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<b>Principal Investigator</b>	<b>Co-Principal Investigator</b>	<b>Co- Principal Investigator (Technical)</b>
<b>Dr. A.K. Gupta</b> Professor and Head, Department of Forensic Science Sam Higginbottom Institute of Agriculture, Technology & Sciences SHIATS, Allahabad	<b>Dr. G.S. Sodhi</b> Associate Professor Forensic Science Unit Department of Chemistry SGTB Khalsa College University of Delhi	<b>Dr. (Mrs.) Vimal Rarh</b> Deputy Director, Centre for e-Learning and Assistant Professor, Department of Chemistry, SGTB Khalsa College, University of Delhi  <i>Specialised in : e-Learning and Educational            Technologies</i>
<b>Paper Coordinator</b>	<b>Author</b>	<b>Reviewer</b>
<b>Dr. Adarsh Kumar</b> Professor (Addl.), Forensic Medicine and Faculty-In-charge Forensic Anthropology & Forensic Radiology AIIMS, New Delhi	<b>Dr. Antara DebBarma</b> Asst. Professor Forensic Medicine Malabar Medical College Modakkallur, Atholi, Calicut, Kerala	<b>Dr. Adarsh Kumar</b> Professor (Addl.), Forensic Medicine and Faculty-In-charge Forensic Anthropology & Forensic Radiology AIIMS, New Delhi
<b>Anchor Institute : SGTB Khalsa College, University of Delhi</b>		

**FORENSIC SCIENCE**
**PAPER No.14: Forensic Medicine**
**MODULE No.16: Blunt Force Injuries: Abrasion & Laceration**

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## 1. Learning Outcomes

After studying this module, you shall be able to know-

- What is abrasion, its types and age of abrasion
- Diagnosis and Medico-legal importance of abrasion
- What is laceration, its types and age of laceration
- Medico-legal importance of laceration

## 2. Introduction-Abrasion

The term abrasion is derived from the Latin word (abrade: noun and abrader: verb) which means to scrape away by friction or by rubbing. Abrasion is defined as type of mechanical injury where there is destruction of the superficial layers of the epidermis. Thus by definition, abrasion does not penetrate the full thickness of the epidermis and a pure abrasion does not bleed, as blood vessels are confined to the dermis. However, because of the corrugated nature of the dermal papillae, many abrasions may enter stratum corneum and slight bleeding may occur. Abrasion is a two dimensional injury and is measured always as per its length and breadth.

### **Mechanism of abrasion:**

Abrasion is caused by destruction of the superficial layers of the skin which can be either due to direct compression force or due to tangential force application. Abrasion most commonly occurs when exposed skin comes in contact with a moving rough surface causing a grinding or rubbing off of the superficial layer of the epidermis. Thus tangential forces over the body cause a linear abrasion or graze abrasion and a compression force over the body causes pattern abrasions like impact abrasion and pressure abrasion.

### 3. Types of abrasion

#### (a) Scratch abrasion or Linear abrasion:

These types of abrasion are caused by a tangential or horizontal friction by the pointed end of weapons like needles, knife etc. or by the perpendicular friction with some linear objects like nail. There is associated loss of the epidermis and heaping up of the epidermis towards the tail end of the injury as a result of the tangential force applied. The abrasion is wider at the starting point and then gradually shows heaping up of the epithelium towards the end. Hence, the direction of the force is from wider side to the narrower side of the scratch.

#### (b) Graze abrasion or Brush abrasion:

Graze abrasion is also known as sliding abrasion, gliding abrasion or scrape abrasion and are the most common type associated with almost all kind of road traffic accidents. They occur when there is movement between the skin and rough surface in contact with it. Graze abrasion is characterized by uneven, longitudinal parallel lines having grooves or furrows, with epithelium heaped up at the ends of these lines. This heaping up of epithelium generally indicates the direction of force. Usually, the skin is uniformly denuded at the start or may be serrated; the epidermis is scraped off, destroyed or detached. A glancing kick by the boot may also produce such kind of injuries. Many of these abrasions may reach till dermis due to the corrugated nature and bleeding occurs. An abrasion caused by violent lateral or tangential rubbing against a surface just like dragging over the ground is called a **brush burn** or **gravel rash**. Friction burn is nothing but an extensive, superficial, reddened excoriated area without serious oozing or bleeding and with little or no mark. Usually occurs due to tangential contact with smooth surface or when the skin is covered by clothing. These brush burns or friction burns are seen in motor cyclists, pedestrians, persons being ejected from vehicle after primary contact from another motor vehicle etc.

### (c) Pressure abrasion:

Pressure abrasion or friction abrasion are caused by crushing of the superficial layer of the epidermis and usually associated with bruise of the surrounding surfaces. Hence, if the movement of the weapon is around  $90^{\circ}$  angles to the skin, usually pressure abrasion occurs. In this type, usually the movement is directed inwards. The ligature mark of hanging is example of pressure abrasion.

### (d) Impact abrasion:

Impact abrasion is also called as imprint abrasion or contact abrasion. They are usually caused by impact with a rough surface, when the force is applied at or near the skin surface. The abrasion is slightly depressed below the surface, unless there is bulging due to the local edema.

Impact abrasion and pressure abrasions reproduce the pattern of object causing it and are called **patterned abrasion**. This injury suggests the pattern of the inflicting weapon. This is caused when the force is produced at right angle to the surface. If skin is struck with a weapon having patterned surface or the body falls on a patterned surface, the abrasion is caused by the ridges of the objects, leading to patterned abrasion. Eg., when a motor tire passes over the skin or imprint of a bicycle chain or ropes or multi-thronged whip.

## 4. Age of the abrasion

Determining the age of the abrasion is very much important from medico legal point of view when question of age of injury.

It is not possible to determine the exact age of the injury and so it is always given in range upon gross examination as follows:

- Fresh (within 12 hours): Bright red in color.
- 12 to 24 hours: Lymph and blood dries off leaving bright red scab formation.
- 02 to 03 days: reddish-brown scab formation.
- 04 to 07 days: Dark brown to brownish black scab formation. Epithelium grows and covers defect under the scab.

- After 07 days: Scab dries, shrinks and falls off leaving depigmented area underneath.
- After 10-

### **Histologically:**

- 04 to 06 hours: Perivascular infiltrate occurs.
- 12 hours: Three layers are seen, a surface zone of fibrin and red cells, deeper zone of infiltrating polymorphs and deepest layer abnormally staining collagen.
- 48 hours: Scab is well formed and epithelial regeneration is seen by the margins of the cell.
- 04 to 05 days: Small abrasions are completely covered by epithelium.
- 05 to 08 days: Sub epithelial formation of granulation tissue is prominent and by 8<sup>th</sup> day reticulum fibers are seen.
- 09 to 12 days: collagen fibers are seen.
- 12 day: Regression begins.

### **Ante mortem and postmortem abrasions:**

The difference between the ante mortem and postmortem abrasion are summarized below. However, abrasion occurring at peri-mortem period literally is very difficult to differentiate.

<b>Trait</b>	<b>Ante mortem</b>	<b>Postmortem</b>
Site	Anywhere on the body.	Usually over body prominences
Colour	Bright or reddish brown depending upon the age of injury.	Yellowish, translucent and parchment like.

Exudation	More, scab is raised as a result	Less or no exudation. Scab often lies below the level of skin.
Microscopic	Vital reactions and congestion seen	No vital reactions or congestion are seen.

### Differential Diagnosis:

#### 1) Erosions produced by ant bite:

Postmortem erosions (abrasion) produced by ant bites are common phenomenon. Usually ants produce brown erosions with minute irregular margins of the superficial layer of the skin. They are most commonly found in the mucocutaneous junctions, over the eyelids, nostrils, mouth, ears, axillae, lips, groins, moist fold of the skin and genitalia. They resemble abrasion and to differentiate between the two, examination has to be done by hand lens which will show multiple crescent shaped, sand like bite marks which is separated by normal skin in between and with no underlying vital reaction.

#### 2) Excoriation of the skin by excreta:

Usually in infants, slight excoriation of skin is seen at the napkin area at the time of death. These, after death become dry, depressed and parchment like with varying color of yellow to brown.

#### 3) Pressure sores:

In prolong bed ridden patients; pressure sores develop which later can be confused with abrasion. Pressure sores usually develop over the point of pressure like buttock.

#### 4) Drying of the skin:

Skin of scrotum may get dried up causing reddish brown coloration resembling abrasion.

## 5. Medico-Legal Importance

- 1) Gives an idea regarding the site of impact and direction of force.
- 2) Age of injury can be opined.
- 3) A simple abrasion can be a tell-tale sign of a grave underlying hemorrhage or concussion.
- 4) Pattern abrasion is helpful in connecting the wound with the weapon of offence.
- 5) Character and manner of injury can be known from its distribution.
- 6) In open wounds, accumulation of grease, dirt and any other foreign particles may lead to the scene of crime or the perpetrator.
- 7) In throttling, crescentic abrasions are seen due to fingernails.
- 8) In smothering, abrasions may be seen in and around the oral cavity and inner aspects of the lips.
- 9) In sexual assault cases, abrasions may be seen on the breasts, genitals, inner aspect of the thigh or anus.
- 10) Abrasions over the face of assailant indicates struggle.
- 11) Abrasion over the face of the victim may give an idea regarding whether the perpetrators nails are long or irregular or broken etc.

## 6. Laceration

**Lacerations** are tears or splits of skin, mucous membrane, muscle or internal organs, produced by application of blunt force to the body, which stresses tissues beyond their limits of elasticity. They are also called tear or rupture of the tissues. Localized portions of the tissue are displaced by the impact of blunt force leading to setting up of traction forces and causing tearing of the tissues. Laceration is a three dimensional injury and is measured in terms of length, breadth and depth of the injury.



### **Salient features:**

1. Margins: The margins of lacerated wounds are typically irregular or uneven as the injury is produced by blunt force impact rather than a sharp cut.
2. Edge: The edges vary as per the direction of the force implied. In an angular impact, the skin on the side of the wound opposite to the direction of motion is torn free and undermined while the skin on the other side from which the blow was delivered is abraded and beveled. In a perpendicular impact the edges will be undermined uniformly.
3. Being a three dimensional injury, the depth is always to be measured and the same depends on the degree of force and depth of the soft tissue parts.
4. Shape and size: Usually shape and size don't correspond to the weapon of offence. But linear laceration is produced by long, thin objects like crow bar or iron rod and if curved, then convexity of the curvature points towards the direction of application of force. Crescentic lacerations are produced by blunt object with an edge like hammer head.
5. Gaping of the wound is present due to the pull of the elastic and muscular tissues.
6. The surrounding skin may be bruised due to the blunt force trauma.
7. The characteristic finding of laceration is tissue bridging which are seen at the base of the wound. It is mainly because the deeper tissues are unevenly divided.
8. The tissue bridges become apparent when the edges of the wound are gently separated manually. The presence of tissue bridges immediately indicates blunt force trauma. Bridging is also seen in internal organs.
9. Hair bulbs and epidermal tags are crushed. Hemorrhages are less in laceration due to the fact that the vessels are crushed and torn irregularly, as a result of which they can retract.

10. Foreign bodies may be present in the wound.
11. If force produces bleeding into the adjacent tissues, the injury is called contused-laceration or bruised-tear. If the margins are abraded, then it is called abraded laceration or scraped tear. If the blunt force produces extensive bruising and laceration of deeper tissues, it is called crushing injury.

## 7. Types of laceration

### (a) Split Laceration:

Split laceration occurs when the skin gets crushed between two hard objects. Scalp laceration occurs due to the tissues being crushed between skull and some hard object like a blunt weapon or the hard ground. Tissue bridging are present in such injury but with no undermining of the splits. **Incised like or incised looking lacerated wound** are wounds produced without excessive skin damage and thus the margins are relatively sharp. Blunt force impact on parts where the skin is close to bone and subcutaneous tissues are scanty, produces a wound with linear splitting of the tissues. Such wound by naked eyes looks like incised wound. But if observed under hand lens, then irregular margins could be appreciated and could be differentiated from an incised wound. The common sites of such phenomena are scalp, eyebrows, cheek bones, lower jaw and shin of tibia.

### (b) Stretch Laceration:

Stretch lacerations are produced by over stretching of the skin against a fixed point, resulting in a large flap of skin to be peeled off the underlying bone or deep fascia. This is seen in running over by a motor vehicle. This flap may indicate the direction of the force. Even a glancing kick by boot may also produce similar injury.

### **(c) Avulsion (Shearing Laceration):**

Avulsion laceration is produced due to any grinding compression from any fast moving tire of a heavy motor vehicle or a rotator heavy industrial machine causes separation or avulsion and losing of a large area of skin from the underlying attachments. The wound is devoid of any overlying skin. The underlying muscles are heavily bruised. This is also known as flaying of skin.

### **(d) Tear Laceration:**

Tear laceration is the commonest type of laceration caused due to tear of the skin and tissues from impact by or against irregular or semi sharp objects such as door handle of a car etc. It may also be caused by blows of a broken glass or fall over a rough projected object. A tear is deeper at the starting point and gradually becomes shallower at the termination.

## **8. Age of laceration**

Age determination of laceration is difficult, unless there are clear signs of healing such as granulation tissue, fibroblast in growth or organizing infiltrate.

### **Ante-Mortem and Post-mortem Laceration:**

The ante mortem lacerations will show bleeding, eversion of the margins, blood stained margins, bruising, gaping, vital reactions while all these will be absent in post mortem lacerations.

## **9. Medico-Legal Importance**

1. The type of laceration indicates the cause of injury and the shape of the blunt weapon.
2. Age of injury could be detected in uninfected wounds.
3. Foreign bodies found in the wound may indicate the circumstances of the crime.

4. A combination of laceration along with abrasion and contusion may give an idea regarding the weapon of offence. They may be produced by different weapon or by same weapon having different edges e.g. kicking and stomping.
5. The manner of production of the injury can be determined by careful observation, whether accidental, homicidal or rarely suicidal.

### **Complications:**

1. Pulmonary or systemic fat embolism due to crushing of the sub cutaneous tissue.
2. Hemorrhagic shock due to laceration of vital organs.
3. Infection may set in if not attended to properly.
4. If laceration is located in an area where the skin is wrinkled or stretched eg., over joints, the repeated oozing of tissue fluids and blood may cause irritation, pain and dysfunction.

### **10. Summary**

- Abrasion is defined as type of mechanical injury where there is destruction of the superficial layers of the epidermis.
- Determining the age of the abrasion is very much important from medico legal point of view when question of age of injury arises.
- Lacerations are tears or splits of skin, mucous membrane, muscle or internal organs, produced by application of blunt force to the body, which stresses tissues beyond their limits of elasticity.
- Laceration is a three dimensional injury and is measured in terms of length, breadth and depth of the injury.
- Incised looking wounds are lacerations which are present over specific area of body like scalp, forehead, eyebrows, cheek bones, lower jaw and shin of tibia.
- Age determination is difficult, unless there are clear signs of healing such as granulation tissue, fibroblast in growth or organizing infiltrate.
- If laceration located in an area where the skin is wrinkled or stretched eg., over joints, the repeated oozing of tissue fluids and blood may cause irritation, pain and dysfunction.