A Pilot Study of an Integrated Accident Research System Based on a Medical and Engineering Data in the Metropolitan Area of Florence

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Abstract The Tuscany Trauma Registry (2009-2010) shows that the preponderance of major trauma due to road accidents occurs in urban areas (33%) and 62% of these involve Powered Two Wheeler (PTW) riders and pillion passengers. So far, the collection of in-depth real world road accident data has been very limited in Italy and completely absent in the Tuscany region. For this reason a team of physicians and engineers have established a collaborative effort to collect and study all the metropolitan road accidents that result in major trauma. The aim of the project is to create an in-depth accident database with a special focus on the correlation between the accident dynamics and the injuries. This paper describes the method adopted and a case study representing a typical example of the approach and outcomes. The analysis of 16 cases out the 60 collected during the first year shows some preliminary results. The next step of the project is to consolidate the data gathering by creating a stable structure able to collect data continuously for at least the next 10 years.

Keywords Accident analysis, Biomechanics, In-depth road accident database, Injuries, Trauma registry.

I. INTRODUCTION

In Europe (EU27) in 2010 about 31.000 people were killed in road collision, about 300.000 were seriously injured and many more suffered slight injuries. During the period 2000-2010, road fatalities have been reduced but only some countries reached the EU target of 50% reductions [1]. Italy reduced the total number of fatalities by 42,8% (4090 deaths in 2010), but the number of slight and serious injuries is still very high (about 300.000 in 2010)[2]. The vulnerable road users (pedestrians, bicyclists and motorcyclists) today are still at very high risk of serious or fatal injury, especially in the metropolitan areas. The 2009 and 2010 data of the Tuscany Trauma Registry (TTR) [3]-[4]-[5]-[6] shows that 65% of the severe injuries in the region are caused by road accidents, while the 35% of the major traumas are caused by agricultural and home accidents, sport, suicide, stabbings and gunshot injuries. In the TTR database are stored medical information of people admitted in a Tuscany Region's Intensive Care Unit and not dead on-scene of accident.

The twenty-nine percent of the severe injuries occurred in non-urban areas and the majority (33%) in urban areas. In the metropolitan area of Florence 62% of the severe injuries involved Powered Two Wheeler (PTW) riders and pillion passengers, 20% car occupants, 10% cyclists and 7% pedestrians. The most frequent serious accidents are vehicle-to-vehicle (73%) and pedestrians (18%). Other important features are the permanent consequences sustained by those severely injured. The follow-up at 6 months after the traumatic event highlights that 7% of the injured die, 2% remain in a vegetative state, 18% and 32% suffer, respectively, a serious and moderate disability while 41% show a good recovery.

While the effects of accidents on car occupants are much better known today than in the past due in part to crash testing and simulations, this is not the case when the collision involves PTW riders, pedestrians or cyclists since in-depth collision data are insufficient and often disconnected between them. Consequently the study of real world accidents, especially in a metropolitan area, is a crucial aspect for understanding the relationship between accident circumstances, vehicle design and injury causation in order to develop measures to mitigate the injury consequences of road accidents, but also to evaluate the change produced by the countermeasures adopted. Moreover, this kind of information allows improving current triage operations developing and validating tools to predict the severity of the injuries in the future.

The Crash Injury Research Engineering Network (CIREN) [7] database in the US, the GIDAS (German In-Depth Accident Study) [8], the Co-operative Crash Injury Study (CCIS) [9], the On The Spot (OTS) [10] study and the

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Motorcycle Accident In-depth Study (MAIDS) [11] in EU are the main references for the real world accidents in-depth studies. In Italy similar studies have been carried out only for a limited time frame as i.e. in the MAIDS project (1999-2000) and in the Safety Net project (2004-2008) [12].

In this study, a team of medical doctors, statistician and engineers has been created to collect in-depth information about the accident, reconstruct it and determine the mechanism of the injuries.

II. METHODS

This section explains our modus operandi used to collect data in order to carry out the in-depth analyses of all serious accidents that occur in the metropolitan area of Florence.

A medical-engineering network for in-depth study of road accidents

The study, named In-SAFE (In-depth Study of road Accidents in FlorencE), is based on the direct collaboration between the Department of Mechanics and Industrial Technologies (DMTI) at the University of Florence and the Anaesthesia and Intensive Care Unit at the Emergency Department (ICU) of the Careggi University Hospital (Florence), and, indirectly, with all the police forces, the Emergency Medical Services (EMS) of Florence and the Emergency Room (ER) of the Careggi University Hospital. The aim of this activity is to conduct in-depth investigation of accidents that have generated severe injuries in the metropolitan area of Florence and to reconstruct the causes and the mechanisms of the injuries. Moreover, the study aims to collect information regarding disabilities sustained by the injured in order to evaluate their social costs and also to determine what changes to vehicle design improvements might mitigate or prevent these injuries in the future. For this purpose a network of physicians and engineers was established in order to link retrospectively environmental data acquired on the scene with the crash data and clinical information about the injuries. The study selected all the road accidents where at least one of the persons involved was admitted to the ICU with a diagnosis of major trauma i.e. an Injury Severity Score (ISS) greater than 15.

Sampling area

The road accidents analysed in this study were collected from the metropolitan area of the city of Florence. This area is made up of nine municipalities, covers an area of 466 km^2 with a population of approximately 604.000 (Fig. 1). The sampling area is mainly composed by urban zones and in small part by extra urban areas.

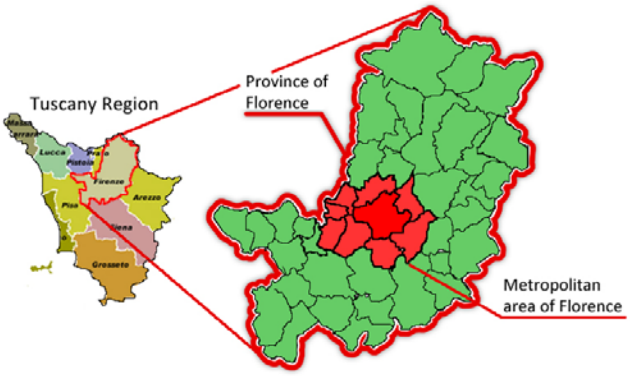

Fig. 1. Sampling area.

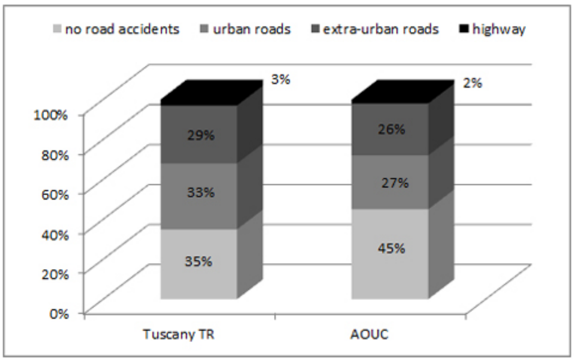

Fig. 2. Number of major trauma in Tuscany and at the Careggi University Hospital (AOUC) for 2010.

The trauma network of the Tuscany Region, since 2005, has organized the ICU that deals with major trauma through the hub/spoke system. For the Province of Florence the hub hospital of reference is the Careggi University Hospital that receives all major trauma patient who are more than 16 years old. In 2010 in Tuscany 65% of the major trauma was caused by road accidents and only 3% of these occurred on highways, as seen in Fig. 2.

An In-depth Multidisciplinary Investigation

With the cooperation of the police forces, the team acquires general information about the crash scene (e.g. point of impact, point of rest), description of the environment (roadway configuration, traffic control data,

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Careggi University Hospital. A. Peris, is the chief of Anesthesia and Intensive Care Unit of Emergency Department at Careggi University Hospital weather conditions), vehicle (type and model, engine size) and people involved in the crash (gender, age, type of licence). In the following the main phases of the study are outlined. They are also shown in Fig.3.

On-site – The team collects more detailed information such as skid marks, debris, deposit of liquids, line of sight of each vehicle's driver/rider or people involved in a crash in order to substantiate the exact point of impact.

Vehicle examination – The In-SAFE team carefully examines each vehicle involved in the accident. All vehicle damage (direct or indirect) and contact points are photographed.

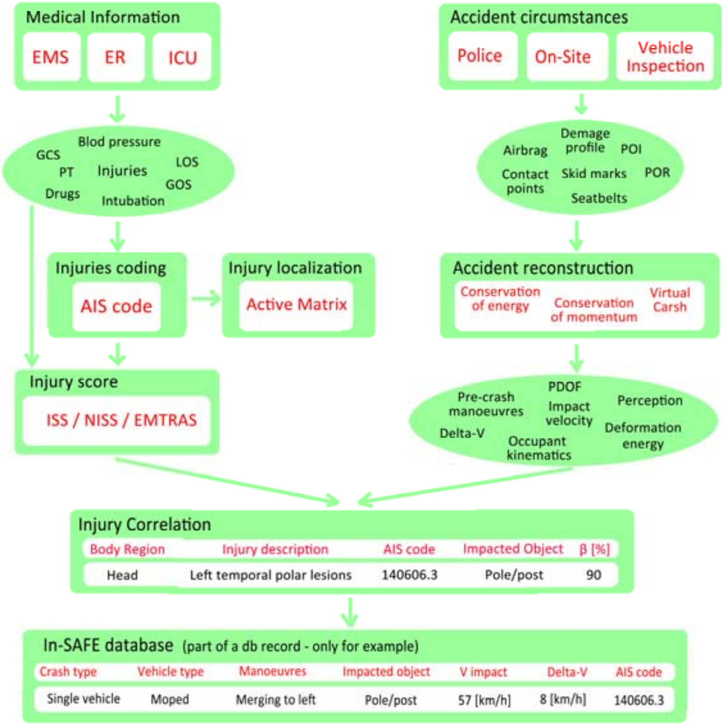


Fig. 3. Flow chart of phases and data of the study.

Exterior parts: The damage profile is quantified measuring the damage width. The latter is subdivided into six parts (C_1-C_6), where the dimension of the damage is quantified (CRASH3 method) [13]-[14]. In order to describe the nature and the location of the direct contact on the vehicle in car and van accidents, the Collision Deformation Classification (CDC)[15] is used. This code has seven alphanumeric digits but, in accordance with the protocols of STAIRS[16] and PENDANT[17] projects, eight digits for a more accurate localization of the damage are used. The first two columns of the code describe the Principal Direction of Force (PDOF) in a clock face, the five successive columns explain the location of the damage and finally the eighth column describes the crush extent. For accidents involving medium and heavy trucks and the articulated combinations, the Track Deformation Classification (TDC)[18] is used. For establishing how a pedestrian or cyclist interacts with a vehicle during an accident, the wraps around measurements are also acquired. These measurements are taken from the ground that wrap around the vehicle (Fig. 4). Finally for the PTW the wheelbase shortening is also collected.

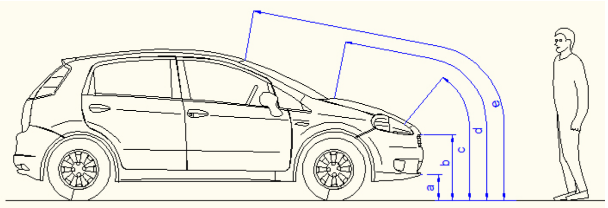


Fig. 4. Set of measures acquired in case of pedestrian investment.

Interior parts: Vehicle interiors are thoroughly investigated for evidence of occupant contacts and for quantifying the intrusions. These data are then stored using the Passenger Compartment Classification (PCC) developed by STAIRS. Special attention is given to the usage of the seatbelt, activation of the pretensioner and airbag activation.

Accident reconstruction – From the previously collected data, the accident is reconstructed to evaluate the accident dynamics and the main physical parameters concerning the crash phase as well as pre-crash phase manoeuvres, such as avoidance actions.

The post-crash velocity of each vehicle involved in a crash is evaluated by means of the analysis of the post-crash motion. The deformation energy and the velocity variation (ΔV) are estimated through Crash3[20] starting from the damage profile and by means of the Triangle method [21]-[22]. The impact velocity of each vehicle is assessed by applying the principles of conservation of energy and conservation of momentum. By the use of the multibody accident reconstruction software (PC-Crash 8.3 and Virtual CRASH 2.2) all the previous data are verified and validated and other parameters such as the PDOF and the impact angle between the vehicles are also evaluated.

In order to assess the range of uncertainty of the analysis the Finite Difference Method (FDM)[23] is used. It is a numeric approach to partial differentiation of the equation used. The method consists in the calculation of the uncertainty range around the nominal value:

$$[Y_{\min}, Y_{\max}] = \left[Y_m - \sqrt{\sum_{i=1}^{S} \delta_i^2}, Y_m + \sqrt{\sum_{i=1}^{S} \delta_i^2} \right]$$

where Y_m is the nominal value for the dependent variable and δ is the input deviations. With the FDM it is also possible to assess a range of uncertainty with a 95% confidence level assigning the same confidence intervals to each of the input variables in the accident analysis.

Medical information – The medical data collected in the database are selected to provide a clear correlation between the injury mechanism, localization and severity.

The main information on the patient’s physiological status and injuries comes from the EMS (e.g. Glasgow Coma Scale, blood pressure, intubation) and ER/ICU (e.g. diagnostics), the Abbreviated Injury Score (AIS), the Injury Severity Score (ISS), the Emergency Trauma Score (EMTRAS) and the Computed Tomography information. The Committee on Medical Aspects of Automotive Safety developed the AIS in 1971[24]. The last revision of the score is the AIS 2005, updated in 2008. Because the different AIS versions are not always compatible, injury severity scoring tools using the new AIS should be compared with those using previous versions in terms of score and predictive performance [25]. Carroll et al. show a reduction in traumatic brain injury (TBI) AIS when recorded using the 2005 revision versus the 1998 one [26]. For this reason the In-SAFE database includes the AIS 2005 and AIS 1998 codes in order to assess differences in trauma severity classifications and to allow the comparison with other databases using both revisions of the AIS. Baker introduced the ISS in 1974 to classify the severity of trauma involving lesions in more than one AIS body region. The score is calculated by summing the squares of the three highest AIS in each of three different body regions [26]-[27]. If a lesion is graded as 6, the ISS is automatically calculated as 75. The ISS puts greater attention on the multiplicity of injury but it can overlook multiple lesions in the same body region. For this reason in 1997 Osler et al. developed the New Injury Severity Score (NISS) that is calculated summing the squares of the 3 highest AIS, without regard to the body region [28]. The authors affirm the superiority of the NISS on the ISS to predict patient outcome and this conclusion is supported by Lavoie et al. [29]. Moreover, for research purposes, the EMTRAS score, a new trauma score developed in Germany in 2009 that is calculated using the age of the patient, the on scene Glasgow Coma Score (GCS), the base excess and the Prothrombin Time (PT) at the ER [30], have been added to the In-SAFE database.

Drug and alcohol abuse are major factors in serious injury in motor vehicle accidents, both in the US and in Europe [31]-[32]. Alcohol and drug presence and concentration in blood samples and urine, collected at admission in ER, are recorded in In-SAFE. These tests include some medical drugs, like benzodiazepines, that can be administrated in the hospital phase by EMS physicians and nurses. To avoid false positives, on scene drugs are recorded as are ER medical treatments. Injury outcome such as ICU Length of Stay (LOS), in–hospital LOS, mortality at 6 months and the follow-up findings in survivors at 6 months are recorded on the ICU database. As an indicator of the quality of life at 6 months after the event the Glasgow Outcome Scale (GOS)[33] and the questionnaire EuroQol5 EQ5-D with scale EQ5-D-VAS [34], that include a medical examination, are used. For patients not able to attend a medical visit, a telephone interview is performed.

Patient pre accident drug treatment and pre-existing medical conditions (PMCs) seem to correlate with worse outcome in terms of complications, ICU and Hospital Length of Stay (LOS) and lower functional outcome [35]-[36]-[37]-[38]. For this reason these data are recorded in a dedicated section of the database that includes the type and number of pre-existing medical conditions and the type and dosage of each drug. Despite some limitations due to the risk related to ionizing radiation, Computer Tomography (CT) remains the most sensitive imaging exam to assess trauma [39]-[40]-[41]-[42]. For this reason for head, neck, face, chest and abdomen CT slices identifying the specific injury are included.

In addition to coding each lesion using the AIS, injuries are identified by means of a three-dimensional localization tool that uses a discretization of the human body based on a set of CT slices equipped with an active matrix (Fig. 5). This was done dividing a human body not affected by clinical pathologies through cross sections of CT scan made at regular intervals in the sagittal plane (z axis). Each slice (or plane) is divided into a point's matrix. In this way each point has its coordinates (x,y,z) fixed, where x and y are read in the transverse plane (CT slice) while the z coordinate is the height of the CT slice with zero value at top of the head. The matrix dimension depends of the size of the section. The body regions head-face, neck, thorax, and abdomen are divided, respectively, into 8, 3, 15 and 13 slices. For the facial bones, vertebrae, rib cage, pelvis and limbs an active matrix built on the anatomical atlas figure is used to localize a lesion with more sensitivity. This type of localization of the lesions for example, provides a means to compare the distribution of the damage (in terms of extent of the lesion) between different people, or even to realize the frequency distributions of the damage (mean and standard deviation) relative to a certain region of the body. More generally, it provides the possibility of correlating the area of damage with other types of information (e.g. impact velocity or direction, type of crash).

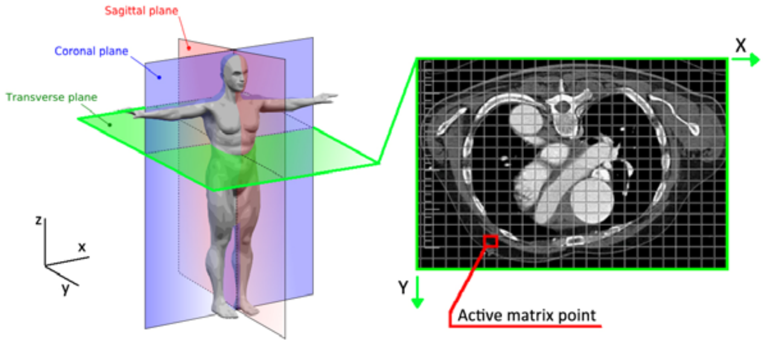


Fig. 5. Graphical method for the active injuries' localization.

Injury Correlation – This phase is the heart of the study but also the most complex and more subject to errors. In this stage the injury kinematics and vehicle dynamics are correlated.

The injury information is assessed mainly by CT scan performed at the admission in the ER; other imaging exams (e.g. vascular CT Scan, Magnetic Resonance Imaging) can be added to CT to identify specific lesions. The dynamic and kinematic information of the vehicles and people involved are assessed through the accident reconstruction methodologies. Once the injury kinematics and vehicle dynamics are clearly identified, a meeting between intensive care physicians and mechanical engineers is organized in order to correlate each injury to its cause. By merging the data previously gathered and using state-of-the-art techniques in impact biomechanics, it is possible to understand the cause and mechanism of injuries. The process ends with the definition of a level of reliability (β), in percentage, of the correlation process and indicates the quality of the data produced. During the data analysis phase a threshold value, equal to β=60%, is used for the selection of the most significant associations (table II).

In-SAFE data stored system

All the data collected are stored in a relational database, where the variables are coded in accordance with state-of-the-art techniques. The standardized protocols taken as reference are the OECD Common International Methodology for in-depth accident investigation [44]-[45], and the Standardization of Accident and Injury Registration Systems (STAIRS) project [16]. The In-SAFE database contains about 700 variables divided in three main groups: environment, vehicles and people. The people group contains both demographic and medical information.

Example of a correlation analysis between injuries and dynamics: a case study

This accident, which occurred on an urban road, involved a 26 year old rider of a moped (scooter style) in a head-on collision against a road sign (single vehicle accident). The road was straight and divided into two roadways separated with a curb indicated by the road sign, as seen in Fig. 6. The rider with a positive blood alcohol level (2.6 g/l) was riding at night (with road illumination) and heavy rainy conditions. The moped was equipped with a windshield. Due to the high blood alcohol level (in this case the primary cause of the accident), the rider failed to keep a straight trajectory and collided with the road sign (1st impact). After a flying phase both the moped and rider impacted with the ground (2nd impact) and continue with a sliding phase before stopping. The total distance covered by the scooter from the point of impact to the point of rest was about 25m, while the total distance covered by the rider was about 21m.

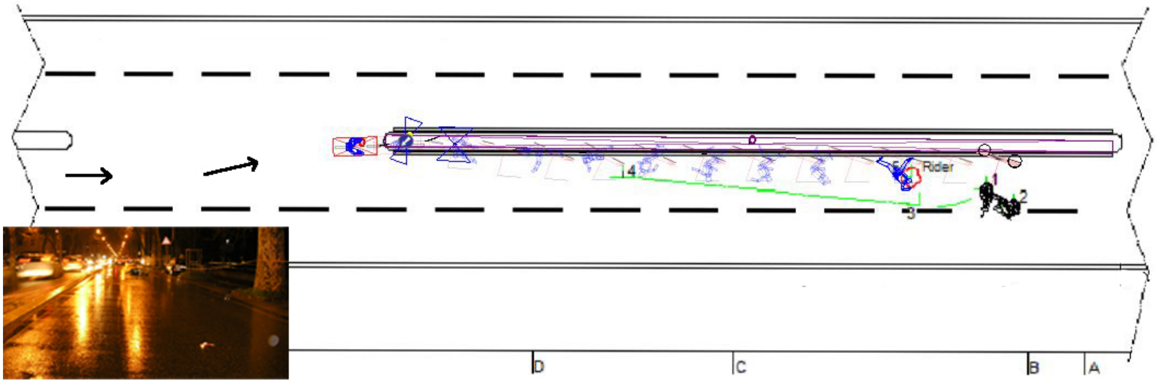


Fig. 6. Scene of the accident, with Point Of Impact (POI) and Point Of Rest (POR) of rider and moped.

Applying the equation of the launched ballistic proposed by Searle[43] it is possible to estimate the impact velocity of the moped (62±5km/h) and through computer simulation it is possible to reconstruct a 3D scenario of the accident and refine and validate the crash parameters, such as the impact velocity (57±5km/h) and the delta-V (8±3km/h). The moped used for the computer simulation is a generic scooter modelled as a rigid body, resized in term of mass, wheelbase and dimension of the wheels. The rider is modelled as a multibody human model available in the software. Comparing the POR of moped and rider obtained with the software and those measured (points 1, 2, 5), as seen Fig. 6, it is possible to see the good quality of the computer simulation performed with the Virtual Crash 2.2 software. The rest position of the rider reconstructed with the software is in good agreement with the actual final position, while the moped is relatively good but does not perfectly match with the actual position, probably due to the simplified model used to represent the moped and mainly in the modelling of the first impact.

The rider was wearing a demi-jet helmet that became detached after the first impact. For this reason, during the impact against the ground, he sustained serious head injuries and eventually died 47 days after the accident. The Maximum AIS (MAIS=4) sustained by the rider is in the head/neck body region and thorax body region, and the ISS score is equal to 33 (table I).

TABLE I
Summary of the injury score

	MAIS
Head or Neck	4
Face	0
Thorax	4
Abdomen	0
Extremities	0
External	1
ISS	33

In agreement with the on-scene and vehicle investigation and reconstruction, in the first impact the rider crashes with the front-left side of the moped with his head striking against the yellow part (zone 1) and the blue one of the road sign (zone 2) (Fig. 7).

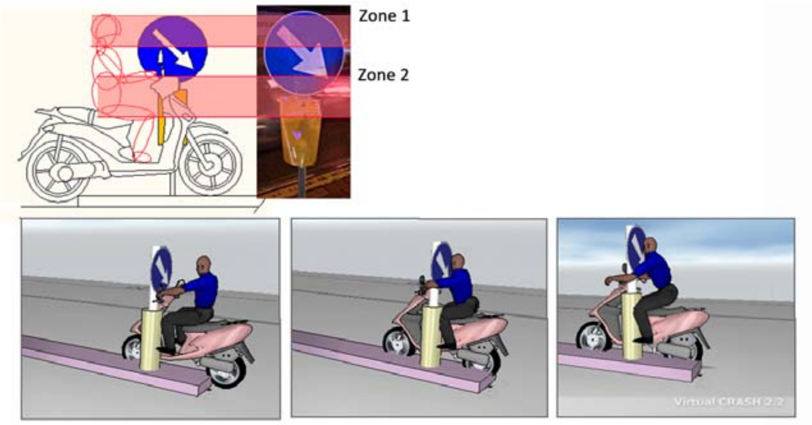


Fig. 7. Impact against road sign (1st impact).

After this impact, rider and moped begin a flying phase which ends with the landing on the ground and the following slither up to rest position. In this phase the rider impacts his head and then his thorax on the ground (Fig. 8).

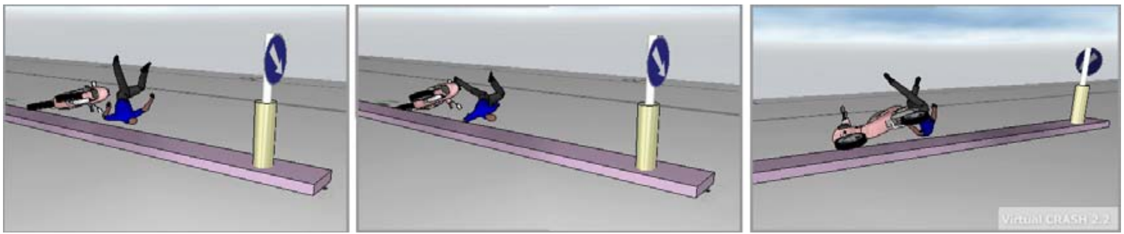


Fig. 8. Rider impact on the ground (2nd impact).

As a consequence of the first impact (against the road sign) with the helmet worn, the rider sustained the following injuries: left temporal polar lesions (2,5 cm) with millimetric left frontal parietal subdural hemorrhage (Fig. 9). The subdural hematoma (or haemorrhage) is classified as a focal TBI (Traumatic Brain Injury) i.e. a coup injury. This is caused by the compressive stresses that are generated when there is a relative motion of the brain with respect to the inner surface of the cranial cavity due to the inertial effects.

As a consequence of the detached helmet, the impact against the ground occurs without any protection, causing the most serious head injuries. Ground contact also accounts for the thoracic injuries. The main head injuries highlighted by CT scan (Fig. 10) are a right temporal-parietal-occipital multiple fractures, depressed in the occipital region and diastatic in the mastoid region; diastatic skull base clivus fracture, involving sphenoid bone body and both carotid channel; right temporal styloid process and right tympanic fracture; right petrous fracture with hemotympanum; pneumocephalus bubbles; lacerated and contused right temporal parietal (2,5 cm) lesions; peri mesencephalic subarachnoid haemorrhage, with relative encephalic pons and mesencephalic hypodensity and widespread cerebral oedema.

The depressed skull fractures are caused by the direct contact with the ground that has generated a high deformation of the skull. This is due to the minor lateral strength of the skull with respect to its frontal and posterior regions [41].

A right upper lobe lung contusion and bilateral lower lobe lung contusion in the paravertebral area are also sustained in the thoracic region (Fig. 11) Both injuries are caused by the compression of the lungs at high impact velocity.

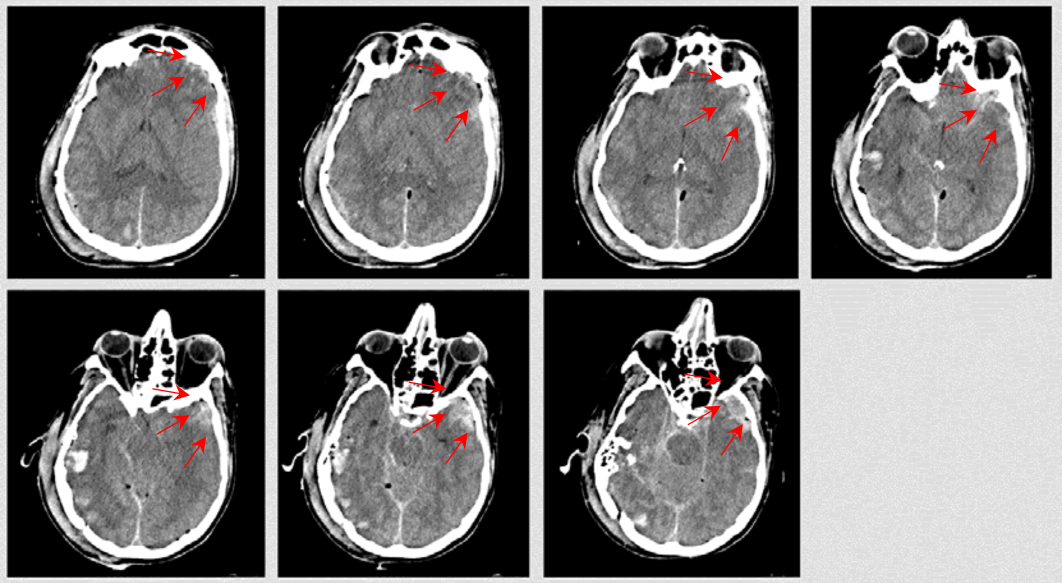


Fig. 9. Head injuries – impact against road sign (please remind that CT image is reversed (mirrored)).

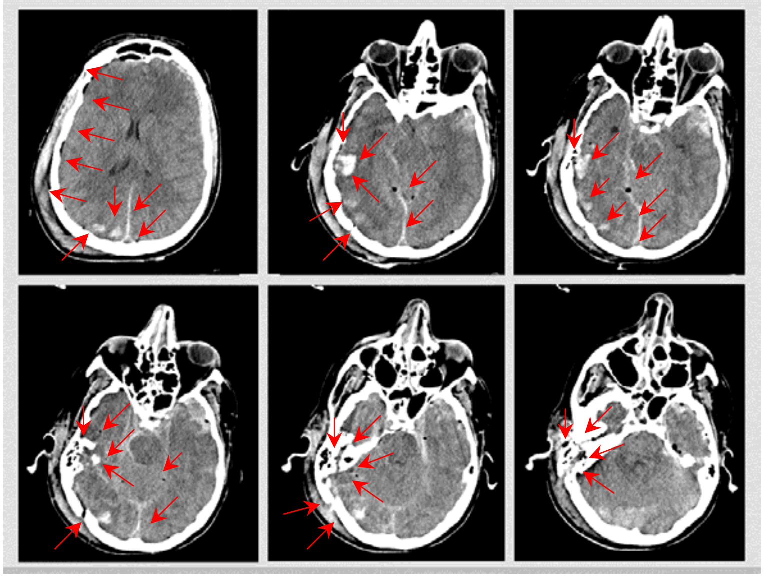


Fig. 10. Head injuries – impact against the ground.

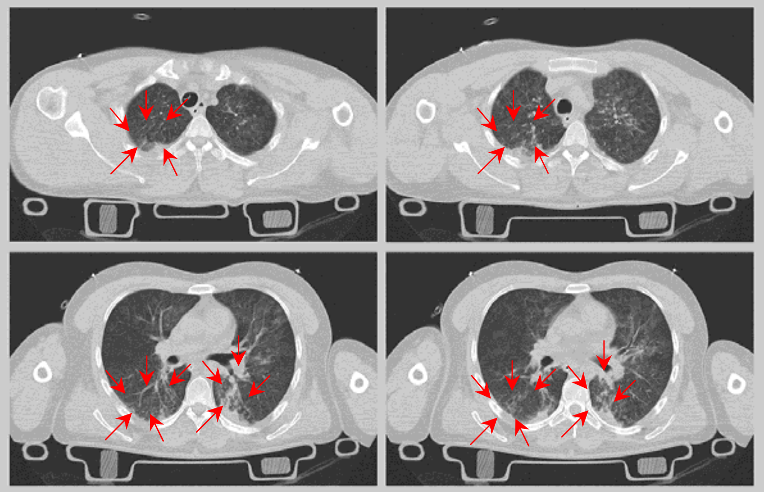


Fig. 11. Thorax injuries – impact against the ground.

A summary table with all correlation results and level of reliability in percentage values is shown in Table II.

TABLE II

Summary of the correlation results between injuries and causes

Body region	Injury description	AIS code	Impacted Object	β [%]
Head	Left temporal polar lesions	140606.3	Pole/post	90
Head	Millimetric left frontal parietal subdural hemorrhage	140651.3	Pole/post	90
Head	Widespread cerebral oedema	140670.3	Asphalt	90
Head	Right temporal parietal occipital depressed fracture	150404.3	Asphalt	90
Head	Right temporal styloid process fracture	150402.2	Asphalt	90
Head	Right tympanic and petrous fracture with hemotympanum	150202.3	Asphalt	90
Head	Right temporal-parietal-occipital multiple fractures depressed in the occipital region and diastatic in the mastoid region	150202.3	Asphalt	90
Head	Lacerated and contused right temporal parietal (2,5cm) lesions	140616.4	Asphalt	90
Head	Pneumocephalus bubbles	140682.3	Asphalt	90
Head	Peri mesencephalic subarachnoid haemorrhage, with relative encephalic pons and mesencephalic hypodensity	140695.3	Asphalt	70
External	Contused and lacerated wounds to the face, hematoma lateral	910400.1	Asphalt	40
Thorax	Contusion of the right upper lobe. Right paravertebral inferior lobe and left paravertebral inferior lobe contusion.	441412.4	Asphalt	90

III. RESULTS

The study, which started in 2011, has collected during its first year 60 road accidents that occurred in the metropolitan area of Florence and that generated major trauma. So far only 16 cases have been completely analysed. Due to the small sample size analysed and its heterogeneity, the following results cannot be considered representative of the real situation; they simply express the potential of the research study.

The age distribution of the people seriously injured collected in the In-SAFE database is showed in Fig. 12. The people (16 cases) most affected are between 26 years and 30 years and about 70% of severely injured people are younger than 45 years.

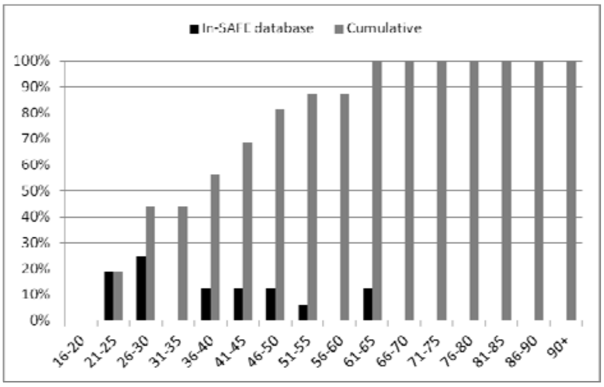


Fig. 12. Age distribution of major trauma in In-SAFE database.

In the sixteen serious accident analysed the 54% of the thirty vehicle involved were cars followed by motorcycles (20%) and bicycles (13%). The main road accident configurations that have produced a serious injury (regardless of type of vehicle) were the head-on side (43,8%) and head-on (18,8%) collisions followed by pedestrians being run over (12,5%). The vehicle-to-vehicle collision configurations (11 accidents) with the highest percentage (36,5%) were the "car to car" and the "car to PTW". The remaining car crashes were with bicycles and vans (9%).

Injury outcome for car occupants (31 people) by seat position (Fig. 13) shows that 25% of the drivers and 33% of the occupants sitting in the rear centre position suffered serious injuries. Another 38% of the drivers suffered minor injuries while the remaining were unhurt. In terms of fatalities left side rear occupants (25%) and right side front occupants (20%) were most vulnerable.

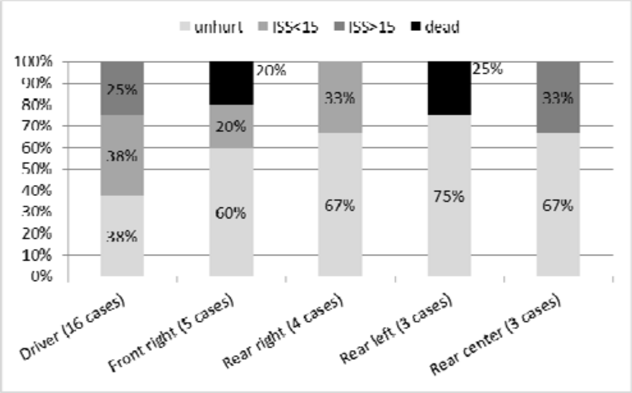
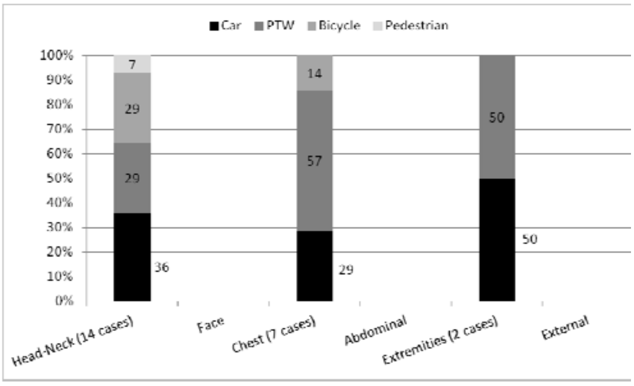


Fig. 13. Outcome (% value) for seat position of the car occupants (31 people).

It is interesting to analyse the frequency (in percentage) of the MAIS 3+ (MAIS≥3) on each body region for different types of road users (Fig.14). The head-neck, the thorax and the extremities predominate. In each of these body regions the road user categories with the higher percentages (between 30 and 40%) were car occupants and PTW riders whereas cyclists had a MAIS 3+ only for the head-neck and the thorax. Injuries to the face, abdomen and external regions were less severe than MAIS 3+ and therefore do not featured in Figure 14.



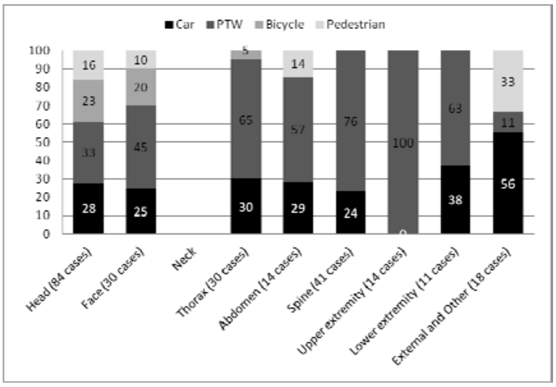


Fig. 14. Frequency (%value) of the MAIS3+ for different types of road users.

Fig. 15. Frequency (%value) of lesions on each body part for a serious injured (with ISS>15).

Fig. 15 shows the percentage of injuries by body part according to the type of road user. Injuries to the head and to the face are prevalent in all users, especially in PTW riders (35%). In the remaining body parts, the highest percentages of injuries were reported for PTW riders followed by car occupants. With the exception of "external and other" injuries where pedestrian (33%) and car occupants (56%) were the most frequent.

Analysing the source of the head injuries in the PTW riders, as seen in table III, the highest percentage of injuries was caused by impact against the road surface (44,5%) and the windshield header rail (37%). Cerebral injuries occurred from all impact sources shown in the table due to the fact that the brain is more sensitive to the inertial forces caused by sudden accelerations and decelerations than the skull base or vault.

TABLE III

PTW occupants: frequency of head injuries and its causes

	Impact object				*Total*
	Asphalt / pavement	Barrier / guard rail	Pole/post	Windshield header rail	
Base (basilar) fracture	25%	0%	0%	75%	100% (8 cases)
Cerebrum	47%	17.5%	12%	23.5%	100% (17 cases)
Vault fracture	100%	0%	0%	0%	100% (2 cases)
Total head injuries	44.5%	11%	7.5%	37%	100% (27 cases)

IV. conclusions

The in-depth knowledge of road accident data is very important for the comprehension of accident causation and for the design of possible intervention. So far, the collection of in-depth accident data has been very limited in Italy and completely absent in the region of Tuscany. Moreover, the few projects conducted in Italy have been limited in time (max 2-3 years of data collection). The aim of the In-SAFE project is to overcome this limitation by creating a network of institutions involved in this activity; indeed, all the police forces, the main hospital in Florence and the University of Florence have been involved in the project. The In-SAFE project provides unique information to the EMS, ER, ICU but also to automotive industries and policymakers responsible for road safety initiatives. The next step of the project is to consolidate the data gathering by creating a stable structure able to collect data continuously for at least the next 10 years. As soon as the database will be populated with a significant number of cases, the authors plan to focus on the analysis of the pre-accident causation factors, as well as in the causation of the injuries from the crash and post-crash point of view.

V. Acknowledgement

The authors gratefully acknowledge all the police forces that have provided the data and the Fondazione Prato Ricerche that provided part of the instrumentation necessary to the study.

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