

INJURY INVESTIGATIONS IN ROAD ACCIDENTS :

TYOLOGY, FACTORS AND MECHANISMS

AND MINOR LESIONS CHARACTERISTICS (AIS  $\leq$  3)

by

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The severity index, used for injuries allows a direct estimation of the vital risk, but cannot be used to specify what role the "minor lesions" play, in worsening and invalidating.

An homogeneous sample must be studied, in order to clarify the epidemiology and the consequences of such injuries.

In this perspective, we used the bi-disciplinary dossier of O.N.S.E.R. - Hôpital de SALON, established during the last year (1980), and concerning the four-wheel crashes :

- two hundred and two vehicles (202), in one hundred and fifty six (156) crashes,
- three hundred and seventy two (372) occupants, with one hundred and eight (108) unhurt, two hundred and forty-seven (247) injured, fifteen (15) dead.

On the first board (board I ), the OAIS distribution can be seen.

But if we leave aside the unhurt occupants, there are two hundred and sixty two (262) injured with a percentage of eighty six per cent (86 %) victims whose the index is equal to, or lower than three, and fourteen per cent (14 %) higher than three.

In this last percentage, there is a six per cent (6 %) death rate.

## EPIDEMIOLOGY

Many statistical approaches are in the study of these two hundred and sixty two (262) injured ; and we are going to examine successively :

1°) The distribution of the injuries, according to the AIS index (between the two groups : lower than or equal to three, higher than three).

As every injured person may be a several injured one, we obtain a medium index of injuries, first globally, then for each group. As eight hundred and seventy one (871) injuries have been found on two hundred and sixty two (262) injured, the medium index is three injuries for one injured (globally) ; but for each group this index is :

- two and eighty seven (2,87) when the OAIS  $\leq 3$ ,
- and five and eighty eight (5,88) when the OAIS  $> 3$ .

This demonstrates, when the index is higher than three, that seriously injured persons present minor injuries the influence of which must be clarified, not only on degree of AIS, but also on post-traumatic results and handicap,

2°) The inventory of injuries (Board 2)

a) According to their own index of seriousness :

- eighty nine per cent (89 %) equal to or lower than three,
- eleven per cent (11 %) higher than three.

b) Within the context of their lesionnal association, and global OAIS index :

- eighty four per cent (84 %) injuries whose index is lower than, or equal to three are found on injured whose the OAIS index is lower than, or equal to three.

- sixteen per cent (16 %) on injured whose OAIS is higher than three.

This demonstrates the significance, in the four wheel crashes, of the AIS index being lower than three. This type of injuries is composing the majority of the injuries.

c) Their distribution according to the corporeal segments : (board 3)

This board shows that "soft injuries" are more than eighty per cent (80 %) of injuries on each corporeal segment, excluding the thoracic viscera, where they are only thirty per cent (30 %), and the abdominal ones where percentage is only seventy per cent (70 %).

d) Analysis according to the type of injury :

The boards ( 4 - 5 - 6 and 7 ) show the type of injuries which will get over the index three, and then will be responsible for the OAIS index higher than three.

The most frequent injuries are contusions and traumatism without any wound or fracture. Exceptionnally, their seriousness index is higher than three, only occuring when cranial traumatism (at once, it is difficult to grade the neurologic injuries of the cerebral trunk).

The index rate of the wounds, superficial or deep, will be different according to their place : those whose index is higher than three mainly concern the thoraco-abdominal viscera (ten per cent, 10%).

Regarding fractures, the index becomes higher than three when there is an opening ; eighty per cent (80 %) of close fractures have an AIS lower than three, but only thirty per cent (30 %) of the open fractures are in this category.

At last, it is interesting to post the types of injuries according to the corporeal segment. When injured have an OAIS index lower than or equal to three, we have noticed no injury the index of which was higher than three. When injured have an OAIS higher than three, we can see in each type of injury the index of everyone (boards 4 - 5 ).

So, we can remove the injuries the index of which is higher than three : the boards 6 and 7 show their distribution, as well as the variety of soft injuries, which are the upper limb, ribs and sternum, and lower limb.

These segments are the most vulnerable ones, and those which give, with cranial traumatism, aesthetic and functional consequences which are ineversible. On the contrary, the thoraco-abdominal injuries with a high index of seriousness, if initially dangerous, leave few invalidating consequences.

The cranial traumatism must be ruled out from this segmental distribution, because the initial type of injury and their progressiveness are difficult to fix (except when very serious).

Dividing the index of seriousness around three is simple, but it does not seem to be a true reflection concerning the influence of the soft injuries on the progressive seriousness of an injured.

Of course, the AIS indexes are interesting for scoring and prognosticating the seriousness ; but it is a very quickly made one, after the accident. And we noticed that these minor-called injuries, when OAIS is lower than three, do not

give strictly the same index two or three days later. So the rule of agreement between AIS and OAIS does not seem to be everytime true.

Moreover, when the index is higher than three, there are generally two or three soft injuries more, which make the index worsened by supplementary bleeding and stress.

e) The role of the OAIS on the Temporary Industrial Disablement (T.I.D) and the hospitalization time (H.T) :

The boards 8 and 9 show that there is an evolution of the T.I.D. and the H.T, in direct relation to the OAIS increase.

But for the injured occupants with OAIS >3, generally, the injuries with gravity AIS <= 3 (limb fractures,..) extend the most frequently the T.I.D and the H.T.

f) The role of the injuring parts in establishing the index of seriousness :

The study of the bi-disciplinary dossier and of the crashed vehicle (by the engineer of O.N.S.E.R.) allows the technical reconstruction of the crash, and to determine the injuring parts.

The board IO is attempting to classify, and we can see that the AIS index higher than three are mainly caused by ejection and lateral structures. The safety plannings being ineffectual in these cases.

That encourages to propose :

- a better planning of the doors,
- the safety belt wearing,
- and the strengthening of the lateral frame,

CONCLUSION

This study allows to become aware of the importance of soft injuries, not only on invalidating but also as worsening the injuries of a lower index.

A P P E N D I X

Remark : On this study, we call :

OAIS : the index of global gravity of one occupant

AIS : the index of gravity of each injury.

BOARD n° I

OAIS DISTRIBUTION

OAIS	0	1	2	3	4	5	6	?	TOTAL
Number	108	102	102	23	13	7	15	2	372
%	29,0	27,4	27,4	6,2	3,5	1,8	4	0,7	100

BOARD 2 INVENTORY OF INJURIES ACCORDING THEIR  
OWN INDEX OF SERIOUSNESS (AIS) AND  
THE GLOBAL SEVERITY OF INJURED OCCUPANT (OAIS)

	OAIS $\leq$ 3	OAIS $>$ 3	TOTAL
AIS $\leq$ 3	652	126	778
AIS $>$ 3	-	93	93
TOTAL	652	219	871

INJURIES DISTRIBUTION ACCORDING TO  
THE INJURED CORPOREAL SEGMENT

	Injuries with AIS $\leq$ 3		Injuries with AIS $>$ 3		TOTAL
SKULL	Brain Traumat.	127 (88,8 %)	16 (11,2 %)		143
	Skull Contusi.	39 (82,9 %)	8 (17,1 %)		47
FACE		167 (96 %)	7 (4 %)		174
CERVICAL SPINE		49 (87,5 %)	7 (12,5 %)		56
UPPER EXTREMITIES		113 (95,8 %)	5 (4,2 %)		118
CHEST : Bones		94 (89,5 %)	11 (10,5 %)		105
CHEST : Internal		3 (30 %)	7 (70 %)		10
ABDOMEN		28 (70 %)	12 (30 %)		40
PELVIS		40 (87 %)	6 (13 %)		46
LOWER EXTREMITIES		118 (89,4 %)	14 (10,6 %)		132
TOTAL		778 (89,3 %)	93 (10,7 %)		871

BOARD n° 4      DISTRIBUTION OF THE INJURIES TO  
INJURED OCCUPANTS WITH OAIS ≤ 3 (227 cases)

	Contusi. Traumat.	Wounds	Ligament Injuries	Closed Fractures	Open Fractures	TOTAL
SKULL *	121	23		1	1	146
FACE	55	73		8	3	139
CERVICAL SPINE	36		5	1		42
UPPER EXTREMITIES	54	25	3	15	1	98
CHEST : Bones	54	4		19	5	82
CHEST : Internal		1				1
ABDOMEN	20	1				21
PELVIS	15		2	12		29
LOWER EXTREMITIES	57	20	4	10	3	94
TOTAL	412	147	14	66	13	652

\* Remark : Brain traumatism without consciousness = 74  
Brain traumatism with consciousness = 40



DISTRIBUTION OF THE INJURIES TO  
INJURED OCCUPANTS WITH OAIS > 3 (35 cases)

	Contusi. Traumat.	Wounds	Ligament Injuries	Closed Fractures	Open Fractures	TOTAL
SKULL *	30	I		7	6	44
FACE	6	I9		6	4	35
CERVICAL SPINE	I	4		9		I4
UPPER EXTREMITIES	I	5		I2	2	20
CHEST : Bones	7	2		6	8	23
CHEST : Internal	2	7				9
ABDOMEN	7	I2				I9
PELVIS	I	I	2	I2	I	I7
LOWER EXTREMITIES	7	7	4	II	9	38
TOTAL	62	58	6	63	30	2I9

\* Remark : Brain traumatism without consciousness = 7  
Brain traumatism with consciousness = 22

DISTRIBUTION OF THE INJURIES WITH GRAVITY  $\leq$  AIS 3 (BOARD n° 6)

	Contusi. Traumat.	Wounds	Ligament Injuries	Closed Fractures	Open Fractures	TOTAL
SKULL *	135	24		6	1	166
FACE	61	91		12	3	167
CERVICAL SPINE	37	4	5	3		49
UPPER EXTREMITIES	55	30	3	24	1	113
CHEST : Bones	61	6		22	5	94
CHEST : Internal	2	1				3
ABDOMEN	27	1				28
PELVIS	16	1	4	19		40
LOWER EXTREMITIES	64	27	8	16	3	118
TOTAL	458	185	20	102	13	778

\* Remark : Brain traumatism without consciousness = 81  
 Brain traumatism with consciousness : 46

DISTRIBUTION OF INJURIES WITH GRAVITY > AIS 3 (BOARD n° 7)

	Contusi. Traumat.	Wounds	Ligament Injuries	Closed Fractures	Open Fractures	TOTAL
SKULL *	I6			2	6	24
FACE		I		2	4	7
CERVICAL SPINE				7		7
UPPER EXTREMITIES				3	2	5
CHEST : Bones				3	8	II
CHEST : Internal		7				7
ABDOMEN		I2				I2
PELVIS				5	I	6
LOWER EXTREMITIES				5	9	I4
TOTAL	I6	20		27	30	93

\* Remark : Brain traumatism without consciousness = 0  
 Brain traumatism with consciousness = I6

BOARD n° 8

NUMBER OF DAYS OF

TEMPORARY INDUSTRIAL DISABLEMENT (T.I.D) ACCORDING TO THE OAIS

OAIS	1	2	3	4	5
Injured Occupants	102	100	23	12	3
Days of T.I.D.	431	2727	1575	1470	480
T.I.D. Average	4,2	27,3	68,5	122,5	160

Remark : T.I.D. Average =  $\frac{\text{Days of T.I.D.}}{\text{Number of injured occupants}}$

BOARD n° 9 NUMBER OF DAYS OF HOSPITALISATION (D.H)

ACCORDING TO THE AIS

OAIS	1	2	3	4	5
Injured Occupants	102	100	23	12	3
D.H.	77	624	410	958	180
D.H. Average	0,75	6,2	19	41,6	60

Remark : D.H. Average =  $\frac{\text{D.H.}}{\text{Number of injured occupants}}$

INJURING PARTS ACCORDING  
TO THE INDEX OF SERIOUSNESS

	Injuries with Gravity $\leq$ AIS 3	Injuries with Gravity $>$ AIS 3
SKULL	Windshield - Lateral structures - Other occupant - Front seat - Dash board	Ejection Lateral structures
FACE	Steering wheel - Windshield - Dash board - Lateral structures - Front seat	Ejection Lateral structures
CERVICAL SPINE	Back of front seat - Strap - Other occupant	Ejection
UPPER EXTREMITIES	Dash board - Lateral structures	Lateral structures
CHEST : Bones	Strap - Lateral structures - Dash board - Front seat	Ejection - Lateral structures
CHEST : Internal	Lateral structures	Ejection - Dash board
ABDOMEN	Strap - Back of front seat	?
PELVIS	Lateral structures	Lateral structures
LOWER EXTREMITIES	Lower part of dash board Steering column - Lateral structures - Front seat	Lower part of dash board - intrusions - Lateral structures