Thermal Injuries

Table 14.1: Degrees of frostbite and their features	
Degree	***Pathological features***
1	Redness and edema of skin
2	Only epidermis is affected, there is blister formation
3	Skin and subcutaneous tissue is necrosed
4	Total loss of tissue in the exposed area including muscle and bone

Classification of Burns

Burns have been classified by the American Burn Association and the American College of Surgeon's committee on trauma as.[13]

1. Minor – superficial burns of less than 15 percent total body surface area (TBSA).
2. Moderate – are defined as
   - Superficial burns of 15 to 25 percent TBSA in adults or
   - 10 to 20 percent TBSA in children or
   - Full thickness burns of less than 10 percent TBSA and burns not involving eyes, ears, face, hands, feet or perineum.
3. Major burns – above plus most full thickness burns in infants and elderly patient.

Table 14.4: Difference between antemortem and postmortem burns		
Features	***Antemortem burns***	***Postmortem burns***
Line of redness	Present around burn area	Absent
Blisters	Present and contains serous fluid rich in protein and chlorides. The base is red, inflamed with raised papilla	Usually absent and if present contains air and clear fluid. The base is dry, pale or yellow, hard and horny
Vital reaction	Present	Absent
Reparative process	Present	Absent
Infection	Present	Absent
Carbon/soot particles in respiratory passage	Present	Absent
Carboxyhemoglobin in blood	Present	Absent or low level
Cyanide in blood	Present	Absent or low level
Enzyme activity (Histochemistry)	Present and is time related - Cathepsin – immediate - Serotonin – 10 min - Histamine – 20 min - Esterase – 1 hour - ATPase – 1 hour - Acid phosphatase – 3 hr - Alkaline phosphatase – 4 hr	Absent

Table 14.5: Age of burn wounds	
Period	***Features***
Immediately to 1 hour	- Redness occurs - Vesication appears - Signs of inflammation - Blood vessels are dilated with oozing of fluid
6 – 12 hour	- Inflammatory reaction intensifies - Polymorphnuclear cell infiltration - Epidermis coagulated
12 – 24 hour	- Exudates begins to dry
24 – 72 hours	- Exudates forms dry, brown crust - Inflammatory zone begins to disappear - Slough and Pus formation begins
4 – 6 days	- Superficial slough fall off
Fortnight	- Deep slough separates out - Granulation tissue covers the surface
Weeks to months	Formation of cicatrix and deformity

Classification

Scalds are classified into three degrees as:[30]

- First degree – characterized by erythema formation of affected part
- Second degree – characterized by blister formation with increased vascular permeability
- Third degree – characterized by drying and desiccation of underlying tissue with necrosis.

Table 14.6: Difference between scalds and burns		
Features	***Scalds***	***Burns***
Cause	Moist heat	Dry heat
Clothes	Not burnt but may be wet	May show evidence of burns, singeing, melting of fibers
Site	Injury occurs at and below the site of application of causative agent	Injury occurs at and above the site of application of causative agent|
Skin	Erythema, blister, may be sodden and bleached	Reddening to Superficial burns to charring
Splashing	Present	Absent
Charring of skin	Absent	Present
Singeing of hairs	Absent	Present
Scar	Thin and less contracted	May be thick and contracted

Death and Changes after Death

Table 7.1: Reflexes and the cranial nerves

Reflex	*Cranial nerve*	*In brainstem death*
Pupillary	Afferent - 2nd	No response
	Efferent - 3rd	
Corneal	Afferent - 5th	No response
	Efferent - 7th	
Vestibulo-ocular	Afferent - 8th	No response
	Efferent - 3rd and 6th	
Grimace	Afferent - 5th	No response
	Efferent - 7th	
Gag/cough	Afferent - 9th	No response
	Efferent - 10th	

Table 7.2: Causes of suspended animation

Yogi

Trance

Cataplexy

Hysteria

Sunstroke

Concussion

Drowning

Electrocution

Frozen coma

Narcotics poisoning

Anesthesia

Table 7.3: Causes of coma

Head injury

Intracranial hemorrhage

Encephalitis

Meningitis

Diabetic ketoacidosis

Uraemic coma

Hepatic encephalopathy

Apoplexy

Opium/barbiturate poisoning

Alcohol intoxication

Epilepsy

Heat stroke

Table 7.4: Causes of syncope

Vagal inhibition

Massive myocardial infarction

Aortic stenosis

Pulmonary stenosis

Pulmonary hypertension

Pulmonary embolism

Cardiac tamponade

Atrial myxoma

Anemia

Blow on epigastrium

Table 7.5: Causes of asphyxia

Mechanical causes

Hanging

Strangulation

Throttling

Smothering

Drowning

Choking

Compression over chest

Toxic causes

Opium poisoning

Carbon monoxide poisoning

Cyanide poisoning

Pathological causes

Acute oedema of glottis

Consolidation

Pleural effusion

Environmental causes

High altitude

Person trapped in well

Respiration in enclosed space

Table 7.6: Correlation between changes after death and type of death

Changes after death	*Type of death*
Immediate change after death	Somatic death
Early changes after death	Molecular death
Late changes after death	Molecular death

Table 7.7: Conditions where heart sounds are feeble

Causes
Feeble circulation
Excessive deposition of fat
Pericardial effusion

Table 7.8: Condition and mechanism of postmortem caloricity

Cause of death	*Mechanism*
Septicemia	Increased production of heat
Infectious disease	Increased production of heat
Sunstroke	Heat regulation center disturbed
Pontine hemorrhage	Heat regulation center disturbed
Tetanus	Heat production due to muscular activity
Strychnine	Heat production due to muscular activity

Postmortem lividity

Dependent part

Appears in patches

Patches coalesce to form uniform staining area

Position of body changed

Lividity not fixed

Position of body changed frequently

Lividity appears at new area

Position of body not changed

No lividity appears

Lividity get fixed

With onset of decomposition lividity gets disintegrating

Table 7.9: Difference between lividity and congestion

Features	*Postmortem lividity*	*Congestion*
Cause	Passive accumulation of blood in vessels	Stasis of vascular system due to presence of some pathology
Situation	Over dependent part of body	Whole or any part of organ may be affected with pathology
Swelling or oedema	Absent	May be present
Nature	Postmortem	Antemortem
Cut surface	Oozing of blood	Exudation of fluid mixed with blood from cut surface

Table 7.10: Color of lividity and cause of death

Cause	*Colour*	*Mechanism*
Carbon monoxide	Pink	Carboxyhemoglobin
Cyanide	Cherry-red	Excessive oxygenated blood
Fluoroacetate	Pink/cherry red	Excessive oxygenated blood
Refrigeration	Pinkish	Retention of oxygen in Cutaneous blood by cold
Hypothermia	Pinkish	Retention of oxygen in Cutaneous blood by cold
Sodium chlorate	Brown	Methemoglobin
Hydrogen sulfide	Green	Sulfhemoglobin
Aniline	Deep blue	Deoxygenated blood
Carbon dioxide	Bluish	Deoxygenated

Table 7.12: Onset of rigor mortis and the conditions

Rigor mortis	*Cause*
Early onset and passes of early	Electrocution,[30] cancer, convulsions, hyperpyrexia, metabolic acidosis, uremia, hot environmental conditions
Delayed onset	Asphyxia, apoplexy, cold environmental conditions, hypothermia
Rapid onset but stays longer	Strychnine, hydrocyanic acid poisoning

Table 7.15: Difference between primary and secondary relaxation of muscles

Features	*Primary relaxation*	*Secondary relaxation*
Time of onset	Immediately after death	After disappearance of rigor mortis and when decomposition occurs
Molecular death	No	Yes
Response to stimuli (Mechanical and electrical)	Present	Absent
Associated features	Nothing particular	Signs of decomposition present

Table 7.14: Difference between rigor mortis and heat stiffening

Features	*Rigor mortis*	*Heat stiffening*
Nature	Postmortem	May be antemortem or postmortem
Degree of stiffness	Comparatively moderate	Comparatively high
Mechanism	Break down of ATP	Due to coagulation of muscle
Associated features	Nothing specific	Signs of exposure to heat will be present for example burning, blisters, heat rupture etc

Table 7.13: Difference between rigor mortis and cadaveric spasm

Features	*Rigor mortis*	*Cadaveric spasm*
Time of onset	1-2 hours after death	Immediate
Muscles involved	All muscles of body are involved gradually	Usually group of muscles (like hand) are involved
Degree of stiffness	Comparatively moderate	Comparatively strong
Predisposing factors	None	Excitement, fear, emotional disturbance, etc.
Mechanism	Break down of ATP	Not known
Medicolegal importance	Helps to know time since death, position of body.	Help to suggest manner of death

Table 7.16: Importance of gases of decomposition

- Causes bloating of features causing difficulty in identification
- Causes disintegrating and shifting of postmortem lividity causing difficulty in assessing the position of body
- Causes postmortem purging of feces, semen, decomposition fluid
- Causes expulsion of fetus from uterus

Table 7.18: Sequence of putrefaction in internal organs

Organs putrefying early	*Organs putrefying late*
Brain	Esophagus
Mucosa of trachea and larynx	Diaphragm
Stomach and intestine	Heart
Spleen	Lungs
Liver	Kidney
	Urinary bladder
	Uterus
	Prostate

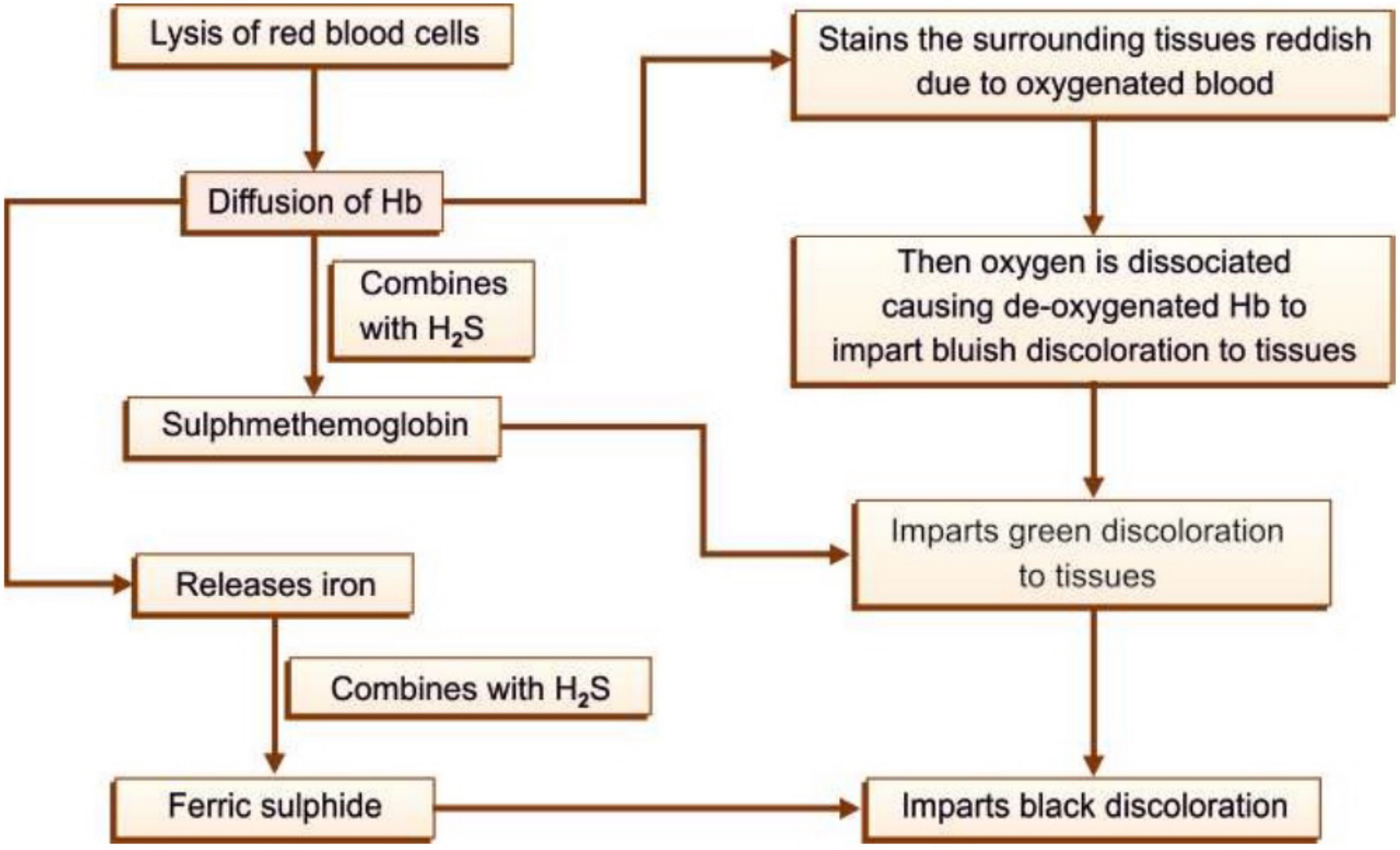

FIG. 7.27: Changes in decomposition

Table 7.19: Conditions that accelerate or retards decomposition

Conditions
Accelerates decomposition
- Septicemia
- Rhabdomyolysis
- Cocaine overdose
- edematous area
Retards decomposition
- Dehydration
- Massive blood loss
- Cold environment
- Embalming

Table 7.21: Causes of sudden natural death[61-65]

Cardiovascular system

- Ischemic heart disease
- Cardiomyopathies
- Myocarditis
- Valvular disorders
- Congenital heart disease
- Cardiac tamponade
- Aneurysm
- Aortic dissection
- Coarctation of aorta

Central nervous system

- Hemorrhage
- Ischemia/thrombosis
- Epilepsy
- Meningitis
- Astrocytoma

Respiratory system

- Pulmonary embolism
- Acute epiglottitis
- Fulminant tracheobronchitis
- Pneumonia
- Bronchial asthma
- Spontaneous Pneumothorax

Gastrointestinal system

- Rupture of esophagus
- Acute Pancreatitis
- Hematemesis
- Strangulated hernia
- Volvulus
- Perforation peritonitis
- Ruptured liver abscess
- Mesenteric thrombosis

Genito-urinary system

- Twisted ovarian cyst
- Toxemia of pregnancy
- Amniotic fluid embolism
- Uterine rupture
- Rupture of ectopic pregnancy

Miscellaneous

- Vagal inhibition
- Diabetic coma
- Status thymo-lymphaticus
- Anaphylaxis
- Amnoitic fluid embolism

Mechanical Injuries

Table 9.1: Difference between antemortem and postmortem abrasion

Features	*Antemortem abrasion*	*Postmortem abrasion*
Site	At anywhere on body	Over bony prominences
Color	Bright red	Pale, dry and parchment like
Covering	Covered with scab composed of coagulation of blood and lymph	No such scab
Inflammation	Signs of inflammation present	No
Microscopy	Congestion and vital reaction present	No

Table 9.2: Age of abrasion

Age	*Features*
Fresh	Reddish, no scab
12 – 24 hour	Dark red scab
1-2 days	Reddish brown scab
3-5 days	Dark brown scab
5-7 days	Blackish scab shrinks and falling begins from margin
7-10 days	Scab falls off, leaving hypopigmented area

Table 9.3: Age of contusion

Age	*Changes*	*Caused by*
Fresh	Red	Fresh extravasation of blood
1-3 days	Bluish	Deoxyhemoglobin
4 days	Bluish black to brown	Hemosiderin pigment
5-6 days	Greenish	Hematoidin pigments
7-12 days	Yellow	Bilirubin pigments
2 week	Complete disappearance of contusion	--

Table 9.4: Difference between antemortem and postmortem contusion

Features	*Antemortem contusion*	*Postmortem contusion*
Swelling	Present	Absent
Extravasation of blood	Present	Absent
Signs of inflammation	Present	Absent
Hemorrhage	Considerable	Insignificant

Table 9.5: Difference between contusion and postmortem lividity

Features	*Contusion*	*Postmortem lividity*
Caused by	Rupture of vessels with extravasation of blood due to application of mechanical force	Due to stasis of blood in the vessels
Site	Any site	Only on dependent part
Surface	Elevated due to swelling	Not elevated
Swelling	Present	Absent
Colour	Variable, depends on the age of contusion	Usually purplish blue
Edges	Ill defined	Well defined
Incision	Show extravasation of blood in the surrounding tissue and cannot be washed off	Shows blood in vessels with oozing of blood from vessel and can be washed off
Microscopy	Signs of inflammation	No signs of inflammation

Table 9.9: Difference between lacerated wound and incised wound

Feature	*Lacerated wound*	*Incised wound*
Edges	Lacerated, irregular, ragged	Clean cut
Bruising of margins	Present	No bruising
Injury to blood vessels, nerves	Crushed	Clean cut
Hair bulbs	Crushed	Clean cut
Bleeding	Less	More
Underlying bone	No sharp injury	Sharp linear injury

Table 9.10: Difference between Antemortem and postmortem lacerated wound

Feature	*Antemortem*	*Postmortem*
Extravasation of blood	Present	Absent
Coagulation of blood	Present	Absent
Increase enzyme activity	Present	Absent
Signs of healing	Present	Absent
Pus/infection	Present	Absent

Violent Asphyxia

Table 15.3: Enlist antemortem and postmortem differences in hanging

Features	*Antemortem*	*Postmortem*
Ligature mark	Produces imprint mark, may be grooved, brownish, parchment like	No such features
Salivary dribble	Present	Absent
Le facie sympathique	Present (rare)	Absent
Blisters	Present	Absent
Asphyxial signs	Present	Absent
Drag marks over body	Absent	May be present

Table 15.4: Difference between hanging and strangulation

Features	Hanging	Strangulation
Manner	Usually suicidal	Usually homicidal
Saliva	Dribbling from mouth over chin or chest	No such dribbling
Ligature mark	Oblique, non-continuous, usually above the level of thyroid cartilage	Horizontal, continuous, usually at or below the level of thyroid cartilage
Tissue underneath mark	Dry, pale, hard and glistening	Bruised
Neck muscle	Injury to neck muscle rare	Injury to neck muscle common
Neck	Stretched and elongated	Not so
Larynx and trachea	Injury/fracture rare	Injury/fracture more common
Bleeding	From nose, mouth or ear is less common	From nose, mouth or ear is common
Signs of asphyxia	Less prominent	More prominent

Table 15.8: Difference between antemortem and postmortem drowning

Features	*Antemortem drowning*	*Postmortem drowning*
Cadaveric spasm	May be seen	Absent
Froth	Fine, whitish, copious, leathery, tenacious, increases on compression of chest	No froth
Stomach and intestine	Water may be present. May also present sand, mud, grit, silt etc	Absent
Respiratory tract	Contains fine froth. May contain mud, sand, vegetations etc	Absent
Middle ear and mastoid air cell	Hemorrhage present	No hemorrhage

Firearm Injuries and Bomb Blast Injuries

Table 10.2: Difference between smooth bore and rifled firearm

Features	*Cartridge of smoothbore gun*	*Cartridge of rifle firearm*
Cartridge case	The posterior surface is made up of metal plate and anterior part is made up of cardboard disc	Made up of metal
Projectile	Pellets are used	Bullet is used
Wad	Present	Absent
Cardboard disc	Present	Absent

Table 10.3: Showing different components emerging from muzzle end of firearm

Components	Effects produced over body
Projectile in form of bullet	- Entry wound - Exit wound - Abrasion/contusion collar
Gun smoke and soot	Smudging/blackening
Gunpowder particles	Tattooing
Gases	Blast effect/ cherry red discoloration
Flame	Scorching/singeing
Metal particles	Metal ring
Grease or dirt	Grease collar

Table 10.4: Effects produced in close shot in rifled firearm

Components	*Distance traveled*	*Effects*
Flame	7.5 cm (revolver/pistol)	Scorching
	15 cm (shoulder rifle)	Singeing
Smoke	30 cm	Blackening
Gun powder	60-90 cm	Tattooing

Table 10.5: Salient features of contact, close, near and distant shots of rifled firearm

Features	*Contact shot*	*Close shot*	*Near shot*	*Distant shot*
Range	In contact with skin	< 8 cm	30 - 60 cm	> 60 cm
Size of entry wound	Larger than bullet	Bullet size	Smaller than bullet size	Smaller than bullet size
Shape of entry wound	Varied	Circular	Circular	Circular
Muzzle imprint	Present	Absent	Absent	Absent
Edges of entry wound	Everted	Inverted	Inverted	Inverted
Scorching	Present	Present	Absent	Absent
Singeing	Present	Present	Absent	Absent
Blackening	Present	Present	Present up to 30 cm	Absent
Tattooing	Present	Present	Present	Absent
Abrasion collar	Present	Present	Present	Present
Grease collar	Present	Present	Present	Present

Table 10.6: Difference between entry and exit wound

Features	*Entry wound*	*Exit wound*
Size	Smaller than the diameter of bullet, however in contact shot may be larger	Larger
Edges	Inverted	Everted
Abrasion collar	Present	Absent
Grease/dirt collar	Present	Absent
Tattooing	Present	Absent
Singeing of hairs	Present	Absent
Scorching/burning	Present	Absent
Bleeding	Less	More
Tissue around the wound	Cherry red due to carbon monoxide	No such change
Metal ring	May be present	Absent
Fat	No protrusion	May protrude

Table 10.8: Features of smooth bore firearm

Features	*Range*				
	Contact	*Close (15 cm)*	*Short 15 cm - 1 m*	*Medium 1 m - 4 m*	*Distant > 4 m*
Number of wounds	Single	Single	Single	Multiple	Multiple
Shape of wound	Circular or varied if bone lies underlying	Circular	Rat hole	Satellite wounds around main wounds	Wider spread
Blackening	Present	Present	Present up to 50 cm	Absent	Absent
Tattooing	Present	Present	Present	Absent	Absent
Singeing	Present	Present	Present up to 30 cm	Absent	Absent
Scorching	Present	Present	Present up to 30 cm	Absent	Absent

Table 10.10: Difference between accidental, suicidal and homicidal firearm injury

Features	*Accidental injury*	*Suicidal injury*	*Homicidal injury*
Site of entry wound	Any part	Head or chest	Any part
Range	Close	Contact or close	Any
Direction	Any	Upward or backward	Any
Number of wounds	One	Usually one	One/multiple
Firearm residue on hand	Present	Present	Absent
Weapon at the scene	Present	Present	Absent or planted
Motive	Absent	Financial worry/depression etc	Present – revenge, robbery etc
Suicide note	Absent	May be present	Absent