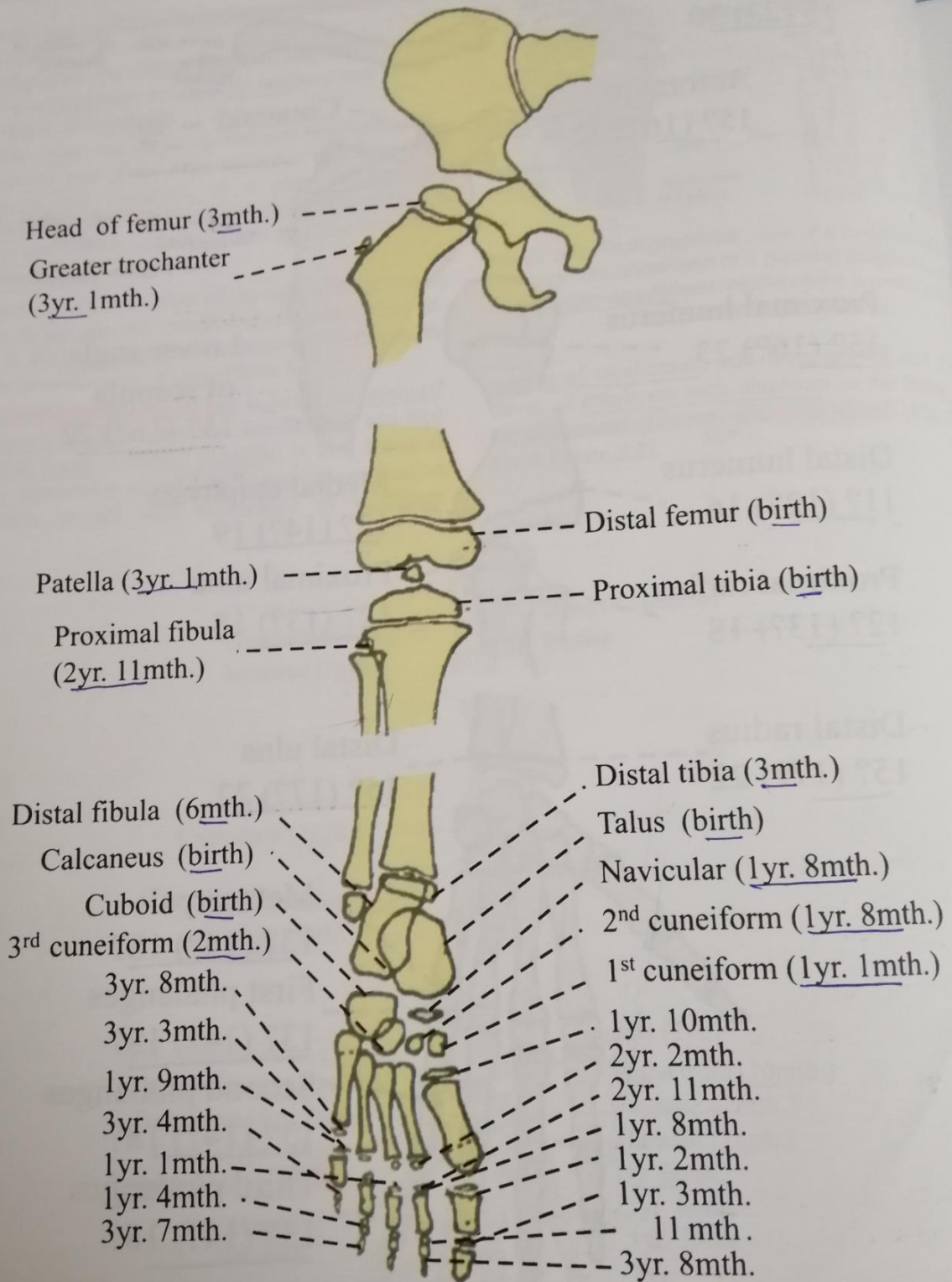
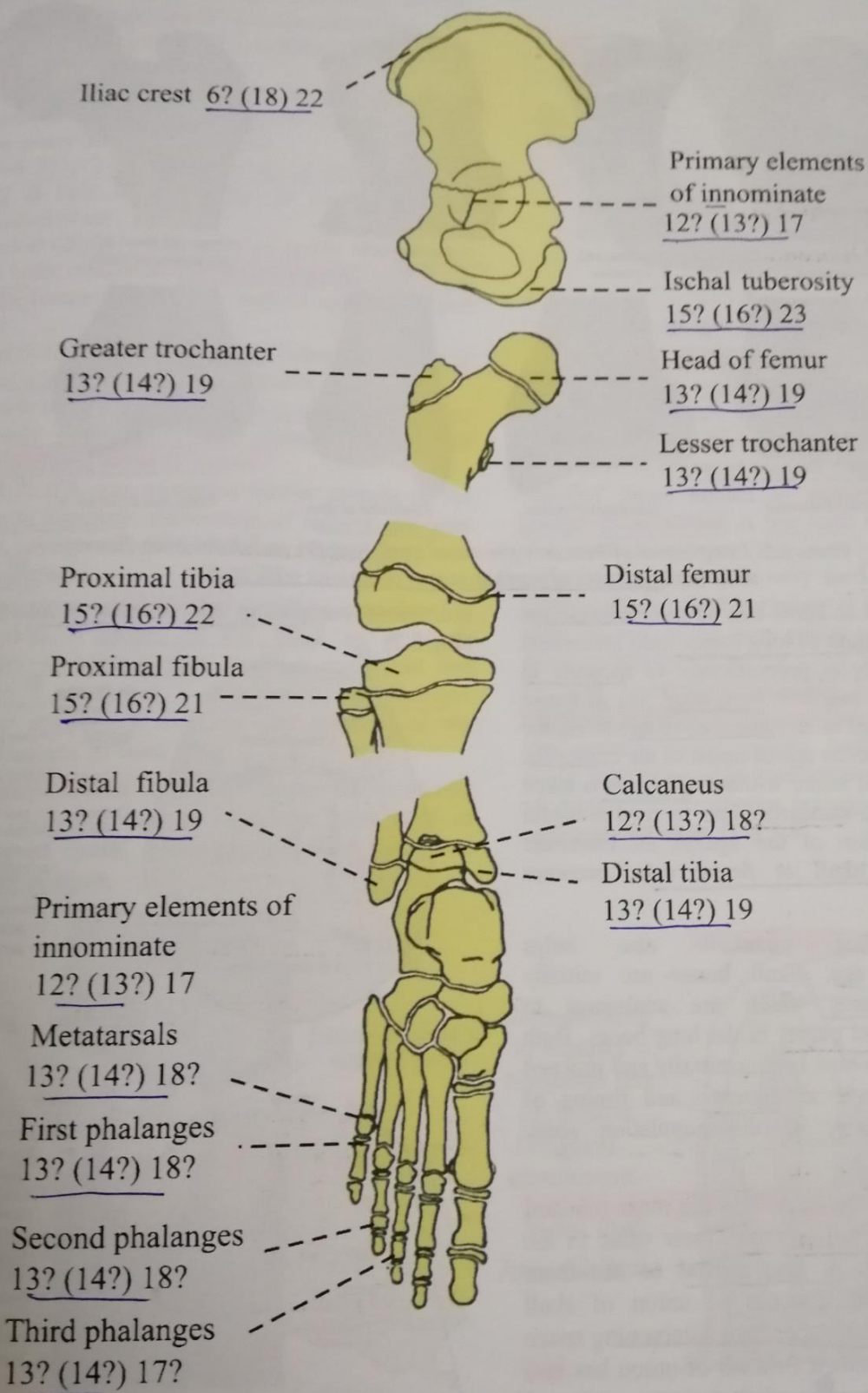


Fig 5.5: Bones of lower limb showing appearance of centers of ossification unto the age of five year



**Fig 5.6:** Bones of lower limb showing location of epiphyses and age unions. Of the three, earliest is age of union in female, second is age of union in males and next is average age of union

Krogman  
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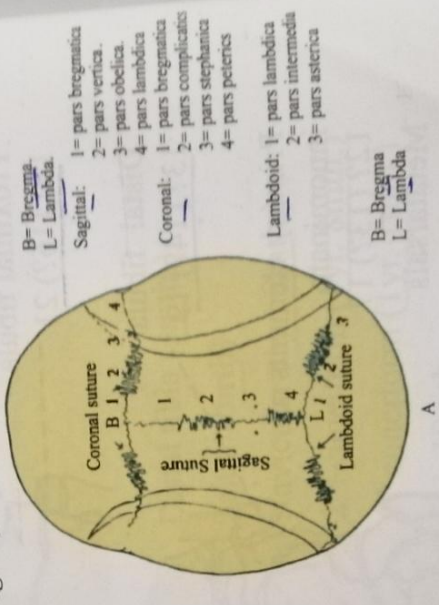


**Photo 5.2:** Long bones of human's proximal ends (upper) and distal ends (lower) showing epiphyses at various stages of unions with shafts obliterated completing the process of ossification. (Fig 5.7)

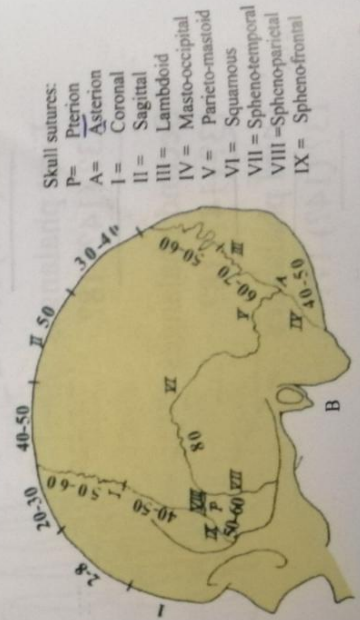
⇒ It is important to know that advancement of age and increase in length of long bones unto attainment of age of maturity is proportionate to increase in height. Therefore, length of long bone, say of femur by itself can be used as an indication of age being the most useful. Before the age of union of the epiphysis, maximum length of femur without epiphysis is taken and compared with standards. This method is useful when the estimation of the age of an immature skeleton without skull or dental data, becomes necessary.

Skull including mandible also helps determination of age. Skull bones are initially separated by sutures which are analogous to epiphyseo-diaphyseal planes in the long bones. Both are loci of growth, which begin centrally and proceed peripherally and have a sequence and timing of union, when majority of the population show complete union.

Cranial sutures of the brain box are more relevant than those of the facial skeleton. Their value in the estimation of age is in later period of life from thirtieth year onward. Process of union of skull sutures begins by reducing of their intervening space and uniting them together. Process of union has two progressions i.e. from inner vault to outer vault and along the lines of sutures. Skull sutures finally get



B = Bregma  
 L = Lambda  
 Sagittal:  
 1 = pars bregmatica  
 2 = pars vertica  
 3 = pars obelica  
 4 = pars lambdica  
 Coronal:  
 1 = pars bregmatica  
 2 = pars complicata  
 3 = pars stephanica  
 4 = pars petetica  
 Lambdoid:  
 1 = pars lambdica  
 2 = pars intermedia  
 3 = pars asterica  
 B = Bregma  
 L = Lambda



Skull sutures:  
 P = Pterion  
 A = Asterion  
 I = Coronal  
 II = Sagittal  
 III = Lambdoid  
 IV = Masto-occipital  
 V = Parieto-mastoid  
 VI = Squamous  
 VII = Spheno-temporal  
 VIII = Spheno-parietal  
 IX = Spheno-frontal

**Fig 5.7:** Cranial vault sutures. A. Subdivision. B. Age closure

Krogman reviewing skeletal development divided changes into seven periods for estimation of age:

**Period 1:** on appearance of centers of ossification from birth to 5<sup>th</sup> year upon

**Period 2:** on further growth of above centers, appearance of additional secondary centers and size of the center from 5<sup>th</sup> to 12<sup>th</sup> year.

**Period 3:** (12-20 years) union of epiphysis with shafts in most of long bones as an indicator for estimation of age.

**Period 4:** (20-25 years) union of nearly all epiphysis in the body, except the center in the medial end of the clavicle (extremely variable both in appearance and union)

**Period 5:** (25-36 years) beginning, extent of closure of coronal, sagittal and lambdoid sutures.

**Period 6:** (36-50 years) progress in closure of sutures and early degenerative age changes in articular surfaces of long bones in joints.

**Period 7:** (50 year onwards) further process of the closure to complete obliteration of sutures and joint change, along with calcification of laryngeal and costal cartilage.

Age changes in mandible should be considered in relationship to shape of the bone as a whole especially its various parts (ramus, condoloid and coronoid processes), dentition, alveolar ridge, muscular attachment marking and position of the mental foramen. (Photo. 5.3)

③ → **Dental data** is another important parameter for age estimation and is based on knowledge of structure of tooth, growth process of teeth and wear-tear of teeth.



Photo.5.3: Age changes in mandible. A. Adult. B. Old age

→ Structure of tooth is composed of dentine having two parts crown and root. Dentine is highly mineralized material, embedded in bony sockets of both jaws and the most durable of all body tissues. It is covered by crown of another extremely and highly calcified tissue known as enamel, which is the hardest of all tissues. A few teeth have a single root and some have more than one root. A substance called cementum again very hard covers all roots. Fibrous tissue called periodontal membrane passes from the wall of the bony socket onto the cementum forming attachment of the tooth. Epithelium around its neck forms a V shaped reflection is called gingival crevice. Tooth possesses a central cavity that contains blood vessels, lymphatic and nerves along with some cells associated with the formation of dentine. These tissues occupy the central cavity called dental pulp. (Fig 5.8)

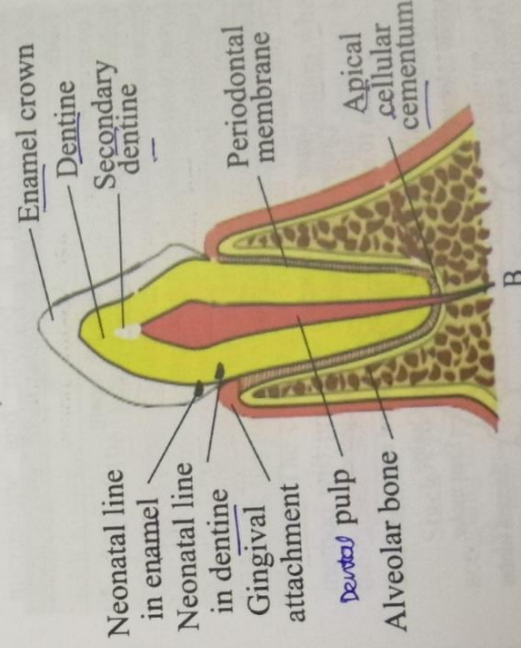
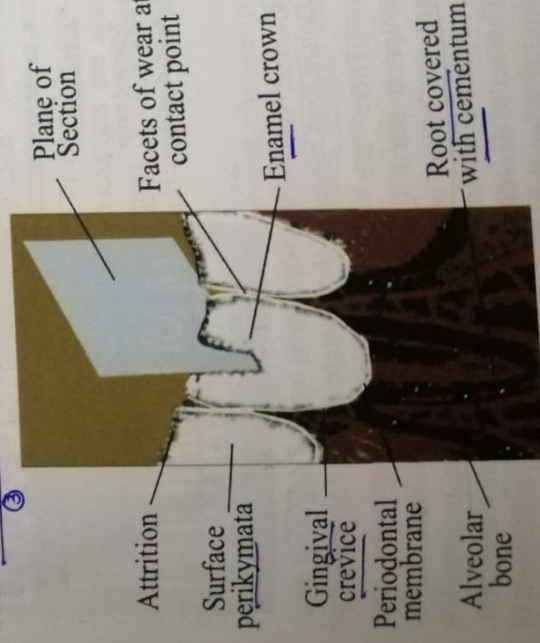


Fig 5.8: Tooth and supportive bony structures A. teeth in situ with plane of section B. longitudinal section



develop-  
ment of  
teeth and  
their  
arrange-  
ment in  
mouth.

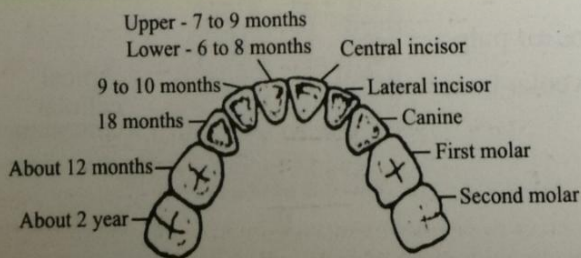
⇒ Growth process of teeth starts during pre-natal period and proceeds through post-natal period till attainment of 25<sup>th</sup> year of age. There are two types of dentitions, milk or deciduous and permanent. They develop one after the other first as soft cartilage and subsequently get calcified. Process of calcification is incremental having phases of activity and rest. Both enamel and dentine are formed by rhythmic alternate periods of formation and rest represented in the teeth as series of fine lines in a thin section, which can be seen under the microscope. Birth causes a marked transitory upset in this equilibrium, which is recorded as a well-marked line, called neonatal line.

⇒ Process of calcification of teeth starts at incisors at their tips of milk teeth, usually at fifth month of intrauterine period, continues at tips of remaining teeth from twentieth week onwards and further to the extent of two third in incisors and one third in canines and just tips in molars at the time of birth. Deciduous teeth remain in jaws for some years. Mixed dentition period ranges from the fall of the first deciduous tooth and eruption of the first permanent tooth starting generally at sixth or seventh year till fall of the last deciduous tooth, which is roughly in the twelfth and thirteenth year. Number with extent of eruption of deciduous and permanent teeth is guideline for estimation of age. (Fig 5.9)

There are ten deciduous teeth in each jaw. Their eruption begin in sixth or seventh month of age when the first tooth appears in the upper jaw and eruption of all deciduous teeth completed by end of two years. Calcification of the roots of these teeth is completed by end of third year. (Table 5.4 & Fig 5.10)

**Table 5.4:**  
Age of Eruption of the deciduous teeth

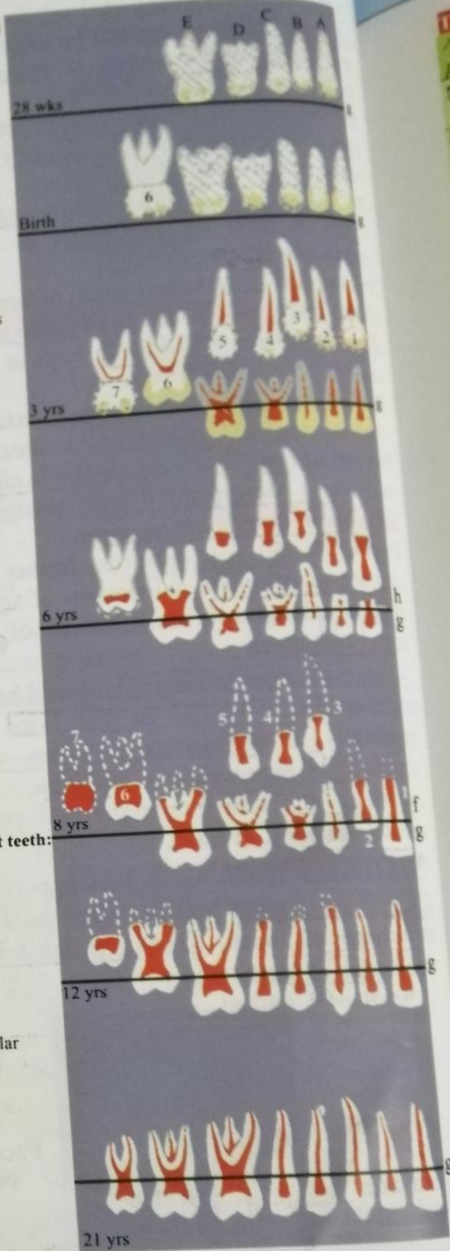
Tooth	Age
Lower central incisor	6 <sup>th</sup> to 8 <sup>th</sup> month
Upper central incisor	7 <sup>th</sup> to 9 <sup>th</sup> month
Upper lateral incisor	9 <sup>th</sup> month
Lower lateral incisor	10 <sup>th</sup> month
First molars	12 <sup>th</sup> month
Canines	18 months
Second molars	2 years



**Fig 5.10:** Eruption ages of deciduous teeth

**Upper deciduous teeth:**

- A- Central incisor
- B- Lateral incisor
- C- Canine
- D- First molar
- D- Second molar
- E- Forming root
- E- Gum level
- E- Resorption of roots



**Upper Permanent teeth:**

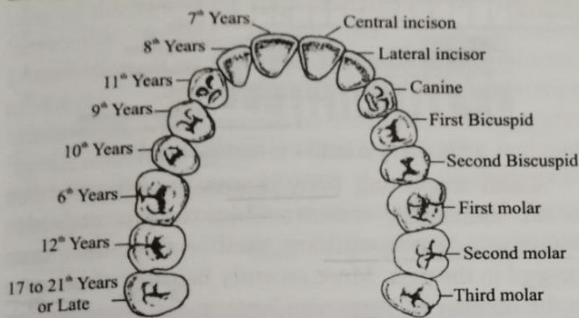
- 1- Central incisor
- 2- Lateral incisor
- 3- Canine
- 4- First premolar
- 5- Second premolar
- 6- First molar
- 7- Second molar
- 8- Third molar

**Fig 5.9:** Deciduous/ permanent teeth at different ages. Dotted lines represent the ultimate shape of forming teeth

There are thirty-two permanent teeth, and eruption starts first in the lower jaw followed by eruption in the upper jaw. Set of thirty-two teeth is completed around eighteenth to twenty-one year. This set of dentition remains in jaws till attainment of senility when they begin to fall out. Last permanent is third molar; also called 'wisdom' tooth may not appear until 25 years. (Table 5.5 & Fig 5.11)

**Table 5.5:**  
Age of eruption and completion of root calcification of permanent teeth

Name	Year of eruption	Year of completion of root calcification
Central incisors	7	10
Lateral incisors	8	11
First bicuspid	9	12-13
Second bicuspid	10	13-14
Canines	11	13-15
First molars	6	9-10
Second molars	11-12	14-16
Third molars	17-18	18-21



**Fig. 5.11:** Eruption timing of permanent dentition

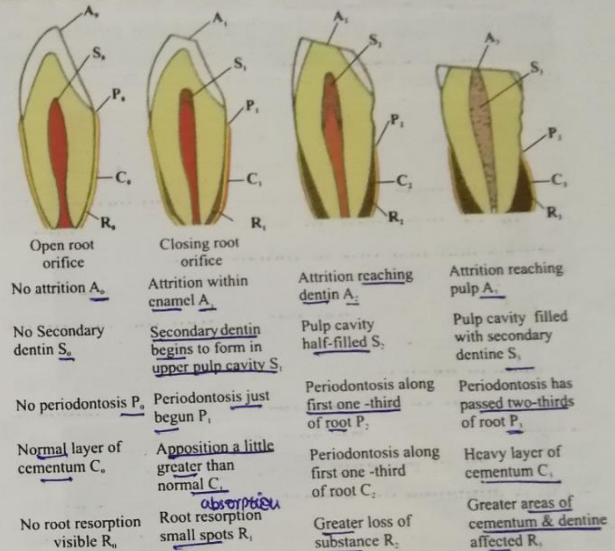
Once dental data is fully mature at about 25 years, age accuracy from them is only to the nearest decade and is based on general appearances in living cases. Further estimation of age from teeth over 25 years is not possible because of completion of processes of development and growth. Certain specialized tests of teeth may give an age in mature adult to within 5-7 years, but only on dead subject.

⇒ **Wear-tear of teeth** and its relationship with age assessment of adult over twenty-one years is complicated and entails consideration of physiological age changes in each of dental tissues, rate of which is not known. These changes are also influenced and obscured by onset pathological conditions. Further, time of dentition can be altered with sex, diet and even with disease.

**Gustafson (1950)** studied wear-tear changes of teeth and this study is the first scientific work on aging of teeth. He observed that teeth damage and repair changes are of six types that were occurring due to constant use. He assigned them values as part of aging process. He is of the opinion that maintenance of shape of teeth after full development is a complex process and no single factor can be relied upon. He claimed that age of any tooth could be ascertained by his method with an accuracy of  $\pm 3$  years. (Table 5.6 & Fig 5.12)

**Table 5.6:**  
Gustafson's criteria

Name of changes	Values			
Degrees of attrition	A <sub>0</sub>	A <sub>1</sub>	A <sub>2</sub>	A <sub>3</sub>
Alteration in level of gingival attachment	S <sub>0</sub>	S <sub>1</sub>	S <sub>2</sub>	S <sub>3</sub>
Amount of secondary dentine	P <sub>0</sub>	P <sub>1</sub>	P <sub>2</sub>	P <sub>3</sub>
Translucency of the root	T <sub>0</sub>	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>
Root resorption	R <sub>0</sub>	R <sub>1</sub>	R <sub>2</sub>	R <sub>3</sub>
Cementum deposit around root	C <sub>0</sub>	C <sub>1</sub>	C <sub>2</sub>	C <sub>3</sub>



**Fig 5.12:** Point's values allotted in determining age

**Miles (1963)** took his studies further on and stated that translucency of root alone is the most reliable of all of Gustafson's criteria for measurement of age. According to him, it can be noted with a microscope and method is relatively easy. He considers it quite accurate for determination of age with accuracy.

**Boyd (1963)** devised a method of age estimation from incremental features of enamel. Striations of the enamel prisms are daily increments of growth at the rate of four microns a day. The method consists of counting the number of cross-striations from the time of birth. The counting procedure is tedious and this method will probably only find its application when the most accurate estimate of age has to be determined.

**Stack (1963)** worked on teeth of infants and according to him, age of an infant is related to weight and height of developing teeth. Tables showing extent of development, calcification and eruption at a given age of a child and young person are available.

## \* ARRANGEMENT OF TEETH

Beside age estimation from development of teeth, their arrangements can help determination of personal identification. It is based upon the theory that arrangement of teeth is individual's specific, visible during life and also remembered by others. Further, teeth bite imprints are also individual's specific when caused on human skin and food stuff. Such bite imprint can act as good means that can be relied upon for personal identity of aggressor in cases of physical/sexual assault. Though rare, yet is an important finding providing indisputable evidence of assailant's personal identity after matching with control. (Photo 5.4)

TEETH  
BITE  
IMPRINTS

Photo 5.4: Bite teeth imprint on shirt and corresponding underlying skin of victim of left chest

Similarly teeth bite imprint on leftover food stuff like cheese or apple at scene of crime can act as good evidence of personal identification. Precaution is that examination and recording of description of teeth bite imprint on food stuff prepared at the earliest before distortion of bite mark along with its, photograph and cast models developed.

Dental fillings have definite shapes that can be recorded by X-ray and they are also individual specific. Dental surgeon can easily recognize own work. X-ray and photograph are good records of such dentine fillings, which can be referred to later. Furthermore, people pay regular visits to dental practitioners who keep accurate records of dental

treatment. Such dental records may help identification of an unknown person especially if the treatment given is in the form of dental fillings, dentures and even extractions. It is necessary to prepare record of findings on a standard dentition chart using specific notation symbols. (Fig 5.13)

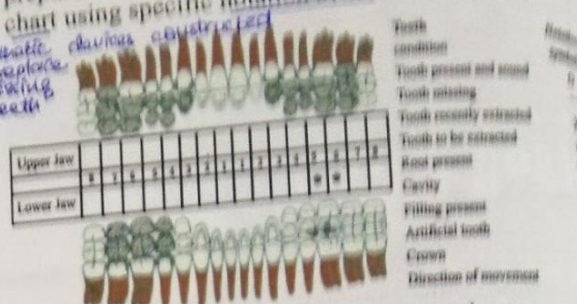


Fig 5.13: Standard dentition charts

Teeth supporting bony tissues are characteristic to an individual, indestructible to fire and also withstand decomposition; their value has been ignored in the past. More recently because of increase in the number of mass accidents in rail, road and air their importance have been enhanced. While investigating such accidents, medical examiner should follow a defined protocol to record observations in a way that others can read and understand. They should also use same symbols for charting.

Teeth forming parts of unidentified remains of mass road, railway or air disaster involving many victims should be carefully collected from accident scene and taken to laboratory for their detailed examination. Objective of such an examination is to know the number of individuals along with determination of their identity parameter such as age, sex, race or any other feature of special interest.

Protocol of examination consists of two stages:

- ① Initial examination at the locus
- ② Subsequent in the laboratory

① → Initial examination at the locus is undertaken in two steps; area charting and collecting of evidence. 1- Area charting starts by its sealing from public interference for smooth search and to avoid contamination. Whole area bearing human remains is divided into plots of reasonable size and each portion numbered. Collecting of evidence is careful search of displaced parts especially teeth, fillings, crowns and dentures. Great care should be exercised in the handling of remains subjected to heat or fire to avoid damage to them. Human remains having teeth should be removed from the scene in special containers,

which are numbered according to the number of portion of the plot. Each container should bear a tag showing number of plot and site of recovery. It should be done after preparing area diagrams or taking area photograph. Advantage must be taken of photography at every stage.

③ → Subsequent in the laboratory examination includes physical examination of each recovery, taking radiograph of the whole dentition/ skull or their supporting parts to know about dental cavities, fillings or any other treatment provided previously. In case of difficulty, the fragments should be removed from the human remain for more detailed examination. It is followed by co-relating collected evidence with individuals' characteristics information, which should be obtained from relatives, friends and other agencies. This information includes full physical description of the individual with photographs and any previous medical and dental treatment along with name of the dental practitioner who treated him.

→ **Determination of sex** till recently was quite simple, but biological research has confirmed that none of the existing criteria for determination of sex are reliable. Categories 'male' and 'female' are not mutually exclusive. Medicine has invented a new term **intersex** to cater for new situation for both **intermediate** and **indeterminate** situations. Current trend to establish precise diagnosis about sex of an individual consists of three investigations:

- ① Anatomical
- ② Chromosomal
- ③ Psychological

① → **Anatomical** comprises of noting of external body appearance of an individual both natural and acquired, more particularly shape of the body such as convexity at nipples, concavity upward of pubic hair, hair style and dress. Additionally, one may perform a **genital test** by observing presence of penis or vagina and may confirm by **gonadal test** the presence of ovary or testis by radiographic exploration and even microscopy of ovarian or testicular tissue.

Determination of sex in cases of mutilated or decomposed bodies depends mainly upon anatomical investigation other than external appearances. Hair, non-gravid uterus and prostate gland resist putrefaction and these structures may help in some cases. Main parameter, which is still left and is useful for anatomical investigation in such cases, is bones. Limitation of this parameter is that age and sex go

together till puberty and recognizable sex differences do not appear up to the age of majority. Unto this age, female bones are comparatively smaller and lighter in weight. After this age, sex can easily be established with considerable accuracy from morphological characteristics of the bones. Both subjective and objective methods should be undertaken for examination of the bones. Bones have a high percentage of accuracy for the determination of sex. (Table 5.7) Bone % of accuracy for sex determination.

Table 5.7:

Percentage accuracy of bones for sex determination

Entire skeleton	100%
Pelvis	95%
Skull	92%
Pelvis and skull	98%
Pelvis and long bones	98%
Long bones	70 - 80%

→ **Skull** in females is smaller, lighter and has 10% less capacity than male skull. **Cranio-facial proportions** are similar in both sexes. Facial portion in the female is relatively smoother. This may be confirmed by observing mandible, contour of the forehead, glabella, supraorbital ridges, orbit, cheekbones and nasal aperture. **Mastoid process** is less prominent in females than males. Superciliary ridges are less pronounced in females. Fusion between nasal and frontal bones shows a smoother curve from the forehead to the base of nose in females whereas in males there is a distinct angulation besides more prominent and rough zygoma. Orbital opening is rounded and smaller in the female where as in male it is squarish and larger. (Table 5.8)

→ **Sternum & manubrium** and their relative size differ in both sexes. Body of sternum is more than twice the length of manubrium in males and average index in males is 46.2 and in females 54.3. (Fig 5.14)

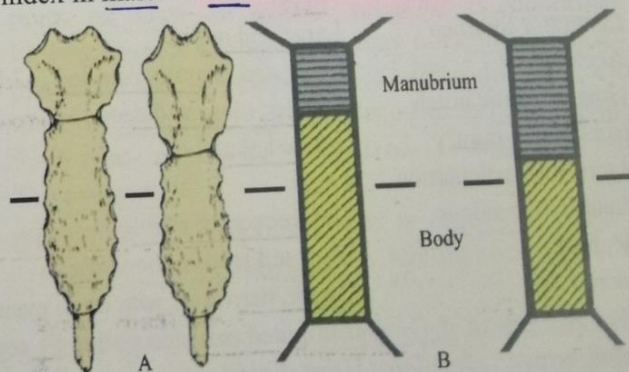


Fig 5.14: Relative size of manubrium and body of the sternum

**Table 5.8:**  
Morphological sex difference in skull

Feature	Male	Female
Whole skull	Large (Endocranial volume is about 200 cc. more in male)	Small
Architectural design	Rugged	Smooth
Orbit	Squatish, relatively smaller, lower and with rounded margins	Larger, higher and with sharp margins
Supraorbital ridge	Medium to large	Small to medium
Cheek bone	Large and more laterally prominent	Small and more flat
Parietal protuberance	Small	Large
Forehead	Steeper and less rounded	Rounded and full
Frontal prominence	Small	Large
Mastoid process	Medium to large	Small to medium
Occipital region	Muscle attachments and protuberances prominent	Muscle attachments and protuberances less prominent
Occipital condyles	Large	Small
Mandible	Large, with higher symphysis and broad ramus	Small, with less corpal and ramal dimensions
Palate	Large, broader and U-shaped	Small, narrow and parabolic
Teeth	Large, with first lower molar having 5 cusps	Small, with all molars having 4 cusps

→ Pelvis as a whole inclusive sacrum in females is light, less massive, and smoother and likes a flat bowl. In males, it is heavier, massive, rugged, with marked muscular sites and deep like a funnel. Subpubic angle in females is of 90° and in males 65° to 70°. The greater sciatic notch in females is wide and in males is narrow. Sciatic angle in females is 90° and in males 70°. Sciatic notch index is the most useful criterion. Acetabulum in females is narrow and in males, it is wide. Sacrum in females is short, wide, light and almost straight in its upper half and curved only in the lower half whereas in males it is longer less wide, heavy and has a uniform curve. The

articular surface in females extends upto 2nd and in males upto 3rd vertebra. (Fig 5.15 & Table 5.11)

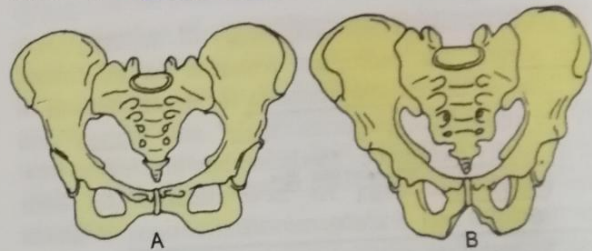


Fig 5.15: Morphological sex differences of pelvis and sacrum A. female and B. Male

**Table 5.9:**  
Morphological sex differences in pelvis

Feature	Male	Female
Whole pelvis	Massive, rugged, marked muscular attachments	Less massive and smoother
Subpubic angle	Acute and V-shaped (65-70°)	Rounded, broader, U-shaped (90°)
Symphysis	Higher	Lower
Obturator foramen	Large and ovoid	Small and triangular
Acetabulum	Large and laterally directed, wide	Small and anterolaterally directed, narrow
Greater sciatic notch	Smaller, close and deep, narrow	Larger, wider and shallower
Ischiopubic rami	Everted slightly	Everted strongly
Sacro-iliac articulation	Large	Small
Preauricular sulcus	Not frequently visible	More frequently developed
Ileum	High and tends to be vertical	Lower and divergent laterally
Sacrum	Larger, narrower, with more evenly distributed curvature; often 5+ segments	Smaller, broader, with tendency to marked curvature in the upper and lower segments
Pelvic brim	Heart shaped	Circular or elliptical
Pelvic cavity	Relatively smaller	Oblique, shallow and roomier

Short, light in its upper half and curved only in lower half.

Sciatic angle 70°

90°

→ **Chromosomal** depends upon a **technique**, in which **nuclear material** of cell could be **disentangled** and render the **constituent parts** of nucleus visible under the microscope. It has been revealed that in humans, there are **46 chromosomes** in **23 pairs**. **Each pair differs both in size and shape**. One component of each pair is derived from each **parent**. Furthermore there is difference in **men and women** in one of the **23 pairs** as **other 22 pairs are indistinguishable** between **sexes**. In females, there is a pair, which consists of **two medium sized chromosomes** known as **X chromosomes**, and in males, one of these X chromosomes is missing and is replaced by **Y chromosome**. Females, therefore have **2X (XX)** while males have **one X and one Y (XY)**.

It was thought that difficulties of determining sex could be resolved by easy process of **identifying sex chromatin**, but nature is not as simple as this. There are many stages of development of **XX embryo** into a normal female, and **XY embryo** into a normal male. Process is complex and on many occasions ends up far from the **expected normal**, resulting in the formation of **different combinations**. **Except the first two, all are classed as intersex**. (Fig 5.16 & Table 5.10)

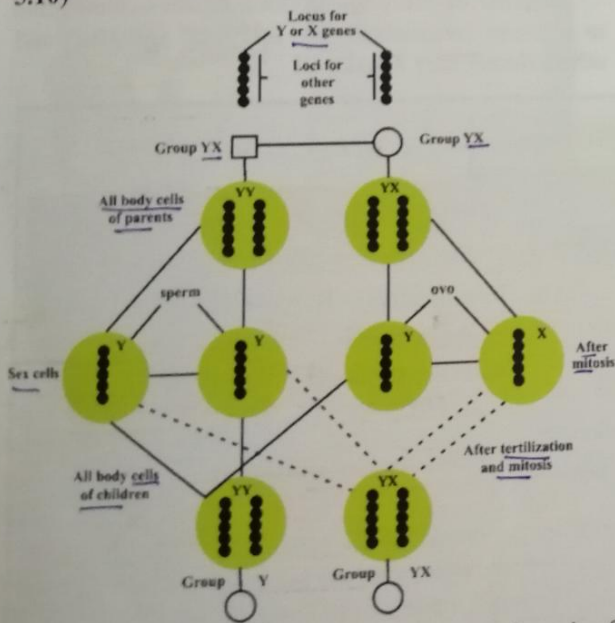


Fig 5.16: A. Diagrammatic representation of a pair of sex chromosomes. B. Inheritance of blood group system XY showing the segregation of the sperm and ova.

→ **Sex chromatin** material recognition in male/female cells is done by locating **Davidson body**, a **drumstick** shaped condensation in some percentage female white blood cells and **Barr body**

situated just close to nuclear membrane in epithelial cells of females especially **buccal mucosa**. Both **stain more deeply than the rest of nuclear material**. (Fig 5.17)

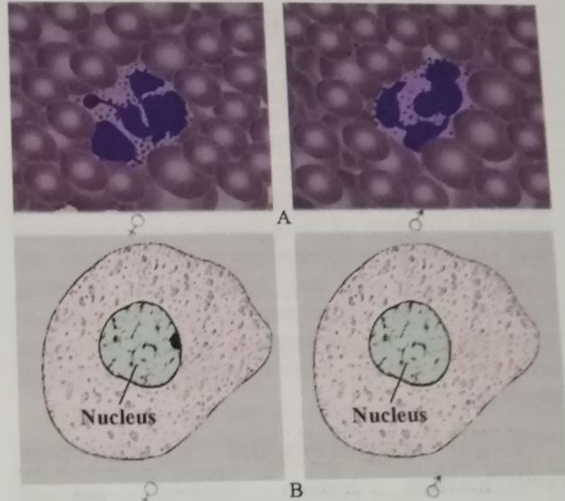


Fig 5.17: Slides showing difference due to sex chromatin. A. Davidson body in female white blood cell. B. Barr body in female buccal epithelial cell.

Table 5.10:

Different combinations to sex chromosomes	
XX	- Normal female
XY	- Normal male
XXY	- Klinefelter's Syndrome (Feminized infertile male)
XXX	- Variant Klinefelter's Syndrome (Mosaicism)
XXX	- Super Female or Triple-X Syndrome
XO	- Turner Syndrome
XX-XY	- True hermaphrodite

⇒ **Psychological assessment**, especially from the point of view of **sexual behavior** is important. Physical sex of an individual may not conform to the psychological development of an individual and those behave abnormal are placed in **intersex group**. Two types are so far recognized; **Transvestite** and **Transsexual**.

- **Transvestite** is the one who is **obsessed** with the clothing of the opposite sex having compulsion to **cross-dress**.
- **Transsexual** has a **dominant wish** to identify with the opposite sex as completely as possible **discarding forever his or her own anatomical sex**.

\* INTER-SEX GROUP

# CHAPTER 6

## 6. Forensic Aspect of Wounding (part 1)

wounding/duration of injury and manner of its infliction are essential inferences. It is emphasized that only those medical practitioners having knowledge and understanding of interaction between weapon of offence causing wounding and body part including various tissues should do this task. Medical practitioner is further advised not to embark upon this task, unless he is formally authorized to do it. Further, such task should be undertaken only at purpose designed/built **medico-legal clinic**, equipped with necessary logistics and supported with a trained paramedic.

**Wounding of body tissue** due to accident, by self or other and when by other, is a cognizable offence punishable under related sections of Pakistan Penal Code depending upon its gravity. When breaking is external, it involves skin with underlying tissues and when internal involves serous lining (membrane) of body cavities with contents (organs). Breaking of body tissue is also associated with other local manifestations at site like pain and bleeding and general body responses like sweating, transient loss of consciousness. Final outcome of wounding may be precipitation of death depending upon gravity having direct relationship to extent of involvement.

**Type of wounding** conventionally has been classified either on the basis of weapon used or manner of its infliction. Typing due to weapon used includes single causative factor injury by blunt and sharp edged weapon and other is fire arm injury due to multiple causative factors weapon like smooth/rifled barrel weapons and bomb blast.

Manner of infliction divides injuries caused due to accident (accidental), by self (self inflicted) and others (homicide). **Chart 6.1**

**Legal requirements of forensic certification** include complete medical observations starting with shape, size, character of margins, description of local at site and generalized responses to whole body including vital system as manifested in the form of signs and symptoms suffered by the victim should be made part of certification protocol. Estimation of age of

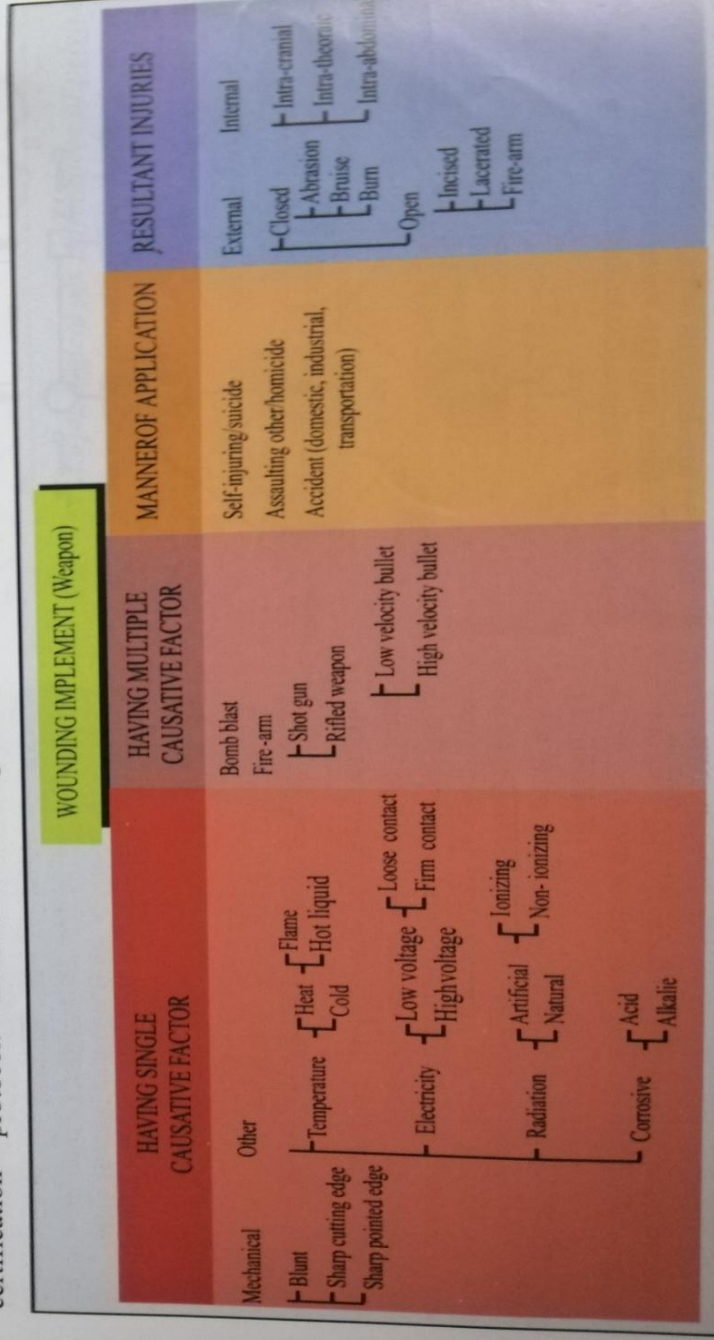


Chart 6.1: Classification of wounding implements (weapon), manner of application and resultant injuries

Wounding when caused mechanically is called **mechanical injuries**. They are the most commonly encountered form of wounding. Medico-legal certificate of such an injury should only be factual statement directed towards its type, site, appearance, gravity, duration of infliction and weapon causing it.

**Factor controlling shape of injury** is either weapon or part struck each having its ingredients. (Table 6.1)

**Table 6.1:**

*Factor controlling shape of wounding*

Weapon	Part struck
Type	Architecture of body part
Weight and velocity	Movement of the part
Manner of execution	Tissue resistance

**A. Factors in weapon:**

**Type of weapon** directly controls and determines the appearance of the wound. Examples are incised and lacerated wounds produced by sharp edged and blunt edged weapons. (Photo 6.1)



**Photo 6.1:** A. Incised and B. lacerated wound

**Weight and velocity of weapon** and their sum-total control and determine appearance of the wound. Velocity has kinetic energy, which is calculated by formula,  $K.E. = 1/2mv^2$ . A bullet in flight though small in mass has greater velocity than a stone bigger in mass having less velocity shall produce greater damage and effect.

**Manner of execution of weapon** is another important factor. There are two manners of execution of weapon or infliction of weapon; **direct** and **indirect**.

**Direct** application produces wounding at the point of the contact like produced with stone or club on the head.

**Indirect** application causes injury at a place away from site of contact. Fracture of clavicle produced by fall on stretched hand is its example.

**B. Factors in part struck:**

**Architecture of part struck** with its behavior following a strike has specific relationship to the outcome.

Human body is composed of different types of tissues. They are *soft* and *elastic* like skin, fat, muscle and internal organ, *relatively rigid* and *less elastic* like ligament and cartilage and *hard* and *limited elastic* like bones. Bone elasticity depends upon person's age, extent of calcification and **shape of the bone**: Bones of infants are relatively elastic than those of adults and old persons, which become brittle and thus, break more easily. Bone shape may be long like those of limbs and ribs, or plate like vault of skull and crest of the ileum or short having irregular shapes like small bones of hands and feet. These shapes along with size and density of bone have relation to the outcome.

Further, a body part may be *compact* as in limbs or *cavity* as in abdomen, chest and cranium. These cavities have organs in them, which are again of different shapes and consistency being composed of different types of tissue. Because of the design of these organs, they have different behavior character:

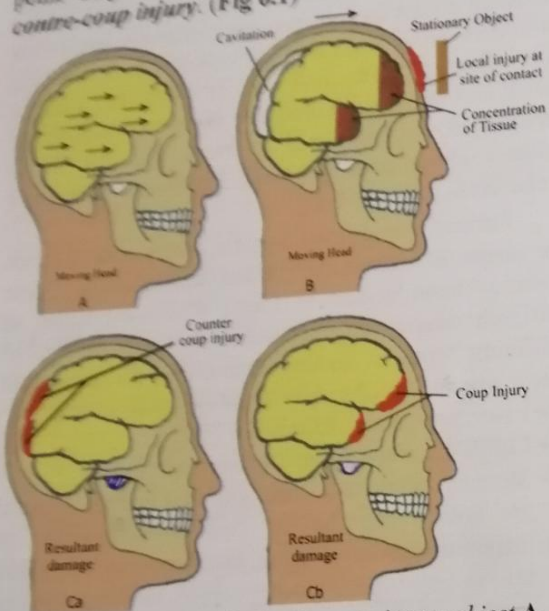
- Liver, spleen and kidney are solid
- Lungs are spongy and contain air in them
- Stomach, intestine, heart, gall and urinary bladder are hollow sacs having fluid or semi-solids of different density in them like blood in the heart, bile in gall bladder, water mixed food in stomach and intestine and urine in the urinary bladder.

Strike with a club, a blunt weapon, having same force on different body parts having different architecture will produce different shaped injuries i.e. on the head it shall produce a laceration, whereas similar impact on the buttocks shall produce a bruise. This difference in the shape of wound is due to the difference in architecture of the body part. Head has scalp stretched over a bone whereas buttock comprises mostly of soft tissues of skin, fat and muscles. Hip bones within are deeply buried.

**Movement of the part** also affects the outcome. Difference can be appreciated by noting injuries produced when the part is stationary or in motion. It is best manifested when a body cavity like head or chest is involved. A strike to a stationary head will produce a local injury of the scalp at the site of contact and damage may extend even to deeper structures. On the other hand, if moving head strikes a stationary object, the resultant trauma to the head



will be combination of local injury externally at site of deceleration and additionally a deceleration effect to the internal contents of the cranium at two sites involving both the membranes and the brain substance. These injuries to membranes and brain are due to pressure strains caused by concentration and rarefaction produced because of movement of the membranes and brain matter. The injury immediately below the site is called **coup-injury** and another at a point diagonally opposite to the point of contact is called **contre-coup injury**. (Fig 6.1)



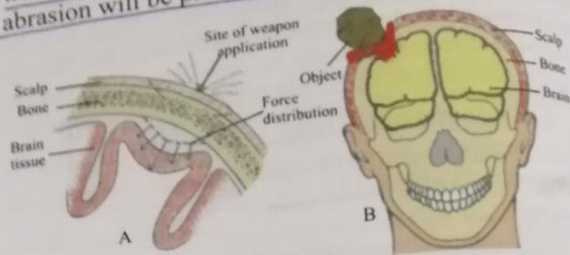
**Fig 6.1:** Moving head halted by a stationary object A. Head in motion B. Local scalp injury at the site of halt, cavitation and concentration of brain tissue Ca and Cb resultant brain tissue coup and contre-coup injuries

**Tissue resistance** can absorb force without suffering damage depending upon tissue type, extent of surface area and also tissue is soft and elastic. Skin and muscle absorb force more effectively causing either no damage or only a bruise. Hard and inelastic tissue like skull having soft scalp over it will not absorb impact and instead will cause scalp laceration and fracture of the bone. (Fig 6.2)

**Relationship of shape of injury with mechanism involved** of most commonly encountered injuries during forensic certification will individually be discussed one by one:

✓ **Abrasion** is an extremely trivial damage restricted to the most exterior part of the skin. Its causation is important. When a hard and rough object

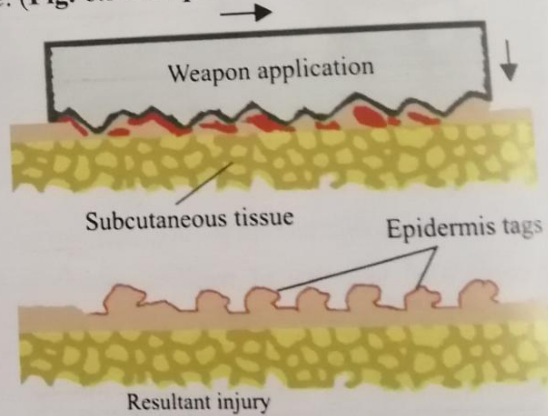
with pressure is moved against body surface, an abrasion will be produced. There are three types:



**Fig 6.2:** Tissue resistance mechanism with hard inelastic skull bone and soft scalp over it A. Force application with distribution of force B. Scalp laceration with skull fracture

- Moving abrasion
- Imprint abrasion
- Friction abrasion

① **Moving abrasion** indicates direction of abrasive force, showing heaping or piling up of the epidermis on the far end. Appearance is characteristic. Example of this variety is a **scratch** produced with fingernail, pin or thorn. Another example is irregular removal of the epidermis occurring during body surface dragging against the rough object such as road as seen in vehicular accident. This abrasion is also called a **graze**. (Fig. 6.3 and photos 6.2 & 6.3)



**Fig 6.3:** Mechanism of moving abrasion



**Photo 6.2:** Scratch on back of chest



**Photo 6.3:** Graze on arm and elbow

② Imprint abrasion is caused by strike of hard and rough object on skin like shoe-heel and friction abrasion by hard ligature material around neck. Its pattern provides corroborative evidence of causative agent. Imprint abrasion produced by hard ligature material such as rope around the neck in hanging shows both indentation and frictional rub. Pattern of ligature material provides corroborative evidence of causative agent. (Photo 6.4 & 6.5)



**Photo 6.4:** Ligature around neck in position



**Photo 6.5:** Frictional rub and indentation of neck skin without ligature

③ It is important to stress and remember that postmortem removal of epidermis by rough handling of corpse or rubbing against hard object occurs during postmortem period. Postmortem abrasion may be confused with ante-mortem abrasion especially when on vital region like neck. Post-mortem abrasion looks fainter and with passage of time after drying acquires parchment appearance. Ante-mortem abrasion shows vital reaction. Example is a case of newly wedded women wearing heavy silver necklace died from massive hemorrhage during consummation of marriage. She, besides vaginal damage also had three post-mortem abrasions; two in front of the neck and third blow left chin caused by heavy silver necklace. Police during initial inquiry labeled her death due to throttling (photo 6.6)



**Photo 6.6:** Postmortem abrasions on the neck and chin

**Age of abrasion** is difficult especially when superficial. It heals rapidly leaving no permanent mark. Age estimation would depend upon changes that take place in the effused serum, which occasionally may also get mixed with blood. Fluid when dry varies in color from straw to yellow to brown, depending upon the amount of blood. It is followed by formation of a soft scab in about two days, which hardens in about another three to four days. Hard scab retracts in another three or four days and finally falls away. Time relation of these changes though variable, yet is only an indicator for duration.

**Bruise** also called **contusion** is a closed wound caused by strike of a blunt weapon. It results from sudden tissue indentation followed by recoil. Area struck becomes swollen, red and painful without solution of continuity of covering skin. Though skin is not dissolved, yet its structure, adjacent subcutaneous tissue and other structures beneath it, depending upon its depth gets damaged. A bruise generally acquires the shape of striking weapon.

Extravasations of the blood from the broken blood vessels spread into the surrounding tissue. It is more commonly met with on body surface, but bruising of internal organs like liver and kidney also occurs. Appearance and severity of a bruise depends upon certain factors (Table 6.2, Fig 6.4, Photos 6.7 & 6.8)

**Table 6.2:**  
Factors controlling appearance and severity of bruise

1. Age (children/old people bruise easily)
2. Amount of force applied
3. Quantity of effused blood
4. Type of tissue (blood spreads easily in lax area around eye and lips)
5. State of health (coagulation defect, disease of blood vessel and liver cause more bleeding giving false impression about severity)
6. Skin color (visibility better in fair people)

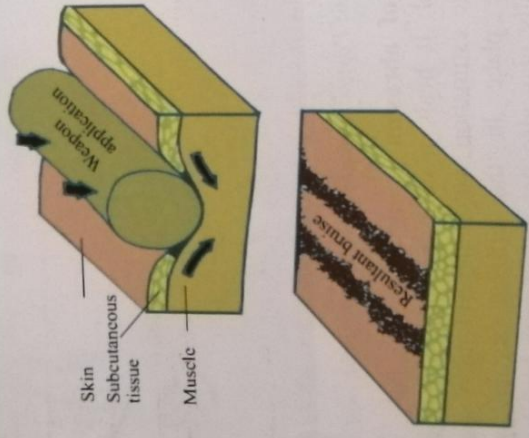


Fig 6.4: Mechanism of Bruise



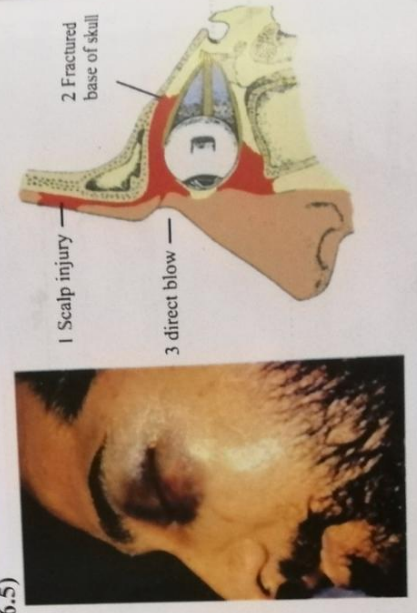
Photo 6.7: Two bruise marks on lateral side of right thigh



**Kidney**

**Liver**

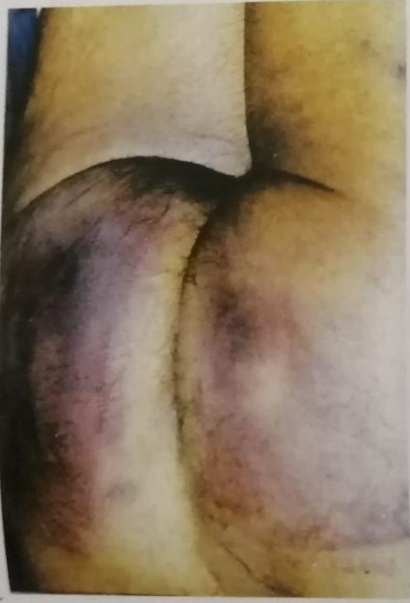
**Photo 6.8:** Bruise mark on kidney and liver  
Gravity shifting of bruise occurs from its initial site along tissue line of least resistance to lower region under the influence of gravity within first 24 hours. It changes both its position and shape as noticed following a blow on the forehead/scalp and later causing black eye. It is advisable and valuable to re-examine victim after about twenty-four hours of the first inspection. Route and known cause of black eye are also indicated in the drawing. (Photo 6.9 & Fig 6.5)



**Photo 6.9 & Fig. 6.5:** Black eye resultant from gravity shifting of blood of injury to forehead

**Age of bruise** is estimated by noting changes in the color of effused blood, which occur with the passage of time. Color changes depend upon ability of the tissue to absorb it. Capillary blood is dark red in color and a recent bruise appears purple in color. It darkens in two days because oxygen in the blood is removed. Tissue enzymes begin to change hemoglobin into blood pigments and in about four/five days, the bruise becomes greenish. Fading of the bruise occurs because of absorption of pigment. Further, within seven to ten days, color changes to yellow and finally disappears in about fifteen days depending upon site, size and depth of the extravasations.

It is necessary and also important to stress that repeated strikes to body part at same point as is done by police during investigation is called **battering**. It breaks body tissues, interferes with process of oxygenation/enzyme action and accelerates blood color change from first two days to few hours causing rapid darkening of effused blood to deep blue in color. It should not be confused with normal color change reaction occurring with passage of time. (Photo 6.10)



**Photo 6.10:** Police battering bruises on buttocks showing deep blue color

**Pseudo-bruising** may appear in skin, internal organs and other tissue spaces by accommodation of intense localized postmortem lividity. It is due to displacement of internal pools of blood by gas pressure into areas away from actual hypostasis. It simulates ante-mortem bruising and should be differentiated. Differentiation becomes difficult in cases of congestion without inflammation. Area showing pseudo-bruising lacks vital reaction. Importance in distinction lies in the fact that bruising is an ante-mortem phenomenon indicating violence before death. (Table 6.3)

**Table 6.3:**

*Salient features differentiating hypostasis from bruise*

**Hypostasis** (Post-mortem lividity)

1. Lacks vital reaction.
2. Blood accumulates within the vessels and when incised, oozes out of the cut mouths of the blood vessel
3. Confined to skin and covering of the internal organ like mucosa or serosa
4. Cuticle of the skin is intact as it is only an accumulation of blood due to gravity
5. Always appears in a dependant part
6. Sustained pressure however prevents appearance of hypostasis

**Lacerated wound** is an open wound showing breach of skin or covering of an internal organ along with underlying tissues caused by strike of blunt weapon. Main characteristics of a lacerated wound are varied shapes with irregular margins, ill defined angles and walls that have bridging tissue tags and hair in bearing area may get pushed into it with hair bulbs crushed. This area finally gets denuded of hair. External hemorrhage is limited. (Photo 6.11)



**Photo 6.11:** Lacerated wound on scalp showing characteristics of irregular margins, ill defined angles and bridging tissue tags

Depending upon mechanism of its causation, there are of three types:

- **Split**, also called **crush laceration**
  - **Over-stretch laceration**
  - **Grinding compression laceration**
1. **Split laceration** occurs on scalp, forehead, chin or any other part of the body where skin is firmly supported by underlying bone. Sudden compression of the skin and other tissues between the weapon and the underlying bone split them. It may resemble an incision wound.

**Bruise** (Anti-mortem)

1. Shows vital reaction (swelling and inflammation)
2. Blood vessels are broken and blood is present in blood surrounding inter-statis tissue. No flow of blood occurs upon cutting of vessel
3. Lies in the inter-statis tissue below epidermis or even deeper to it, as epidermis is without blood vessels
4. Cuticle is damaged and may show abrasions due to the violence causing it
5. Occurs at the site of injury, irrespective of its being dependant.
6. It occurs independent of pressure

Characteristics of recognition of such a wound are breach of skin and underlying tissue showing minimal irregularity and bruising of the edges and surrounding tissue. Hair if present at site of tearing are forced into the wound and bulbs of hair are crushed. Demodation of hair in hair bearing area may occur. (Fig. 6.6 & Photo 6.12)

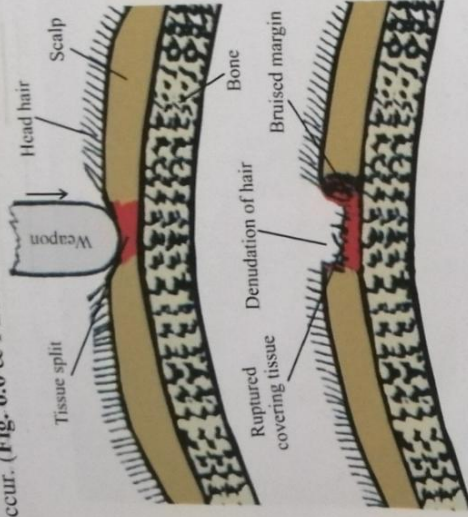


Fig.6.6: Mechanism and resultant split laceration



Photo 6.12: Split laceration resembling incised wound on left cheek

Over-stretch laceration is commonly seen in areas of the body where skin is loosely supported such as back of hand, upper part of the foot, forearm, and axilla. When localized pressure along with push or pull of increasing intensity overstretches the skin, it ruptures and gets separated from the underlying structures. Such laceration generally occurs in road traffic accident and industry. Part of the body while being trapped sustains such an injury. Rupture of the skin due to over-stretching may also occur due to fracture and deformity of a bone. Characteristics of

such laceration are breach of skin and separation from the underlying tissue showing flapping in the direction of stretch. External hemorrhage like other tears is limited (Fig 6.7 & Photo 6.13)

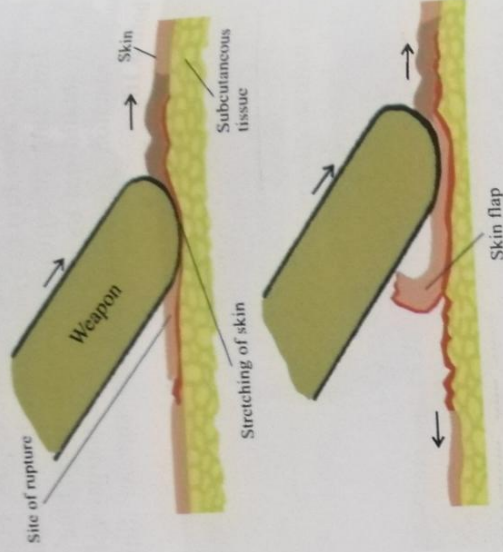


Fig 6.7: Mechanism and resultant split laceration



Photo 6.13: Over-stretch laceration, showing skin flap

Grinding compression laceration is caused by passing of heavy automobile wheel over limbs of the body and producing grinding compression of muscles. Characteristics of such a wound are multiple skin perforations that are also separated from the underlying structures, crushing of muscles and other supportive tissue. There is extreme extravasations of blood into potential spaces of crushed tissue, which shows swelling and is severely painful. External bleeding from these wounds is generally limited. When such laceration occurs over wide area, they may precipitate fat embolism or crush syndrome. Clinical state would depend upon the number of wounds, extent and speed of hemorrhage, finally causing death from renal failure. (Fig. 6.8)

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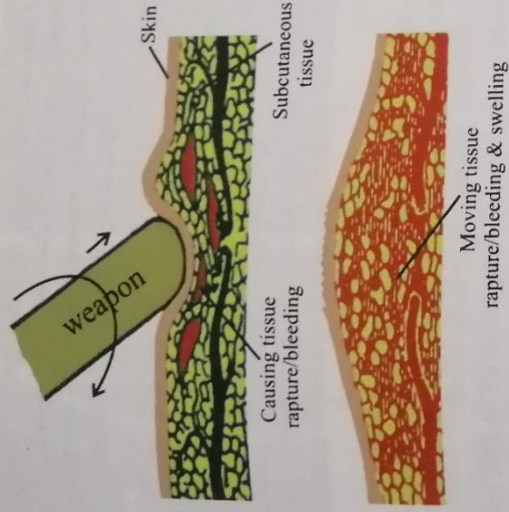


Fig 6.8: Mechanism and resultant grinding compression

**Incised wound** is another open wound resulting from cutting or incision of skin and underlying tissues. The most common instrument causing it is a knife or a sharp edged cutting glass. Movement of the weapon is necessary ingredient for causing a cut in the tissue. Characteristics of such a wound depend upon shape of weapon and manner of its infliction, which affect both its shape and dimension. An important feature of this wound is involvement of covering clothes consistent with site of infliction, which also gets stained with blood. Wound is generally linear or spindle shaped, gaping in the center depending on cleavage lines of Langer. It shows clean cut margins, sharp angles and smooth walls. If involved area is hair bearing, it shows cutting of hair including bulbs. External hemorrhage from incised wound is comparatively more than from a lacerated wound and contrasting features enlisted.

(Table 6.4, Fig 6.9 & Photo 6.14)

Table 6.4:

Contrasting features of incised and lacerated wounds

Features	Incised wound	lacerated wound
Shape	Linear or spindle	Irregular
Margins	Regular	Irregular
Angles	Sharp, well defined	Blurred, ill-defined
Walls	Smooth, having no bridging or tissue tags	Irregular, showing tissue tags
Bleeding	Profuse	Comparatively less
Hair	Cut in its line	Pushed into it
Hair bulbs	Cut in its line	Crushed
Area around	Shows no bruising	May be bruised or denuded of hair
Clothes	Correspondingly cut	No such effect

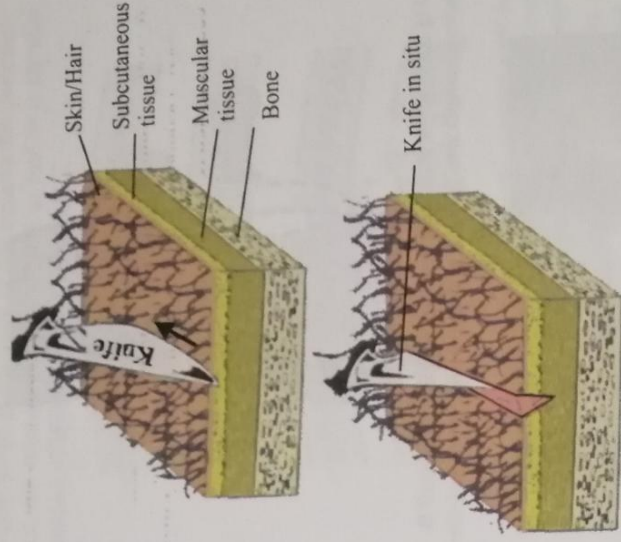


Fig.6.9: Mechanism and resultant incised wound



Photo 6.14: Incised wound on face showing spindle shape, sharp angles and clean cut margins

**Penetrating & puncturing wound** is produced by thrusting sharp edged and pointed weapon into part of the body having a cavity like cranium, chest and abdomen which gets pierced. Shape, external dimensions of length and breadth and internal depth of wound depend upon shape and size of cutting blade of the weapon causing it. Most of the characteristics of this wound are similar to those of an incised wound, except the depth, which is the greatest dimension. (Fig. 6.10 & Photo 6.15)

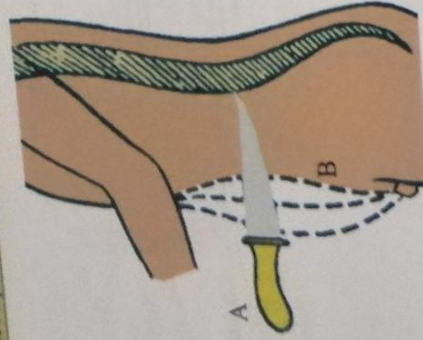


Fig 6.10: Knife A. Thrust into dolled abdominal wall B. Indicate length and breadth of blade penetration and also depth of injury



Photo 6.15: Penetrating wounds chest with weapon in situ



Photo 6.15: Penetrating wound abdomen with bulging out intestines

Description of external wound of such victims is usual routine, but clinical condition is serious manifesting signs of acute hemorrhagic shock due to extensive hemorrhage. In penetration of chest cavity, additional feature is development of hemo-pneumo-thorax and surgical emphysema in the surrounding area.

**Age determination** of open wound because it comparatively does not stay clean and would whether lacerated, incised or penetrating would depend upon if it remains **clean and non-gaping or infected and gaping**.

**Clean and non-gaping** wound gets covered over by lymph and blood, which clot in first twenty four to thirty six hours. It is followed by adherence of edges in about three to four days. Process of healing is completed with red linear scar formation in about seven to ten days. Color of scar gradually changes to brown.

**Infected and gaping** wound estimation of age depends upon gravity of inflammation and there are two situations; **slightly or grossly septic**:

- **Slightly septic** wound margins swell in first twelve to sixteen hours, followed by appearance of sero-purulent discharge in about three to four days. It is followed by formation of red-granulation tissue in the bed of the wound in about five to six days, skin grows over it and healing gets completed in twelve to sixteen days. Fresh scar in such a wound is more prominent and slightly raised over the surface of the skin

- **Grossly septic** wound remains open indefinitely and no estimation of age is possible

**Bone fracture** takes place either by direct mechanical application of force or indirect application of force. Long and skull bones are mainly affected depending upon amount of force weather **slight or greater**:

- ✓ • Slight force within the limit of bone elasticity will cause a local indentation at site of impact without breaking bone and then recoil back to its original shape like any soft body tissue
- ✓ • Greater force beyond the limit of bone elasticity will produce fracture, which commences at the point of maximum convexity

① **Long bone fracture** of adult occurs either at the point of impact or bone acting as a lever diverts the force to other remote weaker point, which gets fractured. Long bones of children are comparatively more elastic and show less damage to only one side of bone close to application of force resulting in **green stick fracture**. Examples of indirect application of force are spiral fracture by limb twisting and transverse fracture or separation of epiphysis by limb push/pull as generally seen in **battered baby syndrome**. (Photo.6.16)

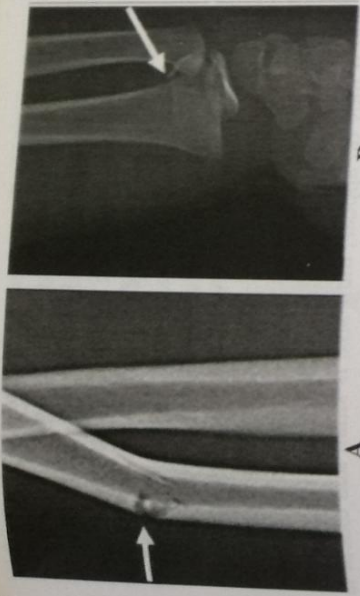


Photo.6.16: X-ray image of radius of children A. Greenstick fracture B. Transverse fracture of distal end

② **Skull bone fracture** and its pattern depend upon skull bone anatomical structure and its strength. It varies at different parts due to thinness's and thickening's in both vault and base. When direct force is applied, a linear fracture radiating from the point of impact occurs and in case of indirect application of force, fissured fracture distant from site of impact occurs. Occasionally force from the face like a blow on the mandible, may be transmitted to the base of the skull, fracturing the weakest portion namely cribriform plate of ethmoid. Another example is transmission of force upward through spines after a fall from height on feet or buttocks fracturing base of the skull.

**Rowbotham** divides mechanism of fracturing of skull bones into; **local deformation** at the site and **general deformation** of the whole skull.

① **Local deformation** at the site occurs, if the force applied is sufficient to cause crushing of outer table into diploe or a bend of the skull bone. Sequence of events at the site of impact is formation of a shallow cone. Apex of cone stretches the inner-table and compresses the outer table. At the periphery of the cone convexity of the bend is directed outwards. If the distortion is beyond the strength of the bone, a fracture confined to the inner-table at the apex of cone results. If force is greater than the strength of both inner and outer tables of the skull, both fracture. Inner-table at the apex of the cone fractures before the outer table, whereas at the periphery the outer table fractures first. Extension of the break both of inner table at the apex to the outer table and at the outer table at the periphery to the inner-table completes break in both tables and cause depressed comminuted fracture. Fracture line in such depressed comminuted fracture tends to run radially from the

→ diploe → a spongy cancellous bone of skull separating the inner and outer tables

central point at the apex of the cone to the periphery and the fracture lines also tend to run in a circular manner. (Fig 6.11)

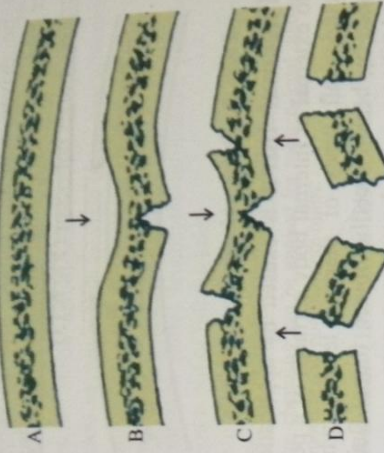


Fig 6.11: Fracture by local deformity, starting from A. Normal bone B & C. Start of fractures of inner and outer tables D. Precipitating comminuted depressed fracture.

③ **General deformation** of whole skull occurs due to compression of the skull. When skull is compressed in one plane, it behaves as an elastic sphere and bulges out in other plane, where fracture occurs. Examples of this mechanics are compression of skull of infant by forceps during delivery and head in traffic and industrial accidents. Skull when compressed laterally, it elongates in its vertical and longitudinal plane, producing fractures in these planes. These fractures are usually fissured ones occurring at parts of skull distant from actual site of application of force. Complication of the fracture of the inner-table leads to the development of adhesions between dura-matter and brain substance and may precipitate traumatic epilepsy. (Fig 6.12)

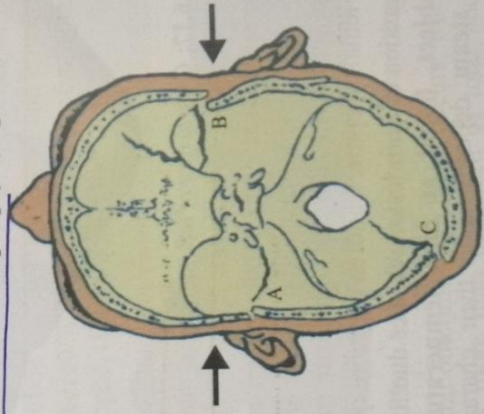


Fig 6.12: Skull bone fractures at sites A, B & C caused by general deformation during bilateral compression



**Moritz** claims that if skull is compressed, *spongiosa* between the inner and outer tables being fragile, a circumscribed segment of the outer table may be driven into the diploe without disturbing inner table. This type is an uncommon finding and generally, it does not occur (Fig 6.13)

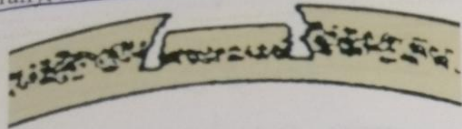


Fig 6.13: Outer table crushed into diploe

**Thermal burn** is caused by application of heat to external or internal body surfaces of a person. It includes all types of thermal lesions whether produced by heated metallic object, flame, fluids at or near boiling point and pressure steam.

Progressive stages of thermal lesion are redness, which appears at once, followed by blistering of skin, which takes some time to appear. Pricking and removing of blister leaves a pink raw surface from which fluid oozes. These lesions do not bleed. After few hours, there will be leucocytes infiltration and area may readily get infected followed by appearance of pus and granulation tissue. Hypertrophied scarring occurs in partial thickness burn and contracture in full thickness severe burns, which may follow months after the injury. (Photo.6.17)

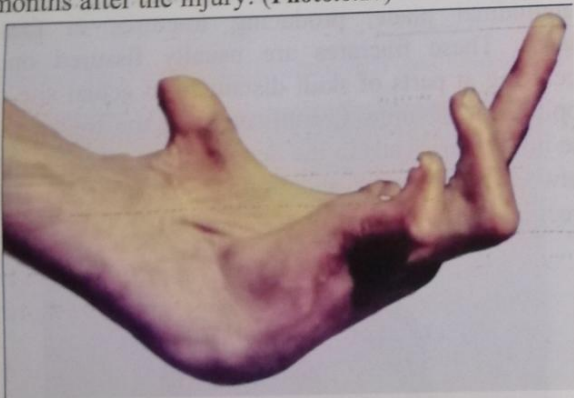


Photo 6.17: Contracture of left hand in full thickness severe burn

Prognosis of skin burns depends upon extent of surface area involved irrespective of the depth of burn. Age, physical health and immediate treatment influence lethal outcome. Children die more quickly.

Recognition of burn lesion whether due to **flame**, **heated object**, **liquid at high temperature** and **pressure steam** depends upon their characteristic appearance:

**Flame and heated object lesion** is dry lesion, which does not bleed and feels hard to touch. It is a very painful injury. Erythema appears immediately, followed by development of areas of coagulation and roasted patches of both skin and deeper tissue. Use of electric cautery is based on this property of coagulation of tissue including blood vessels by heat. Singeing of hair occurs. Worn clothes show burning. There will be deposit of carbonaceous material in air passage especially if live-victim is trapped in flames. Vesicles in most cases do not appear in such burns and if they do appear, their size is small and extent is minimal. (Photo 6.18 & 6.19)



Photo 6.18: Flame burnt corpse of female having burnt clothes, skin erythema and vital demarcating line between burn body area and healthy tissue



Photo 6.19: Flame burnt portion of child's corpse showing roasted patches at leg, groin, abdomen and vital line

**Liquid at high temperature** and **pressure steam** lesion, on the other hand, show erythema and large size vesications. Both clothes and hair do not show burning or singeing. Instead, they become wet with the type of liquid (milk or oil). There will be no deposit of carbonaceous material in the air passages. (Photo 6.20 & Table 6.5)



A



B

**Photo 6.20:** High temperature liquid/pressure steam burns lesion **A**. Multiple vesicals with erythema on arm **B**. Erythematous dermis of leg after removal of epidermis

**Table 6.5:**

Features of flame and hot liquid burns

Characteristic	Flame	Hot liquids
Erythema	Present	Present
Area of coagulation	Present	Absent
Roasted patches	Present	Absent
Vesication	Rare	Extensive
Size of vesicles	Very small	Large
Singeing of hair	Present	Absent
Condition of clothes	Burnt	Soaked

**Ante-mortem burn** recognition depends upon presence of vital reaction. It is a complicated issue, because there is no sharp line of distinction between the life and death. Cells or organs continue to remain viable for a variable period after clinical death. In the case of skin, the period is about ten to twelve hours. Wright (1850) pointed out that as long as the dead body is still warm, the fire flame effect of skin is similar to that of observed during life. Different forms of skin vital reactions in burns due to different agents can easily be detected both by naked eye as well as microscopy. (Table 6.6)

**Table 6.6:**

Skin vital reaction

**Naked eye**

- Heated objects and flame produce well marked reddening, 1/4 inch in width, bordering the lesion
- Pressure steam and liquids at high temperature cause blisters having plasma exudate containing albumin. Raw skin surface is pink

**Microscopy**

- Burnt skin shows leucocytes infiltration, provided the lesion is not of full thickness
- Histo-chemistry\* at the periphery of the burnt skin indicates increased enzymes reaction

\*Histo-chemistry can be applied for medico-legal distinction of ante-mortem and post-mortem burns.

*Rackaiio* (1961) was first to study enzyme histo-chemistry. *Faltch* (1965) confirmed his findings in the human skin and *Mallik* (1968) applied them to skin burns. Chosen study enzymes were alkaline phosphatase, acid phosphatase, Lucien amino-peptidase and non-specific esterase. Drawn conclusions were as follows:

- Increase in enzyme reaction at the periphery of the burn, which can be detected much earlier than histological changes.
- Changes are similar in all burns of same age and the reactions are stable to withstand period of delay between death and postmortem examination.
- Reactions are also not altered with topical applications.

Victim, while dying in fire, inhales carbon monoxide and sooty material into the air passages of lung and may also swallow these particles into the stomach. Presence of black sooty particles in trachea, bronchi and stomach and the presence of more than 70% carbon monoxide in blood and other tissue like bone-marrow are strong evidence of an ante-mortem catastrophe. (Photo.6.21)



**Photo.6.21:** Black sooty particles in trachea

Fatal outcome from burns occurs, when involved area is more than one third of total body surface. Most serious cases are those in which the trunk is

involved. Chronological order of thermal burn complications upon the body as a whole are:

- Immediate primary shock due to pain
- Secondary shock with circulatory collapse due to loss of fluid and hemo-concentration
- Death occurs either within 24-36 hours due to toxemia (production of toxins by burnt tissue) or after many days, due to infection and septicemia

Medico-legal certification important criteria of thermal burn are extent of body surface involved and depth of the burn. Generally two depths are referred to in the medical certificate; superficial, which does not involve full thickness of skin and others, which involve full thickness of skin and deeper tissues. Other important points of medico-legal certification in such cases are:

- Recognition of type and cause of thermal lesion
- Distribution of burnt area consistent with history of the case
- Extent of burnt surface and its relationship to death
- If death occurs, whether burn lesion is ante-mortem or otherwise

During forensic certification, Medical Examiner takes advantage of the **rule of nine** to calculate the extent and percentage area involved bearing burns of the body surface. (Table 6.7)

**Table 6.7:**

*Rule of nine*

Face, neck and scalp	9%
Arm, forearm and hand of right side	9%
Arm, forearm and hand of left side	9%
Front of thigh, leg & foot of right side	9%
Front of thigh, leg & foot of left side	9%
Back of thigh, leg & sole of foot of right side	9%
Back of thigh, leg & sole of foot of left side	9%
Front of chest	9%
Back of chest	9%
Front of abdomen	9%
Back of abdomen and buttocks	9%
Perineum	1%

**Autopsy findings;** *externally* there are skin flame burns of different severity. Clothes are also burnt. Dead body acquires a specific boxer attitude called **pugilistic attitude** due to heat coagulation and shortening of flexor muscle proteins. Finding has no significance, as even a dead body will attain it.

*Internally* findings are marked pallor of liver and kidneys. **Curling ulcers** develop in gastric and duodenal mucosa, which occur due to pain and stress

accompanying severe burns. They are circular less than 1 mm. in diameter and superficial and should be differentiated during autopsy from intense hyperemia, even superficial erosion, which occurs during agonal period within minutes.

**Postmortem artifact**, which are produced during fire needs recognition and should be located. They are *flaking bone fracture* aided by muscle shortening, protein coagulation and bends at joints, *skin splits* for the same reason and *extra-dural heat hematoma* in the immediate vicinity of external burn of head. Heat hematoma is light in color and has a spongy and honeycomb appearance.

**Medico-legal importance** of burn lesions is that they are invariably caused as a consequent of an accident at home or in industry. Criminal infliction of thermal burn with lit cigarette or solid bodies at elevated temperature occurs during torture, especially by police. Homicidal or suicidal cases though are rare, yet cannot be ruled out.

Destruction of the murder victim's body by fire to conceal crime and eliminate the evidence is the oldest method. Therefore burnt corpses require careful scrutiny of available human remains from this point of view. Examples are two cases (Photos 6.22 & 23)



**Photo 6.22:** Post mortem burnt male corpse without vital reaction, cause of death suffocation by cloths stuffing into mouth, which got speared from burning being in mouth cavity



**Photo 6.23:** Another similar corpse without vital reaction, cause of death strangulation by rope around the neck, which got speared from burning by chin overlap

**Electrical Lesion** is caused to humans at home, in industry and occasionally in hospital all over the world. It is an important accidental injury. Domiciliary accident occurs because of defective wiring and appliances. Causation of local lesion depends upon **electricity voltage** and **electrical considerations**:

*Electricity voltage* safe range is 100-110 at 60 cycles and fatal range is just about 200. Different electricity voltages are used in Pakistan; domestic from 220-240V, industry including railways 600V-1200V and transmission lines 11KV. Contact with above mentioned three voltages produce three effects:

- **'Hold-on effect'** at 220-240V (domestic) causes muscle spasm, responsible for non-release of live conductor
- **'Throw-off effect'** at 600V-1200V (industrial) reduces period of contact, responsible for survival of victim
- **'Arcing effect'** at 11KV (transmission lines) requires no contact for causing lesion.

*Electrical considerations* having intimate relation with outcome are; **body resistance**, **electricity pathway** and **contact with earth**.

- **Body resistance** role depends upon whether body tissue is comparatively dry or wet and otherwise vulnerable to the effect of electrical current like nervous and muscular tissue.

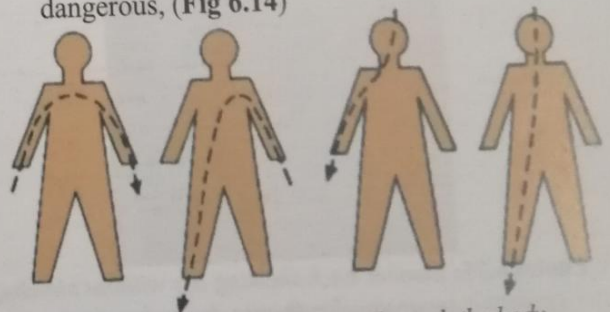
a) Body tissues in respect of fluid content are blood vessels and skin of palm and sole. Blood vessels having maximum fluid offer almost no

resistance and act as good conductor. Skin of palm and sole, being relatively drier offers resistance and generates heat causing thermal lesion at point of contact. Further loose contact additionally generates spark and causes metallization instead of pure burn.

- b) Brain and spinal cord are more vulnerable producing minute hemorrhages in brain matter and passage of electric current through spinal cord cause injury to cardiac and respiratory centers in the medulla.
- c) Cardiac including respiratory muscles offer negligible resistance and respond by strong contraction. From clinical point of view, electrical contact causes long periods of apnea, ventricular fibrillation and cardiac arrest.
  - i) Low voltage produces myocardial fibrillation due to direct action on pace maker, conducting system and actual muscle fibers
  - ii) High voltage either causes heart muscle to fibrillate or then becomes nonfunctional or produces spasmodic contraction and asystole.

When current is broken, ventricle may jump back to normal rhythm and arterial blood pressure restored. Presence of cardiac disease, physical fatigue and intoxication, all predispose to early death.

- *Electricity pathway* through body of the victim are four:
  - i) From one hand to opposite foot passes across chest in diagonal direction involving both heart and respiratory muscles is dangerous
  - ii) & iii) From one hand to other and similarly from one foot to other involves no vital organ and are not dangerous
  - iv) From head to either foot as normally happens in lightning involves brain stem having vital cardiac and respiratory centers is the most dangerous, (Fig 6.14)



**Fig 6.14:** Electricity pathways through the body

- 'Contact with earth' and its role; better the contact between person and earth, more serious is the outcome. Bathroom situation is very dangerous due to both moisture and perfect contact of water pipes.

**Electrical lesion** occurs on body skin at both points of entry and exit and differs in appearance weather caused by domestic or industrial voltage current. Domestic lesions are further divided into two types; **loose** and **firm contact lesion**.

*Loose contact lesion*, also called *spark lesion* is an area of dry burn of varying size showing either area of blackening, separation of epidermis or burning due to heat emitted at the point of contact. It has a central parchment surrounded by hyperemia. Microscopically, there is shrinkage of superficial cells of epidermis showing multiple pricked or pitted metallization with metallic particles liberated from the conductor, which get embedded in the tissue. All such lesions do not show the full picture.

Posted are two cases of i) a girl who committed suicide following a suicidal pact, tied her right wrists with positive and left wrist with negative electrical wires and put the switch at on-position and died immediately (**Photo 6.24**) and ii) a male whose lumber region back remained in loose contact with live wires for some time (**Photo 6.25 & 26**)



**Photos 6.24:** Massive blackening around right and slight with erythema around left wrist without bleeding from live loose contact of electrical wire



**Photos 6.25:** Lumber back showing dry without bleeding epidermis separation/erythema due to loose contact through shirt with live electrical conductor



**Photo 6.26:** Loose contact exit lesions **A.** Circular charring and blackening surrounded by hyperemia on ventral surface of foot **B.** deformed metallic stud of sole due to passage and earth contact

*Firm contact lesion* usually occurs on working finger pads and is very characteristic in appearance. It is a raised blister containing either gas or a little fluid. Depth of the lesion is invariably full thickness of skin. Area of destruction is visible as a white slough surrounded by a rim of bright red color caused by passage of current and also due to capillary injury.

*Industrial lesion* occurs either at a point of contact with high voltage wire due to hold on effect or arcing, which actually does not require contact. Arcing effect to an approaching person produces flash burns. Both lesions resemble advanced thermal burns involving large areas of skin as seen in cases of injured linemen working at high-tension transmission lines. Lesions are extensive, varying in appearance from burns by highly heated object, to crocodile skin, to completely carbonized tissue. (**Photo 6.27**)



**Photo 6.27:** Massive industrial burn lesions **A.** while holding conductor on hand **B.** due to earth contact on foot

Death during electrocution may occur as immediate and delayed. Immediate death is due to vagal inhibition by fright, ventricular fibrillation due to effect on heart muscle and asphyxia due to paralysis of modularly vital centers or respiratory muscles. Delayed death occurs due to complications of burns and their toxic effects. Homicide and suicide is possible.

**Autopsy findings** depend upon the mode of death. External lesions are burns due to contact with conductor both at the point of entry as well as exit. Internal lesions are due to passage of electrical current through the body. Neurological brain and spinal cord lesion are focal petechial hemorrhages affecting medulla and gray matter mostly in judicial electrocution. Brain tissue also shows irregular tears or fissures.

# CHAPTER 7

## 7. Forensic Aspect of Wounding (Part 2)

**Introduction to Fire-arm weapons** is necessary, because of their more lethal effects and their ability to kill multiple people at a far distance. They are last of invented dangerous weapons having multiple causative factors. It is unfortunate that efforts are on to further improve their lethality by increasing bullet speed, control over their availability is not propionate and these weapons are replacing rapidly previously used weapons.

Proper understanding of cause-effect relationship of wounding by fire-arm/bomb to people within the vicinity would require detailed information about their design, physics of propulsive forces and elements used. Firearms weapons as a group contain weapons like revolver, riffle, shot-gun and bomb. Study of understanding of their cause-effect relationship of wounding with them is based upon a knowledge of special **ballistics** subject having three components:

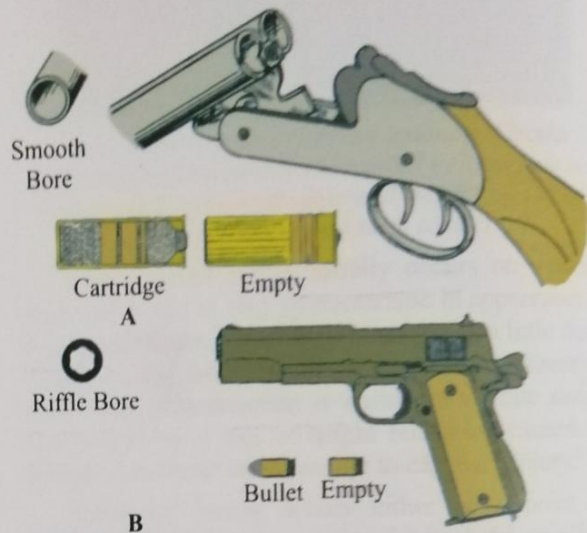
- Interior ballistics
- Exterior ballistics
- Wound-complex ballistics

*Interior ballistics* deals with forces of propulsion of projectile (bullet/shot charge) dependent upon design of **barrel** and **cartilage** and remains limited within the bore of barrel till its exit from the muzzle end. What happens within the barrel is a **chain of events**.

**Barrel** from point of view design is either long or short, has two ends; breech and muzzle and a bore; smooth and rifled. Smooth bore may be a true cylinder or choked while rifled one has grooves and lands, which go spirally throughout the length of the barrel.

**Cartridge** design has many parts consisting of a case having primer, powder charge, wad and projectile, which fits suitably breech end of barrel. Primer is situated at the base having ability to fire and its composition is barium, lead and other metallic salts. Powder charge varies in its physical and chemical composition to control its burning rate, thus of two types; black consisting of potassium nitrate, sulfur and charcoal and smokeless consisting of nitro-cellulose and nitroglycerine. Wad is made of cork or some other material to acts as a partition between the powder charge and projectile. Projectile is generally

made of lead and is of two types; bullet that is single and shot-charge, which consists of many small pellets. (Fig. 7.1)



**Fig: 7.1:** Firearm design **A.** Twin-barreled smooth-bore shot-gun and cartridge **B.** Semi automatic rifled-barrel pistol and bullet

**Chain of events** takes place in six stages within the bore of barrel:

- Strike of firing pin at the primer begins the chain
- Powder charge gets ignited liberating gases at a very high temperature. Composition of gases in accordance with quality of powder and generally are carbon dioxide, carbon monoxide, nitrogen, sulfurated hydrogen and methane. One-grain weight of powder generates 200 to 900 ml. of gas.
- Chamber pressure increased sharply from zero to four to six tons for a revolver and pistol and about 20 tons for a rifle due to production of gases.
- Chamber pressure acts equally in all directions upon breech end of the barrel through the cartridge case, including base of projectile through partition wad.
- Strength of metal of firearm resists this pressure and forces projectile to move forward through the bore accelerating continuously. In case of a rifle, bullet besides acquiring acceleration is subjected to groove effect forcing the bullet to spin increasing its rotation upon its axis during forward motion.
- Exit of projectile from the barrel brings the chamber pressure to zero ending chain of events. pellets. (Fig. 7.2)

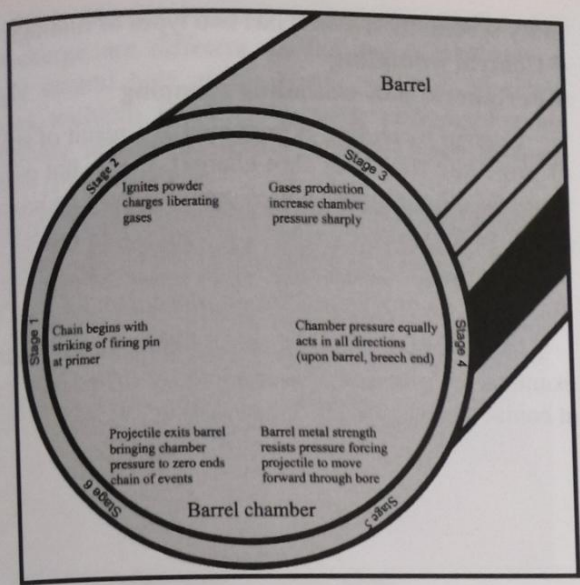


Fig. 7.2: Six seriatim chain of events stages within barrel chamber

Exterior ballistics deals with forces that act on bullet during its flight from the moment, it leaves the barrel to place of impact on the target. During flight, there is interaction between the forces originating from projectile motion, those present in the medium and force of gravity. Forces originating from projectile motion are its velocity having two components, speed and direction. Projectile velocity at the muzzle end is either low (less than 1200 feet per second) or high (above 2000 feet per second), depending upon with type of firearm. (Table 7.1)

**Table 7.1:**  
Projectile velocity at muzzle end

Revolver	600 to 900 feet per second
Pistol	1200 to 1400 feet per second
Rifle	2000 to 3000 feet per second

Sooner lateral support of barrel ends, forces of medium take over making the bullet unstable especially in earlier part of its flight. Forces present in the medium are air resistance, which is negligible and force of gravity, which draws the bullet towards earth. It forces line of flight of bullet to follow a curved path known as **bullet trajectory**, very slight for a short distance not even appreciable, but becomes apparent over a long distance. Further tip of the bullet follows the axis, but its tail describes circles around line of flight for some distance from the muzzle end called **bullet tail-wag**. Distance of tail-wag from muzzle end for a pistol is 60 yards and for a rifle 200 yards. After this distance bullet becomes stable and settles down into gyroscopic progression.

Wound-complex ballistics is the resultant effects of **fire-blast** at the target on human body after coming out of the barrel of firearm. Fire-blast, besides projectile (bullet) or short charge, which has its diameter, shape, weight, rigidity and terminal velocity also contains other elements like flame, hot explosive gases, smoke and some other components of ammunition such as wad, unburned powder and grease taken by the bullet from within the barrel.

Fire-blast effects on the target can be understood by meticulously observing interactions between above stated contents of fire-blast and body tissues of part struck. Factors in the part struck are resistance of the tissue dependent upon its nature, density and architectural design. The most important factor is projectile (bullet) and its velocity either **low** or **high**.

*Low velocity bullet* while striking the body part, it pushes and rotates to produce an indentation in soft and elastic tissues like skin and finally perforates it. It allows passage of the bullet. During passage through the tissue, bullet energy radiates laterally causing damage proportionate to diameter of the bullet. It is represented as path or track of the bullet.

*High velocity bullet*, on the other hand, additionally produces a temporary cavitation in soft tissues pushing them more laterally over and above the damage caused by the low velocity bullet. Energy in the bullet is very high and it tends to dissipate in the surrounding tissues more effectively in radial fashion creating instant cavitation. Period of cavitation is extremely short and soon after the passage of the bullet, tissues recoil and collapse back leaving a permanent cavity or damage, which is larger than the diameter of low velocity bullet (Fig. 7.3)

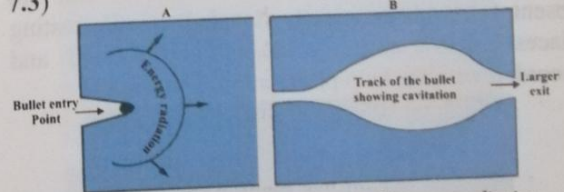


Fig. 7.3: Bullet path showing A. Energy radiation B. Cavitation and larger exit

When high velocity bullet strikes a bone, depending upon its strength, the bullet shatters its target more effectively. Greater the density of the tissue, greater is the amount of energy discharged. Rapid transmission of large amount of energy fractures bone and ruptures other tissues situated even at considerable distance from the bullet path. When bone fractures into pieces, its bony speculae



act as secondary projectiles and spread in various directions causing many secondary tracks.

When a hollow viscus containing fluid is hit by a high velocity bullet, its contents get separated into small particles, which get displaced explosively in all directions away from the bullet path and behave as secondary projectiles. In conclusion, it may be stated that characteristic of damage by high velocity bullet is disintegration and disorganization of large areas of the tissue immediately adjacent to the track as well as surrounding it.

Correct interpretation about identification of the firearm weapon, bullet trajectory through the human body, cause and manner of death all depend upon proper analysis of wound-complex. A word of caution must be kept in mind that there are now numerous firearms weapons having their specific ammunition, interpretation of wound-complex produced by them individually may become difficult task.

**Firearm wound-complex** is name allocated to some-total resultant damage findings of fire-blast on target. It has four parts:

- **Entry wound**
- **Trajectory with direction**
- **Bullet resting place**
- **Exit Wound**

Forensic requirement of certification of fire-arm complex should include description of all four parts. Trajectory with direction needs proper exploration for its location and should be preserved by placing radio-opaque material and x-ray recording of the finding enclosed with certificate. If any of them like place of resting of bullet and wound of exit are absent, it should be clearly stated. Projectile resting places are variable and should be located and recorded with the help photograph. (Photo.7.1)



**Photo.7.1:** Projectile resting place, bullet embedded in heart

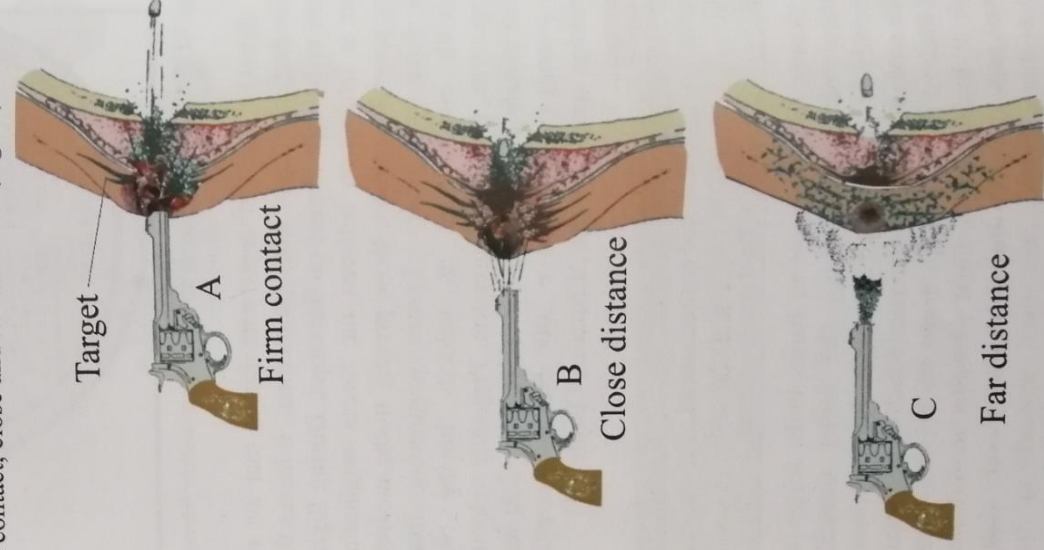
Entry wound by fire-arm has two types of findings:

- **Central wounding**
- **Peripheral non-wounding stamping**

*Central wounding* is produced as a result of strike of projectile (bullet or shot-charge), flame, hot gases, wad and other component of ammunition like broken pieces of bullet.

*Peripheral non-wounding* is caused by imprinting by smoke, unburned powder and grease.

Above stated findings can be appreciated during examination of cases of wounding by rifled fire-arm at contact, close and far distance. (Fig.7.4)



**Fig.7.4:** Rifled fire-arm wound target effects: A. Firm contact having central wounding mixed with flame burning and soot/gunpowder within tissue B. Close distance having central wounding partly stamped surrounding skin with soot/gunpowder C. Far distance having central wounding without soot/gunpowder over skin

*Entry wounds* descriptions by rifled bullet and shot-charge are different. Rifled bullet produces a single central hole at the target whereas shot-gun causes multiple holes along with peripheral non-wounding imprint on cloths or body when without cloths. (Photo 7.2)



**Photo.7.2:** Entry wounded by rifle bullet showing single central hole surrounded by non wounding imprint on shirt and adjacent lower part of neck

Rifled weapon entry wound is typically circular hole with inverted margins like poking of a lead pencil through skin. It is becoming less common since replacement of low velocity bullet with high velocity. Hole of entry wounding is smaller in size than bullet, when it perforates skin while it is stretched due to push before making the hole. Larger jagged irregular wounding more than diameter of the bullet occurs both due to tail-wag effect and also by explosive blow back effect of the gases against hard bone like on forehead and face (chick bone).

Shape of central hole on the skin gets modified depending upon angle and distance of fire. It may be circular, oval, elliptical, stellate or an elongated furrow. Other characteristics of entry wound on skin at or around the hole of bullet are abrasion, bruising, flame scorching, powder tattooing, smoke blackening, and grease effect and gross splitting.

**Abrasion** is always marginal and appears as a collar. It is usually present when the strike is from some distance. Rubbing of screwing motion by bullet of margins of the wound of entry produces it. When bullet enters perpendicularly to skin, abrasion ring is circular and uniform. When it enters obliquely, it presents more of an elliptical shape, longer axis pointing to the direction of the approach. When the angle is very small, there may be a furrow through the skin before complete entry into the tissue. Tangential strike produces only an elongated furrow in the skin and tissue.

**Bruising** mainly occurs at or around the wound of entry due to general tissue trauma. Pressing of the muzzle end against the body tissues may produce it. Gases of the blast may get pushed into or under the skin ballooning and bruising them.

**Flame scorching** is present both in contact and close range wounds. Flame from the muzzle end reaches a few inches in the case of revolver and about a foot in a case of shotgun. Depending upon coverage of area by hair, it will show scorching of the hair and skin. Surface hair may be completely removed by burning or may be shriveled and clubbed owing to burning and melting of the free ends. Skin itself may also show characteristics of a burn ranging from reddish brown flare to scorching mainly at the free margin of the wound of entry.

**Smoke blackening** is mainly due to black powder. It is less marked or even absent with smokeless powder. At contact or near distance, the carbon containing gas gets deposited as minute particles upon the clothing or skin around the wound of entrance. Smoke mark may indicate range and direction of the fire. Beyond a yard, it is absent. Powder tattooing or stippling is present around the wound. These marks resemble peppering and are due to unburned or partially burnt powder particles. They are far more common with black powder. Beyond two yards, tattooing is not present.

**Grease mark** is present only at the margin of clothes or the wound. The bullet removes such substance from the barrel by wiping and deposits it on the margins of the wound. (Photo.7.3)



**Photo.7.3:** Bullet entry wound margins characteristics A. Flame scorched entry margin B. Powder stamping around entry C. Collar of abrasion & D. Elliptical entry indicating angle of fire

**Gross splitting** of skin generally occurs with high velocity bullet and contact wound of low velocity bullet. In latter case, gases of fire-blast from muzzle end pass into the tissue under pressure distending and lacerating skin and subcutaneous tissue. If there is no hard structure like bone under the skin, gases easily get dispersed into the tissues. When there is hard bone as in scalp or cheek, it resists entry of gases, which return with extreme force; **blowback phenomenon** causing stellate or ragged wound with everted margin. Occasionally bullet exits through original entry wound. (Photo.7.4 & 7.5)



Photo.7.4: Rifled firearm Stellate shaped entry wound on forehead



Photo.7.5: Rifled firearm Stellate shaped entry wound on face cheek

*Trajectory with direction* is track between entry and exit wound. Track shape and diameter depends upon velocity of the projectile and type of tissue through which it passes. It may be a single uniform course proportionate to diameter of the projectile while it passes through soft tissues or a changed course in shape, size and direction if projectile hits a hard object like bone. Later course has two distinct portions; initial primary through soft tissues and subsequent secondary through hard bone and remaining soft tissue. Primary portion with low velocity bullet through soft tissues is usually proportionate or slightly smaller to the diameter of the projectile and secondary either is larger or multiple due to broken bone pieces having little relation to diameter of the projectile. If site of ricocheting prior to entry is different, both entry wound and its path will be totally unpredictable and may assume a bizarre shape. It is important in such cases that projectile be examined for possible foreign inclusions originating from intermediary target (Fig. 7.5 & 7.6)

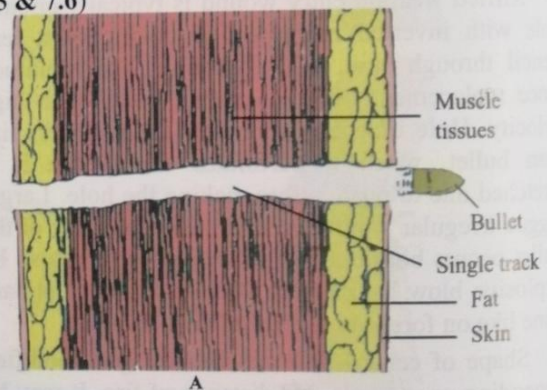


Fig. 7.5: Projectile uniform track through soft tissue proportionate to its diameter

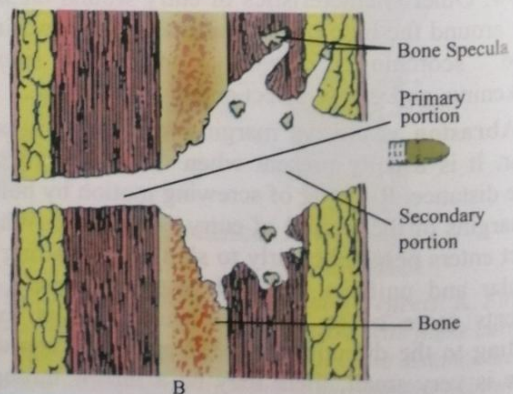


Fig. 7.6: Projectile changed track in size and shape having multiple courses through bone having no relation to its diameter

Exit wound by rifled bullet in soft and hard tissue presents different appearances. Soft tissue exit is larger than entry without fire-blast imprint effects. Body hard tissues are bones of different character like short, long and plate as in skull. Only skull

shows characteristic entry and exit rifled bullet holes, which indicate direction of trajectory. Entry hole is a simple hole, whereas exit shows beveled margins. Holes may also accompany radiating fractures traveling away in the direction of dispersion of energy. (Photos.7.6)



A



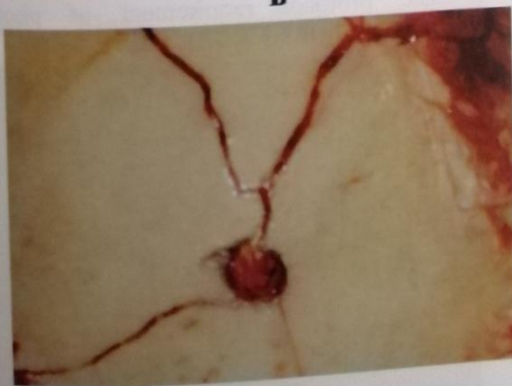
A.1



B



B.1



C



C.1

Photo.7.6: Rifled bullet holes on external/internal surfaces of skull A & A.1 Entry holes with clear margins B & B.1 Exit holes with beveled margins C & C.1 Entry and exit holes with radiating fractures

Forensic Aspect of Wounding (Part 2)

Summary of differences of character of entry and exit wound is tabulated at. (Table 7.2)

Differences of entry and exit wounds		Exit
Character	Entry	Larger
Diameter	Smaller or equal	Irregular
Shape	Regular (circular/oval/stellate)	Everted
Margins	Inverted	More
Bleeding	Less	Absent
Fire-blast imprint	Present	

*Entry wound by shotgun* differs in appearance from rifled wound. Main difference is number of holes i.e. rifled wound has single hole and shotgun many holes depending upon distance of fire:

- Contact wound makes single en-mass entry with burnt irregular margin
- Short distance wound makes a pattern having central en-mass entry with a few peripheral holes
- Far distance wound lacks central en-mass entry and pellets with wider dispersion make individual holes almost of the size of each pellet without charring. Diameter of dispersion has relationship with range. Wound in inches is equal to distance between muzzle end and target in meters. Maximum effective range of shotgun is about 20 meters. (Photos. 7.7 & 7.8)



**Photo.7.7:** Close distance shot gun entry wound on face causing central en-mass entry and pellets making two holes due to limited dispersion



**Photo.7.8:** Far distance shot gun entry wound on chest causing no en-mass entry; pellets widely spread making holes without charring

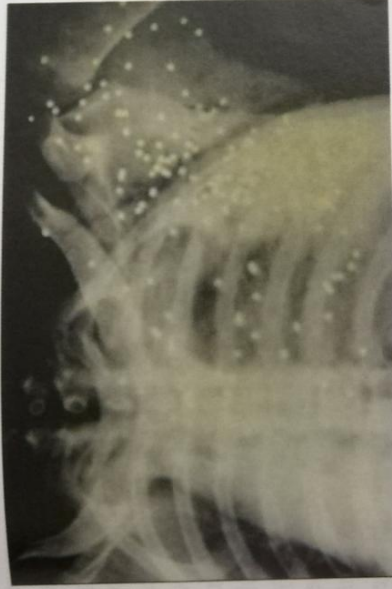
Forensic protocol for certification of fire-arm injuries should include detailed written description, photographs of victim's wounding area with and without clothes and X-ray of wounded part to locate and record presence of short-charge within body of corpse are essential requirements. Further, if targeted area is covered by clothes, stained with blood and bear shot-charge hole/holes, it should be encircled with permanent marker, signed and dated by examining medical examiner to identify in the court of law during evidence. A shotgun injury case is chosen and listed below seriatim to emphasize forensic protocol requirement of photographs. (Photo.7.9 A, 7.10 A.1 & 7.11 A.2)



**Photo.7.9 A:** Victim's wounding area on left chest. Shirt showing blood stains and en-mass central entry with widely spread pellet holes



**Photo.7.10 A.1:** Same case without shirt showing en-mass central entry and widely spread pallet holes on left chest and left hand



**Photo.7.11 A.2:** X-ray of same case showing central aggregation and widely spread pallet holes on left chest

While discussing forensic certification protocol of fire-arm injury, forensic medical examiner is advised to remember differentiation points between wounding by bullet and shot charge. (**Table 7.3**)

### Bomb blast including suicidal

**bomber injuries** are classed as special trauma. Mechanism of blast, resultant atmospheric changes and injuries caused to human beings within its vicinity would require knowledge about:

**Table 7.3:**

*Differentiation points between wounding by bullet and shot charge*

Character	Bullet	Shot charge
Number of entry wounds	Single	More than one
Shape of entry wound	Round or oval	Pattern made by pellets
Size of entry wound -	Proportionate to the diameter or larger	Small or proportionate to diameter of pellet
Margin of the entry wound	Inverted	Non specific
Imprint around the entry wound	Less prominent or absent	More prominent
Tail wag effect	Present	Absent
Track	Single	Multiple
Exit	Present in majority of cases	mostly absent

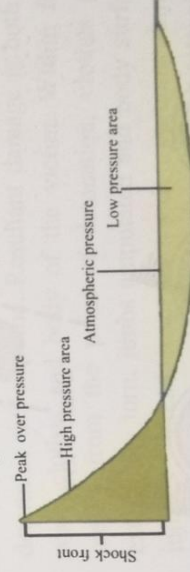
### • Bomb design

#### • Physics of explosion forces

*Bomb design* comprises of a container, explosive material and detonation device. Container usually a pipe or glass cylinder made of any suitable material such as plastic, glass or metal that can be sealed airtight. Explosive material can be a solid, liquid or gas and most commonly used is commercial gelignite and sugar-sodium chlorate mixture. Detonation device is either time-delayed or remote controlled. Recently along with explosive material other items such as nails, balls from ball bearing or metallic pieces of different sizes are used.

*Physics of explosion forces* are hot expanding gases of extremely high magnitude, which increase atmospheric pressure in the region of explosion instantaneously and generate **pressure waves**. These pressure waves travel concentrically in all directions at very high speed about 21,000 km/hour. Like sound waves, the pressure waves have the ability to flow around barriers and also get reflected by them. The pressure is very high at the front of the wave and the maximum differential between the pressure in the region of explosion and the normal atmospheric pressure is called **peak over-pressure**.

It is measured in pounds per square inch. A partial vacuum is formed behind these waves of the peak over-pressure lowering the atmospheric pressure to below normal. Length of time between the passage of shock waves and return to the normal pressure is known as **positive pressure duration**. (**Fig. 7.7**)



**Fig 7.7:** Atmospheric changes in the region of explosion

Pressure wave's front can pass through the human body tissue depending on their resistance, type and architectural design. They may pass differentially through coverings of the body, muscles and internal organs. The passage through solid organs like liver and spleen is relatively smooth producing less damage. Organs containing air like lungs and middle ear are more susceptible and are subjected to shredding effect at the tissue-air interface as the waves cross it and produce shearing movement in the other portion causing it to be bruised. Lungs show patchy alveolar hemorrhages throughout and death may occur due to respiratory embarrassment. Tympanic membrane shows reddening, bruising and perforation. (Fig. 7.8)

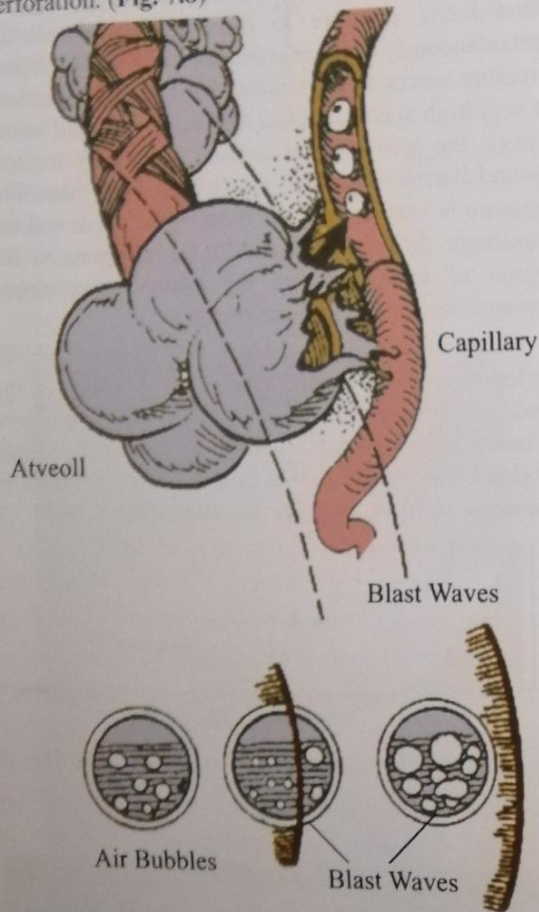


Fig. 7.8: Passage of blast waves through the soft tissue

Besides explosion in atmospheric air, it may also occur under water, which is 800 times denser and 1000 times less compressible than air. It transmits blast waves more efficiently. Injuries produced from the same blast occurring under water are far more serious and severer. (Fig. 7.9)

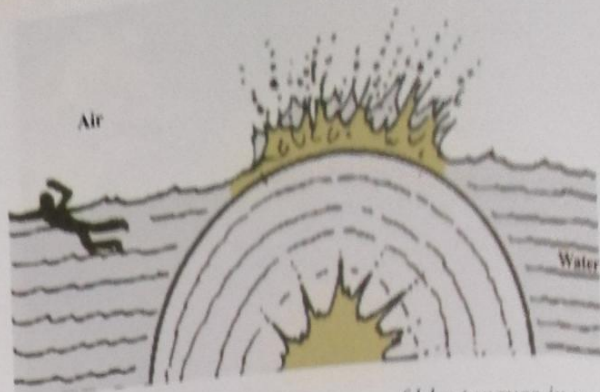


Fig. 7.9: Pattern of transmission of blast waves in water

Explosion, besides blast waves, produces flame of very short duration, smoke and solid fragments originating from within the bomb and environment. The sum-total effect is conversion of bomb material and surroundings elements into a violently expanding atmosphere of pressure waves containing flame, hot gases and solid fragments. These factors influence the outcome depending upon physical characteristic of the bomb, distance between point of detonation and victims and protecting or reflecting effects of adjacent structures. Pressure waves have the property to be deflected around any barrier, which come in the way, flow laterally and join the *pressure wave's front* reinforcing and enhancing effect causing damage more severely.

These elements cause external injuries to the victims in the vicinity of blast in four ways:

- Primary effect
- Secondary effect
- Tertiary effect
- Other effect

*Primary effect* is direct impact of steep *pressure wave's front* travelling at a very high speed. Pressure wave's front acts like those of blunt force and produce injuries. Air over-pressure above 100 lbs. per square inch is necessary to endanger a human being:

- If the victim is in contact with bomb at the time of detonation, he is literally blown into pieces which fly in all directions for variable distances up to 200 yards. Careful search and collection of human material at site of such a case presents bizarre and senseless picture.
- Other cases, when distance between victim and bomb is about one meter, torso is grossly damaged, cloths torn and limbs amputated blown off. Beyond this range, body is not mutilated and only gets injured. (Photos.7.12, 7.13 & 7.14)



**Photo 7.12:** Collected blown apart body pieces of victim by primary pressure wave's front close to bomb at the time of detonation



**Photo 7.14:** victim's body beyond one meter injured without mutilation



**Photo 7.13:** Victim's body within one meter range of bomb face, chest and abdomen grossly wounded, right arm blown off and shirt massively torn

*Secondary effect* is an indirect consequence in the form of injuries received by the victims due to impact of debris energized by the blast. Debris consists of **primary missiles** originating from components of the bomb itself and **secondary missiles**, which are nearby articles thrown into flight by blast. Victim's distance from point of detonation and nature and velocity of flying fragments are important factors to determine the outcome. Resultant damage is both to worn clothes and body of the victim. Within few meters from the point of detonation, clothes get extensively torn, limbs amputated and body surface injuries spread over a wide portion. Injury characteristics are either in the form of **dirt tattooing** or **triad of bruises, abrasions and small lacerations**. Bruises and abrasions are circular, two-ten mm in diameter and in some cases, may coalesce together to give the skin a purple discoloration. The size of the lacerations is slightly larger unto 3 cm in diameter. In cases where victims are beyond few meters of the blast, tattooing effect disappears. Only large fragments may get impacted in various parts of the body or pass into or through body cavities. (Photos. 7.15)





**Photo.7.15:** Dirt tattooing/triad of bruises, abrasions and laceration of face and neck by energized debris and two splinter injuries on shoulder and chest

*Tertiary effect* is also an indirect injury caused to victims by his striking against a wall or other barrier under the effect of pressure wave front. On most occasions victim is lifted off the ground and propelled against the barrier precipitating deceleration effect to the contents of his body cavities.

*Other effect* on the victim is due to the **explosion atmosphere** having flame and hot gases due to combustion of clothes and surrounding items; inhalation of noxious gases and falling masonry structures. Ionizing radiation effects are only present in cases of nuclear blasts.

Original flame due to detonation is so momentary that secondary fire masks its effects. Those caught inside collapsing buildings sustain bruises, abrasions and lacerations of nonspecific kinds, which must be differentiated from those due to blast effect. These victims die mostly either due to multiple injuries of demolition or crush asphyxia.

**Suicidal bomber**, wearing suicidal vest containing explosive material mixed with multiple metallic items, which act as projectile (nails, iron pieces of different sizes, balls from ball bearing and occasionally bullets) comes to scene to do the job and die. He is determined to cause maximum damage to people. Detonation device is either under control of suicidal bomber or another person placed remotely. Injuries caused to victims within the vicinity of suicidal bomber are no different from those already described above. As regards injuries to his person, his torso is extensively burnt and mutilated, occasionally only sparing partially his head and terminal portions of lower limbs. This is why in majority of cases, recoverable parts of suicidal bomber are his head and portion of lower limbs. (Photo.7.16 & 7.17)



**Photo.7.16:** Suicidal bomber torso extensively burnt and highly mutilated sparing head and partially upper limbs



**Photo.7.17:** Three suicidal bombers' unidentified heads recovered from different locations

**Forensic autopsy** of bomb blast victims is an anatomical exercise similar to sorting of skeletal remains. Determination of cause of death in most cases is obvious. Examination is guided by three principles:

- Identification of marker (trace evidence) within victim's body to know its source
- Allocation of parts to each victim to determine numbers in mutilated bodies
- Reconstruction of victim's remains to locate and recognize sites, types and distribution of injuries

Task may be simple if victim is relatively intact or it may become very difficult, even impossible, when victims' are more than one and are badly mutilated into fragments. This exercise can become extremely complicated when smaller fragments of human origin get mixed with disintegrating masonry structures or when they are not available. There are three steps of such an investigations:

- Non-human tissue, if any, should be identified and discarded
- Isolation and labeling of various parts and organs of the human origin
- Allocation of these human parts is done to the individual bodies to determine their number.

Radiology is useful and assists in identifying the trace evidence and matching of contained skeletal structures.

**Forensic evaluation of wounding** is necessary in every medico-legal case and also extremely important. Its proper understanding by investing police, law enforcement persons and eventual consideration by law courts for making decision is essential upon forensic medical examinations. Forensic medical certification is incomplete without this essential inference. A good example is a case of an injury:

- i. Self-inflicted, accidental or homicidal
- ii. Ante-mortem or post-mortem
- iii. Possibility of volitional activity after injury
- iv. Duration of fatal period.

Enlisted issues are discussed one by one:

*Self inflicted* commonly is an abrasion, incised wound and not a bruise or laceration:

- Self-inflicted abrasion is seen on the body of a female, mostly produced by her own nails as

scratches on her face, front of shoulders and chest.

Self inflicted bruise is difficult to produce on one's own self, being very painful process. Stimulation of a bruise though can be produced by rubbing of an irritant material on the skin and can be differentiated from a true bruise. False bruise has a defined outline and tiny vesicles at its margins, which can be seen with magnifying lens.

Self-inflicted laceration is a remote possibility unless person is very desperate or mentally ill. Only site is forehead, which is injured by striking a blunt object or banging it against wall.

**Self-inflicted cuts** are most common and they are multiple, arranged parallel to each other and on the accessible parts of the body such as scalp, arm, forearm and abdomen. They show tailing towards working hand and do not involve clothes. (Photos.7.18, 7.19, 7.20 & 7.21)



**Photo.7.18:** Healed scars of characteristic self-inflicted skin cuts on left arm/forearm and head



**Photo.7.19:** Multiple healed scars of characteristic self-inflicted skin cuts on abdomen of same individual with single fresh such cut on chest



**Photo.7.20:** Characteristic self inflicted multiple, parallel having tailing cuts on forearm of female



**Photo.7.21:** Characteristic self inflicted multiple and parallel cuts on forearm of male

Contrasting features of self inflicted injury and assault are listed in (Table 7.4)

**Table 7.4**  
*Contrasting features of self inflicted incised wound with those of assault*

Characteristics	Self-inflicted	Assault
Site	Accessible	Anywhere
Depth	Superficial	Usually deep
Number	Multiple	One or more
Arrangement	Parallel	Random
Tailing	Present	Absent
Clothes	Not involved	Involved
Defense wounds	Absent	Present

**Elective suicidal sites** with knife and firearm are different. With knife they are throat (carotid artery and trachea), chest (heart), wrist (radial artery) and upper thigh (femoral artery). With firearm they are face (forehead, temple and mouth) and chest (heart). Weapon weather knife or firearm remains clutched in hand due to cadaveric spasm.

**Cutthroat features** for suicide and homicide are specific.

- Suicide cutthroat comprises of one or two superficial hesitation cuts at point of initiation followed by final deep lethal wound in neck. Hesitation incisions are usually high up on left side in the right handed person and final lethal wound runs obliquely and downward. Depth is more on the side of initiation reducing towards the working hand. Carotid artery is usually spared on this side. Site in left handed person will be reversed.

- Homicidal cutthroat is boldly placed in the centre having maximum depth in the middle. Neck structures are equally cut on both sides.

Contrasting features of suicidal and homicidal cutthroat are present at neck and other body parts. (Table 7.5 and photos 7.22 & 7.23)

**Table 7.5:**  
*Contrasting features of suicidal and homicidal cut-throat*

Feature	Suicidal	Homicidal
<i>At site</i>		
Hesitation cut	Near initiation point	Absent
Wound position in neck	High up	In the middle
Number	Usually single	More than one
Neck structures involved	Opposite side of working hand	Equally on both sides
Depth of wound	Maximum at the point of initiation	Maximum in the middle
Tailing	Present on working hand side	Absent
<i>Others</i>		
Cadaveric spasm	May be present	Absent
Defense wounds	Absent	May be present
Clothes staining	In front, from above downward	Consistent with body posture



**Photo.7.22:** Suicidal cutthroat having more depth at point of initiation gradually reducing in depth



**Photo.7.23:** Homicidal cutthroat showing two bold wounds in the middle of the neck

Suicidal sites with firearm as pointed above however are front and side of face, oral cavity or blow chin and left side of the chest from close range. Suicidal wound complex shows blast effect around wound of entry staining it with smoke, gun powder, scorching entry margin and singeing of hair, if on hair bearing area. Suicidal person rarely injures through clothes and bleeding from site flows down staining cloths. (**Photos 7.24, 7.25, 7.26 & 7.27**)



**Photo: 7.24:** Firearm elective suicidal site of forehead,



**Photo: 7.25:** Firearm elective suicidal site of temple of working hand side.



**Photo: 7.26:** Firearm elective suicidal site of mouth cavity



**Photo: 7.27:** Firearm elective suicidal site left side of chest

Forensic Aspect of Wounding (Part 2)

Firearm homicidal sites are not as clearly demarcated as those of suicidal and may be on any part of the trunk (front, side or back) usually on inaccessible parts involving internal vital organs. They are more than one and presence of two wounds strongly favors diagnosis of homicide. Covering clothes are always involved. Occasionally weapon may remain embedded and stuck in vertebral bodies in wounding of neck, chest and abdomen and acts as trace evidence. (Photos. 7.28 & 7.29)



Photo. 7.28: Sharp edged pointed weapon homicidal wounds, knives embedded in neck and abdomen



Photo. 7.29: Multiple sharp edged pointed weapon homicidal wounds, knives embedded in chest

Defense wound with sharp-edged weapon like knife on the body of victim is a strong indication of homicidal attack. Such wounds are present on palm and hand fingers in one line or back of forearm. They are received during an attempt to hold or ward off weapon. With blunt weapon, there may be a bruise on back or medial side of forearm. (Photo. 7.30)



Photo. 7.30: Sharp edged weapon defense wounds on hands A, palm B, C & D fingers

Possibility of volitional activity before death depends upon extent of damage and which vital organ or system is involved. Each case has to be assessed on its own merits. Important factors are speed of bleeding, amount of hemorrhage and degree of resultant embarrassment of the tissues. There are reasonable number of cases on record, in which volitional activity has been possible even after involvement of heart and brain.

Ante-mortem injury and its recognition depend upon the presence of vital reaction. Immediate and simplest form of vital reaction is bleeding within and externally from the injury. If the skin is not ruptured, the site looks red, more so in a person having fair complexion. During autopsy, a cut at site will show presence of bleeding under the skin and appearance is characteristic. In cases of flame burn, a red line of

vital reaction demarcates damaged tissue from the healthy tissue. (Photo.7.31)



Photo.7.31: Post mortem cut on back of right buttock during autopsy confirms presence of bruise under the skin

Other form of vital reaction is initiation of the process of repair. It becomes visible microscopically in about four to six hours, as invasion of white blood cells at the site of injury. With naked eye, inflammatory response becomes visible rather late. Subtle biochemical changes also take place at the site of injury, which are more reliable. Detection of these changes requires elaborate procedures.

**Fatal period** along with estimation of its duration is an important inference. Its determination depends upon type of involved injury, vital organ/system or blood vessel that is responsible for causing death. There are two important periods; *direct (primary) and soon after and indirect (secondary) and delayed* period and causes of which are discussed after (Table 7.6)

Table 7.6:

**Causes of death**

**Direct (primary) and soon after causes**

- Air embolism
- Rupture of blood vessel causing quick and extensive hemorrhage
- Mechanical injury to vital organ
- Combined effect of the latter two

**Indirect (secondary) and delayed causes**

- Wounds infection leading to septicemia/pyemia
- Infective processes within internal organs such as pneumonia, pleurisy, pneumonitis, meningitis or brain abscess
- Subsequent necrosis with or without secondary hemorrhage
- Non-current disease, occurring due to wound itself or by lowering resistance of the patient

**Air embolism** precipitates immediate death. Air may enter into circulation by intravenous infusion, laparoscopic surgery, craniotomy, urethra-scopy, fallopian tube insufflations, aortography and abortion. It can also enter through neck veins in cases of cutthroat. Factors like positive pressure in the arteries especially near the heart and negative pressure in the veins are responsible. Volume of introduced air sufficient to cause death is about 60 ml or more.

**Rapid loss of blood**, one third of the body is sufficient to cause immediate death in general terms. In certain specific situations especially when bleeding is within cranial and pericardial cavities, a little hemorrhage will precipitate quick death because of interference with function of these vital organs. Effusion of about 10-15 oz. of blood into the pericardial sac will prove fatal due to cardiac tamponade.

**Mechanical destruction** of vital organ like heart, both lungs and brain embarrasses their functions and precipitates shock, which results in immediate death.

Indirect and delayed death occurs in those cases that have non-fatal trauma. Secondary causes are therefore, results from infection involving internal organs, complication of surgery and anesthesia. Death in such victims is delayed and the period is variable depending on the mechanism of death.

**Relationship of injury to precipitation of disease** is an issue of any person who suffers an accidental injury or occupational disease. He can claim compensation under social security laws. The decision, whether injury or any of its complication is the outcome of an occupation may be a simple and straight forward question having this relationship already recognized and established. When the relationship of occupational disease to injury is not clear, as at times happens, it is a problematic situation. Such matter goes to the court and legal guidance on the issue is of limited character. Probability of the development of subsequent disease including neoplasm at first time site of trauma is unlikely. Trauma is a common event in life and one can easily recollect some injury to most parts of his body, when one is asked about it, especially in cases in which compensation depends upon this association. Memory tends to be encouraged even in those having moral integrity. Some of the conditions in which relationship of trauma to subsequent complications have already been established. (Table 7.7)

**Table 7.7:**

*Trauma and related conditions*

- Infection
- Aggravation of existing condition
- Consequent conditions
- Post traumatic stress syndrome
- Neoplasm
- Occupational disease

**Infection** has a strong association of trauma. The most obvious example of infection going directly into the wound is an open wound caused by gunshot or other penetrating weapon. The not obvious cases are the development of meningitis and pneumonia following fracture of anterior fossa of the skull and pulmonary contusion respectively. An infected part may spread infection to other parts situated remote from the site of injury or even to the whole body. The organisms infecting uterus following a criminal abortion may cause meningitis. In such a case, it is essential not only to show that the infection followed uterine interference, but also that the infecting organism isolated in the meningitis and uterus or vagina was similar. The example of spread of infection to whole body is seen in a case of bruising of a pre-existing staphylococcal lesion in bones with subsequent development of septicemia.

**Aggravation of existing injury by trauma** is a common occurrence and is seen in cases of occlusion of coronary following direct injury to the artery having atheromatous disease, rupture of existing aneurysm following direct violence over it. Further the rupture of pre-existing aneurysm and precipitation of cardiac infarction with severe pain, collapse and even death due to increased demand for blood by a heart with deficient arterial supply due to coronary atherosclerosis while tightening a bolt are good examples.

**Consequent conditions** like **embolism, crush syndrome** and **bronchopneumonia** may occur following trauma to the body, more so in crushing injuries to the limbs especially when associated with bony and soft tissues like muscles and adipose tissue.

*Embolism* occurs either at the time of injury or during movements of injured part during transport of the patient to the hospital and is of three types:

- i. *Fat embolism* occurs during surgical procedures on parts rich in fat, like breast and abdomen. Fat emboli are present in almost all cases of trauma and section of the brain and kidney stained for fat will give

confirmatory evidence. These findings are essential to establish that death is due to fat embolism.

- ii. *Air embolism* occurs as a result of incised wounds involving large veins, especially cut throat. It may also occur in crush injury of chest, or as a complication of therapeutic procedures such as insufflations of the fallopian tubes. Its association with criminal abortion is well known. Opinion differs regarding length of time between the introduction of air and collapse; it is usually believed that the period has to be appreciable. Postmortem appearance is characteristic showing presence of a chain of bubbles in the neck, coronary veins and on opening the heart; its right side is filled with frothy blood. It is generally possible to trace the air bubbles to the site of entry.
- iii. *Pulmonary embolism* has well-established association with injury. It occurs following development of deep vein thrombosis especially in legs from where an embolus gets detached and causes death. Injury increases viscosity of blood, makes platelets adhesive and induces venous stasis, these acts as predisposing factors for the development of thrombo-phlebitis, which develops in about two weeks following an injury.

*Crush syndrome* is a difficult medico-legal problem, met in cases of industrial or vehicular accidents or severe battering by police especially involving buttocks and lower limbs. It was first described during the Second World War while dealing with the victims of air raids having severe crushing of the tissue. Pigments like myohemoglobin and granular casts are seen in the tubules of kidney. This is associated with swelling and necrosis of epithelium and eventual renal failure. It was suggested that it is due to attempt on the part of kidney to excrete acid metabolites from damaged muscles. The current view negates it stating that it is due to renal ischemia and not to mechanical obstruction by casts etc. A possible combination of both conditions may be present.

*Bronchopneumonia* occurs in elderly people following fractures of lower limbs and consequent immobility of the patient. Shock and bad postural drainage are considered probable causes. Curling ulcer in the duodenal part of intestine occurs as a complication of burns or scalds. The mechanism is not known.

**Neoplasm** definitely develops at the site of repeated trauma and there is considerable medical evidence in its favor. However, its development at

the site of single injury is doubtful. Growth and repair by healing both involve lying down of new tissue. When the repair process, for any reasons becomes irrepressible, neoplastic change sets in. While entertaining its possibility, it must be remembered that the organization of the affected area takes time and when these processes become malignant further time is required. Latent period may be long.

**Eying postulates** are an attempt to introduce some relationship into assumption that the two events, which are chronologically related in time, may be cause and effect. These postulates do not provide scientific proof of the relationship even when these are satisfied. (Table 7.8)

Table 7.8:

**Eying postulates**

- Integrity of the part prior to injury
- Substantial or adequate injury to the part
- A reasonable interval of time for the development of symptoms
- Development of growth or tumor at the site of the injury
- Proof of nature of the tumor by microscopy

Assessment of the first two depends on the integrity of the witnesses who must always be tested with great care. Rest depends upon the ability of the medical examiner and on the thoroughness of medical examination.

**Occupational disease** especially after the application of physico-chemical trauma, which a worker suffers, is a possibility. Industrial atmosphere has noxious material and chronic exposure to toxic atmosphere produce illness by direct effect of toxic chemicals like asbestosis or indirectly by reducing

immunity and making a worker vulnerable to other diseases like tuberculosis. Criteria of relationship of trauma to occupational disease (Table 7.9)

Table 7.9:

**Relationship of trauma to occupational disease**

- Significant association between exposure to the agent and subsequent development of the syndrome
- Correspondence between extents of exposure and essential elements of the syndrome (some degree of dose-response relationship be demonstrable)
- Demonstration of agent or its metabolic products in the tissue
- Development of similar pathological changes in animal following exposure to similar agent (failure to obtain such changes does not negate other evidences of causation)

**Koch's postulate** "an agent identified in a case can be grown in successive cultures and can reproduce the disease in animals". The postulate may not be applicable as the agent may not be found in every case and it does not multiply. It may not always produce the disease or same effects in experimental animals. The effects of the agent may be modified by other factors such as the type of exposure, individual response and susceptibility. Other synergistic agents may be present in the same exposure.

Role of numerous attendant circumstances capable of influencing the appearance or manifestation of the disease initiated by the agent in question should be evolved on determination of the casual relationship based on preponderance of the evidence rather than an absolute proof.



## 8. Forensic Aspect of Transportation

**Modern transportation** on road, rail and by air have tremendously benefited mankind with speed and comfort. But it has also been accompanied, throughout the world, with increasing traffic accidents at an alarming rate. There are now more deaths due to accidents than due to cancer. Further, those injured in such accidents are young and die at prime of age. Number of accidents is directly proportional to the number of vehicles on the road and ratio of death and injured is one death against 10 seriously and 40 slightly injured. West Germany having same population as U.K., total deaths is much more because of more vehicles. In Pakistan correct statistics is not available, but it is felt that number of dead and injured per mile traveled is much more than many other countries. (Table 8.1)

**Table 8.1:**

*Ratio of number of deaths and injured of road accidents*

Country	Deaths	Injured
USA	40,000	2,000,000
U.K.	7,000	350,000
West Germany*	17,000	850,000

\* More vehicles

**Traffic accidents** have been investigated from point of view of mode of travels i.e. road, rail and air. Road accidents are on the top with much higher in number comparing with other modes, thus more important. Motorized vehicular accidents involve both pedestrians and occupants. Victims of impart accidents are mostly occupants. Crash accidents produce damage to both pedestrians as well as occupants. Two-wheeler is unstable and unprotected and is responsible for major share in causing injuries to the victims, who are mostly pedestrians sparing vehicle occupants. Another basis

of investigation is type of accidents. As regard accident causation including determination of motive, driver's health and intoxication are of paramount importance especially with single vehicle. (Tables 8.2, 8.3 & chart 8.1)

**Table 8.2:**

*Road-traffic accident causation*

**Mechanical factor**

Faulty engine (carbon monoxide poisoning),  
Mechanical failures (breaking of tie-rod or burst of tyre)

**Environmental factor**

Poor visibility  
Traffic density versus speed of vehicle  
Audio-visual distractions

**Personal factor (driver)\***

Physical disability (loss of vision, hearing or limbs)  
Psychological disability (depression, mania, schizophrenia)  
Acute episode of pathological condition (coronary disease, epilepsy)  
Spontaneous illness (renal colic)  
Systemic disease (hypertension, renal disease, diabetes)  
Drugs (alcohol, tranquilizers, amphetamines)  
Fatigue (precipitates mental block and power of decision)

\* More important for medical certification.

**Table 8.3:**

*Type of road-traffic accidents*

• **Number of vehicles involved**

Single or more vehicles

• **Direction of the impact**

Frontal, lateral and rear impact

• **Motive of accident**

Crash with motive (homicide, suicide or to mask accident) or without motive (due to intoxication)

• **Extent of damage to injured**

*Minor* (injuries trivial, victim not hospitalized)

*Moderate* (injuries serious, victim hospitalized for a week)

*Severe* (injuries endanger life, victim hospitalized for more than a week)

*Fatal* (victim either dies on the spot or within 30 days of hospitalization)

ROAD TRAFFIC ACCIDENT			
NUMBER OF VEHICLES	DIRECTION OF IMPACT	EXTENT OF VICTIM'S DAMAGE	MOTIVE DETERMINATION
Single	Frontal	Minor	Crash without motive (Intoxication)
More (mass accident)	Rear	Moderate	
	Lateral	Severe	Crash with motive — Homicide — Suicide — Mask accident
		Fatal	

**Chart 8.1:** Classification of road traffic accident

**Victims of traffic accident** are knocked down pedestrians, pedal cycle rider, vehicle seated passengers including driver and un-seated occupants of public transport. In case of mechanized road and rail transportation, victims are both pedestrians and occupants whereas in the case of travel by air victims are occupants only. Injuries on the body of the victims are generally consistent with circumstances of accident, type of vehicle and seating arrangements of occupants. Mode of transportation such as road, rail or air also modifies type of injuries.

**Distribution of transportation accidents injuries** is divided into two groups

depending upon causation i.e. impact and acceleration/deceleration mechanism. Impact injuries to pedestrians occur at sites of impact involving external surfaces of the body and their distribution depends upon whether impact is **primary, secondary or tertiary**.

*Primary impact injuries* are situated on legs, thighs or hips, *secondary impact* on back of body, face/fore-head and top and *tertiary impact* may occur during dragging/run-over and burning of vehicle, which only occurs if vehicle catches fire. (Fig. 8.1)

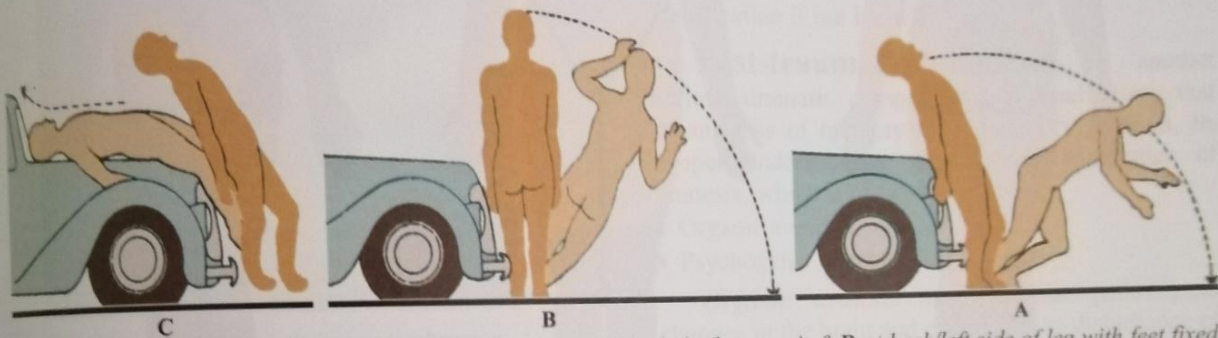


Fig 8.1: Primary impact sites on external surface to victim's body by bumper A & B at back/left side of leg with feet fixed on ground. C. Secondary impact sites at back of trunk with feet sliding from ground.

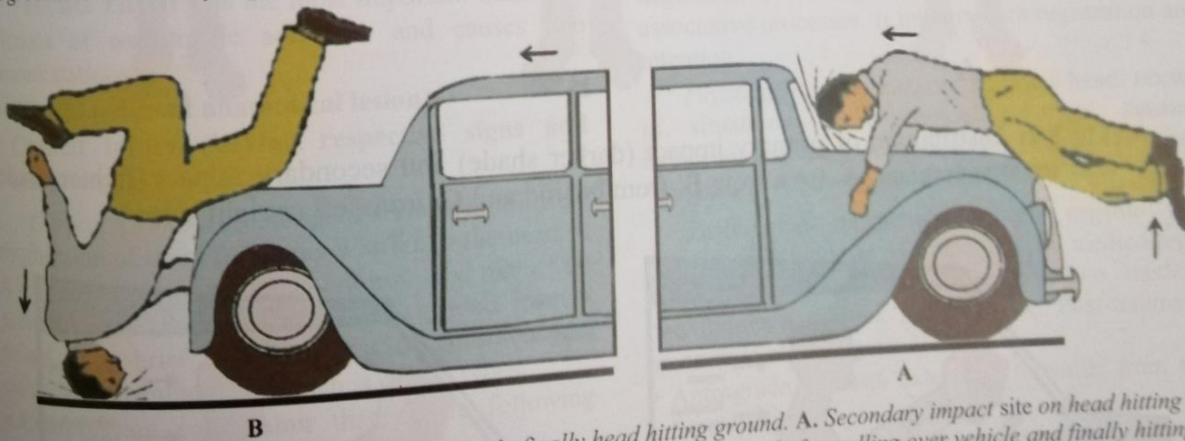


Fig 8.1: Victim lifted and sliding over the vehicle finally head hitting ground. A. Secondary impact site on head hitting bonnet/windscreen with feet lifted from ground B. tertiary impact site at head after rolling over vehicle and finally hitting ground

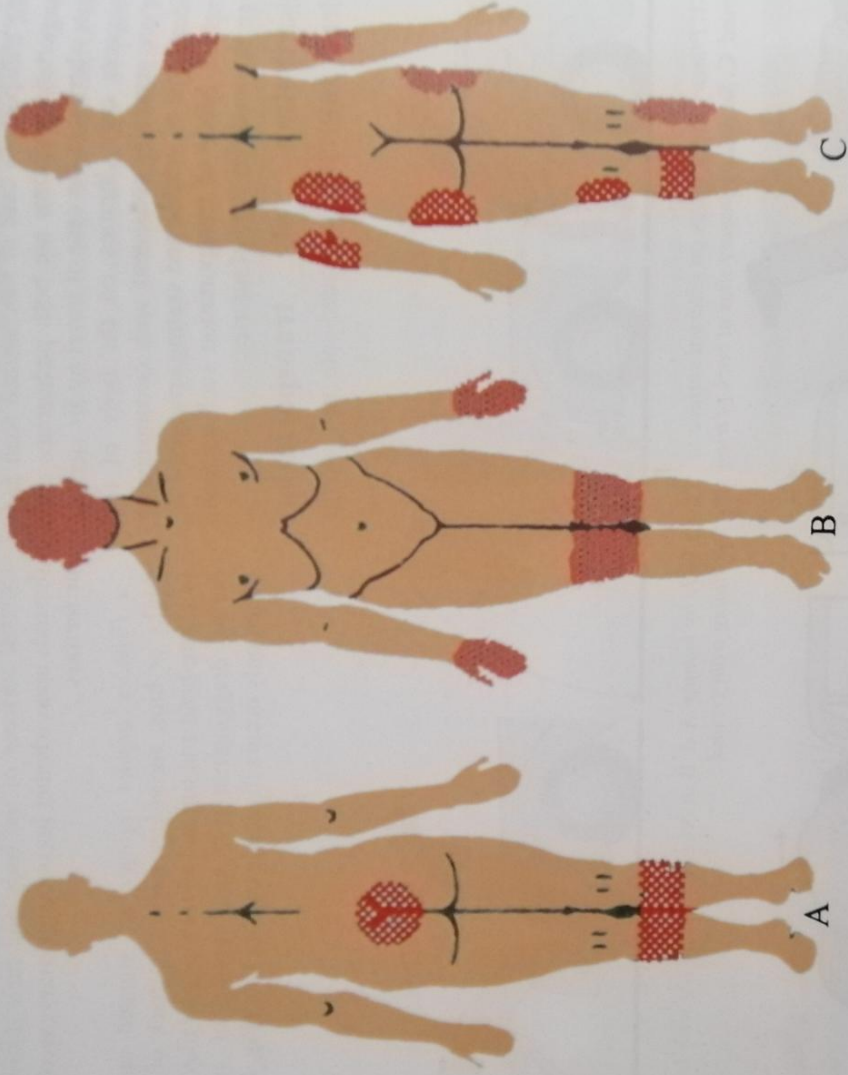
*Acceleration/deceleration injuries* occur to occupants of vehicle involving internal organs of body cavities mainly head and chest while it is accelerated or de-accelerated. There are three mechanisms:

- Frontal impact of vehicle against an object causes deceleration of vehicle and common parts of body

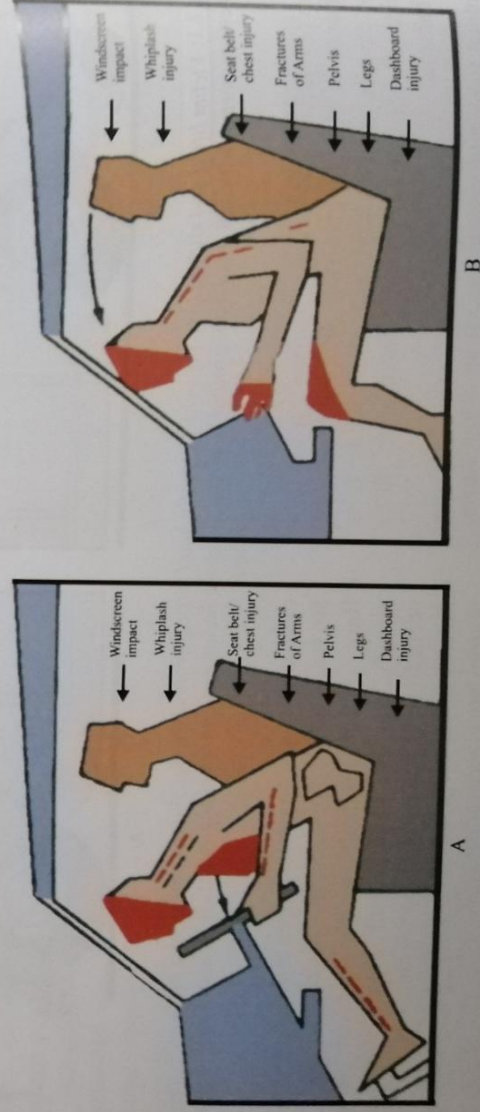
- of front seat occupant including driver get injured are scalp, face, chin, chest, hip, knees and legs
- Rare impact produces acceleration of vehicle already running vehicle and injuries generally occur to neck, lumber and hip regions.
- Lateral impact is at middle part of the vehicle and injuries are always crash type.

Besides, there are injuries due to structures that are fitted inside the vehicle. These structures are seat belts, steering assembly, instrument panel, dashboard,

windscreen, backrest and door handles. (Fig. 8.2 & 8.3)



**Fig 8.2:** Distribution of primary impact (darker shade) and secondary impact (lighter shade) injuries to pedestrians. A. from front B. from behind and C. from left or right side



**Fig 8.3:** Impact injuries to front seat occupants, A. driver B. other

Besides above stated injuries, during accident there are other injuries. A characteristic chest injury to driver is an imprint abrasion caused by seat belt. If door of vehicle gets opened and occupant thrown out from tertiary injuries, which are due to suffer, striking against road, dragging or run-over against, striking against road, dragging or run-over by other vehicle and in case of fire burn injuries.

(photo.8.1)



Photo 8.1: Seat belt imprints abrasion

**Head Injury** is the most important trauma to victims of road-traffic accidents and causes two manifestations:

- **Clinical (without anatomical lesion)**
- **Cranial injury (having respective signs and symptoms)**

*Clinical (without anatomical lesion)* is transient dysfunction of brain following a strike to the head. It is common injury of transportation and industrial accidents and even due to fall on ground from a height. It is brief period of loss of consciousness called **brain concussion**, which is of two types:

- **Compression concussion** that occurs following application of force to stationary head
- **Acceleration concussion** which is caused by the application of force to head in motion

*Acceleration concussion* is severer of the two. It is said to result from jerky movement of the brain substance in the hard cranial cavity. **Post-concussive syndrome** may occur in some cases after recovery of consciousness. Symptom-complex of this syndrome is nervousness, headache and dizziness. Residual symptoms may get prolonged in compensation cases after head injury. It is difficult to ascertain that a given train of symptoms is true post-concussive

manifestation. Many are of the view that *post-traumatic neurosis* is a separate entity and it should be differentiated from post-concussive syndrome. Post-traumatic neuroses like hysteria, anxiety and terror neurosis have now been replaced with a broader diagnosis of *post-traumatic stress syndrome*. Careful study of related factors, which include psychological and economical aspects of injury, will disclose the true picture. There are no positive findings in EEG and autopsy except a few petechaeal hemorrhages in brain substance along with disintegration of brain cells having some alteration in the nucleus and that too in very few cases. Its significance is not known.

**Post-traumatic amnesia** is another serious dramatic complication of head injury that means loss of memory after an injury to brain. Its proper understanding depends on knowledge of amnesia, which is of two types:

- Organic amnesia
- Psychogenic amnesia

*Organic amnesia* results from pathological changes in the brain and occurs due to disturbance of neurons through chemical alteration, trauma or degenerative change, which interferes with associative processes. It impairs both registration and retention.

*Psychogenic amnesia*, on the other hand, occurs in situations of psychological stress causing interference in the process of recall. Strictly speaking, “forgetting” is psychogenic amnesia.

Differential diagnosis between organic and psychogenic amnesia is important in medico-legal practice and to differentiate between two, medical practitioner must look for the cause. Post-traumatic amnesia is of two types:

- Antrograde amnesia extending forwards from the time of injury
- Retrograde amnesia extending backwards from the time of regaining of consciousness.

In cases of severe injury to the head, there may be retrograde amnesia showing loss of memory extending backward over a period, which is accompanied by loss of consciousness. It may also follow in many other forms of organic interference with cerebral function like an epileptic fit. Recovery from this type of amnesia does occur and recall is chronological, those memories nearest to injury being last to recover. Retrograde amnesia may also be

psychogetic in origin and has been known to stretch back over a long period.

Behavior of the victim before and after an incidence is important evidence in deciding responsibility. In offenses associated with epilepsy, there is often no attempt at concealment, if there has been true amnesia. An attempt by the offender to run or conceal the act suggests knowledge of what he has done. Amnesia for the crime is usual complaint and forgetting the act of crime does not affect responsibility.

Cranial injury occurs in both traffic and industry accidents especially to the mobile head. Various types are bruising/laceration of scalp, fracture of skull bones cerebral contusion/rapture of brain matter and intracranial hemorrhages to head. Gross crushing of head is characteristic of run-over accidents precipitating sudden death. (Photo 8.2 & 8.3)



Photo.8.2: Re-placed top portions of crushed head following run-over accident



Photo.8.3: Gross skull fracture, rapture of covering, displaced out brain and massive hemorrhage

### Mechanism of causation of head

injuries to mobile head is acceleration/deceleration of the brain. Resultant injuries are:

- Coup

- contre-coup

Effects on the brain are immediate because of direct consequence of trauma. Site of coup injury certifies point at which accelerating or decelerating force has been applied. Greater the forces, severer are the injuries. Lesion may not be symmetrical and many varieties of lesions within the cranium are produced because of many partitions of cranial cavity. While interpreting cerebral injuries, a word of caution that multiple mechanisms produce complex picture and one may find lesions in brain, which cannot be explained by a single mechanism. What is important that sites of intra-cranial hemorrhage and their relationship with clinical signs and symptoms is properly understood. Important sites of intra-cranial hemorrhages are:

- Extradural hemorrhage
- Subdural hemorrhage
- Subarachnoid hemorrhage
- Intra-cerebral hemorrhages

*Extradural hemorrhage* in adults is exclusively traumatic. However, extravasations may occur due to blood dyscrasias in infants. A depressed fracture over a sinus, or a linear fracture across line of the meningeal artery or vein ruptures them causing hemorrhage. The most common site of extradural hemorrhage is temporal fossa due to the rupture of middle meningeal vessels. Posterior fossa hemorrhage may not be immediately fatal, in these cases, chronic hematoma is often seen at autopsy and they are not encapsulated. (Photo.8.4)



Photo.8.4: Extradural hemorrhage over left temporal

*Subdural hemorrhage* is also traumatic in origin, though it may occur due to effusion of blood into the subdural space following rupture of an existing aneurysm in the cerebral blood vessels. Primary type

is due to a laceration in superior cerebral vein at the point of contre-coup. Accumulation of blood occurs over the upper part of dorsolateral surface of the cerebral hemisphere, which flattens convolutions of the opposite side with distortion and dislocation of the ventricle. In acute cases, symptoms of compression manifest in about 24-48 hours. Typical symptom complex is lethargy increasing to stupor and coma, unless this lesion is treated surgically. There may be slowing of pulse, dilatation of pupils and development of unilateral motor manifestations accompanied with high temperature. The patient may develop labored respiration, sweating and rapid pulse before dying. When recovery does not occur following surgical evacuation of the subdural clot, such patient remains in vegetative state for weeks before death. Softening of dorsolateral cortex by direct pressure of hematoma may take place, which is seen during autopsy.

Latent form of subdural hemorrhage develops due to slow leakage from a perforating vein. No symptom of this mishap appears. Subdural space has no meso-thelial lining and thus can do very little to resolve it. Subdural hematoma eventually becomes a blood cyst, which remains so for months or even years. The hematoma becomes encapsulated and the covering membrane gradually thickens. The secondary type occurs in association with gross contusion of frontal and temporal lobes with blood seeping through the covering into the subdural space. They are usually located over the injury. (Photo 8.5)

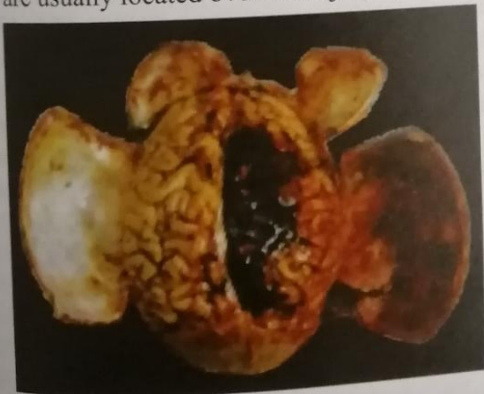


Photo 8.5: Subdural hemorrhage over right temporal

Subarachnoid hemorrhage may be traumatic in origin or may occur otherwise. Traumatic hemorrhage occurs in a considerable percentage of patients suffering from cranial injuries who remain unconscious for more than three hours. Primary type occurs in patchy distribution and is of mild degree

over parietal and occipital region of one or both sides or about posterior margin of the cerebellum. Other variety other than traumatic subarachnoid hemorrhage may also occur due to a rupture of an aneurysm usually at the base of the skull. In very severe injuries, the entire subarachnoid space may be filled with hemorrhage. Secondary type occurs in the immediate neighborhood of the contusion or lacerations of brain. Traumatic subarachnoid hemorrhage seldom plays a part in fatal issues and is just a contributory factor to other causes. (Photo 8.6)

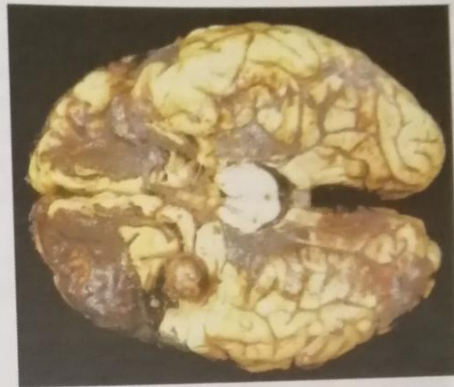


Photo 8.6: Subarachnoid hemorrhage

Intra-cerebral hemorrhages are sustained in traffic accidents, falls from height or in industry. They are the results of coup/contre-coup mechanism. A high percentage occurs in fatal head injury cases. i) Primary variety is the direct result of injury and found in the central part of frontal or temporal lobe. The frontal lobe effusions extend upwards and laterally whereas the temporal effusion is in the middle portion extending into the occipital lobe. The hemorrhage dissects its way along the fiber bundles. A larger effusion may rupture into a ventricle when death usually follows. The clinical course of this type of hemorrhage is slow manifestation in a variable interval after the injury. If the interval is more, it is called *delayed traumatic apoplexy*. After a posttraumatic interval of days or even weeks, a hemorrhage effusion may be found in the substance of brain. Any interval longer than three weeks suggests a spontaneous rather than delayed traumatic hemorrhage.

ii) Secondary type is a complication of severe contusion of the brain substance. A clot of considerable size may be found in the brain substance beneath the superficial lesion. Death usually occurs due to severe degree of cerebral edema, cerebral contusion and associated hemorrhage. The traumatic

intra-cerebral hemorrhage should be clinically differentiated from spontaneous apoplexy. The distinction is not so simple. In the case of traumatic variety, the interval between the injury and the onset of symptoms is usually a week. Injury to the head must be sustained while the head is in motion. Location of post-traumatic hemorrhage is usually in white matter of frontal and temporal regions. Occasionally it may be in the occipital region and post-traumatic hemorrhage is more common in young healthy individuals. Spontaneous hemorrhage is usually in the ganglion regions in a patient who is overweight and has a history of high blood pressure prior to the onset of stroke. The most common etiological condition associated with this type of hemorrhage is aneurysm of the intracranial arteries. There may also be evidence of degenerative arterial disease either clinically or at postmortem examination, particularly at the margin of the hemorrhage. Usually there is no difficulty in distinguishing between the two types during postmortem examination. (Photo 8.7)

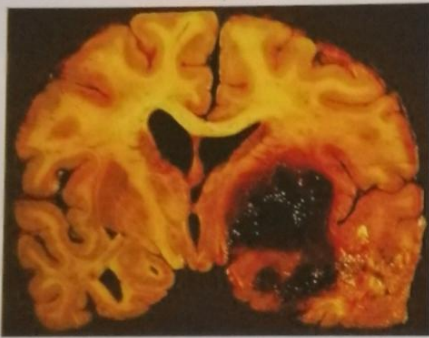


Photo 8.7: Intra-cerebral hemorrhages

### Road traffic accident investigation

is a teamwork calling entire spectrum of expertise, especially in mass accidents. Team generally comprises of three experts:

- Medical Examiner
- Vehicles Examiner
- Forensic Science Expert

Medical aspect of investigation is the responsibility of Forensic Medical Examiner, who is generally asked to act as team leader. He may have to be assisted by other specialist like pathologist, toxicologist, serologist and odontologist, (wherever necessary) for preparation of report about identity of driver and other victims. Vehicle Examiner is there to examine vehicle/vehicles in case of mass accident and prepare report about their conditions. Scrutiny,

sketching, photographing and collection of evidence from scene fall within the domain of Forensic Science Expert. Role of police at the scene of accident is exclusively to protect it from public interference.

Investigations differ when accident is by **single vehicle** and **mass vehicles**:

- *Single vehicle accident* requirements is careful transportation of injured victim/victims, dead body/bodies from scene of accident to hospital and autopsy room and non-biological material to forensic laboratory taking precaution not to lose any trace evidence during transit. Medical examination in hospital/autopsy room includes examination of clothes and persons of the victims like other medico-legal examinations.
- *Mass vehicles accident* requirement is guided by numbers of bodies of victims and types of injuries on them. It requires elaborate arrangements at site, which are nearly always improvised. A temporary secretariat is established for incoming information, which facilitates the job. Area should be sealed off by police to protect and preserve property of the victims from unauthorized intruders.

Establishment of personal identity of each victim including that of driver/pilot is important and performed in two stages; preliminary at scene and subsequent detailed examination of injured in hospital and dead persons in autopsy room. Objective of both medical examinations is same.

Clothing of victims is examined for damage and fresh contamination with foreign fragments such as glass, paint or any other thing in them. Special attention should be paid to peculiar characteristics such as tyre and grit marks, any other foreign smears on the skin or foreign material in the wounds, distance of injuries from heel and direction in relation to body planes. Careful efforts should be made to recognize specific injuries and their distribution consistent with history of accident. Attempts should also be made to establish direction of impact. Study of motive of accident being accident, suicide, homicide should be done to determine any mask mechanism. Determination of mode and cause of death with role played by a disease or intoxication especially in the car driver or aircraft pilot will establish human cause of accident.

Identification of the driver is a pre-requisite to know human cause of accident. There is normally no problem in identification of driver in case of road and

rail transportation but in case of aircraft accident, personal identity of the pilot may be extremely difficult because of severe degree of burns caused by conflagration. In many cases, even the assessment of number of victims is a difficult task. Prior existence and availability of accurate passengers' information helps the job and its absence is notable complication to the determination of personal identity of victims.

Principle used for the personal identity of the victims is that initially all identifiable bodies should be separated, numbered and accurately plotted as to the position of their discovery before they are removed from the scene. It is followed by collection of mutilated human parts to reconstruct bodies by matching of the parts. Disassociated effects should also be numbered and mapped. Objective parameters of personal identity such as possessions, clothing, human body parts or of those having specific pathology or dentition should be transported to the laboratory for further examination such as X-ray and microscopy. Objects removed in the mortuary from the body should be placed in already numbered containers.

It is established beyond doubt that personal factor is the major cause of accidents. As regards mechanical and environmental factors, they play comparatively little role. Fitness of road vehicle driver is of paramount importance. Safety on road with so many speeding vehicles and many pedestrians at the same time imposes great responsibility on the driver to be fit before taking charge of his vehicle. Eligibility of driver to possess a driving license depends upon two things:

- Skill of driving of vehicle
- Physical/mental fitness to perform driving.

Both above criteria are legally laid for issue of driving license in all countries including Pakistan.

**Motor Vehicle Ordinance 1965** has prescribed conditions for issuing of a driving license. Additionally it prohibits issuing of driving license to persons suffering from certain diseases or disabilities, which are enlisted in schedule. For this purpose, besides other conditions, the most important one is medical fitness certificate to be filled by registered medical practitioner. (Table 8.4 & Fig 8.5)

**Table 8.4:**

*Laid conditions for issue of driving license*

- 1) Prescribed application form
- 2) Prescribed medical certificate of fitness from RMP \*
- 3) Applicant age, 18 years for private and 21 year as paid employed
- 4) Skill of driving (to be tested) by licensing authority

\*Special attention to distant vision and condition of arms, hands and joints of both extremities

**MEDICAL CERTIFICATE OF FITNESS TO DRIVE A VEHICLE**

(To be filled up by a registered medical practitioner)\*

1. What is the applicant's apparent age?.....
2. Is the applicant subject to epilepsy, vertigo or any mental ailment likely to affect his efficiency?.....
3. Does the applicant suffer from any heart or lung disorder which might interfere with the performance of his duties as a driver? .....
4. (a) Is there any defect of vision? If so, has it been corrected by suitable Spectacles? .....
- (b) Can the applicant readily distinguish the pigmentary colors red and green? .....
- (c) Does the applicant suffer from night blindness?.....
- (d) Does the applicant suffer from a degree of deafness which would prevent his hearing ordinary sound signals?.....
5. Has the applicant any deformity or loss of member which would interfere with the efficient performance of his duties as a driver? .....
6. Does he show any evidence of being addicted to the excessive use of alcohol, tobacco or drugs? .....
7. Is he generally fit as regards (a) bodily health,.....
- (b) eyesight?.....

5. Marks of identification: (i).....  
(ii).....  
I certify that to the best of my knowledge and belief the applicant is the person herein above described and that the attached photograph to a reasonably correct likeness of the applicant

Space for Photographs

Signature .....

Name .....

Designation.....

**Fig 8.5:** Prescribed specimen of medical certificate

Issue of inheritance, whenever all family members die in an accident, is important. Medical findings in such cases remain inconclusive and it has to be resolved on the basis of the presumption of law of survivorship at the time of death of each victim. Presumption of law of survivorship is that:

- Younger in age shall survive the older
- Male shall survive the female
- Healthy shall survive the diseased