Head and face injuries among cyclists admitted to the Craniomaxillofacial and Oncological Department at the Medical University of Lodz

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Abstract

Background. Cycling is a very popular type of activity in our times. People of all ages use bikes for many purposes like sport, entertainment or as means of transport. Unfortunately, this activity exposes cyclists to more frequent injuries of the face and head region.

Objectives. The aim of this study was to characterize bike-related injuries with special consideration to the injuries to the facial region. Secondly, we investigated the impact of wearing helmets on head and facial region traumas.

Material and methods. In our retrospective research, we analyzed 41 patients (28 men and 13 women) aged between 33.2 ±13.3. The data included in our study concerned the age, sex, duration of hospitalization, type of bike, types of injuries and fractures, cause of injury, circumstances, place and type of accident, wearing helmet during injury and the occurrence of brain concussion.

Results. Men were the most prevalent in the analyzed group of patients (68.3%). Dental traumas were the most commonly observed type of injuries – they were diagnosed in 21 out of 41 patients (51.2%). Soft issue injuries were observed in 19 out of 41 cases (46.3%). Fractures of the facial skeleton were the rarest – they were noted in 13 people, in 4 of them mandibular fractures were observed. A statistically significant dependency was observed that people with helmets were more likely to suffer from coexisting traumas in comparison to those without them. The cause of brain concussion was statistically correlated with the type of accident.

Conclusions. Males more often experienced accidents than females. Falling from a bike caused most accidents. The most frequent among injuries were dental traumas and among fractures – mandibular fractures. Cyclists wearing helmets had more frequently coexisting traumas. Brain concussions mostly resulted from traffic crashes.

Key words: injuries, head trauma, cyclists, helmets, traumatic brain injury

Słowa kluczowe: urazy, urazy głowy, rowerzyści, kaski, wstrząs mózgu

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Cycling is a very popular type of activity in our times. People of all ages use bikes for many purposes like sport, entertainment or as a means of transport[1]. Despite many advantages, cycling is also associated with a higher risk of various accidents and many serious traumas, sometimes even fatal ones.[2–4] According to Polish statistics collected in 2011, the percentage of cyclists seriously injured reached 9.2% and fatally injured reached 7.5%.[5] Poland is one of the countries were the risk for "unprotected" road participants (which include pedestrians, cyclists, motorcyclists) is very high.[6] In road accidents in 2010, pedestrians and cyclists constitute 30% of all injured and 39% of fatalities. However, in 2015 these numbers were even higher, respectively 32% and 42%, thereby becoming one of the highest results among other countries of the European Union.[7]

There is official data on bike-related accidents in Poland gathered by government institutions based on data collected from 38 units, including the Ministry of Infrastructure, management of roads and units of traffic managers. The database obtained by the Supreme Chamber of Control showed that the number of accidents involving cyclists in different periods – 2010 compared with 2015 – increased by 18.3% and the number of injured cyclists increased to about 16.9%.[6] Also, in the Lódź region an increased amount of incidents caused by bicycles can be observed – in 2013 it was 186 and in 2015 it was 207.[8] However, data coming from so many sources seems to be incomplete, as it does not include injury characteristics.

Cyclists are at a higher risk of dangerous traumas, but they are especially exposed to major head and face injuries. Helmets are one of the suggested precautions aiming to provide cyclists adequate protection.

Some articles confirmed that helmets protect cyclists from complications associated with traumatic brain injuries and are effective in reducing the risk of head injury.[9,10] But on the other hand, there is no association between helmet use and the risk of facial injuries. Also, they do not protect the lower facial region.[11,12]

Not every type of bicycle helmet protects in the same way. Sometimes cyclists with helmets increase their speed and have decreased risk perception and because of that the safety effect can be counterproductive.[1]

The aim of this study was to characterize bike-related injuries with special consideration to the injuries to the facial region. Secondly, we investigated the impact of wearing helmets on head and facial region traumas.

Material and methods

Our research contained 41 patients with cyclist-related injuries admitted to the Maxillofacial and Oncological Department at the Medical University of Lodz between the years 2013 and 2016. The mean age of the patients was 33.2 ±13.3. Twenty-eight (68.3%) of them were male with the average age of 34 years and only 13 (31.7%) were female with the average age of 31 years. The data included in our study concerned the age, sex, duration of hospitalization, type of bike, types of injuries and fractures, circumstances, place and type of accident. Additionally, the most commonly types of injuries among helmeted and non-helmeted cyclists were characterized with particular attention paid to patients with brain concussion and facial region traumas.

Statistical analysis

At first, the rate structure was calculated. For comparison, the frequency a χ^2 test with the Yates amendment was used to analyze the epidemiological data. An univariate regression analysis was performed, and a statistically significant p value < 0.05 was assigned.

Results

In the analyzed group of patients, men prevailed (68.3%). Fifty-six point one percent of patients were over 30 years old. The duration of hospitalization equaled from 1 to 10 days, in an average of 2.8 ±2.6 days. Slightly more than half of the patients were hospitalized only for 1 day. The mean length of hospitalization in the case of male patients was 2.4 days and in the case of female patients was 3.5 days.

Dental traumas were the most commonly observed type of injuries – they were observed in 51.2% of cyclists. They consisted of tooth luxations that were diagnosed in 16 out of 41 patients and tooth fractures – in 5 out of 41 patients. The second most common type of traumas were soft issue injuries which were observed in 46.3% of patients. Fractures of the facial skeleton were the rarest – they were noted in 11 people, in 4 of them mandibular fractures were observed, in 4 zygomaticomaxillary complex fracture, in 2 nasal bone fracture and only in 1 case orbital floor fracture was present.

Concomitant traumas occurred only in 31.7% of patients. Ten out of 13 cases had soft tissue injuries of the upper extremities and in 3 subjects fractures of upper extremities were noted. Among men, the most frequent injuries were dental traumas and then soft tissue injuries, whereas in the case of women, the tendency was reverse. Twenty-two percent of patients confirmed that they were wearing a helmet at the time of the accident. Among them, 21.4% were male and 23% were female. In all cases, the most frequent cause of injuries was a fall from the bicycle (73.2%). Only 26.8% had a road accident. Detailed data is shown in Table 1.

During the accident 46.1% of women confirmed using a trekking bike. Fifty percent of men declared using a mountain bike at the time of the accident. The accurate data is presented in Table 2.

Table 1. Characteristics of accidents

Type of injuries*	Sex				p-value
	men (n = 28)		women (n = 13)		
	n	%	n	%	
Tooth luxatio	12	43	4	31	0.693
Tooth fracture	3	11	2	15	0.930
Soft tissue injuries	12	43	7	54	0.511
Fractures of facial skeleton (mandible)	2	7	2	15	0.793
Fractures of facial skeleton (zygomaticomaxillary complex fracture)	2	7	2	15	0.793
Fractures of nasal bones	1	4	1	8	0.834
Fractures of facial skeleton	1	4	1	8	0.834
Fractures of orbital floor	1	4	–	–	0.691
Cause of injuries					0.993
Fall from a bike	20	71	10	77	
Road accident	8	29	3	23	
Coexisting injuries					0.455
Soft tissue injuries of extermities	6	21	4	31	
Fracture of radial bone	1	4	2	16	
Cases without coexisting injuries	21	75	7	53	
Brain concussion					0.691
No	19	68	8	62	
Yes	9	32	5	38	
Injuries of helmeted cyclists					0.774
No	22	79	10	77	
Yes	6	21	3	23	

* Number of injuries is bigger than the number of patients because some of them had more than one injury.

Cyclists using trekking or city bikes experienced less dental trauma than others bike users ($p < 0.05$). This is in contrast to cyclists using mountain bikes, who more often suffered because of dental trauma ($p < 0.05$). And the most common place where this type of injury occurred was a bicycle path in the city ($p < 0.05$). Traumas like soft tissue injuries most often occurred as a result of accidents on bicycle paths outside the city and, contrary to that, the most infrequent place of this injury was the roadside ($p < 0.05$) (Table 3).

Table 2. Characteristics of injuries

Categories	City		Treckking		Mountain		Road	
	n	%	n	%	n	%	n	%
Sex								
Woman	4	30.8	6	46.1	3	23.1	0	0
Man	7	25	3	10.7	14	50	4	14.3
Type of Injury								
Facial fracture	4		3		4		0	
Dental trauma	4		5		10		2	
Soft tissue injuries	4		5		8		2	
Cause of Injury								
Fall	6		7		13		4	
Collision	3		4		4		0	

Table 3. Comparison of injuries

Trekking bike			
Fracture	yes	other	
Yes	3	8	
No	8	22	$p < 0.05$
Trekking bike			
Dental trauma	yes	other	
Yes	5	16	
No	6	14	$p < 0.05$
City bike			
Dental trauma	yes	other	
Yes	4	17	
No	5	15	$p < 0.05$
Mountain bike			
Dental trauma	yes	other	
Yes	10	11	
No	7	13	$p < 0.05$
Bicycle path inside the city			
Dental trauma	yes	other	
Yes	9	12	
No	3	17	$p < 0.05$
Bicycle path inside the city			
Soft tissue injuries	yes	other	
Yes	2	17	
No	0	22	$p < 0.05$
Roadside			
Soft tissue injuries	yes	other	
Yes	1	18	
No	0	22	$p < 0.05$

Helmeted cyclists more often experienced injuries in collisions, while people cycling without helmets mostly experienced trauma because of the fall. This dependence occurred to be statistically significant ($p < 0.05$).

Also, statistically significant was the observation that patients with helmets had a lower rate of coexisting traumas ($p < 0.01$). Thirty-four percent of cyclists suffered a brain concussion. This trauma more often affected people who were not wearing a helmet at the time of the accident (37.5%), but this dependence was not statistically significant. This data is shown in Table 4.

When the cause of trauma was the road accident, people more frequently had coexisting injuries and facial fractures than in cases when people fell from the bicycle. Also, 72.7% of them had a brain concussion, which proved to be statistically significant ($p < 0.01$) (Table 5).

Table 4. Characteristics of accidents

Type of injuries*	Did cyclists wear a helmet during accident?				p-value
	no (n = 32)		yes (n = 9)		
	n	%	n	%	
Tooth luxatio	12	38	4	44	0.993
Tooth fracture	5	16	-	-	0.357
Soft tissue injuries	15	47	4	44	0.641
Fractures of facial skeleton (mandible)	2	7	2	22	0.630
Fractures of facial skeleton (zygomaticomaxillary complex fracture)	2	7	2	22	0.630
Fractures of nasal bones	2	4	-	-	0.941
Fractures of facial skeleton	2	4	-	-	0.941
Fractures of orbital floor	1	4	-	-	0.606
Cause of injuries					**0.0277**
Fall from a bike	26	81	4	44	
Road accident	6	19	5	56	
Coexisting injuries					**0.0087**
Soft tissue injuries of extermities	8	25	2	22	
Fracture of radial bone	-	-	3	34	
Cases without coexisting injuries	24	75	4	44	
Brain concussion					**0.648**
No	20	63	7	78	
Yes	12	37	2	22	

* Number of injuries is bigger than the number of patients because some of them had more than one injury.

Table 5. Correlation between the cause of the injury and observed injuries

Type of injuries*	Cause of injuries				p-value
	fall from a bike		road accident		
	n	%	n	%	
Tooth luxatio	12	40	4	36	0.881
Tooth fracture	5	17	-	-	0.365
Soft tissue injuries	16	53	3	27	0.259
Fractures of facial skeleton (mandible)	1	3	3	27	0.090
Fractures of facial skeleton (zygomaticomaxillary complex fracture)	2	7	2	18	0.612
Fractures of nasal bones	-	-	2	18	0.115
Fractures of facial skeleton	-	-	2	18	0.115
Fractures of orbital floor	-	-	1	9	0.597
Coexisting injuries					**0.448**
Soft tissue injuries of extermities	8	27	2	18	
Fracture of radial bone	1	1	2	18	
Cases without coexisting injuries	21	70	7	64	
Brain concussion					**0.0054**
No	24	80	3	27	
Yes	6	20	8	73	

* Number of injuries is bigger than the number of patients because some of them had more than one injury.

Discussion

In the a cross-sectional study that analyzed 2008–2011 years, the major group of victims of bike-related accidents in Poland were people on average aged between 20 and 40 years and 70.2% of them were male.[5] Our study also confirmed that fact – 68.3% of our patients were male in the mean age of 33.9 years. Many other researches on bicycle crashes have shown that adult males pose the major risk group.[1,2,4,14,15] The higher level of risk-taking behaviors in this group was probably caused by the young age of cyclists.[13] Accidents most often occurred when cycling for recreation or fitness purposes, which also increased the number of accidents among men as the main group of bicycles users.[1,14,16] Different concepts, possibilities and reasons for accidents occurring among participants of this sport were extensively discussed. In the case of young people, trauma can be caused by inexperience and limited knowledge of traffic rules. On the other hand, among older people it can depend on their poor vision or longer reaction time.[17]

The data of cyclists collected for study purposes consists of age, sex, helmet usage, type of injury, concussion and the type of accident. We did not collect data on the weight and height of patients, because they were not registered after every accident in the medical documentation. As with most studies based on clinical or survey data, the weight and height are rarely recorded.[15,16] It seems that they are more important in the mechanism of the accident itself and in the evaluation of the intensity of the suffered injury only at the moment of direct reconstruction of the event.[18] The correlation between the weight, height and severity of head injuries was hard to observe in other studies, because none of the authors, despite collecting this data, included this in their statistics.[15,16]

In our research of different types of injuries, dental traumas dominated, followed by soft tissue injuries and fractures of the facial skeleton (mandible, zygomatic complex, nasal bone and orbit floor fractures). We detected that a fall from a bike was a major cause of injury.

In most studies, head injuries were frequently mentioned as the primary trauma.[1,13,15] Facial skeleton fractures (mandibular, condylar fractures, dentoalveolar traumas) were the second most commonly reported types of injuries.[19] Stier et al. observed that the most commonly occurring fractures were those that concerned the nasal bone, orbital bone, zygomatic bone, maxilla and mandible.[20] Some authors also confirmed that falling is one of the major causes of injury, especially among older people.[1,21] However, most researchers regarded collisions as the main causes of accidents.[22–24] It was proved that head injuries were the main cause of hospitalization and were responsible for deaths in 69–93% of fatal bicycle accidents.[4,13] Soft

tissue injuries most frequently were caused by accidents on bicycle paths outside the city and least often appeared in accidents on the roadside. De Geus et al. confirmed that major and fatal accidents more frequently take place in less urbanized areas in contrast to urban areas.[16]

Literature data also analyzed the occurrence of a particular injury according to the type of bicycle and the place of accident. In our research we observed that men more often than women suffered accidents and they were more frequently using a mountain bike. This may possibly be due to the fact that females were less likely to demonstrate risky behavior when cycling.[25] However, older people (over 50 years old) were more likely to prefer other bikes, such as electrically assisted bicycles, city bikes and only 2% chose mountain bikes.[26]

Twenty-two percent of our study population was wearing a helmet during their accident. Most of them were men. People cycling without any safety measures were mostly injured due to a fall after losing control of their vehicles. Helmeted cyclists were most likely to be injured due to a street collision. It was found statistically significant that people wearing helmets were more likely to suffer from coexisting traumas (55.5%) then those without them (26.7%). Many other authors obtained similar results. However, the fact that the group wearing helmets was more likely to suffer from coexisting traumas can be explained by their feeling of safety and general tendency to engage in more risky behaviors. It was affirmed that other road users, i.e. car drivers would in general pass closer to a cyclist wearing a helmet, which could be an example of risk compensation. A car driver would most likely assume that a cyclist wearing a helmet has more road experience and is less likely to act erratically.[1,3,5]

In our research 37.5% of cyclists without helmets suffered from concussions as a result of their accidents, whereas only 22.2% of the population with helmets received the same injuries. The cause of concussions was statistically correlated with the type of accident. Only in 20% of cases concussions followed a fall from bike, while even 72.7% of concussions were a results of traffic crashes. The cause of injury was also an important factor in reference to the type of trauma. Collisions were most likely to cause fractures in the craniofacial region, while a fall was predominantly related with dental trauma.

The efficacy of helmets against major head trauma and facial injuries is a debatable question. There is no conclusive research about this problem. However, some authors show that there is a lack of scientific evidence that various types of helmet protect in the same way against brain injury,[27] which also makes it more difficult to evaluate their effectiveness. Rivara et al. stated that cycling with a helmet can significantly reduce the risk of fatality, but was not associated with the severity of the injury.[2] This research also confirmed our statement about the fact that a collision with a vehicle increased the risk of severe injuries.[2]

Dagher et al. noticed that cyclists without helmets had more severe traumatic brain injuries, however this observation was not statisticaly significent. On the other hand, they found that helmeted cyclist had a higher risk of polytrauma.[9]

Many studies still confirm the protective effects of helmets in the case of head and face injuries.[28–30] Amoros et al. claimed that cyclists with helmets were more frequently involved in collisions with pedestrians or bicycles and had a higher appearance of coexisting injuries in regions other than the head and face, which is similar to our results.[28]

Considering the cyclists' speed, which is very important in regards to accidents, we are not able to present this factor in our study. In Poland, speedometers are not popular bicycle gadgets, especially because of economic reasons. In the literature it is also a rarely discussed problem. This factor can be most frequently found in sponsored researches.[21,31,32] Recording such types of data is hard because of the difficult access to this information and the lack of accurate measurements of speed during the collision. Likewise, studies focusing on cyclist-car accidents for the most part include data about speed of motor vehicles – not cyclists. In relation to cyclists, it was stated that their average speed was 18.6 km/h, cyclists on mountain bikes reach 20.5 km/h, on road or racing bikes (25.5 km/h) and slower on city bicycles (17 km/h).[33] Kuehn's research emphasizes that the faster speed of cars, 51 km/h, causes more severe injuries.[33] Also, in the case of cyclists' injuries, it was observed that increased speed was not correlated with the higher possibility of head injuries. On the other hand, lower speed of vehicles resulted in a minimal amount of fatal injuries among helmeted cyclists and decreased fatality in non-helmeted cyclists.[34,35]

Conclusion

Men are a higher risk group in regards to accident. The head and face area are the body regions most exposed to injuries. People experienced more severe traumas in the case of collisions and also more frequently had brain concussions. Cyclists with helmets had more coexisting injuries. Bike users with helmets probably felt more confident on the road and demonstrated more risky behaviors, which resulted in more dangerous accidents.

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