THE CLINICAL PATTERN OF INJURY IN ROAD ACCIDENTS

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The Royal Hampshire County Hospital, Winchester, is the main hospital for acute cases in a rural area through which run many main roads, including some leading to the South Coast and the South-west. For this reason it is felt that if the road-accident figures for such a hospital were capable of analysis, both clinical and statistical, certain factors of interest in assessing the clinical pattern of injury in road accidents might emerge as a result of the findings. With this in mind, all the road-accident cases, no matter how trivial their injuries, attending in the two-year period ending December 31, 1952, have been investigated, comprising all those attending the hospital in its capacity as the parent hospital of the management committee group, and those which could not be dealt with in the cottage type of hospital.

It is not claimed that the findings resulting from a scrutiny of the 717 cases concerned present in any way a picture of a national trend, or even an accurate cross-section of road-accident casualties treated in the hospitals of this country. The investigation is merely a fact-finding one on a fairly large number of such cases attending a particular hospital, and can in no way be related to general mortality figures through road accidents, as the deaths recorded are only of those who died after admission to hospital.

The cases taken are subdivided into five broad groups: motor-cyclists, motorists, cyclists, pedestrians, and miscellaneous (lorries, omnibuses, etc.). In Tables II and III the miscellaneous group is split into its component parts for the sake of clarity.

The grading of injuries presented a very difficult problem, as many of the patients suffered from multiple injuries, and in order to build a complete picture all these have been included, no matter how slight. A general classification, based on broad functional end-results, has been adopted, as follows:

0 = Minor injuries in which full recovery took less than three months and left no disability.

+ = Cases in which recovery took longer than three months and/or left the patient with some permanent disability or disfigurement, but not enough to interfere with normal wage-earning.

++ = Cases in which enough permanent disability resulted to interfere seriously with the patient's livelihood.

+++ = Complete disability.

The last three together are referred to as "severe" injuries. Finally, as in Tables I and IV, the deaths are shown separately with the injuries sustained.

One great difficulty lies in considering individual lesions, because a person may be completely crippled through having multiple injuries, yet each taken separately might be classified + only. For this reason, in Table I the numbers shown refer to persons, whereas in Tables III and IV figures are expressed as injuries rather than persons.

Deaths (Tables I and IV)

It is worth while to consider the 27 deaths in the series together. The largest number occurred among the motor-cyclists—13 (50% of the whole series or 5% of all motor-cycle cases). The largest proportion in any group, however, occurred among the pedestrians—9 deaths (10% of

TABLE I.—*General Table of Severity of Injury*

	Total	Degree of Severity								Cause of Death
		0		+		++		+++	Deaths	
	No.	No.	%	No.	%	No.	%	No. %	No. %	
Motor-cyclists	268	197	74	29	11	17	6	12 4	13 5	Head injuries, 11; ruptured liver, 1; torn pericardium, 1
Motorists	180	155	86	11	6	11	6	1 1	2 1	Fractured thyroid cartilage, 1; ruptured spleen, 1
Cyclists	120	105	87	11	9	1	1	1 1	2 2	Head injuries, 2
Pedestrians	91	64	70	10	11	6	7	2 2	9 10	Head injuries, 5; haemothorax, etc., 1; shock (multiple injuries), 1; pulmonary embolism, 1; haematemesis, 1
Miscellaneous	58	50	86	5	8	1	2	1 2	1 2	Head injuries, 1
Totals	717	571	80	66	9	36	5	17 2	27 4	Head injuries, 19 (70%); thoraco-abdominal injuries, 4 (15%); others, 4 (15%)

TABLE II.—*Type of Vehicle and Manner in which Patient was Involved, by Age and Sex*

	Males										Females										Total
	0–14		15–24		25–44		45–64		65+		0–14		15–24		25–44		45–64		65+		
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	
Motor-cycles:																					
Drivers	—		107	50	87	40	18	8	1	1	—		—		3	1	—		—		216
Passengers	1	2	11	21	6	12	1	2	—		1	2	15	28	11	21	6	12	—		52
Cars:																					
Drivers	—		6	9	24	37	20	30	5	8	—		1	2	6	9	3	5	—		65
Passengers	14	12	8	7	10	9	7	6	3	3	13	11	5	4	19	17	24	21	12	10	115
Cyclists	14	12	38	32	21	17	17	14	4	3	7	6	8	7	5	4	5	4	1	1	120
Pedestrians	21	23	3	3	10	11	9	10	14	15	9	10	2	2	5	6	4	5	14	15	91
Lorries:																					
Drivers	—		1	14	3	43	3	43	—		—		—		—		—		—		7
Passengers	2	10	5	23	8	38	4	19	2	10	—		—		—		—		—		21
Buses:																					
Passengers only	1	7	—		3	20	4	26	—		1	7	—		4	26	2	14	—		15
Vans:																					
Drivers	—		—		1	100	—		—		—		—		—		—		—		1
Passengers	—		1	20	1	20	—		—		1	20	1	20	1	20	—		—		5
Miscellaneous	—		—		—		2	100	—		—		—		—		—		—		2
Doubtful	—		2	29	3	42	—		—		—		—		2	29	—		—		7
Total	53	7	182	26	177	25	85	12	29	4	32	4	32	4	56	8	44	6	27	4	717
					526 (73%)										191 (27%)						

the cases in that group). Most deaths were due to head injuries—19 (70% of all deaths). In the motor-cyclists no fewer than 11 of the 13 deaths (85%) were due to this cause, though, possibly owing to the increased use of crash-helmets, these figures may be a little higher than would be expected at the present time. Nevertheless, even if the motor-cyclists are discounted, head injuries still predominate among the remainder (8 out of 14, or 57%).

The next commonest cause of death was crushing injury. In this group there were 4 (15% of all deaths). In the remaining 4, 2 deaths (from a haematemesis and a pulmonary embolus) can be regarded to some extent as coincidental—both occurred in elderly pedestrians. If these are excluded the pedestrian mortality drops to 7.5% of the cases in that group. Even this figure, however, is significantly higher than in any other group under review.

Motor-cyclists

There were 268 motor-cyclists involved (38% of the total), made up of 216 drivers and 52 passengers. The drivers were almost exclusively male (99%), as is to be expected, whereas most of the passengers were female (63%).

TABLE III.—*All Injuries, by Site and Type of Victim**

	Total Cases	Total Injuries Sustained	Arm				Head and Neck	Trunk	Leg				Shock Only
			Right		Left				Right		Left		
			a/e	b/e	a/e	b/e			a/k	b/k	a/k	b/k	
			No. %	No. %	No. %	No. %	No. %	No. %	No. %	No. %	No. %	No. %	No. %
Motor-cycles:													
Drivers	216	368	24 7	33 9	15 4	28 7	115 31	21 6	35 10	42 11	30 8	24 7	1
Passengers ..	52	74	—	7 9	5 7	5 7	24 33	10 14	7 9	7 9	2 3	7 9	—
Cars:													
Drivers	65	111	6 5	6 5	6 5	11 10	41 37	10 9	14 13	2 2	12 11	3 3	—
Passengers ..	115	190	9 5	7 3	11 6	10 5	81 43	17 9	19 10	8 4	12 7	8 4	8 4
Cyclists	120	191	15 8	20 11	26 14	15 8	67 35	14 7	11 6	9 4	9 4	5 3	—
Pedestrians ..	91	155	4 3	8 5	11 7	9 6	49 32	15 10	21 13	9 6	19 12	10 6	—
Lorries:													
Drivers ..	7	12	—	2 17	1 8	1 8	5 42	—	1 8	2 17	—	—	—
Passengers ..	21	36	6 16	3 8	2 6	2 6	10 27	6 16	2 6	2 6	2 6	1 3	—
Buses:													
Passengers only	15	20	—	3 15	1 5	—	8 40	1 5	3 15	2 10	1 5	1 5	—
Motor vans:													
Drivers ..	1	1	—	—	—	—	1 100	—	—	—	—	—	—
Passengers ..	5	9	1 11	1 11	2 22	—	1 11	—	2 22	1 11	1 11	—	—
Miscellaneous ..	2	6	—	1 17	—	1 17	1 17	1 17	2 33	—	—	—	—
Doubtful	7	10	1 10	1 10	1 10	—	4 40	1 10	—	—	2 20	—	—
Totals ..	717	1,183	66 5	92 8	81 7	82 7	407 34	96 8	117 10	84 7	90 8	59 5	9 1

TABLE IV.—*All Injuries, by Site and Severity**

	Degree of Severity	Total Cases	Total Injuries Sustained	Arm				Head and Neck	Trunk	Leg				Shock Only
				Right		Left				Right		Left		
				a/e	b/e	a/e	b/e			a/k	b/k	a/k	b/k	
†Motor-cyclists	0	197	352	21	28	18	31	118	29	30	30	25	21	1
	+	29	29	—	5	1	1	6	—	4	8	2	2	—
	++	17	20	—	2	—	—	3	—	—	6	2	7	—
	+++	12	22	3	3	1	1	1	—	6	4	2	1	—
	Deaths	13	19	—	2	—	—	11	2	2	1	1	—	—
	Total	268	442	24	40	20	33	139	31	42	49	32	31	1
†Motorists	0	155	275	14	13	17	21	116	24	26	9	19	8	8
	+	11	11	—	—	—	—	2	1	3	1	2	2	—
	++	11	11	1	—	—	—	3	—	3	—	3	1	—
	+++	1	2	—	—	—	—	—	1	1	—	—	—	—
	Deaths	2	2	—	—	—	—	1	1	—	—	—	—	—
	Total	180	301	15	13	17	21	122	27	33	10	24	11	8
Cyclists	0	105	175	14	20	24	15	60	12	8	9	8	5	—
	+	11	12	1	—	2	—	5	1	2	—	1	—	—
	++	1	1	—	—	—	—	—	—	1	—	—	—	—
	+++	1	1	—	—	—	—	—	1	—	—	—	—	—
	Deaths	2	2	—	—	—	—	2	—	—	—	—	—	—
	Total	120	191	15	20	26	15	67	14	11	9	9	5	—
Pedestrians	0	64	123	4	8	10	9	41	11	15	6	15	4	—
	+	10	11	—	—	1	—	1	—	2	1	3	3	—
	++	6	8	—	—	—	—	1	1	3	—	1	2	—
	+++	2	3	—	—	—	—	1	—	1	1	—	—	—
	Deaths	9	10	—	—	—	—	5	3	—	1	—	1	—
	Total	91	155	4	8	11	9	49	15	21	9	19	10	—
†Miscellaneous	0	50	86	8	10	6	4	28	9	8	5	6	2	—
	+	5	5	—	—	1	—	1	—	2	1	—	—	—
	++	1	1	—	—	—	—	—	—	—	—	—	—	—
	+++	1	1	—	1	—	—	—	—	—	—	—	—	—
	Deaths	1	1	—	—	—	—	1	—	—	—	—	—	—
	Total	58	94	8	11	7	4	30	9	10	7	6	2	—
All types	0	571	1,011	61	79	75	80	363	85	87	59	73	40	9
	+	66	68	1	5	5	1	15	2	13	11	8	7	—
	++	36	41	1	2	—	—	7	1	7	7	6	10	—
	+++	17	29	3	4	1	1	2	2	8	5	2	1	—
	Deaths	27	34	—	2	—	—	20	6	2	2	1	1	—
	Grand Total	717	1,183	66	92	81	82	407	96	117	84	90	59	9

* In Tables III and IV a/e and b/e=above and below the elbow respectively, and a/k and b/k above and below the knee.
† In this table passengers and drivers are not separated.

Of the passengers, 32 were known to have been brought in with their drivers, while the driver of one case was known to have been admitted to a Service hospital elsewhere. There were two accidents involving motor-cycle combinations in which more than two passengers were injured. Of the remaining 17, it is not recorded if they were brought in alone or with their drivers. In addition, it is known that the pillion passengers of two drivers were killed outright and are therefore not included.

Injuries

Motor-cyclists not only were the most numerous of the various groups under review, they also had the largest proportion of severe (non-fatal) injuries (22%). The mortality rate (5%) is misleading, as only patients admitted alive to the hospital are considered. When the mortality and morbidity of motor-cyclists and pedestrians are compared (5% of motor-cyclists and 10% of pedestrians died; 22% of motor-cyclists and 20% of pedestrians had injuries) it is important to note the differing age structures (Table II). Children are included among the pedestrians, whereas there is no one under the age of 16 among the motor-cyclists. The mean age for severe injuries was 28 for motor-cyclists and 44 for pedestrians, and for deaths 43 and 59 respectively. Motor-cyclists tend to be injured at an age when they are of most use to the community, as 118 (44%) cases occurred in the 15–24 age group.

As might be expected a large number of injuries to the head and neck were sustained in this group (Table III) although the great majority were not severe (Table IV shows 118 in the minor injury class). Possibly this is an argument in favour of the wearing of crash-helmets, as in many of the 118 cases such injury could probably have been avoided by the use of helmets.

As regards individual injuries, Table III shows that there is a slight but definite preponderance of injuries to the right side (155 right limbs to 116 left). Similarly, in the severe cases, there were 29 patients with right-sided injuries to 16 left, 3 having injuries to limbs on both sides. A suggested explanation is that where the rule of the road is the left the right side of the body is more likely to be injured by opposing traffic. This possibility is borne out by an interesting accident which occurred in August, 1951, when two motor-cyclists, each with a pillion-rider, travelling in opposite directions in traffic, apparently simultaneously decided to overtake their respective streams and collided. The four people involved all sustained serious injuries to their right sides.

The first motor-cycle had on it two 18-year-old soldiers. The driver sustained multiple injuries to his right upper limb, including a complete traumatic brachial plexus palsy, and, in the right lower limb, fractures of the femur, patella, and medial malleolus (the first two compound), a lacerated ankle, and vasospasm of the main vessels below the knee. The pillion-rider had injuries to the right leg consisting of fractures of both neck and shaft of the femur (the latter compound), tibia, and fibula, and a laceration opening the knee-joint. The second motor-cycle carried a brother and sister aged 27 and 24 years respectively. The driver had multiple injuries to his right arm, including a fractured scapula, humerus (at two levels with musculo-spiral nerve involvement), radius, and ulna, and extensive lacerations of the hand. In his right leg he had two fractures of the femoral shaft (the lower one compound) and an open wound of the knee-joint. The pillion-rider had a complete disorganization of her right knee, with compound fractures of both femoral condyles and a comminuted, simple fracture of the right tibia and fibula. Thus, in this accident, only the right side of each individual was involved, all four sustaining compound fractures of the femur and open wounds of the knee-joint, while the drivers, in addition, had very severe injuries to their right arms.

Attention is drawn to one specific injury in that in three cases there were *complete, irrecoverable brachial plexus injuries: (a)* the case already quoted above, *(b)* a boy of 16½ with a left brachial plexus palsy; and *(c)* a man who, in addition to very severe injuries to the right leg, sustained such a severe traction injury to the right axillary region that there was complete disruption of both nerve and vessels, and a high above-elbow amputation had to be carried out. This number is too small to be statistically significant, and during the two years under review no other cases of brachial plexus injury were seen at all.

Of the eight people who attended the hospital twice following road accidents, no fewer than six were motor-cyclists. This point emphasizes the greatly increased risk of accident to motor-cyclists compared with the other groups of road users. It is of interest to note that of the 216 drivers of motor-cycles 197 (91%) were aged 15–44 (which in itself can be narrowed by reason of the fact that no person may drive a motor-cycle at 15). This age period may be taken to include the most venturesome years—a fact which no doubt was a contributory cause.

Motorists

There were 182 motorists in this series—65 drivers, 115 passengers, and 2 whose status was not known. (In the tables these two have had to be included in the "doubtful" category.) Of these, 8 were detained 24 hours for observation, no specific injury being discovered. These have been classified as "shock" only. Among them were 5 children whose parents were among those admitted.

There were 55 male and 10 female drivers. It cannot be deduced from these figures that men are worse drivers than women, as the ratio of male drivers to female clearly cannot be ascertained. The ages of drivers were fairly evenly spread over all groups from 20 to 64, and no significance can be drawn from them.

There were 73 female and 42 male passengers. The only inference to be drawn from this is the obvious one that where husband and wife motor together the husband usually drives. There was nothing of significance to be obtained from the age grouping; the figures correspond roughly to a cross-section of the community as a whole.

What is brought out by these figures, however, is the ratio of passenger casualties to drivers. Further, as a large number of cars have only the driver and many others have only one passenger, the suggestion is that the passengers run a greater risk of injury than the drivers. This impression is supported by the fact that it is known that 33 of the passengers came in groups of two or more from 14 cars in which the driver was not injured. A further 41 single passengers were brought in without their drivers, so that only 41 are known to have been brought in with the driver of their vehicle also injured (29 drivers). There was no mention of passengers among the remaining 36 drivers, though, of course, some may have had passengers with them who escaped injury.

It is also of interest to note that of the 14 children under 5 brought in from motor-cars, two fell out of the car while it was moving, though neither was seriously hurt.

Injuries.—On the whole this series shows that injuries to motorists tend to be fairly light. There were two deaths, both of passengers. One, a woman of 50, who was a passenger in the rear seat of a car run into from behind, sustained crushing injuries to the abdomen and chest. The other was a man of 37 who sustained a fracture of his thyroid cartilage and suddenly collapsed and died in the casualty department while being examined. As in other groups, the majority had some kind of injury to the head and face (122 cases, 68%), but only five of these were classified as severe. Among individual injuries it was noticeable that of the 78 lower limbs involved 36 affected the knee (46%). This proportion was a little higher among the drivers (61% of lower limbs) than among the passengers (36%), presumably because the driver strikes his knee on the dashboard. Also of interest was that there were 4 posterior dislocations of the hip, all right-sided—three in passengers and 1 in a driver. These were the only cases of dislocated hip in the whole series. No explanation can be offered of why the right hip only was involved.

Cyclists

There were 120 cyclists (94 males, 26 females). As with motorists, no inference can be drawn from the high incidence of males, as the sex ratio of a normal cross-section of cyclists is not known. The age grouping shows a marked predominance of cases (52, or 44%) occurring between the years 10 and 24.

Injuries.—Injuries to cyclists were comparatively light; 11% of all cases were classified as severe, the lowest proportion of any group (Table I). There were two deaths, both from head injuries. One explanation of the lightness of the injuries suffered by this group may be that cyclists tend to fall off their bicycles rather than to crash into other fast-moving vehicles. Of individual injuries one feature was the greater proportion of upper limbs involved compared with lower limbs (70% of all injuries in this group) (Table IV). A possible explanation is that cyclists often come off their bicycles by going over their handlebars, and put out their hands to protect themselves, whereas motor-cyclists, moving so much faster, do not have time to do this.

Pedestrians

Of the 91 pedestrians 57 were males and 34 females. At first sight it would seem that male pedestrians are more careless than females; but the ratio of accidents between the sexes is reasonable in view of the fact that there are more men working outside the home than women; and from observance of the various means of transport it is possible to form the opinion that men are more at risk as pedestrians than women. It is, however, unsafe to do more than speculate on the evidence to hand in view of the comparatively few cases involved.

Most cases occurred at the two extremes of life. There was a heavy toll of children, no fewer than 20 of the 91 cases occurring in the five-year period comprising the ages of 3 and 7. There was a similar trend in the older age groups, 28 being 65 or over.

The greater incidence in the advanced age groups is even more obvious when the number of accidents is related to the very much reduced number surviving in those groups.

Injuries.—The relative severity of the injuries to pedestrians compared with the other groups is the outstanding feature—33% received severe or fatal injuries (Table I). This is a very high proportion when it is realized that every road-accident patient brought into the hospital during the period under review has been included, no matter how trivial the injuries. It was noticeable that there was a bigger proportion of lower-limb injuries than in any other group—32 upper to 59 lower limbs, or a ratio of 1 to 1.8. When the severe cases are considered this is more obvious still. Of the 18 cases 14 had severe lower-limb lesions only, and a further case classified +++ sustained, in addition to a very severe head injury, a central dislocation of the right hip. So 15 out of 18 (83%) severe pedestrian injuries involved the lower limbs, whereas there was only one serious upper-limb lesion.

Miscellaneous

The vehicles in this category are subdivided as lorries, 28 cases; omnibuses, 15; motor-vans, 6; wheel-chair, 1; farm trailer, 1; vehicle not known, 5. These numbers are all too small for detailed analysis, but one or two points of interest are worth noting.

Lorries.—Of the 28 cases in this series, no fewer than 21 (75%) were passengers, and 15 of these came in without the driver, 5 being in one lorry. Two more drivers came in with their passengers. As it must be more common for lorry drivers than car drivers to travel alone, it appears that lorry passengers are even more vulnerable than passengers in cars. Possibly, this is due to the increased vulnerability of people travelling in the body of an open lorry. There were 12 known instances of this practice in the series, and there may have been others.

Omnibuses.—All 15 cases were passengers. Of these, 9 came from the only bus crash in which the occupants were hurt. Five of the remaining 6 were adults who were injured while boarding or alighting. Points that arise therefore are: (*a*) Only one accident to a bus in the whole series caused casualties among those travelling in it, which suggests that buses are a very safe form of transport. This does not, of course, include other road users injured by buses. (*b*) Many injuries in buses occur when boarding or alighting from a moving vehicle.

Motor-vans.—Of the 6 cases involved only one was a driver; this again emphasizes the increased risk to the passenger.

Summary

Of the 717 road-accident injuries attended at one hospital over a two-year period the principal findings were: motor-cyclists comprised the largest number of cases and, with pedestrians, the greatest number of severe injuries and deaths; by far the largest single cause of death was head injury; in motor-cyclists the right side was injured more often than the left; in motorists knee injuries were common and passengers appeared to be more vulnerable than drivers; cyclists tended to sustain injury to their upper limbs more than did other groups; pedestrians tended to have leg injuries; most pedestrian cases occurred at the two extremes of life; in all groups males predominated over females.

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DASHBOARD FRACTURE OF PATELLA

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The purpose of this article is to draw attention to the potentially disabling injury of the knee-joint commonly sustained by the driver or front-seat passenger of a motor-car involved in a collision. The outstanding feature of the injury, which is produced by impact of the knee with the dashboard, is a fracture of the patella. It will be shown, however, that this particular fracture of the patella differs in mechanism, pathogenesis, and prognosis from that produced by lesser forms of direct or indirect violence. Furthermore, and in so far as it is related to automobile design and equipment, this injury is preventable.

Mechanism of Injury

The form of the fracture is determined by the height of the dashboard and the length of the limb: a central transverse or a comminuted fracture involving the entire bone occurs if the patella is driven against the flat face of the board; a comminuted fracture of the inferior pole in the direction from above downwards and backwards if the lower pole strikes the free edge; and a comminuted fracture of the superior pole in the direction from below upwards and backwards if the knee is driven under the free edge.