THE IMPACT SITES OF CAR FRONTS FOR FATAL INJURIES OF PEDESTRIANS AND CYCLISTS, ANALYSIS OF THE URBAN ACCIDENTS IN FINLAND IN 1998-1999

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ABSTRACT

The data on fatal injuries of 36 pedestrians and 23 bicyclists were collected from among the urban (<60 km/h) accidents reported by the Road Accident Investigation Teams in Finland in 1998- 1999. Only car collisions with a pedestrian or bicyclist were included.
The principal cause of death resulted in 29% of the injuries as from impact of windscreen, 27% from impact of windscreen frame, and 23% resulted from impact of the 4 EEVC test area of car fronts.
The adoption of 4 EEVC tests could prevent about 3% of all traffic deaths annually in Finland, or about eight pedestrian (10-15%) and two (3-5%) bicyclist deaths. Despite speed limits in the urban areas, we need safer car fronts. In addition to the legislation of 4 EEVC tests it is of great importance to decrease the risk of pedestrians and bicyclists hitting the windscreen and the hard structures around the windscreen. Due to the fact, that of the cars 61% were over 10 years old the protective effect of new safer car models will reduce serious road accident injuries slowly during the next 5-15 years in Finland.

Key words; Accident investigations, pedestrians, bicyclists, injuries, windshield

INTRODUCTION

During the years 2001-2002 the EU institutions have examined a draft agreement between the European Commission and the European car industry on safer car fronts for pedestrians and cyclists. Since the majority of fatal and serious injuries to pedestrians and cyclists result from impact with car fronts, this area of action has very high potential for casualty reduction. On the basis of studies carried out within the EU programme, it is estimated that around 2,000 pedestrian and cyclist deaths and 18,000 serious injuries could be prevented annually if all cars in EU met the EEVC tests. Correspondingly, it is estimated that 21 lives could be saved and 190 serious injuries prevented annually in Finland (Crash 2/2001).

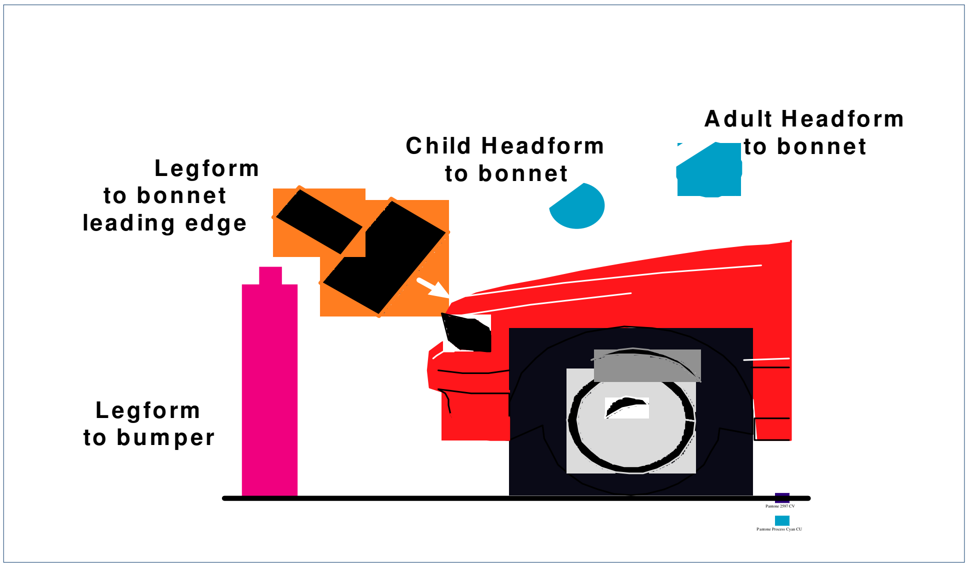

Figure 1 The European Enhanced Vehicle – Safety Committee (EEVC) tests proposed for legislation. Impact speed 40km/h (Crash 2/2001).

The aim of the present study was to address the following questions:

1) How often did the impact site of the fatal injury focus on the 4 EEVC test area of the car fronts?
2) To estimate how many deaths could be prevented annually in Finland by the 4 EEVC tests legislation
3) To find possibilities for other preventive measures.

METHODS AND DATA SOURCES.

The data on fatal injuries of 36 pedestrians and 23 bicyclists were collected from among the urban (<60 km/h) accidents reported by the Road Accident Investigation Teams in Finland in 1998- 1999. Only car collisions with a pedestrian or bicyclist were included. A total of 129 pedestrian fatalities and 117 bicyclist fatalities occurred in Finland during 1998-1999. 118 (92%) of the cases involving pedestrians and 90 (77%)of those involving bicyclists were analysed and reported by the Road Accident Investigation Teams in Finland. In 72 cases of pedestrian fatalities and in 44 cases of pedestrian fatalities, the accident occurred in the urban speed limit area (<60 km). 54 pedestrian and 29 bicyclist fatalities resulted from collisions with cars. The data on fatal injuries of 36 pedestrians and 23 cyclists represent 67% and 79% of these fatalities, respectively. In this study all victims were autopsied and the cars photographed and analyzed after the accident. In addition, there was often documented description of the accident mechanism by a witness to the accident. The analysis based on the damages on the car fronts, and if the outer skin injuries or fractures were on the same side of the body as the collision with the car, the hit was considered as being caused by the car involved; if on the other side, they were considered to be caused by ground injuries.

Table 1 The selection of cases of all pedestrian and bicyclist fatalities during 1998-99 in Finland.

	Pedestrian fatalities (N)	Bicyclists (N)	Total
All fatalities	129	117	
Analysed by The Road Accident Investigation Teams	118	90	
Acc site with speed limit<60 km/h	72	44	
Car involved	54	29	
The case series	36	23	= 59

RESULTS

The circumstances of the accidents and features of the participants. The estimated impact speed was <40 km/h in 39% and < 50 km/h in 67 % of cases. Of the cars 61% were older than 10 years and 19% of them were under 5 years old. Middle-sized cars accounted for 58%, big cars for 20%, small cars for 19% and jeeps for 3%. Of the cars involved in an accident 34% had an angular front (bonnet leading edge) or prominent bumper. The proportion of accident cars by size is quite smilar to the known data of the the cars on the roads in Finland in 1997 (69% medium-sized, 15% large and 15% small cars, Central Statistical Office of Finland, AKE 2001).

Table 2 Classification of the cars by the shape of car fronts (Appendix 1)

The shape of car front	**N**	**%**
1. **Small**, round front/small bumper (e.g. Opel Corsa, VW Golf 92-)	8	14
2. **Small**, angulated front/ prominent bumper (e.g.Fiat Uno, VW Golf –91)	4	7
3.**Medium-sized/** ,round front / small bumper e.g. Mazda 323	22	37
4. **Medium-sized/**, angulated front / prominent bumper e.g.. BMW 312 (-80)	12	20
5. **Large car/** round front/ small bumper e.g.. MB200	7	12
6. **Large car/** angular front/ prominent bumper e.g. Saab 900,Volvo200	4	7
7. **Jeeps** (e.g. Toyota Land-cruiser)	2	3
Total	**59**	**100**

The average age of the pedestrians was 61 years (range 3-93 yrs) and of the bicyclists 56 years (range 6-83 yrs). There were 2 pedestrians and 4 bicyclists aged under 16. 58% of the victims were male. However, the majority of victims among bicyclists over 64 years (7/11) and among pedestrians over 80 years (7/12) were female.

Table 3 The size (height) of pedestrians and bicyclists (classification according to Okamoto et al. 2000)

SIZE	**Height cm**	**N**	**%**
Small child	<115	3	5
Large child	115-151	4	7
Small adult /female	152-175	26	44
Average adult/male	176-186	12	20
Large adult / male	187-	3	5
Total		49	83
Unknown		10	17
Total		59	100

There were 36 pedestrians and 23 bicyclists in the case series. Only one of the bicyclists used a bicycle helmet (with unfastened strap). The blood alcohol concentration (BAC) of 12 pedestrians (33%) and five bicyclists (22%) was over 50mg/dl. Most were heavily drunk, 11 pedestrians had a BAC over 200 mg/dl and three bicyclists over 300mg/dl.

Table 4 The behaviour of the pedestrians and bicyclists just before or during the collision.

BEHAVIOUR	**N**	**%**
Pedestrian		
walking in front of the car	27	46
with walking aid/ skis	4	7
sitting /lying down/going on all fours	3	5
falling on the road	1	2
other	2	3
Bicycists		
in front of the car	17	29
falling on the road	5	9
other	1	2
Total	59	100

When the collision occurred, the pedestrian or bicyclist was in front of the car in 44 accidents (75%).

Injuries. Head injury was the principal cause of death in 20 (57%) pedestrians and 20 (87%) bicyclists. The main cause of death was pelvis/abdomen injury in 8 pedestrians (23%) but in none of the bicyclists, chest injury in 6 pedestrians (17%) and one bicyclist (4%), lower extremity injury in 2 pedestrians (6%) but none of the bicyclists, and cervical spinal cord injury in 2 bicyclists (9%) but none of the pedestrians.

The estimated accident mechanisms for the main fatal injury were a hit by the car in 65% of cases, being thrown or falling to the road in 22%, both a hit by the car and being thrown or falling to the road in 13%. Being run over resulted in death of 3 victims (9%).

The impact site in the car. 29% of the injuries as the principal cause of death resulted from impact of windscreen, 27% from impact of windscreen frame, and 23% resulted from impact of the 4 EEVC test area of car fronts (Table 5 and Figure 2).

Table 5 The impact site in the car of the fatal injury.

IMPACT SITE	**PEDESTRIAN N**	%	**BICYCLISTS N**	%	**TOTAL N (%)**
Windscreen	9	26	8	35	17 (29)
Windscreen frame	11	31	5	22	16 (27)
Bonnet leading edge	6	17	0	0	6 (10)
Bonnet	3	7	2	9	5 (9)
Bumper	0	0	2	9	2 (4)
Other	6	17	6	26	12 (20)
Unknown	1	3	0	0	1 (2)
Total	36	100	23	100	59 (100)

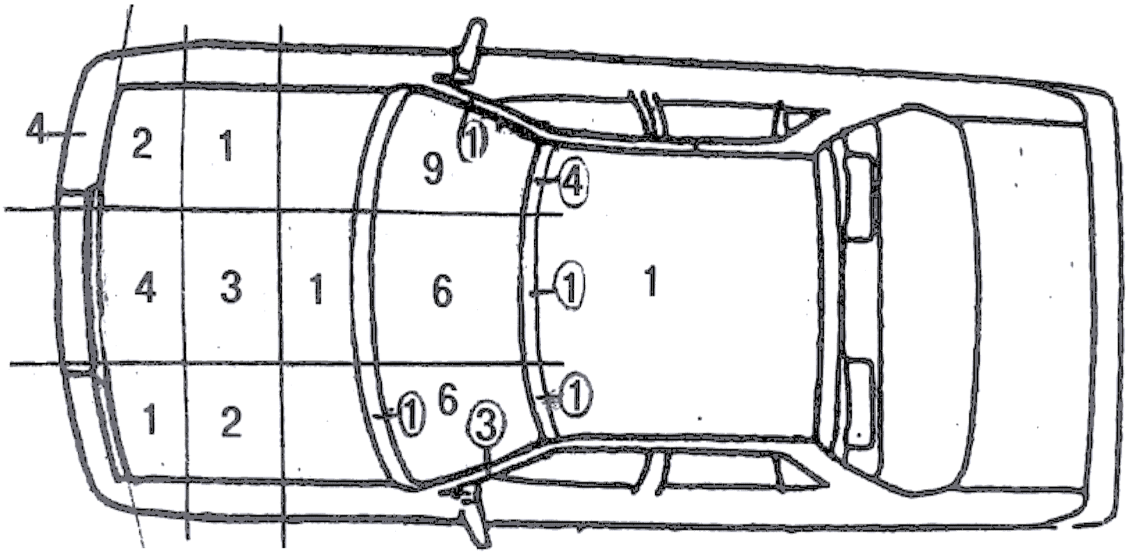

Figure 2. The impact site in the car of the fatal injury of the bicyclists and pedestrians (compare with Table 5).

DISCUSSION

The coverage of the study object is satisfactory: the Road Accident Investigation Teams in Finland analysed and reported 77-92% of the potential cases. However, the study concerns only fatalities without comparable nonfatal pedestrian and bicyclists injuries. The majority of cars included in the study were 10 years old, and there were only few new cars. The study has a relatively low number of cases, which hampers the analysis of subgroups.

This study was aimed at analyzing the impact sites for principal fatal injuries. This might result in a higher percentage of impact caused by vehicle than the ground. Vehicle impact has been reported to cause more common and more serious injuries than the secondary road impact (Otte 2001). However, the road impact might sometimes be difficult to demonstrate clearly from visible damages like abrasion.

On the basis on this study, the legislation of 4 EEVC tests could prevent about 3% of all traffic deaths annually in Finland, or about eight pedestrian (10-15%) and two (3-5%) bicyclist deaths. The significance of safer car fronts is probably much higher among nonfatal life-threatening pedestrian and bicyclists injuries (Crash 2/2001, Otte 2001). Currently the information from nonfatal traffic accidents is recorded in an uncoordinated manner by different organisations, e.g. health care, police, and traffic insurance companies. The result is a high number of recorded accident cases with limited information, whereas in-depth studies of fatal traffic accidents provide a lot of information from few fatal accidents. Due the risk for death is related for many confusing factors (e.g. age, health disorders, intoxicants) it is important to study nonfatal accidents as well. Recently a project entitled STRADA was launched in Sweden, linking police and hospital information (Olle Bunketorp, personal communication).

Drunken victims and advanced age were common in this case series. Severe body injuries were considered the principal cause of death in all of these victims. It is known that alcohol as well ageing I are related to both the risk to be involved in an accident as well as the probability of death in case of injury.

This study strongly supports the importance of decreasing the risk of pedestrians and bicyclists hitting the hard structures around windshield. This can be done e.g. by integrating pedestrian protection airbags at the windshield pillars.

CONCLUSION

The main message of this study is that despite speed limits in the urban areas, we need safer car fronts. In addition to the adoption of 4 EEVC tests it is of great importance to decrease the risk of pedestrians and bicyclists hitting the windscreen and the hard structures around the windscreen (Berg et al 2000). This can be achieved e.g. by integrating pedestrian protection airbags at the windshield pillars (Otte 2001). Due to the high average age of the cars in traffic in Finland, the protective effect of new safer car models will reduce serious road accident injuries slowly during the next 5-15 years.

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