## BIOMECHANICAL ASPECTS OF HEAD TRAUMA IN PEDESTRIANS

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Besides the many services meter vehicle brought us in our era it had also many negative consequences, expressed in the anual figure of 150.000 deaths and 6-7.900.000 wounded people in traffic accidents all over the world.

The casualities fellowing traffic accidents represent today the great majority of civil traumata (Dérobert). Among these the head trauma are the most frequent by far. Hadengue and Leriat (queted by 2) note among the street injured people 52% of head trauma, in 20% there are associated theracic trauma and in 15% there are associated abdominal trauma. On the other hand 46% of the abdeminal trauma and 40% of the theracic trauma are associated with head trauma. The partitition and gravity of lesions in traffic accidents is expressed for Nicolas (quoted by 2) by the fellowing percentages: head - 66% as frequency and 70% mertality rate; abdomen - 3,9% as frequency having a mertality rate of 3.3%; therax - 15.6% as frequency having a mertality rate of 5.% the spine - 7.3% as frequency having a mertality rate of 1.8%. In 70% of traffic accidents there is always present a head trauma (Maleney, queted by 2). Half of deaths occuring after traffic accidants are due to head trauma (Elliet, queted by 3).

As regarding the percentages of cranio-cerebral trauma in pedestrians Slatis (quoted by 6) gives a figure of 64% and Gögler (quoted by 6) a figure of 81%. Among the medical causes incriminated in producing death in injured pedestrians the cranio-cerebral trauma dominate all the other lesions. These percentages are also confirmed by our data in which in 50% of the cases death was due to a cranio-cerebral trauma. In spite of the fact that usualy pedestrians show up as politraumatized (65% of the cases), the gravity of their lesions is confered by the cranio-cerebral trauma which in this way becemes the most frequent cause of doath (our study was done on 500 such cases - pedestrian victims of road accidents).

The biomechanical and lesional aspect in traffic accidents depends on the physical phenomena triggered by collision, the agressional factors acting on the human being as a complex of mechanical and cinetical order.

The pedestrian wounding is usualy decomposed in many parts, which are not always achieved but their morpholesional mark allow us the retrospective understanding of the impact and its bionochanical consequences on the head. These have a, great importance in biomechanical reconstitution of the accident.

The cellision - in which the lesion depend on the site of impact and on the intensity of trauma (directly propertional with the vehicle's speed). Lesions produced by direct impact, function of magnitude of speed are ecchymosises, haematomas, contusive, wounds, fractures located on the same part of the impact site. Two lesional aspects have a peculiar deductive value: l. the full correspondence between the lesion's level and the vehicle's part that hits (e.g. the body of a lerry, for the skull trauma) and

2. the tipical mark of a part of the vehicle on the skull (a contusive lesion of the skull having the shape of a headlight), splitting wounds produced by metal excressences (produced for example by mudguards), cutted wounds by a wind screen, wounds of peculiar aspect produced by the car radiator, etc. Sometimes on the contrary the head's mark remains on the vehicle (holes produced in the wind screen by the head). The wounds of pedestrians produced by a direct shock are so peculiar that they allowed the retrospective assessment of the mechanism by which the accident was produced, the recognition of car's characterist tics and its identification by the impact marks on the car's bedy (crushed tissues, blood, hear, etc.).

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The fall or the projection - in which the lesions depend on the vielence of the impact, the angle on which the victim is cought and on the ground's nature. At a speed bellow 20 Km/hour the pedestrian is hit and falls. Above this speed an adult who was hit bellew the centre of weight is first tipped on the car's heed and then prejected and an adult which was hit above the centre of weight (or a child) is projected from the begining. Regarding the angle on which the victim was cought and projected is mentioned the fact that if we know exactly this angle we could deduct the vehicle's speed using Desmarez's curves (queted by 6). If the pedestrian is cought in an acute angle the distance of prejection is longer than when the angle was straight. The lesiens will be more serious of the surface of projection is hard and rough. On shock absorbant surfaces (water, snow) the projective lesiens may be missing. These lesiens are usualy located en the preminent parts of the head (nose, forehead) and on the opposite site of the impact lesions with the vehicle. The merphologic expression of these lesions are occhymosises, contusive wounds and iselated fractures. The pest-mertem examination reveals many contusions of the deep layers of the scalp, sub- and extradural haemerrhages, cerebral centusiens.

<u>Treading or crushing</u> gives lesions which usualy are the consequence of striking-projection. There are also lesions caused by driving over the body or over parts of the body and which have some peculiarities:

1. with regard to the vehicle's whight there may be sovere lesions as comminutive fractures with bursting of the skull and crushing of the brain. The skull may shew irregular fronto-eccipital cracking wounds through which one may see many fracture lines and bone fragments. Sometimes the skull is flattened, the facial massif crushed and a total laceration of the cerebral mass may be seen;

2. semetimes on the scalp there are marks of the tyre which accurately repreduce its shape (design) by post mortem parchmenting; 3. there may be extremely peculiar lesions like ejection of the eye ball at a considerable distance from the corpse, presence of brain tissue in the cavum oris by crush of the base of the skull.

The lesions of solitary treading (the victim in a obrious state is fallen or asleep on the stroot) are expressed by tread ing lesions with the same importance in the dynamic reconstitution of the accident and the assessment of the position of the victim regarding the vohicle.

In case of body collision with vehicles, the lesions are similar to these produced by compression during treading. In body collision there is a greater correspondence between the collision site and the part of vehicle that was bumping.

<u>Dragging</u> - in which the lesions depend greatly on the ground surface aspect and on the distance on which it took place. Usualy there are multiple vital or postvital scratches eriented only in one way and located on the prominent parts of the bedy.

The mechanism of cranic-cerebral lesions production may be the acceleration (direct striking), deacceleration (projection) compression (by treading) or by a combined mechanism (Table No.1) Table No.1 Lesions production mechanism

	paround on a moon on the	2
General mechanisms of lesion production	Mechanisms of cranie- cerebral trauma preduction	Ne.cases
striking	acceleration	73
striking-projection	deacceleration	247
treading	compression	45
striking-prejection-tradi	ng combined	145

The open or closed cranic-corebral lesions involve both viscoral and neural cranium. They may involve also the soft tiesues of the scalp, the skull and the brain. At a lew speed the skull, absorbs the whole kinetic energy and the bone does not broke. At high speed the bone fracture is a rule. The skin abserbing 10 times less kinetic energy it will be less involved and injured than, the bone which will be more frequently involved by direct impact. The bone may be depressed bellew the skull level,flattened and puly seldem is comminutively fractured er cracked. Merphelegically there are wounds of the scalp, fractures of the base of the skull,closed fractures of the vault of the skull,open fractures of the vault of the skull,cranio-cerebral wounds,cerebral lacerations,intracranial haematemas,cerebral centusion (Table No.2).

Table Ne.2 Numeric repartitition of cranic-cerebral lesions

N• .	Cases
Pericranial lesions	368
Bene lesions - fractures of the vault of the skull - open	36
- clese	d 99
- fractures of the base of the skull	315
- head crushes	60
Lesiens of the cerebral substance	
- certusion	127
- cranio-cerebral wounds+lacoration	233
- intracranian haematemas	96
- cerebral eedema+subarachneid haemorrhage	54
Associated lesions	
- of the thorax	153
- of the abdomen	201
- spine+limbs	276

The visceral cranium suffers injuries in 17% of the cases. The seriousness of its lesion is marked by an impaired spontaneous breathing asking for respiratory ressuscitation and controled ventilation. Later on mastication, fonation and swellowing will be highly impaired.

The brain may be directly injured by cranian fractures er indirectly by the vibrating meuvements which take place in the skull during trauma. During these meuvements (shocks) the brain may suffer contusions by striking against endocranian beny protuberances (orbitar ceilling, the petrous part of the temperal bene, crista spheneidei).

The gravity of brain injuries may be deduced also from

the fact that mestly the death supervenes at the accident site, during the transport of the pacient or in several from the accident time (Table No.3).

Table Ne.3 The place of death	۷
	Ne. cases
At the accident site	321
During transport	27
At the hespital - in the first 24 hours	98
- after 24 hours	54

If at the immediate gravity of the cranio-cerebral trauma we add the possible complications as chronic subdural haematemas, infections (meningitis, abscess), focal neurological complications (meter complications, aphasia, sensitive complications, sensorial complications) and those related to the frequency of posttraumatic epilepsy or organic or psychogenetic subjective syndrome we get a complete image, even if it is a brief one, on the risks of cranio-cerebral trauma in pedestrians in traffic accidents

For all the above reasons the prophylactic measures taken against traffic accidents are fully justified. For this speaks n not only their immediate gravity but also the sequelae that invalidate this people for the rest of their lives changing this people in true victims of the highways.

## R • f • r • n 6 e st

1.Benedek P. - Cirugia del Uruguay 1973,43,2,148-150
2.Dérebert L. - Médicine Légale, Ed.Flammarien, Paris 1974
3.Ifiiguez R.A. - Cirugia del Uruguay 1973,43,2,157-159
4.Oblu N.,Sändulescu Gh.,Rusu M.,Stanciu A. - Censf.Accid.Circul.
Iaşi 1962
5.Scripcaru Gh.,Terbancea M. - Medicină Legală, Ed.didactică,
București 1970
6.Scripcaru Gh.,Pirezjnski T. - Relația em-vehicul-stradă
Ed.Junimea,Iași 1973

7.Wilson W.P., Hohman L.B., Workman S.N. - N.Carol.Med.J. 1965/10.