TRANSPORTATION INJURIES 1

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TRANSPORTATION INJURIES

- Road traffic injuries
  - Railway injuries
  - Aircraft injuries
- Navigational injuries

MOTOR VEHICLE INJURIES

MOTOR VEHICLE INJURIES

- With an increasing use of vehicles,injuries due to them are so common nowadays that it is necessary for a medical officer to be able to assess the injuries,the mechanisms by which they are caused,the cause of death,and if intoxication by alcohol or drugs played any part
- The injuries often assume a definite and distinguishing pattern in case of a pedestrian,and a driver or a passenger,depending on the type of impact.

MOTOR VEHICLE ACCIDENTS

- A large variety of injuries are sustained by persons involved in traffic accidents
- A traffic collision,also known as a traffic accident,motor vehicle collision,motor vehicle accident,car accident,automobile accidents,road traffic collision,road traffic accident(RTAs).

- The road traffic accidents, injuries may be sustained to.
  1. Pedestrian .
  2. Cyclist / motorcyclist.
  3. Occupants of a vehicle.

PEDESTRIAN INJURIES

Three patterns of injuries are often seen;

1) **Primary impact injuries** by the vehicle striking the victim
2) **Secondary injuries** due to victim falling on the ground or other stationary object
3) **Run-over injuries** due to the vehicle running over some part of the victim.

PRIMARY IMPACT INJURIES

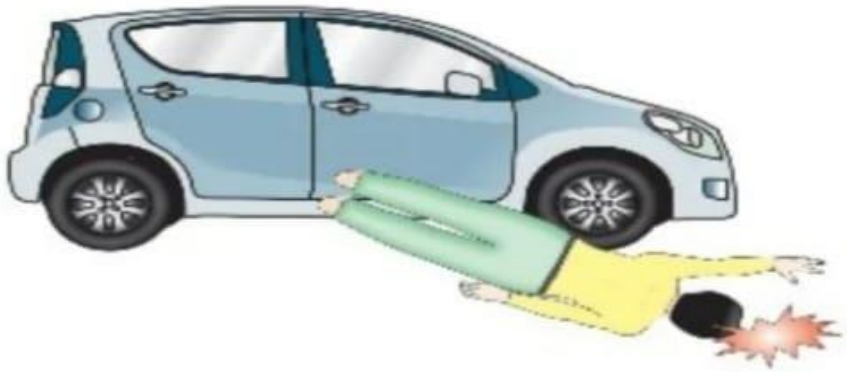
The primary impact injuries are sometimes subdivided into two groups;

a) Those due to initial impact of the vehicle;and

b) Those due to subsequent impact with the same vehicle,as may result from being lifted on to the vehicle after initial impact(**secondary impact injuries**).

Bumper impact → Primary impact injury

Hood and Windscreen impact → Secondary impact injuries



Ground impact → Secondary injuries

PRIMARY IMPACT INJURIES

- These injuries are caused by impact between the vehicle and the pedestrian
  - The height of the pedestrian often determines the site and nature of injuries
  - They are usually found on the head of children and on the trunk and legs of adults due to some part of the car(bumper,fender,lights,radiator,or bonnet, hitting the body)

PRIMARY IMPACT INJURIES

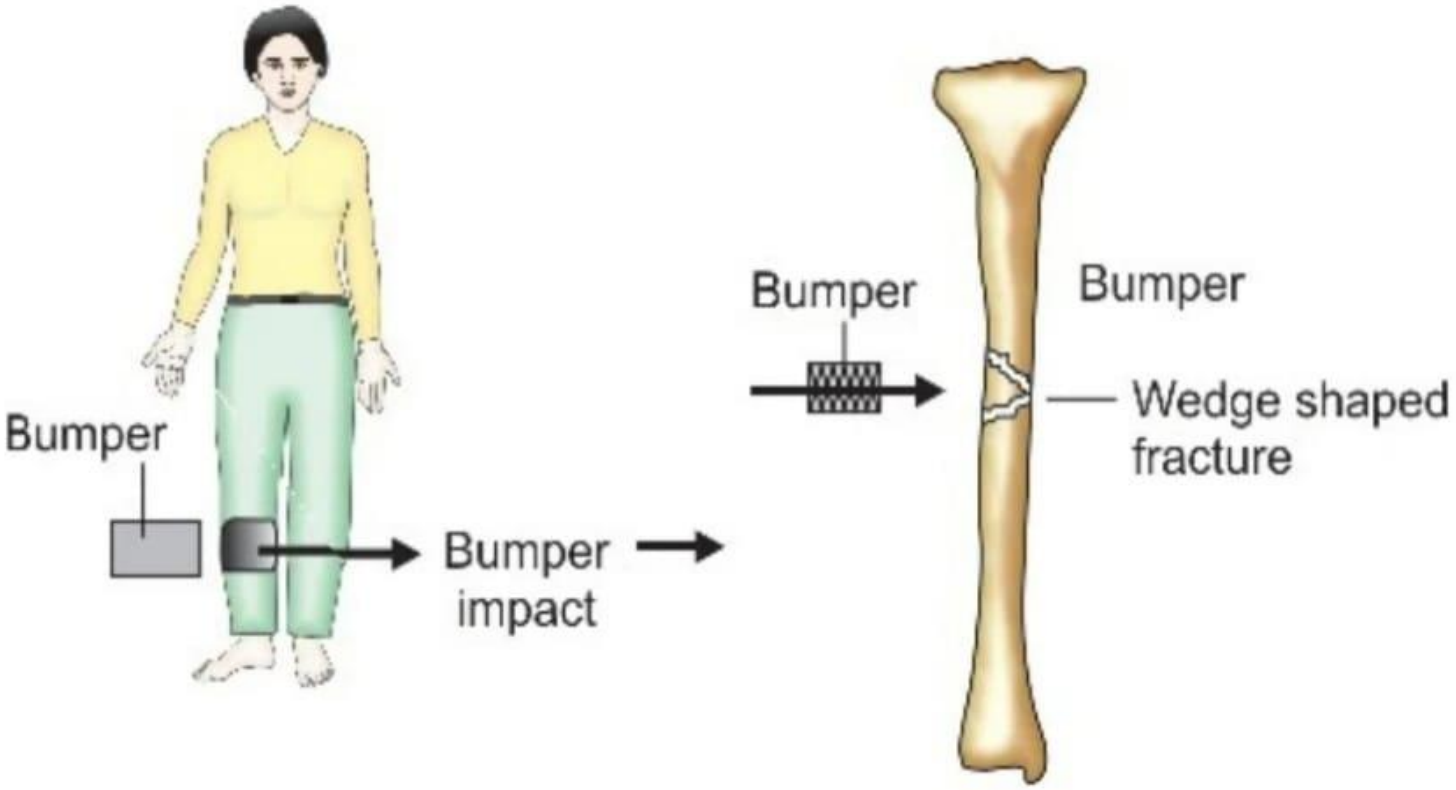
- If the pedestrian is struck from behind,he may sustain a fracture dislocation of the thoracic spine or lumbar spine
- An almost simultaneous impact on the buttocks may drive the femoral head through the acetabulum
- Striae,like superficial tears of the abdomen or inguinofemoral regions,may be seen due to over-stretching of the skin
- Projections of the car may cause specific injuries(bumper fractures; fracture of the tibia and fibula of one of both legs
- Not infrequently,injuries are at different levels on two legs or absent on one leg suggesting that the victim was walking or running when struck
- The fracture is usually spiral or wedge-shaped
- In the latter,the base of the wedge indicates site of impact and the apex points in the direction the vehicle was moving in

PRIMARY IMPACT INJURIES

- When bumper fractures are present,it is advisable to measure the distance from the heel to the fracture site as it gives Information regarding the height of the bumper and if brakes were applied
- When brakes are applied before the accident,the distance from the heel to the fracture is less than the height of the bumper
- The front bumper tends to rise during acceleration and dip under breaking
- If the pedestrian is hit from the side,there may be a unilateral fracture of the nearest leg or sometimes only bruising in the absence of fracture

PRIMARY IMPACT INJURIES

- If the pedestrian is facing the vehicle,he may sustain intra-abdominal injuries and/ injuries to the chest wall and thoracic contents.sometimes pelvis may be fractured
- External injuries may be found in any region of the body which has been struck by the vehicle and sometimes the pattern may correspond with some portion of the vehicle.


Bumper
Bumper impact
Bumper
Bumper
Wedge shaped fracture

SECONDARY IMPACT INJURIES

- These vary according to the nature of the impact
- If the point of impact is at or above the centre of gravity as is in the case when children are involved,the victim is directly thrown to the ground as a result of primary impact and may be run-over by the same car,with consequent undercarriage injuries and stains from grease,oil,etc;the hot exhaust pipe may cause burns
- However,if the victim is an older child or an adult,the point of primary impact will be beneath the centre of gravity and it tends to lift the pedestrian up onto the bonnet or hood,or sometimes even on the road behind the vehicle,depending on the speed of the car
- Secondary impact injuries may then occur from contact with the windshield and may result in severe head injuries and lacerations
- The body may then fall sideways and be run-over by a passing vehicle

Hood and Windscreen impact → Secondary impact injuries

SECONDARY INJURIES

- These are found on parts opposite to primary impact and on the head,and are due to the person violently falling on the ground
- They are most pronounced over the unclothed areas of the body but may be found also beneath the clothing even if this remains intact
- Injuries due to contact with the ground include abrasions(grazes) and bruises over the face,hands,hips,and legs,and lacerations over bony prominences,and these are usually soiled with traces of dirt
- Fractures of ribs are common
- The skull and cervical spine may be fractured and in these cases,there is frequently a contre coup brain damage indicating that the injury was due to a moving head striking a stationary object
- All kinds of intracranial hemorrhages and brain injuries may occur.

III. Secondary Injuries

- These are the injuries that occur after second impact injuries when the victim is thrown off the vehicle on the ground.

RUN-OVER INJURIES

- Children are often involved in accidents of this nature
- The severity of injuries will depend upon the part of the body run-over and the weight and speed of the vehicle
- When a limb is run-over by the wheel of a light motor vehicle,the skin and sub-cutaneous fat may be dragged away from the deeper muscles with or without any break in the continuity of the skin.This is known as degloving
- Tyre marks may be present on the unclothed parts or even clothed parts,if the clothes are not thick
- The grease and oil stains from the under-carriage will be present on the clothing and wound

RUN-OVER INJURIES

- The exhaust pipe under the vehicle may cause burns
- If the wheel moves over the trunk,rupture of viscera may occur and,if it moves over a fleshy part,an avulsion injury may result with extensive degloving of a wide area,usually the thigh.

FREQUENCY OF INJURIES IN PEDESTRIANS

Considering the dynamics of pedestrian accidents;

- Legs are involved in **85%** cases
- Head between **50 to 80**%
- Arms
- Pelvis
- Chest
- Abdomen

Injuries to the neck and spine are relatively infrequent

DRIVER AND PASSENGER INJURIES

- After the pedestrians,the driver is the most frequent casualty in road traffic accidents as in most cases,he is the only occupant of the vehicle
- Next in frequency is the front seat passenger followed by rear seat passengers.

TYPES OF DRIVER AND PASSENGER INJURIES

The driver and passenger injuries depend upon the type of impact crash;

1) Front impact crash
2) Side impact crash
3) Rear impact crash
4) Roll-over crash
5) Other types of mishaps

UNDERSTANDING INJURY PATTERNS

- While the injury patterns are discussed under five categories,it must be remembered that different types of combinations can occur
  - For example; a car after a collision may roll over and be deflected sideways into a tree or another stationary object
  - The resultant injuries can be better understood from the **sequence of three collisions** that occur;
    - the first collision
    - The second collision;and
    - The third collision

THE FIRST COLLISION

It has been defined as that between the vehicle an its environment,that is,when a car strikes another car head-on or a fixed object such as a tree or electric pole,and stops.It produces vehicular damage.

THE SECOND COLLISION

It has been defined as that between the occupants and interior of the car.Although the car stops,the occupants continue to move in the same direction and same velocity as the car was moving.The unrestrained occupants will strike some part of the interior of the vehicle and be injured.

THE THIRD COLLISION

It has been defined as that between the internal organs and the cavities which contain them.Although the body stops moving,the internal organs continue to move in the direction of impact and this may result in serious internal injuries even without evidence of corresponding external injury.

The Driver And Passenger Injuries

can be:-

1. Front impact crash:
   This happen when one car strikes

   - Another car head- on or
   - Strike a stationary object,
   - Like an electric pole/ tree

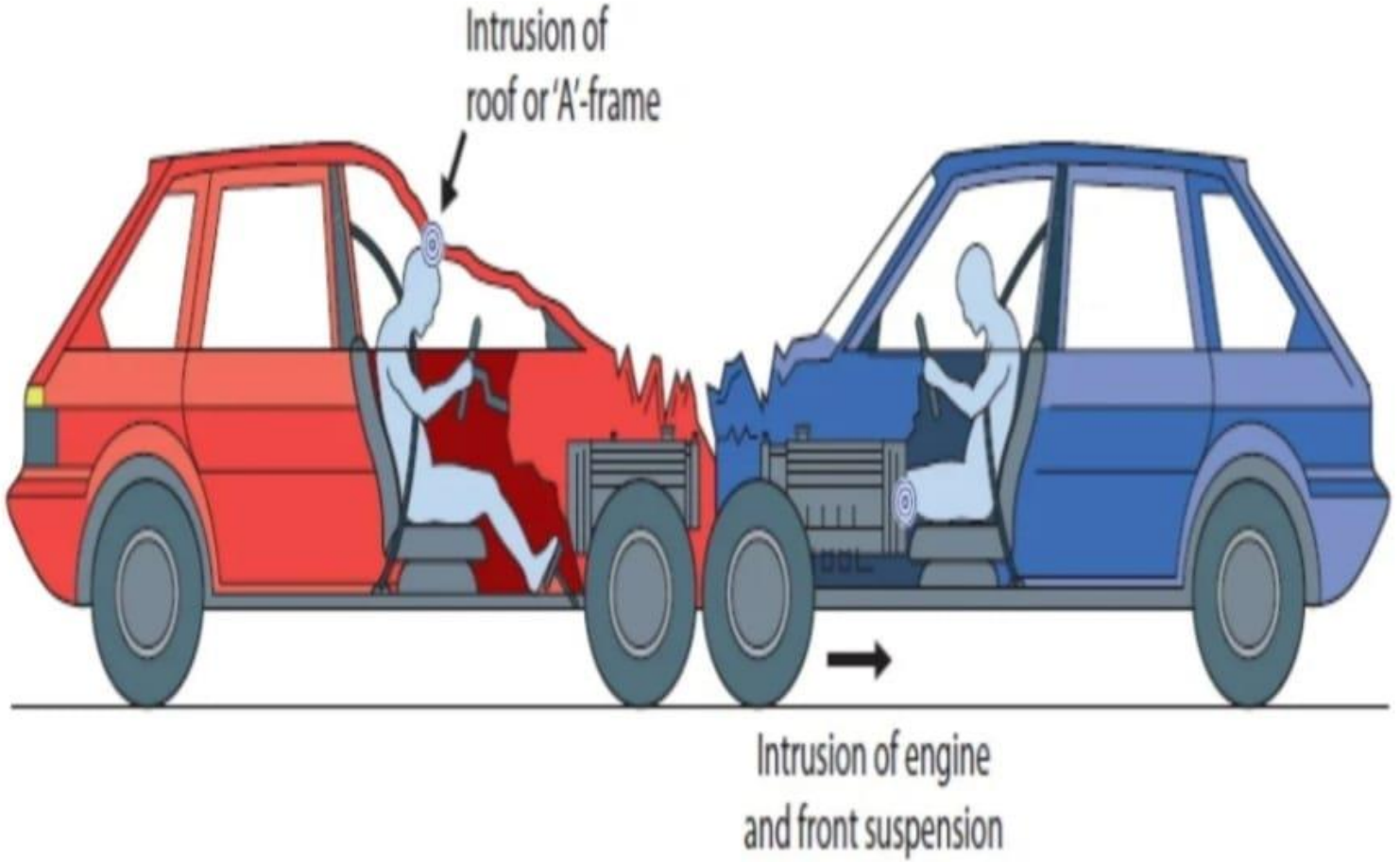
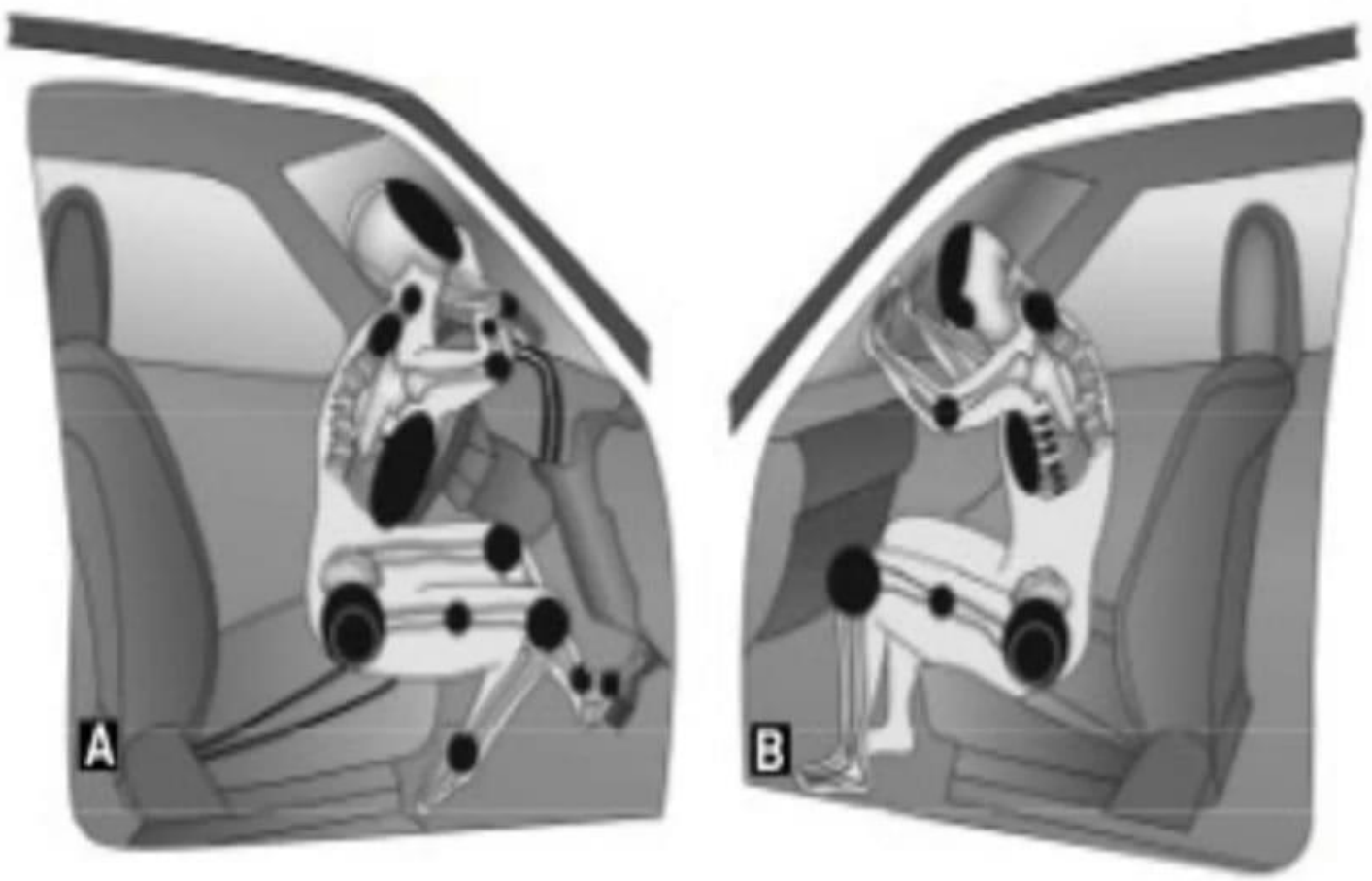


Figure 9.4 When vehicle structures impinge on the occupants even belt restraints offer little protection. The engine, front suspension, roof and 'A' frame are frequent intruders.


A
B

- **Unrestrained Driver**

- First slides forwards so that his legs strike the fascia/parcel-shelf area, and his abdomen or lower chest contacts the lower edge of the steering wheel.

- The body then flexes across the steering wheel and begins to rise.

- The heavy head goes forwards, and there is flexion of the cervical and thoracic spines.

- The upward and forward component causes the head to strike the windscreen, the upper windscreen rim or the side pillar.

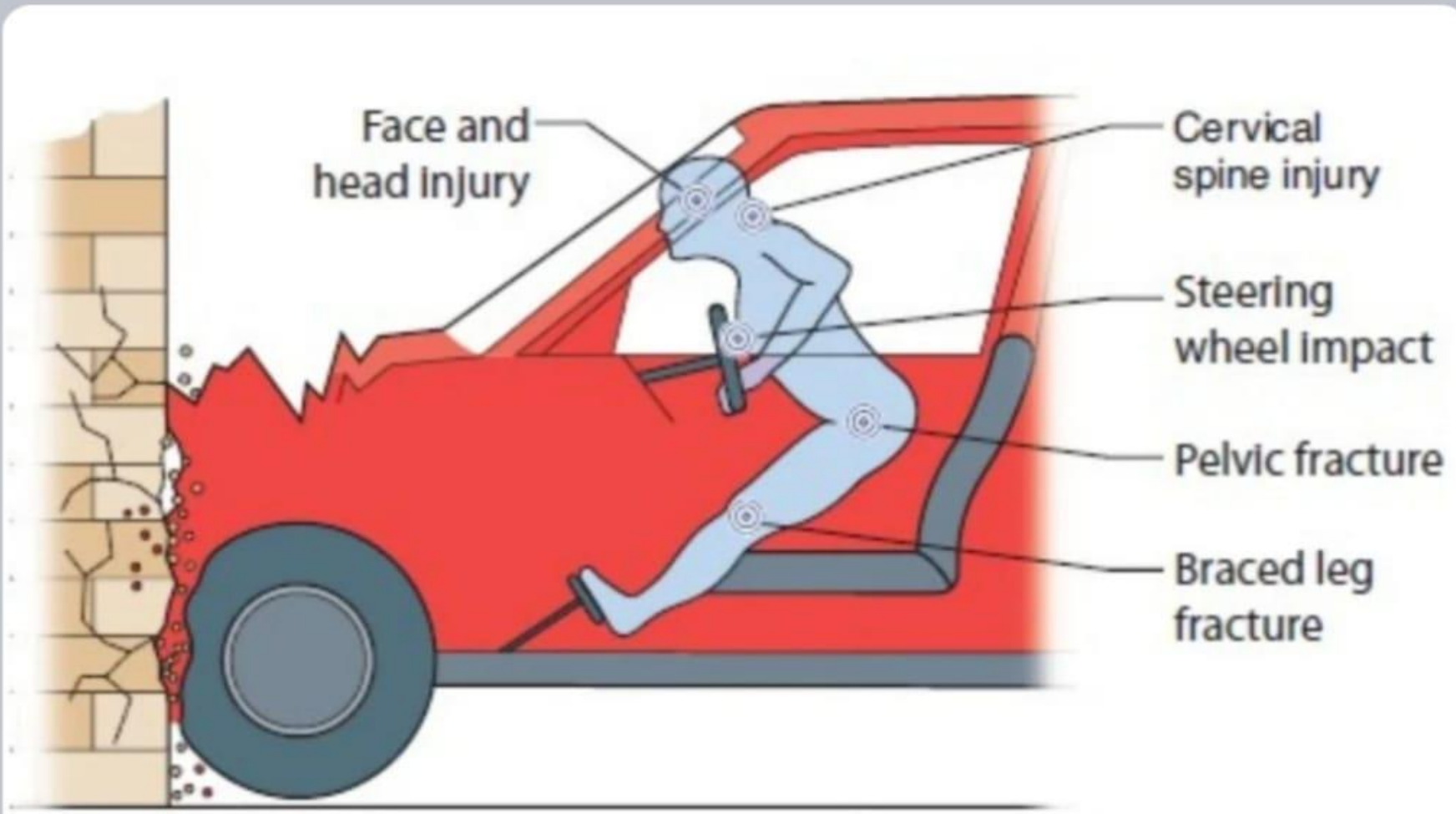


Figure 9.1 Major points of injury to an unrestrained driver of a vehicle in deceleration impact.

- The windscreen is often perforated by the head or face, And the whole body may be ejected through the broken glass, to land on the bonnet or even on the roadway ahead.

- The intrusion of structural parts into the passenger compartment

- The engine or front-wheel assembly may be forced back into the seating area, intruding upon the driver.

- The roof or front corner pillar (the so-called ‘a’-frame) may cave in on top of the driver

- The steering column may be forced back to ‘stab’ or crush the driver’s chest or abdomen.
- Column, engine, or gearbox intrusion may be to force the floor up and backwards against the driver’s feet and legs.
- Pedals cause transmitted force up the legs and into the pelvic girdle
- Door may burst open and the driver, if unrestrained, ejected sideways onto the road, especially in a crash that has a roll-over component.

- Rear impact, the driver is violently accelerated
- If no rigid head restraint is fitted to the seat, severe hyperextension of the neck occurs, causing ‘whiplash’.
- In side impacts, the injuries depend upon the amount of intrusion of the driver’s door and side panels.

The driver receive.

1. Fracture of wrist and arms occur when driver brace himself against the steering wheel.

2. The fracture or dislocation of
    1. Tibia, fibula &
    2. Pelvis
    3. Impact from pressing on the break and clutch pedals.

3. Impact of the knees against the dashboard
    1. Fracture of the tibia, fibula, femur & pelvis.

1. Severe impact against the windshield pillar may cause
    1. Avulsion of the skin of the forehead,
    2. Basilar skull fractures,
    3. Closed head injury and
    4. Fracture or dislocation.

2. Steering wheel impact injury: The steering wheel may cause
    1. Fracture Of The Jaws And
    2. Facial Bones.
    3. Abrasions, Bruises And Contusions Of The Chest Or
    4. Bilateral Rib Fracture.
    5. Laceration Of Spleen & Liver May Be Seen.

Front Seat Passenger/

1. Whiplash injury:

2. "Sparrow Foot marks".

3. injured against internal fittings, like
    1. Doors,
    2. Handles or
    3. Ejected through burst-open doors.

Figure 9.2 Facial lacerations from a shattered windscreen in an unrestrained driver. The toughened glass breaks into small fragments, which produce the characteristic 'sparrow-foot' marks. The laceration on the forehead was made by the windscreen rim.

2.Rear impact crash:-

- Low velocity rear impacts
  - cause whiplash injury
  - Neck fractures are rare.

- A high velocity rear impact crash can deform and rupture the gas tank with ignition of the fuel.

- In a rear impact, the driver is violently accelerated and, if no rigid head restraint is fitted to the seat, severe hyperextension of the neck occurs, often followed by the sequence of deceleration events when the car is cannoned into the vehicle or other obstruction in front, causing the popular, if inaccurate name of ‘whiplash’.

Whiplash injury:-

3.Side impact crash:-

- The vehicle strikes on the
  - Side of another vehicle or
  - Skids sideways into a fixed object.

  - Injuries are often severe, because
  - The side of a car has a thin metal wall door and
  - No other components to absorb the force of impact.

I. Dicing injuries may occur which are superficial cuts of the skin caused by fragments of tempered glass.

II. They are

- Linear,
- Right angel or
- V- shaped laceration
- Seen typically on the face, forehead and arms
- On the right side of the driver and left or
- Right side passenger.

III. Other injuries

- Cervical spine fracture ,
- Fractured ribs,
- Contusions, lacerations and
- Explosive tearing of the lung on the right side of the impact common.

III. In the abdomen,

- A lateral impact on right causes laceration of the right lobe of the liver and right kidney.
- The pelvis may be fractured from an impact on the either side.

4. Roll-over crash:-

- A roll over crash, the occupants receive the surprisingly moderate impact, if the vehicle is not brought to a sudden stop.
  - The crashing of different sides of the vehicle absorbs the forces of impact.
  - If the passenger compartments remains intact,
  - The belted occupants frequently survive the crash.

- Non belted occupants are involved into two types of injury:
  - Tumbling around inside and striking
  - Ejection out from the vehicle.

OTHER MISHAPS

The other mishaps that may follow the occupants of the car are;

1) Ejection
2) Fire;and
3) submersion

EJECTION

- It occurs in front impact crash and roll-over crash
- It depends upon vehicle doors opening during impact
- Sometimes,an occupant may be ejected even through the windows
- It increases the multiplicity and severity of the injury regardless of the position occupied by the occupant
- The head,chest and abdomen of the ejected occupants bear the brunt of impact
- Rib fractures,injuries of the chest viscera,and contusions and lacerations of the liver are common
- Head injury is often the cause of death.

FIRE

- Fire after a vehicle crash is rare
- Majority of vehicular fire burn injuries are associated with vehicles not involved in collisions
- Rarely,burn injuries may be the only cause of death.

SUBMERSION

Drowning is another rare cause of death in accidents when a car is submerged in water.

❖Role of seat belts and air bags:-

- Numerous safety features such as
  - Safety belts,
  - Air bags,
  - Collapsible steering columns,
  - Softened interior dashboard and
  - Anti lock breaks

- The air bag system reduced chest and facial trauma, in those individuals not using seat belt.

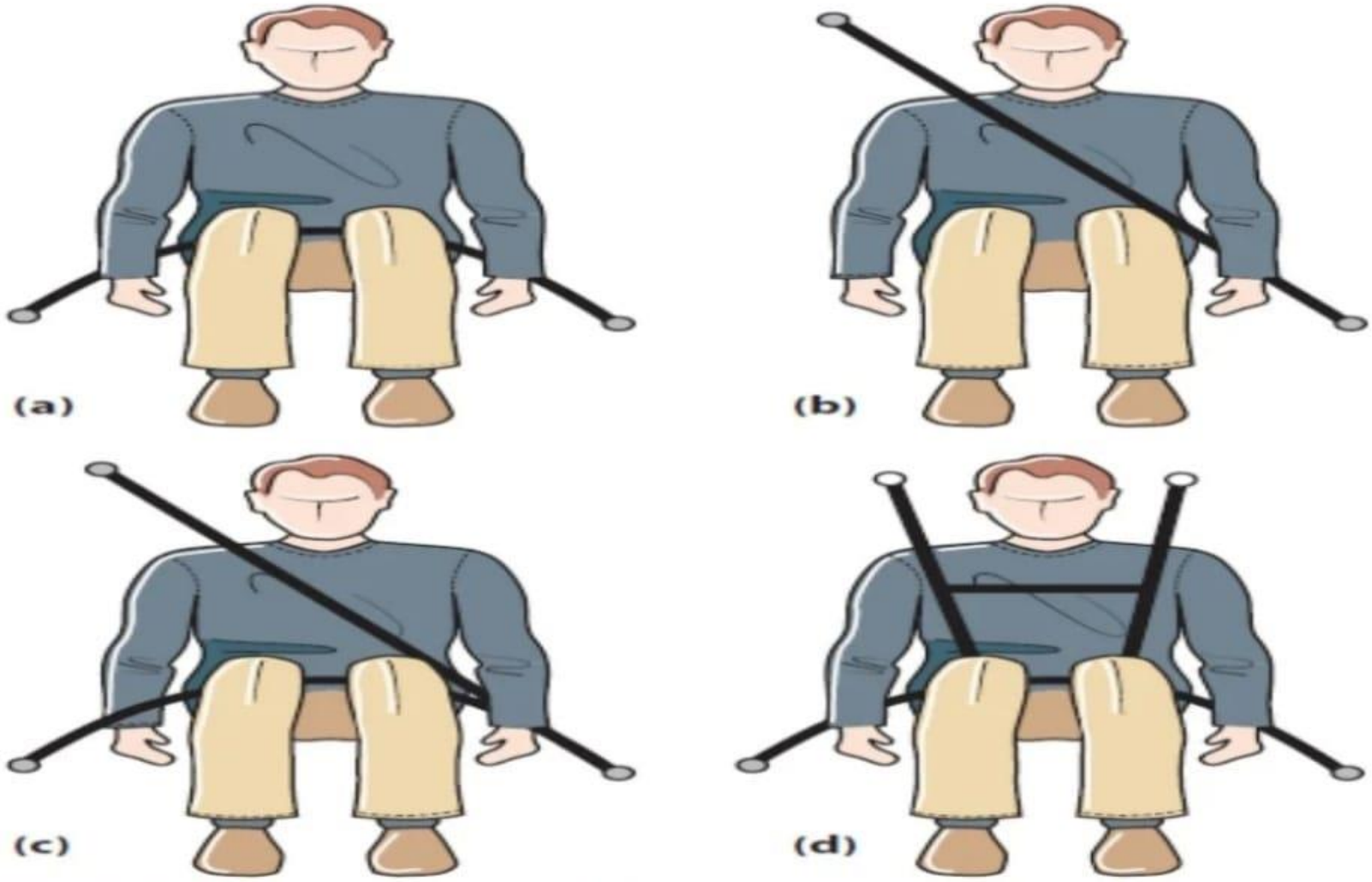


Figure 9.13 Types of seatbelt restraint: (a) simple lap-strap (dangerous to aorta); (b) diagonal only (can slip underneath); (c) diagonal plus lap-strap (usual car type); and (d) shoulder harness (used in aircraft and racing cars).

- Wearing seat belts reduces the risk of fatalities to front seat occupants by 45% since.

i. Injuries are of less severity, except whiplash injury.

ii. Probability of severe head injury is lower.

iii. Probability of being ejected from the vehicle is lower.

iv. There are fewer fatal/ major injuries to head, neck, chest & abdomen.

- Lap belts can produce tears of the mesentery, omentum and laceration of the bowel .

- Shoulder belt may produce a linear abrasion running downward and medially on the right side of the driver and left side of front seat passenger.

- Although seat belts reduce mortality, they cause a specific pattern of internal injuries.

Injury By Seat belt

MOTORCYCLE INJURIES

INJURIES SUSTAINED BY MOTORCYCLIST

Injuries sustained by motorcyclist are much more serious than motor vehicle injuries because;

- Inherent instability of two wheeler compared to for wheelers
- Unprotected and lack of protective gear
- Even small motorcycles can attain high speed
- Their size is relatively so small that they are easily overlooked by larger vehicles
- Their weight is relatively much less than average four wheeled vehicles and they are therefore at a mechanical disadvantage
- The vehicle does not remain upright in an accident
- He is almost always thrown off and subject to very severe impact forces
- Rash and negligent driving.

CAUSES OF MOTORCYCLE ACCIDENTS

- Alcohol and drugs
- Reckless driving
- Environmental factors(pot holes,oil slicks,poor visibility,slippery road)
- Failure of drivers of cars to see the motorcycle
- Loss of control over vehicle may result in crash against stationary object with fatal results
- If driver is reckless and does not see or loses control over the vehicle,he may have his head or limbs amputated by cables or wires stretched across the road(uncommon).

INJURIES TO THE MOTORCYCLIST

When an accident occurs,the injuries are often severe as there is very little crushable material to absorb the impact and the driver and/ passengers are always thrown off.

INJURIES TO THE MOTORCYCLIST

All types of injuries may be present. In a high speed impact of a motor cycle there may be;

- Primary injuries(as a result of initial impact)(mostly open fractures of the tibia and fibula);followed by
- Secondary injuries from striking the ground(mostly fractures of the skull and cervical spine as well as contusions of the brain).

INJURIES TO THE MOTORCYCLIST

- Head and neck injuries ; include skull fractures,contusions and lacerations of the brain,intracranial hemorrhages,ocular and orbital open lesions,facial fractures,cervical fractures and lesions of the spinal cord
- Thoracic injuries ; include fractures of the sternum,clavicle, and ribs;hemopneumothorax;contusions and lacerations of the lungs and heart;and rupture of aorta
- Abdominal injuries include lacerations of the liver,spleen and kidney;rupture of the bowels and urinary bladder;and fracture of the pelvis
- In upper extremity,fractures of radius,ulna,and metacarpals are common

INJURIES TO THE MOTORCYCLIST

- In the lower extremity, open fractures of the tibia and fibula are most often seen;fractures of femur and metatarsals may be present
- Traumatic amputations in both upper and lower extremities may be seen
- Thermal injuries due to hot metal sliding against the street and fire caused by gas tank puncture
- Skid marks(grazes) on the skin due to contact with road gravel are seen.The direction of travel may be easily identified by the presence of skin tags at the rear most(far)end of these scratches.

CAUSE OF DEATH IN MOTOR CYCLE INJURIES

- **A fracture of the skull** with associated **brain injury** is the most common cause
  - **Multiple fatal injuries** constitute typical fatal motor cycle accident
- **Submersion** may occur in attempt to cross a frozen lake(not realizing ice is not thick enough to sustain weight of the vehicle and its rider.

USE OF CRASH HELMETS

- This has reduced fatalities at low speeds
- Offer little or no protection at high speeds
- A crash helmet is designed to reduce friction of the head against the ground and make deceleration less drastic by allowing the protected head to skid across the ground rather than to come to an abrupt halt
- A full face helmet is better than an open face helmet as it provides greater protection against facial excoriations and fractures as well as against spinal injuries.

SKULL INJURIES TO THE MOTORCYCLIST

- Fall on the side with side impact to head results in basal fracture of skull especially hinge type(**hinge fracture;motorcyclists fracture/transverse fracture**)
- Impact on the face causes fracture of facial skeleton
- Impact on forehead causes **sagittal fracture** of base of the skull
- Impact on chin causes **mandibular fracture**
- Impact on crown of head by fall may cause **ring fracture**.
- **Fracture of temporo-parietal** bone due to fall on road resulting in impact on lateral aspect of the skull.

MOPED AND BICYCLE INJURIES

MOPED(MINI-BIKE) INJURIES

- **Primary impact injuries** of the legs;and
- **Secondary injuries** to head,shoulder,and trunk

FATALITY IN MOPED(MINI-BIKE) INJURIES

Where the speed is lower,the usual fatal injury is due to another motor vehicle striking the rider.

INJURY PANORAMA/PATTERN

It is the same as that of motorcycle accidents but a moped is estimated to be **only one-third as dangerous** as a motorcycle.

BICYCLE ACCIDENTS

The majority of fatal bicycle accidents are **collisions between bicycle and a motor vehicle**.

CAUSE OF DEATH IN BICYCLE INJURIES

The most common cause of death is **cranio-cerebral injury**.

TYPES OF BICYCLE INJURIES

When a bicyclist is struck by a motor vehicle,he sustains;

- **Primary impact injuries**(struck by vehicle);and
- **Secondary injuries**(at points of impact with pavement and bicycle)

Whilst being thrown off the bicycle,he may sustain **injuries from** handle bars and other **projecting parts**.

INJURIES TO THE BICYCLIST

- **Head injuries** include dental trauma,fracture of facial bones,contusions of the brain,fractures of skull and cervical spine
- **Trunk injuries** include mainly superficial contusions and excoriations;fractures of ribs,spine and pelvis seen;intra-thoracic and intra-abdominal lesions seldom seen but handle bars may cause rupture of bowels and laceration of liver,spleen or kidney
- **Injury to extremities** include shoulder contusions,clavicular fractures,metacarpal fractures,knee and ankle dislocations and fractures of lower part of tibia and fibula and rarely of femur and metatarsals

INJURIES TO THE BICYCLIST

- An injury peculiar to the bicycle riders,especially children,is the **bicycle spoke injury** which occurs when the child falls from a bicycle and his foot and leg are wedged between the spokes of the wheel.The result is compression or crushing of soft tissues of the leg.The most common site of skin necrosis is at the level of the lateral or medial malleolus.Other common sites are over the Achilles tendon or lateral aspect of the foot.Fractures of the ankle or lower part of the tibia and fibula may be seen.

THANK YOU