

TPOLOGY OF LESIONS OBSERVED IN

CYCLISTS AND MOTORCYCLISTS

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This study, concerning approximately 500 observations, was made by the bilateral engineer-doctor team which has been operational in Salon-de-Provence since early 1974, in symbiosis between the local Hospital's Department of Highway Traumatology and the Lyon Impact Laboratory which delegated an engineer to Salon.

BASIC DATA FOR STUDY

The observations made cover 488 cases of two-wheel vehicle operator injuries, of which

- 276 were from the Lyon Investigation Center
- 212 were from the Salon-de-Provence Investigation Center

The study covers the period early 1974 to early 1976. The only casualty files used were those containing complete information on : the operator, the vehicle, the obstacle, the type of protection (helmet), and the lesions.

CLASSIFICATION

Classification was established in relation to the vehicle used due to the great difference between the various two-wheel vehicles, from the point of view of manoeuvrability, speed, mass, legislation, traffic laws, etc...

We have formed 5 categories :

- Bicycles
- Mo-peds < 50 cc.
- Motorbikes > 50 cc → < 125 cc.
- Motorcycles > 125 cc → < 350 cc.
- Motorcycles > 350 cc.

In each category, we have grouped the lesions of operators "not wearing helmets" and those "wearing helmets", according to the type of helmet worn : either classical or integral.

GENERAL STATISTICS GIVE US THE FOLLOWING RESULTS

By category :

- Bicycles : 23 injured (4,7%).
- < 50cc : 281 injured (57,6%) including 241 w/o helmet, 40 w/helmet.
- > 50cc; < 125cc : 70 injured (14,3%) including 11 w/o helmet, 59 w/helmet.
- > 125cc; < 350cc : 50 injured (10,2%) including 7 w/o helmet, 43 w/helmet.
- > 350cc : 64 injured (13,1%) including 11 w/o helmet, 53 w/helmet.

So we are concerned essentially with two-wheel vehicles, that is, bicycles, motorbikes, and motorcycles. Out of 488 cases, there are 195 wearing helmets (40%), 20% of whom with a vehicle under 50cc; and 80% for the other categories of two-wheel vehicles.

Total average age of occupants is 24

- Bicycles : 27 1/2 years old
- < 50cc : 31 1/2 years old (23 1/2 for those w/o helmet)
- > 50cc; < 125cc : 27 1/2 years old (24 for those w/o helmet)
- > 125cc; < 350cc : 19 years old (20 1/2 for those w/o helmet)
- > 350cc : 23 years old (20 for those w/o helmet)

A comparison between occupants wearing helmets and those without helmet shows that the latter are often the younger.

Sex

- Male : about 75%
- Female : about 25%

Lesional conclusions

The lesional conclusions appear on Table I.

Two-wheel vehicles		Bi-cycles	<50 cc	>50:125 cc	125:350 cc	>350 cc	TOTALS by lesion
Lesions	Cases	23	281	70	50	64	%(if > 1%)
<hr/>							
SKULL:Contusions,wounds,TC-PC	2	101	25	17	16	161	(11,2%)
TC+PC,coma,fractures.....	8	85	9	8	25	135	(9,4%)
FACE:Contusions,wounds.....	11	132	13	6	14	176	(12,3%)
Fractures.....	-	10	3	-	3	16	(1,1%)
NECK:Contusions, wounds.....	1	5	2	2	6	16	(1,1%)
Cervical sprains.....	-	2	-	1	1	4	
Fract.,dislocation of C Rachis	1	-	-	-	3	4	
SHOULDER:Contusions, wounds....	5	39	5	4	10	63	(4,4%)
Fractures, dislocations	4	24	2	4	5	39	(2,7%)
UPPER LIMB:Contusions, wounds..	13	114	36	14	17	194	(13,5%)
Dislocated elbow.....	1	-	-	-	-	1	
Fractured arm.....	2	6	-	-	-	8	
Fractured forearm.....	1	11	4	4	3	23	(1,6%)
Fractured hand.....	-	10	6	3	4	23	(1,6%)
CHEST:Superf. wounds,contusions	-	23	4	2	8	37	(2,6%)
Simple fracture of ribs..	-	3	-	-	2	5	
Flail chest.....	-	-	-	1	1	2	
Fractured sternum.....	-	-	-	-	-	-	-
Intra-thoracic lesions...	-	-	2	-	-	2	
DORSAL RACHIS:Trauma.....	-	1	-	-	-	1	
Fractures.....	-	1	1	-	1	3	
ABDOMEN:Contusions, wounds.....	-	5	1	-	6	12	
Visceral lesions.....	-	-	1	-	1	2	
LUMBAR RACHIS:Trauma.....	-	3	-	-	1	4	
Fractures.....	-	-	1	-	-	1	
PELVIS:Contusions, wounds.....	1	24	13	10	9	57	(4%)
Fractures.....	-	-	1	-	2	3	
Dislocated hip.....	-	2	3	-	3	8	
LOWER LIMB:Contusions, wounds..	12	192	54	33	41	332	(23,1%)
Dislocated knee.....	-	1	-	-	1	2	
Fractured thigh.....	2	13	2	5	1	23	(1,6%)
Fractured leg.....	2	15	6	4	6	33	(2,3%)
Fractured knee-cap.....	1	8	1	-	2	12	
Fractured foot.....	1	8	3	6	4	22	(1,5%)
Sprains.....	1	7	3	1	-	12	
<hr/>							
TOTALS	69	845	201	125	196	1436	Lesions
<hr/>							
(number of lesions by category)							

TABLE N°I

This table indicates :

- the number of lesions per casualty, 3 on an average (1436 lesions for 488 casualties) ; this figure is constant whatever the category concerned : cyclists or different cc. for two-wheel vehicles.

- the lesional associations bear essentially on 4 areas :

- the skull
- the face
- wounds and contusions of the upper limbs
- wounds and contusions of the lower limbs

which is logical, since these are the areas more exposed. On the contrary, it is noteworthy that there are few cases of rachidian and thoraco-abdominal lesions :

- 2,6% thoracic lesions with only 2 thoracic flails,
- 4 visceral abdominal lesions and 8 fractured rachis.

The latter figure is rather astonishing, for one might have expected the spinal column to be relatively exposed in motor-cycle spills. Note that this figure hardly varies according to whether the impact was caused by the vehicle or whether the fall was spontaneous.

The percentages of lesions that we have determined consist of two types of statistics. First of all, the general percentage of lesions in relation to the total number of lesions recorded. Then, a relative percentage by type of lesion, which enables us to determine the chance factor of having such a lesion in a two-wheel vehicle accident.

It is also interesting to observe a distribution of the casualties according to the AIS (Abbreviated Injury Scale).

(:	:	:	:	:	:	:)						
(	A.I.S.	:	I	:	2	:	3	:	4	:	5	:	6)
(-----)
(	Cases	:	I98	:	I35	:	IO6	:	28	:	6	:	15)
(-----)
(	%	:	40,6	:	27,7	:	21,7	:	5,7	:	1,2	:	3,1)
(-----)

A.I.S. "6" was allocated to cases of decease within 24 hours. The A.I.S. average is 2,1.

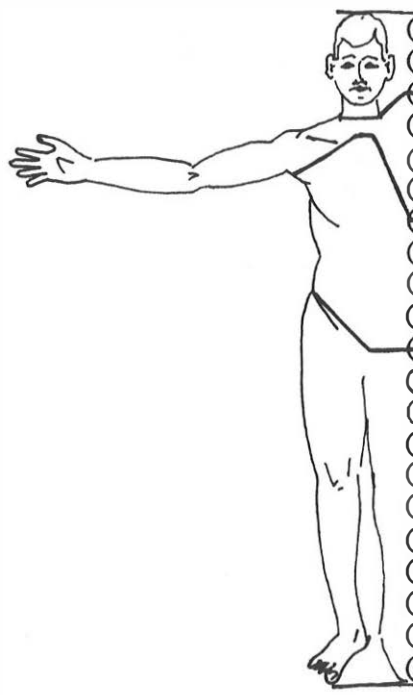
These figures point to a relatively low fatality rate, lower than for 4-wheel vehicles, due undoubtedly to the much lower speed since, out of the vehicles under consideration, we have only 23% over 125 cc.

This distribution can be tabulated more clearly by differentiating between 4 body segments :

- Skull, face, neck, cephalic extremity
- Shoulders and upper limbs
- Chest, dorsal rachis, abdomen, lumbar rachis
- Pelvis and lower limbs,

and by dividing into 2 categories :

- Slight lesions : Contusions
Wounds
Concussion w/o loss of consciousness
Sprains
Simple rib fractures
- Serious lesions : Fractures
Dislocations
Concussion w/loss of consciousness, or coma
Intra-thoracic lesions
Visceral lesions



Slight lesions	: 357 (24,9%)	512)
Serious lesions	: 155 (10,8%)	35,7%)
Slight lesions	: 257 (17,9%)	351)
Serious lesions	: 94 (6,5%)	24,4%)
Slight lesions	: 59 (4,1%)	69)
Serious lesions	: 10 (0,7%)	4,8%)
Slight lesions	: 401 (27,9%)	504)
Serious lesions	: 103 (7,2%)	35,1%)

This table shows that the gravity of the lesions goes in decreasing order from the skull and the face towards the lower limbs, in which the rate of the lesions rises again.

It is also interesting to study the obstacles involved in the collision, in the following table :

(:)
(	OBSTACLES	: NUMBER OF ACCIDENTS
(-----	-----
(	"On one's own"	150
(
(	Hit by car	123
(	Hit car	95
(
(	Hit by truck	8
(	Hit truck	12
(
(	Hit by two-wheel	
(	vehicle	2
(	Hit two-wheel vehicle ..	16
(
(	Hit Pedestrian	10
(
(	Hit fixed object	6
(
(:)

This table shows the importance of 2-wheel/4-wheel collisions, confirming the advisability of separating the circulation of these two types of vehicle.

Note finally in these general remarks that there were 13% pillion passengers in the total two-wheel vehicles under study.

It is interesting now to retrace a table of lesions based on whether a helmet was worn or not, placing it in relation to table I and regrouping the number of presumed lesions met in 100 cases. In this table II, we do not mention bicycles since helmets are not worn.

	:	:	:	:	:	:	:	:
Number of lesions supposed	:	< 50 cc	:	> 50 cc	:	> 125 cc	:	> 350 cc
to be found in 100 cases	:		:	< 125 cc	:	< 350 cc	:	
	:	:	:	:	:	:	:	:
(without helmet	:	w/o	:	with	:	w/o	:	with
and with helmet)	:	100:	:	100	:	100	:	100
	:	:	:	:	:	:	:	:
SKULL:Contusions,wounds,TC-PC	:	37	:	30	:	18	:	39
TC+PC,coma,fractures.....	:	32	:	18	:	36	:	8
FACE:Contusions,wounds.....	:	49	:	38	:	54	:	12
Fractures.....	:	4	:	-	:	18	:	2
NECK:Contusions,wounds.....	:	2	:	3	:	-	:	3
Cervical sprains.....	:	1	:	-	:	-	:	14
Fract.,disloc. of C Rachis	:	-	:	-	:	-	:	14
SHOULDER: Contusions,wounds....	:	12	:	8	:	9	:	7
Fractures, dislocations...	:	9	:	8	:	-	:	3
UPPER LIMB:Contusions, wounds..	:	42	:	33	:	64	:	49
Dislocated elbow.....	:	-	:	-	:	-	:	-
Fractured arm.....	:	2	:	5	:	-	:	-
Fractured forearm.....	:	5	:	-	:	9	:	5
Fractured hand.....	:	3	:	5	:	18	:	7
CHEST:Superf. wounds,contusions	:	9	:	5	:	-	:	7
Simple fracture of ribs...	:	1	:	3	:	-	:	-
Flail chest.....	:	-	:	-	:	-	:	2
Fractured sternum.....	:	-	:	-	:	-	:	-
Intra-thoracic lesions.....	:	-	:	-	:	-	:	3
DORSAL RACHIS:Trauma.....	:	1	:	-	:	-	:	-
Fractures.....	:	1	:	-	:	-	:	2
ABDOMEN:Contusions, wounds.....	:	2	:	3	:	-	:	2
Visceral lesions.....	:	-	:	-	:	-	:	2
LUMBAR RACHIS:Trauma.....	:	1	:	-	:	-	:	-
Fractures.....	:	-	:	-	:	-	:	2
PELVIS:Contusions, wounds.....	:	9	:	8	:	27	:	17
Fractures.....	:	-	:	-	:	9	:	-
Dislocated hips.....	:	1	:	-	:	9	:	3
LOWER LIMBS:Contusions, wounds.	:	68	:	73	:	73	:	78
Dislocated knee.....	:	1	:	-	:	-	:	-
Fractured thigh.....	:	5	:	5	:	-	:	3
Fractured leg.....	:	5	:	5	:	9	:	8
Fractured knee-cap.....	:	3	:	-	:	-	:	2
Fractured foot.....	:	3	:	5	:	9	:	3
Sprains.....	:	3	:	3	:	-	:	5
	:	:	:	:	:	:	:	:
TOTALS	:	311	:	258	:	362	:	272
	:	:	:	:	:	:	:	:
	:	:	:	:	:	:	:	:
	:	:	:	:	:	:	:	:

TABLE N° II

COMPARATIVE STUDY OF LESIONS OF CEPHALIC EXTREMITIES IN CASES

IN WHICH HELMET IS WORN OR NOT

We note that the frequency in the wearing of a helmet is 40%. The distribution in the various categories is as follows :

- Bicycles : 0%
- Mo-peds : 15%
- Motorcycles → 125cc : 83%
- Motorcycles 125cc - 350cc : 86%
- Motorcycles > 350cc : 84%

We made a study of all these cases, separating those wearing helmets from those who did not :

- Cases in which there was no lesion of the cephalic segment,
- Cases in which there were lesions of this segment, differentiating between serious lesions and slight lesions.
- Their distribution according to the Abbreviated Injury Scale (A.I.S.) and the A.I.S. average for the two categories.

The results are grouped in the following tables, in which, to obtain an easier comparison, we have confined our results to 100 cases.

Comparison of the lesions of the cephalic segment

(:	:)
(	:	No helmet	: Helmet
(:	-----	
(	:	37 cases	: 49 cases
(:	-----	
(	:	63 cases	: 51 cases
(:	-----	
(	:	122 lesions	: 80 lesions
(	:	83 slight	: 59 slight
(	:	39 serious	: 21 serious
(:	-----	
(:	-----	

Comparison of the overall Abbreviated Injury Scale for those wearing helmets and those not wearing helmets : Distribution and A.I.S. average

(:	:	:	:	:	:	:	:)							
(	A.I.S.	:	1	:	2	:	3	:	4	:	5	:	6	:	A.I.S. average)
(-----	:	-----	:	-----	:	-----	:	-----	:	-----	:	-----	:	-----)
(:	:	:	:	:	:	:	:	:	:	:	:	:	:	:)
(	Helmet	:	46	:	28	:	18	:	5	:	1	:	2	:	1,9)
(-----	:	-----	:	-----	:	-----	:	-----	:	-----	:	-----	:	-----)
(:	:	:	:	:	:	:	:	:	:	:	:	:	:	:)
(	No helmet	:	36	:	28	:	24	:	6	:	2	:	4	:	2,2)

We note that those wearing helmets reveal an A.I.S. average slightly lower than those without helmets. Also, the wearing of the helmet enables 49 cases out of 100 to have no lesions to the head, while 37 only of those without a helmet have no lesions.

It is noteworthy also that, if the wearing of a helmet permits a decrease of approximately 35 % in cephalic lesions, its effect is even more beneficial in the case of serious lesions, for a reduction of 30 % of the slight lesions and 45 % of the serious lesions is observed.

Among those wearing helmets, the fact that we found 105 wearing a classical helmet and 95 wearing an integral helmet permits an interesting comparison of the lesions recorded. We note that the wearing of an integral helmet is practically null for operators of mopeds, and that the percentage is identical for the wearing of classical helmets as far as the other categories are concerned. A comparison of the A.I.S. averages of the two categories shows that the value is identical for the two samplings (1,86). As for the lesions of the cephalic segment, they are grouped in the table below and, to enable a clearer comparison, have been reduced to 100 cases in each category.

(:	:)				
(	:	Classical helmet	:	Integral helmet)		
(:	-----			:	-----)
(	Cases without	:	31 cases	:	69 cases)	
(	cephalic lesions	:	:	:	:)	
(:	:	:	:	:)	
(:	:	:	:	:)	
(	Cases with cephalic	:	69 cases	:	31 cases)	
(	lesions	:	:	:	:)	
(:	:	:	:	:)	
(:	:	:	:	:)	
(:	:	:	:	:)	
(	Number of lesions in	:	84 lesions including	:	75 lesions including)	
(	the cephalic extremity	:	63 slight and	:	54 slight and)	
(	:	:	21 serious	:	21 serious)	
(:	:	:	:	:)	

So we notice that the integral helmet gives better protection as far as the frequency of lesions is concerned, but when the lesions occur they are relatively more serious, no doubt due to the disintegration of the helmet under a certain intensity of impact, thus reducing the protection and even adding further lesions from fragments of the broken helmet. Apparently then helmets known as "integral" do not possess, at least those used in France, ideal technical qualities.

COMPARATIVE STUDY OF LESIONS ACCORDING TO CATEGORY OF VEHICLES

We are going to make a comparison for the various categories; first of all those not wearing helmets, since in the "Bicycle" and "Moped" categories there are no helmets. The comparisons reveal a variation of the A.I.S. values. An interpretation is relatively difficult, due to the great variation of samples, since the maximum number of cases is found in the mopeds without helmets. The index is lower than for bicycles, but on the contrary the index goes up for 50 cc - 125 cc and especially over 350 cc, which is logical considering the greater speed of the two-wheel machines under study. If one now includes by category the casualties wearing helmets whose average index is much lower, one realizes that the A.I.S. values for mopeds goes from 2,17 to 1,8, which shows that a considerable improvement could be made if all two-wheel operators wore a helmet.

The comparisons of lesions by parts of the body reveal an almost total absence of injuries to the chest, the abdomen and the rachis among cyclists, and only a small number among moped operators. The frequency of lesions in the other parts of the body vary only slightly, whatever the category under study; which shows effectively that the parts exposed are practically the same, and that it is not the phenomena of deceleration which occur as in 4-wheel vehicle accidents, but direct impacts and obstacles encountered which are obviously the same whatever the type of vehicle.

CONCLUSION

This study would require further, more detailed research to consider the influence of other factors such as the scene of the accidents (open road or in town). However, it shows the great importance that must be given to 2-wheel vehicle casualties who represent a very high proportion of the lesions recorded in national statistics, which obviously do not concern themselves, except for the fastest machines, with the safety measures in force at present, particularly enabling the protection of the lower limbs.

Improvements in the manufacture of helmets are desirable, and are clearly significant in the statistics we have collated; it also points to the interest whenever possible of separating 4-wheel and 2-wheel traffic circulation.