FACIAL-, HEAD- and NECK INJURIES ORGINATING FROM ROAD-TRAFFIC ACCIDENTS

A comparison between car drivers and front seat passengers using seat belts and those not using seat belts by

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The number of injuries to the head and face has increased during the last twenty years due to the effects of increasing number of road-traffic accidents. Injuries from road-traffic accidents is one of the most important causes of death in young individuals and is the all dominating back-ground to invalidizing injuries in the same age-group. Due to the fact that road-traffic injuries will to a large extent hit individuals in productive ages the economical consequences to individuals and society are considerable.

Field studies from road-traffic accidents demonstrate according to Heulke and Sherman, 1975, that 20 to 60% of all persons involved in automobile collisions sustain injuries to the face. The face is highly vulnerable to crash forces and no other body region, except the cranium and its contents ranks as high in frequency of injury. In another study by Murray, 1975, injuries to the face were demonstrated in 70% of injuried persons. Tolhagen, 1977, described damage to the head and face in 70% of the injuried persons in his study. The majority of all facial injuries described in various publications are at the lower end of the injury severity spectrum. Damage to the face as such is seldom life threatening, unless it causes breathing difficulties or is combined with heavy bleading. Remaining facial deformities, facial paralysis, scarring, dental malocclusion and possible vision defects can, however, cause life-lasting physical and physiological suffering. A correct handling of the patient, early diagnosis and treatment of qualified specialists will decrease these risks. However, even under best circumstances severe damage of the face will cause remaining defects in many of the patients.

Significant reduction of maxillo-facial injuries can be obtained by prevention. It is pointed out by Huelke and Sherman, 1975, that the two most important preventive measures is to prevent the automotile occupant from striking the interial components of the car and eliminating the hazards of ejection. The use of available lap-and shoulder belts prevents, not only fatalities but also significantly reduces the number of injuries particularly those of the face. Huelke and Sherman complains that available restrain systems have received little attention by the medical profession in terms of preventive medicine.

In Sweden interests for the preventive action of seat belts has been considerable. Thus, the construction and preventive effects of various types of restain systems have been discussed in a number of publications from this country (Lindgren and Warg, 1962; Bäckström, 1963; Aldman, 1962; Voigt, 1969).

Important publications concerning these problems have been published among others, also by Schneider et al., 1968; Hudson-Walker, 1970; Grattan, 1972; Murray and Hall, 1975; Schultz, 1967, 1975; Christian, 1976 and others.

The 1st of January, 1975, a law was passed in Sweden making the wearing of a three-poing seat belt in the front seat compulsory in all cars, besides trucks and busses. The positive effect of the introduction of this law was demonstrated by Andersson et al., 1976, 1979 and by Andreasson and Roos, 1977. In the present study we have analyzed the difference with regard to damage to the face, neck and head between drivers and passengers wearing the seat belt and not wearing seat belt. In this study we have used the material collected in the Saab/Scania Factories since 1971. The collection of material has been continuous and been devided into 12 months periods. The same criteria for selection of material have been kept all the time in order to make statistical comparison between the various periods possible. Thus the collection of material has been limited to deal with severe car damages and to the last three years models of the car Saab 99. The severity of the car damage was calculated on the bases of repair costs and were limited to cost higher than 6.500 SKR, equivalent to around 2.500 dollars at the end of 1975. There has also been a geographical limitation. Only one case was included from the area of a country located north of a line drawn through the two cities Gävle and Falun. The area south of this line contains about 85% of the population of the country.

The present material contains accidents from 4 years material collected from 1971 to 1975 and includes 697 traffic accidents. 377 drivers had seat belts and 318 were without the seat belt. 168 front seat passengers were wearing the seat belt and 115 were without the seat belt. The analysis includes only surviving drivers and passengers.

RESULTS

Frequency of injuries in drivers and passengers with and without seat belt

The frequency of facial injuries is twice as high in drivers without belts as those with belts. More than twice as high in passengers not carrying the belt as those with belt (table I and II).

Of other injuries combined with injuries to the face the difference between belted and not belted drivers and passengers was most striking with regard to head injuries, which were three times as common in drivers without belt as those with belts. Among 168 belted passengers there was only one case with head injury, whereas there were 11 cases not wearing the belts. Even damages to the chest, abdomen, back and extremities showed much higher frequency among the non-belted drivers and passengers. This was true also for brain damage (table III, IV, V, VI).

The distribution of various types of face injuries shows striking difference between belted and non-belted drivers and passengers with regards especially to severa soft tissue injury. This indicates that several of those not wearing seat belts had damages from glass-cuts due to damaged wiht-shields. The number of face injuries including fractures and some advanced soft tissue damages is comparatively high, however, even among the belted drivers and passengers, showing that the general out-come of face and brain injuries was fare less advanced in the belted, than in the non-belted (table VII, VIII).

Pain in the neck was a comparatively common symptom in belted drivers and 3 vertabral fractures were found in the neck of belted drivers. The number of incidences with back pain was larger in the belted than in the non-belted. The figures was higher among the drivers than among the passengers (table IX-X). The AIS-index is strikingly lower for the 16 belted drivers with skull-injury among which only 5 out of 16 had index 2, compared to the non-belted drivers. Among 35 non-belted drivers with skull-injury the AIS-index was as high as 3 in three people and 2 in 13 (table XI).

In drivers with damage to the face the AIS-index was higher than in the non-belted but the number of damages was low (table XI-XII). Table XIII demonstrates that as many as 20 drivers had some sort of symptoms from the neck and one had AIS-index of 2, 3 and 4 respectively. Only 12 non-belted drivers had neck pain and only one had index 3.

The AIS-index does not show any difference between the front seat passengers with regards to face and neck damage if they were belted or not.

Relation between the direction of impact and frequency of injuries (fig. 1-5)

Figure 1 demonstrates that the head-on crash is a dominating reason for facial injuries for belted drivers. Even the impact from the left side of the front gives facial damage in a number of cases depending on the fact that the driver will reach the A-pole and the side-window. Only one facial injury occurred in a car, which turned over. The impact from the right side of the front gave no facial injuries. In this direction the driver is completely protected by the belt from reaching any part of the car. The non-belted driver is injuried in the face independent of which direction of the car is hit. The passengers in the front seat has a low frequency of facial injuries and(fig2) is hurt mainly on head-on collisions and collision from the right side, where he reached the A-pole on the right side and the side-window on the right side. As espected the non-belted passengers have a higher incidence of more severe facial injuries independent on direction of impact as long as the impact is from the front or the side. No facial injuries appeared when direction of impact was from the rear end of the car. Fig 3 shows a striking difference between skull- and brain injuries between drivers who were belted and non-belted. It also demonstrates a wide spread of directions of impact including turn-over of the car. Head-on and brain injuries were five times as common on head-on collisions in the non-belted as in belted. The same striking difference is found between the non-belted and belted passengers with regards to head- and brain injuries among passengers in the front seat (fig. 5). Fig. 4 is interesting, especially with regards to direction of impact in drivers with neck injuries were the belted drivers got their neck injuries especially in head-on collisions and impact from the frontal left side. Whereas the non-belted driver had their neck injuries especially in the rear end impact (fig. 4).

DISCUSSION

The present study demonstrates the protective effect of the seat belt with regards to severe damage of the skull and the brain in drivers as well as passengers engaged in traffic-accidents in a medium sized car. 21.483 persons were injuried in the Swedish traffic in 1976. Tolhagen, 1976, found that 73% of the traffic injuried had some form of damage to the face or skull. In the present material the frequency of head- and face injuries is considerably lower, than in the figures given by Tolhagen. Only 13% of persons engaged in the accidents had facial injury and 8% had skull injuries including commotio cerebri. 44% of the patients with head injury also had injury of the face. This gives a total of 17% of all drivers and passengers, surviving the accident who had head- and face injuries. This is equivalent to the lowest figure given by Huelke and Sherman.

The reason for the low figure might depend partly on the fact that half of the group of drivers and passengers were belted which gives a real reduction of the number on head- and face damages. This is, however, only a part of the protective factors in car accidents. None of the cars was built before 1968. Each of them was provided with a series of safety devises decreasing the risk for the driver and the passenger. Andersson et al., 1976, found a reduction of facial injuries of to one third in front seat passengers when the seat belt was used. Andreasson and Roos, 1977, demonstrated a reduction of the number of persons injuried in traffic accidents in cars from the last three months 1974, to the last three months of 1975, with the increasing use of seat belt after introduction of the seat belt law in Sweden in 1975. It is quite clear from the study by Andersson et al., 1978, that the number of impact points by driver and passengers in the car at collision is reduced by the seat belt. The driver and front seat passengers do not reach the instrument panel with the face, nor do they reach details of the car located above the instrument panel like the wind-shield. A driver with belt can, however, reach the stearing wheel in collisions at high speed or if the belt is wrongly adjusted or if the driver is located too far forward. Although, serious head- and brain injuries as well as a serious soft tissue damages to the face is radically reduced when the driver is using his seat belt, the number of face- and head injuries is still too high to be accepted.

The main reason for the injuries of the face in belted drivers is that the steering-wheel decreases the free space available for a reduction of the speed of the body. A driver who sits close to the steering-wheel or has his belt wrongly adjusted has a special risk to hit the wheel with the face. It is true, however, that belted drivers as well as front seat passengers survive traffic accidents with a comparatively higher crash speed than if the belt is not used. With the present construction of the belt the head will rotate forward after the upper part of the body has been stopped by the seat belt. The head will rotate forward and backward again and head and face will reach the stearing wheel or side parts of the car including the side window or parts of the car being pushed into the cabin. It is quite clear from the present experience in Sweden that the fact that about 80% of the drivers and front seat passengers in Sweden use the seat belt has led to a considerable decrease in severe head- and face injuries.

In order to reduce the collision injuries a choice of mainly three rotes seem to be possible.

I. Development of preventive systems which increase the use of seat belts from at present 80% to as close as 100% as possible. Passive seat belt systems are possibly the best way to reach this high percentage to usage seat belts.

II. Development of new seat belt constructions with increased protective effect. Certain injuries could possibly be avoided if a construction was developed which gave a better deceleration of the body including the head and were the lode on the body is more distributed over the body than with the present 3-point belt. In order to reach this goal it is possible that a combination of belt and air bags or other systems must be constructed.

III. A better construction of the steering-wheel in order to reduce the effect of contact between the face and head and part of the steering system.

In increased interest in the medical profession for prevention of accidents may, however, be the most important factor in prevention of traffic death and traffic injuries. Even the most efficient preventive system inside the car is useless in traffic accidents in high speed with very high retardation.

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Table I Relative frequency of facial injuries for drivers with or without seat belt

	Number of drivers	Facial injuries sustained by	%
With seat belt	377	33	9
Without seat belt	318	53	17
Unknown	2	-	-

Table II Relative frequency of facial injuries for passengers with and without seat belt, front seat

	Number of passengers, front seat	Facial injuries sustained by	%
With seat belt	168	13	8
Without seat belt	115	23	20
Unknown	-	-	-

Table III Facial injuries combined with other injuries sustained by drivers

	With seat belt	Without seat belt
Number of drivers	377	318
Facial injuries	33	53
Skull -"-	5	14
Neck -"-	1	3
Chest -"-	8	12
Belly -"-	-	4
Back -"-	1	-
Extremities injuries	26	46

Table IV Facial injuries combined with other injuries sustained by passengers, front seat

	With seat belt	Without seat belt
Number of passengers, front seat	168	115
Facial injuries	13	23
Skull -"-	1	11
Neck -"-	-	-
Chest -"-	3	6
Belly -"-	-	1
Back -"-	-	1
Extremities injuries	7	22

Table V Drivers - skull injuries

	With seat belt	Without seat belt
Commotio cerebri	17	36
Contusio cerebri	-	3
Skull fracture	-	2

Table VI Passengers, front seat - skull injuries

	With seat belt	Without seat belt
Commotio cerebri	2	11
Contusio cerebri	-	-
Skull fracture	-	-

Table VII Drivers - facial injuries

	With seat belt	Without seat belt
Fractures:		
- Frontalsinus	1	1
- Orbita golv	-	1
- Zygomaticus	2	1
- Maxill	1	1
- Mandibel	1	-
- Nose	3	2
Tooth injury	8	11
Soft parts injury		
< 4 cm	23	56
> 4 cm	12	48

Table VIII Passenger, front seat - facial injuries

	With seat belt	Without seat belt
Nose fracture	1	2
Tooth injury	1	4
Soft parts injury		
< 4 cm	16	30
> 4 cm	1	9

Table IX Drivers - neck injuries

	With seat belt	Without seat belt
Vertebra fracture	3	-
Luxation	-	1
Neck pain	17	11

Table X Passenger, front seat - neck injuries

	With seat belt	Without seat belt
Vertebra fracture	-	-
Luxation	-	-
Neck pain	4	3
Contusio med. spin.	1	-

Table XI Skull injuries - drivers

		AIS-index				
	Number	1	2	3	4	5
With seat belt	16	11	5	-	-	-
Without seat belt	35	19	13	3	-	-

Table XII Facial injuries - drivers

		AIS-index				
	Number	1	2	3	4	5
With seat belt	33	27	5	1	-	-
Without seat belt	53	51	1	1	-	-

Table XIII Neck injuries - drivers

		AIS-index				
	Number	1	2	3	4	5
With seat belt	20	17	1	1	1	-
Without seat belt	12	11	-	1	-	-

Table IVX Facial injuries - passenger, front seat

		AIS-index				
	Number	1	2	3	4	5
With seat belt	13	11	2	-	-	-
Without seat belt	23	22	1	-	-	-

Table VX Neck injuries - passenger, front seat

		AIS-index				
	Number	1	2	3	4	5
With seat belt	5	4	1	-	-	-
Without seat belt	3	3	-	-	-	-

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DISTRIBUTION OF IMPACT - FACIAL INJURY

DRIVER

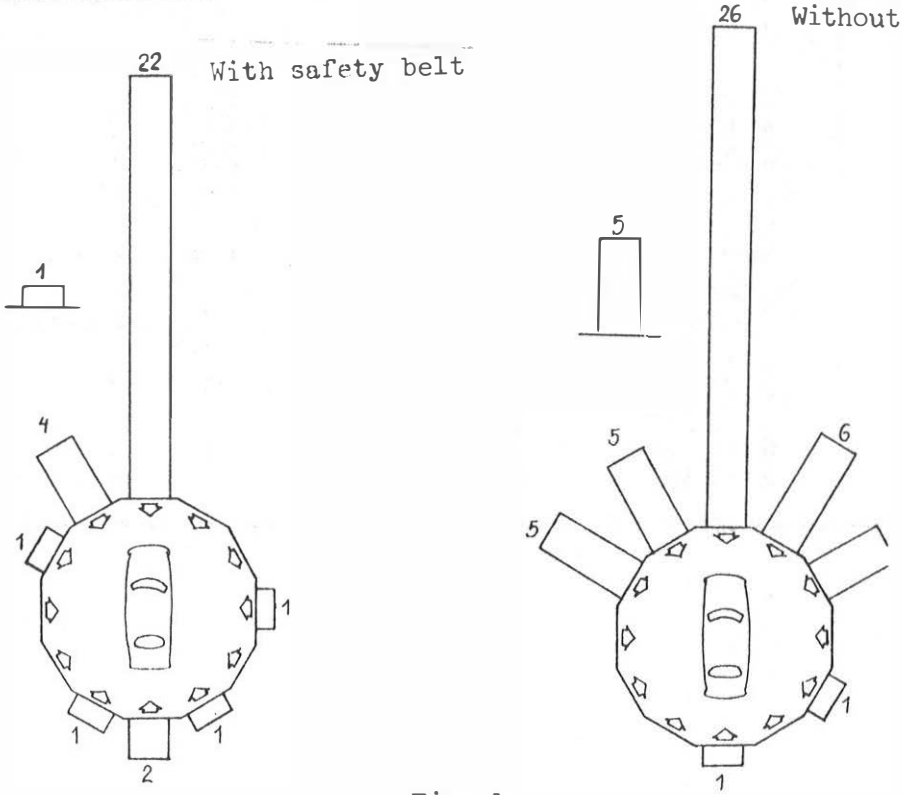

Fig. 1

DISTRIBUTION OF IMPACT - FACIAL INJURY

FRONT SEAT PASSENGER

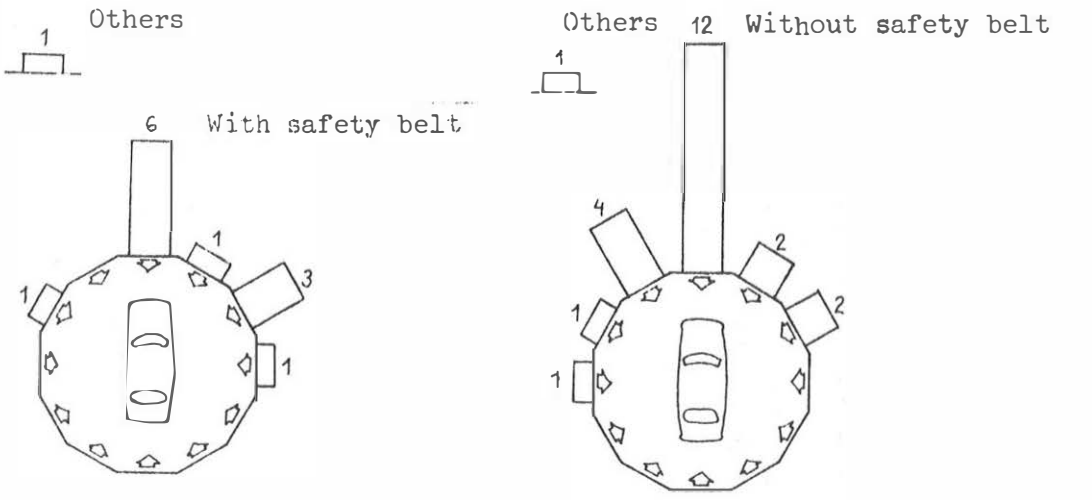

Fig. 2

DISTRIBUTION OF IMPACT - SKULL - BRAIN INJURY

DRIVER

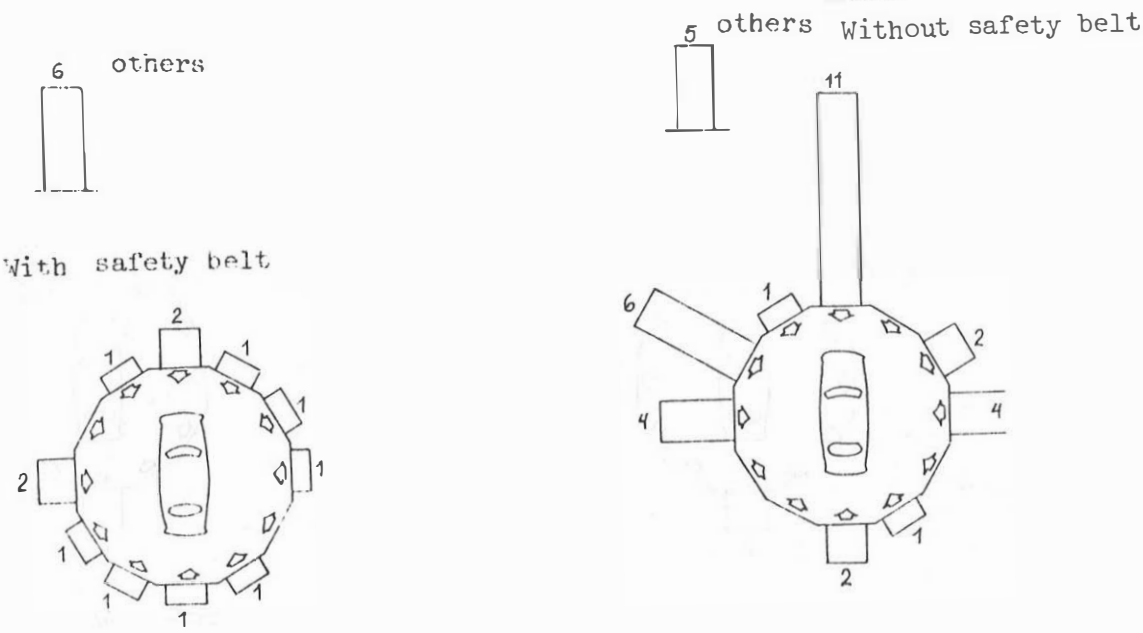

Fig. 3

DISTRIBUTION OF IMPACT - NECK INJURY

DRIVER

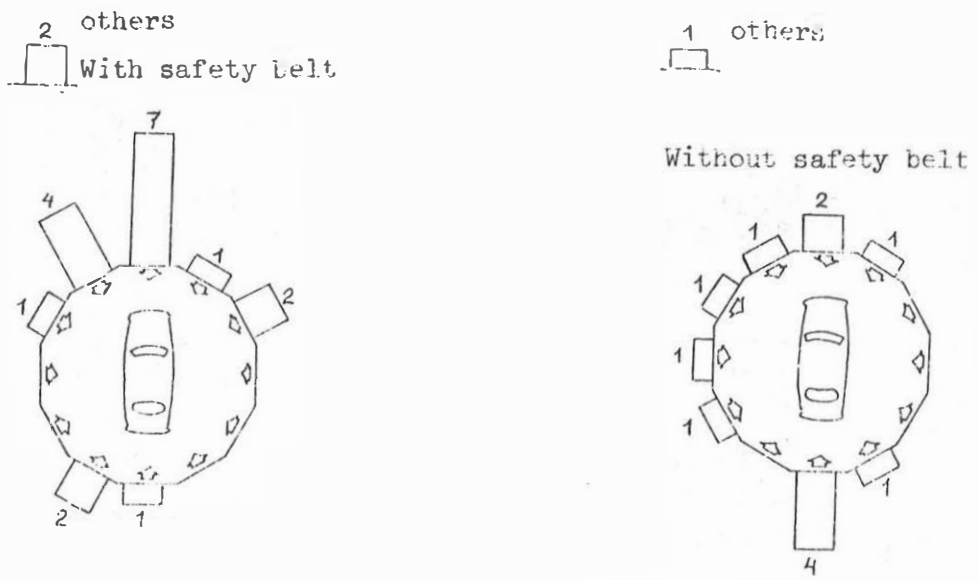

Fig. 4

DISTRIBUTION OF IMPACT - SKULL - BRAIN INJURY

FRONT SEAT PASSENGER

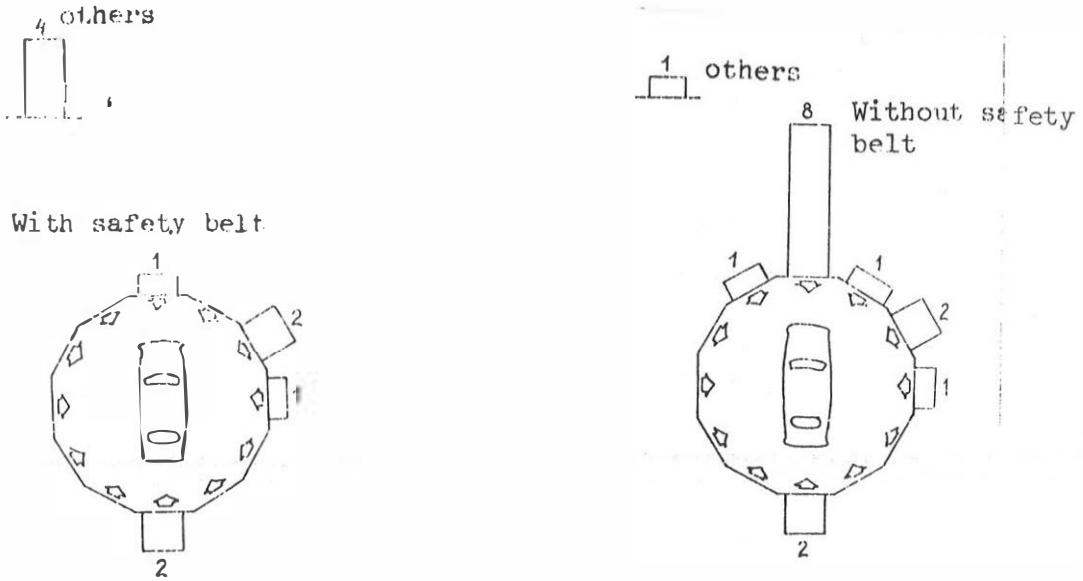

Fig. 5