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CHARACTERISTICS OF LOWER LIMB INJURIES IN NON-FATAL ROAD TRAFFIC ACCIDENTS: A RETROSPECTIVE ANALYSIS OF FORENSIC MEDICAL EXAMINATIONS

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Abstract

Background. Fractures of the lower limbs are one of the most common injuries in road traffic accidents, however, the frequency and localization of fractures, as well as associated trauma, are not well understood. The **purpose** of the study was to conduct a retrospective analysis of forensic medical examinations of victims with the road traffic injuries of the lower limbs. **Results.** The research material was 100 reports of forensic medical examinations of victims with fractures of the femur and/or shin bones resulting from

a non-fatal road traffic accidents. The study found that the average age of the victims was 41.5 ± 18.8 years (18 - 81 years). The main contingent of those injured was pedestrians (82%). In victims, the most common injury was polytrauma; closed limb fractures were more common. Hip fractures of various localization were found in 39%, shin fractures - in 59%, ankle fractures - in 12%. Closed head injury with a concussion of the brain of a mild degree (23%), closed fractures of the ribs (3%), self-healing dislocation of the humerus (1%), diaphyseal fractures of the forearm (3%), distal radial bone fractures (7%), and fractures of styloid process of the ulna (2%) were also noted. **Conclusions.** The main victims of road traffic accidents are pedestrians with polytrauma. The most common localization of fractures of the lower extremities is the diaphysis of the femur and the diaphysis of the shin bones.

Key words: **mechanical trauma of the lower extremities; fractures of long bones; road traffic injury; forensic medical examination.**

Introduction. Over the years, road traffic accidents (RTA) remain a constant endemic phenomenon and a heavy economic and medical-social burden for many countries of the world. According to the report of the World Health Organization (WHO) in 2018, 1.35 million fatal RTA were recorded in 2016, which resulted in road traffic injury taking the 8th place among causes of death in the general population and the 1 place - in children and young people aged 5 to 29 years [1]. For each case of death from injuries, approximately 30 hospitalizations and 300 requests for outpatient treatment are received [2]. In 2019, there were 160,675 road traffic injuries in Ukraine, which was on average 440 road accidents per day, during which 3454 people died (10 people per day) and 32,736 people were injured (90 people per day) [3]. Road traffic injuries are 35.4% of all types of injuries, they take the first place among the causes of death from mechanical damage, are one of the main reasons for disabled citizens of working age [4] and cost most countries 3% of their gross domestic product [1]. In high-income countries, in 2016, deaths from road accidents between the ages of 15 and 49 reached 9.5% (9.0–9.9), amounting to approximately 255 million DALYs [5]. Given the potentially lost years of life, the socio-economic losses of society due to fatal accidents exceed similar indicators for malignant diseases, heart diseases and cerebrovascular diseases [6].

The number of road accidents continues to grow, together with the increase in population and the number of vehicles. WHO estimates that road traffic injuries will become the fifth leading cause of death worldwide by 2030, unless effective action is timely taken to improve a road safety [1].

Epidemiology and risk factors for fatal RTA are studied comprehensively at both the national level and the WHO. At the same time, the structure of non-lethal road traffic injuries is less known. Also, the nature of injuries in a criminal road traffic injury, for which a forensic medical examination is required, has not been sufficiently studied.

It is been reported that, regardless of the type of RTA (collision of vehicles, collision of a vehicle and a pedestrian, collision of a vehicle with a fixed obstacle) and its participants (pedestrian, driver and / or passenger of a car / motorcycle / scooter / bicycle), the lower limbs are one of the most often injured [7]. However, the structure of lower limb injuries in various types of injured in non-fatal RTA, including criminal RTA has not been sufficiently studied.

The purpose of the study was to conduct a retrospective analysis of forensic medical examinations of victims with the road traffic injuries of the lower limbs.

Material and methods. Material of the study - 100 reports of primary forensic medical examinations of victims with moderate severity of bodily injuries resulting from trauma to the lower extremities. In all cases, an expert assessment was carried out in Kharkiv Regional Bureau of Forensic Medical Examination, within a period of not more than 1 month after an injury. Reports of forensic medical examinations were selected by random sampling, for the period February – June 2018.

Inclusion criteria - 1) isolated fractures and/or dislocations of the femur or lower leg bones; 2) non-fatal polytrauma, in which the injury to the lower extremities was the leading injury; 3) a forensic medical examination is conducted not later than 1 month from the day of injury.

Exclusion criteria: 1) fatal isolated injuries of the lower extremities in an accident; 2) fatal road traffic injury of the lower extremities, 3) forensic medical examination in a period exceeding 1 month from the day of injury.

Data processing was performed using descriptive statistics. The average age of the victims was determined by the formula M ± m, where M is the arithmetic mean, m is the standard error of the mean.

Results. The average age of the victims was 41.5 ± 18.8 years (18 - 81 years). The largest number of victims was at the working age of 18-60 years old - 73%; of injured older persons (61 - 81 years old) - 27%. There was a slight prevalence of males (53%), which in relation to the men to women ratio was 1.1 : 1.

It was found that the most often, by collision of person with a moving car - 82%. Damage to a passenger (7%) and a driver (8%) in a passenger compartment, a collision of a person with a moving motorbike (2%), and damage from a driver falling out of a moving

motorcycle (1%) were much less common (Table 1). Thus, active road users (drivers) participated in 8% of road accidents, passive participants (pedestrians and passengers) - in 92%.

Multiple trauma prevailed among road traffic injuries - 72% (Table 1), in which bone fractures were the leading lesion; closed fractures predominated (71%). Fracture of the femur and / or lower leg bones in all cases was accompanied by bruised and lacerated wounds, bruises, abrasions, and subcutaneous hematomas of the head, and/or trunk, and/or upper limbs. Closed head injury with a concussion of the brain of a mild degree was diagnosed in 23.0% of cases. Also, in 3.0% of cases, closed fractures of the ribs were revealed; in one victim - self-healing dislocation of the humerus, in 3.0% - diaphyseal fractures of the forearm, in 7.0% - distal radial bone fractures, in 2.0% - fractures of styloid process of the ulna.

Table 1. Nature of injuries and road traffic injury mechanism in patients with moderate bodily injuries

Parameters	Number of victims (n = 100)	
	abs.	%
Polytrauma	72	72
Isolated fracture of the lower legs bone	18	18
Open damage	29	29
Closed damage	71	71
Injury mechanism		
- collision of a man with a moving car	82	82
- damage to a passenger in a car cabin	7	7
- damage to the driver in the car cab	8	8
- damage from a driver falling out of a moving motorcycle	2	2
- collision of a person with a moving motorbike	1	1

With multiple fractures of lower extremities (10%), ipsilateral and contralateral fractures of the femur and tibia appeared with almost the same frequency - 4% and 3% cases, respectively. In 2% of cases, a double fracture of the leg bones was revealed (Table 2).

Table 3. The nature of long bones damage to the lower extremities due to mechanical injuries with bodily injuries of moderate severity

Nature of damage	Number of victims (n = 100)	
	abs.	%
Medial fractures of femoral neck	4	4
Transtrochanteric fracture	1	1
Femoral diaphysis fracture	32	32
Fracture of the distal femur epimetaphysis	2	2
Fracture of the proximal tibia epimetaphysis	10	10
Diaphyseal fracture of the shin bone	47	47
Double diaphyseal fracture of the tibia	2	2
Fracture of the medial / lateral ankle	3	3
Fracture of both ankles	9	9

According to the nature of the damage, diaphyseal fractures of long bones predominated, which together accounted for 78% of the cases. Of these, femoral diaphysis fractures accounted for 32%, diaphyseal fractures of the tibia - 47%. Intra-articular fractures of various localization were formed in 26 injured in traffic accidents. In this case, the hip joint suffered less often than others: medial fractures of the femoral neck were recorded in 4% cases. Intra-articular fractures of the knee and ankle joints formed with the same frequency - 11 observations: with damage to the distal femur epimetaphysis - 2%, proximal tibia epimetaphysis - 10%, internal / external ankle fracture - 3 %, both ankles - 9% (Table 2).

Discussion. Road traffic injuries are the most common cause of fractures in human bones [8, 9], and fractures of long bones of the lower extremities, regardless of the circumstances of RTA, are the most frequently damaged areas of the human body [5, 10, 11]. Isolated fractures of the femur or shin bones are rare when vehicles collide with each other or hit a pedestrian at a low (30 - 40 km/h) speed. With an increase in the speed of vehicles involved in RTA, the severity of the injury and the number of skeleton fractures increase accordingly. In non-lethal polytrauma, fractures of the femur and shin bones with fractures with the pelvic bones fractures, fractures of the long bones of the upper extremities are most often recorded [9, 12, 13]. Closed fractures of long bones of the lower extremities are more typical for drivers and passengers of automobiles [9], while a motorcycle injury is

distinguished by the predominance of open multi-fragmented fractures of limb bones [12]. About 40% of victims with polytrauma and multiple bone fractures exceeded speed [9], moreover, at a car speed of 50 km / h, the risk of a fatal collision with a pedestrian is 26%, at a speed of 58 km / h - 50% and 82% - at 70 km / h [13]. At the same time, a decrease in vehicle speed from 40 km / h to 30 km / h reduces the risk of collision with a pedestrian by 28% [14].

Conclusions. In the structure of non-fatal road traffic injury according to the forensic medical examination, the most common types of damages accidents were a collision of a moving car with a pedestrian (82%). In the structure of fractures of long bones of the lower extremities, diaphyseal fractures of the femur (32%) and shin bones (47%). The main victims of road traffic accidents are pedestrians. Improving road safety and reducing the number of injured pedestrians can be achieved by reducing vehicle speed and improving the geometry of the front of the vehicle.

Conflicts of Interest No conflict of interest.

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