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# PROPERTIES OF THE WHEEL-BICYCLE INJURIES IN PRESCHOOL CHILDREN

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# CECHY URAZÓW ROWEROWYCH-KOŁOWYCH U DZIECI W WIEKU PRZEDSZKOLNYM

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## SUMMARY

### Introduction

Among the bicycle related injuries there is special category of trauma, which is obtained when the leg of a child falls between wheel and fork. A child gets injured while riding on the frame or the trunk without a special seat. Not only extensive injury but also fractures of the long bones may occur. The average duration of treatment in the hospital with this pathology greatly exceeds the average duration of treatment of other trauma.

Minimal changes in the social and technical sphere can lead appearing of new types of injuries or to increasing the number of infrequently occurring injuries. The number of bicycle-wheel injuries has increased in recent years. These injuries need the long-term treatment. It requires the preventive actions. Bicycle is a very popular way of transportation and recreation in children, but it can be a source of serious damage.

### Aim

The aim of our study was to determine the prevalence and importance of the bicycle-wheel related injuries among other injuries in children.

## STRESZCZENIE

### Wstęp

Wśród urazów rowerowych istnieje specjalna kategoria – uszkodzenie, które powstaje, gdy noga dziecka znajdzie się między kołem a widelcem. Dziecko zostaje ranne podczas jazdy na ramie lub bagażniku bez specjalnego fotelika. Mogą wystąpić nie tylko rozległe obrażenia, ale złamania kości długich. Analizie poddano 20 przypadków takiego urazu, które były leczone w okresie kwiecień-wrzesień 2015 u 8 chłopców i 12 dziewcząt, średni wiek wynosił 4,4. Średni czas leczenia w szpitalu tej patologii znacznie przekracza średni czas trwania leczenia innego urazu.

Nawet niewielkie zmiany techniczacyjne i społeczne mogą prowadzić do wystąpienia nowego rodzaju urazów lub do zwiększenia liczby urazów rzadko występujących. Ilość urazów rowerowych wzrosła w ostatnich latach. Wymaga to aktywnych działań zapobiegawczych.

### Cel

Celem badania było określenie częstości występowania i następstw urazu rowerowego na tle innych urazów u dzieci.

## Materials and methods

There were analyzed 428 cases of children with different bicycle-related injuries turned to the emergency room in April – September of 2015.

We analyzed 20 cases of specific wheel-leg trauma that were treated in April-September of 2015 in 8 boys and 12 girls in Department and Clinic of Traumatology and Orthopaedics which the average age was 4.4. Method – epidemiological observational research – ecological study.

## Results

In 80% of cases the injury was on the external surface of the ankle, in 20% on internal surface, and in 50% on the posterior surface of the heel. In most cases, besides the main injury, multiple compressions of the leg and foot were observed. Significant number of children (45%) had fractures of the leg in the lower and middle third. One child had compression fracture of the heel.

Cast with padding was used in treatment of all fractures. Ointment dressings were applied in cases of the soft tissue injuries. Necrectomy was performed in 8 cases, skin grafting was not necessary.

## Conclusions

The average duration of treatment in the hospital with this pathology greatly exceeds the average duration of treatment with other trauma. Common average duration of treatment with other trauma in 2015 year was 9.2 days and with this pathology at 14.3 days.

**Keywords:** bicycle-related injury, special category, new type of injury, preschool child, duration of treatment.

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## Materiał i metody

Analizowano przypadki dzieci (N=428) z różnymi urazami rowerowymi, które skierowano do izby przyjęć szpitalnych w okresie od kwietnia do września 2015 roku.

Przeanalizowano 20 konkretnych przypadków urazów rowerowo-kołowych, którzy byli hospitalizowani w Klinice Traumatologii i Ortopedii w 2015 roku u dzieci w wieku średnio 4,4 roku życia.

## Wyniki

W 80% przypadków stwierdzono uszkodzenia zewnętrznej powierzchni stawu skokowego, 20% powierzchni wewnętrznej, a 50% w tylnej powierzchni pięty. W większości przypadków, oprócz głównego uszkodzenia, obserwowano wiele przypadków kompresji stopy i goleni. Znacząca ilość dzieci (45%) miała złamania kości piszczelowej w części dystalnej i 1/3 długości. Jedno dziecko miało złamanie kompresyjne pięty.

W leczeniu złamań zastosowano bandaże gipsowy, lub bandaże z maścią w przypadkach urazów tkanek miękkich. Usunięcie tkanki martwej przeprowadzono w ośmiu przypadkach, przeszczep skóry nie był potrzebny.

## Wnioski

Średni czas leczenia w szpitalu tych urazów znacznie przekracza średni czas trwania leczenia z innego urazu. Średni czas trwania leczenia innego urazu w 2015 roku wynosił 9,2 dni, tej patologii – 14,3 dni.

**Słowa kluczowe:** uraz rowerowy, nowy rodzaj urazu, dziecko w wieku przedszkolnym, czas leczenia szpitalnego

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## Introduction

The bicycle's invention has had an enormous effect on society, both in terms of culture and of advancing modern industrial methods.

The great majority of today's bicycles have a frame with upright seating that looks much like the first chain-driven bike. These upright bicycles almost always feature the diamond frame, a truss consisting of two triangles: the front triangle and the rear triangle.

Bicycle is a very popular way of transportation and recreation in children, but it can be a source of serious damage.

Bicycling injuries can be classified into bicycle contact, traumatic, and overuse injuries (Silberman 2013).

Most injuries are associated with riding at high speed, most serious injuries and fatalities result from *collisions with motor vehicles* (Ng *et al.* 2001). The majority of cyclist casualties are adults, with approximately 11% being children. Cycling accidents increase as children grow older, with 10 to 15 year old riders being more at risk than other age groups, including adults until about the age of 60 years. To some extent, this reflects increased cycling as children grow older followed by a switch to motorized transport from the late teens onwards. It also coincides with the age when children attend secondary school and may start to indicate riskier behavior.

Most cycling accidents happen in urban areas where most cycling takes place. Almost two thirds of cyclists killed or seriously injured were involved in collisions at, or near, a road junction, with T-junctions being the most commonly involved. Roundabouts are particularly dangerous junctions for cyclists. Not surprisingly, the severity of injuries suffered by cyclists increases with the speed limit, meaning that riders are more likely to suffer serious or fatal injuries on higher speed roads. Almost half of cyclist deaths occur on rural roads.

More cycle accidents occur during the spring and summer months (May to

September) than the autumn and winter months (October to April). However, the casualty rate in terms of miles travelled is higher over the autumn and winter period.

Crashes involving children – overwhelming involvement of children under the age of 14 – accounted for 38.7% of all crashes (Hansen *et al.* 2005). Note that in these categories, the bicyclist made the primary error and the motorist had insufficient time to adjust and avoid a collision. These bicyclist errors were often the result of inexperience and improper or deficient bicycle training and education. Many crashes occurred in residential neighborhoods, where children with poor bicycle skills have little fear of riding (Bicycle – Motor Vehicle Crashes – Cornell University).

*Bicycle-related head injuries* are responsible for most fatalities and long-term disabilities. Children and adolescents continue to ride bicycles without wearing helmets, resulting in severe head and facial injuries and mortality (Powell *et al.* 1997; Kaushik *et al.* 2015). Educational campaigns, provider counseling, and mandatory helmet legislation may encourage helmet use and reduce bicycle-related head injuries.

*Overuse injuries* may contribute to a variety of musculoskeletal complaints, compression neuropathies, perineal and genital complaints (Thompson *et al.* 2001). These include:

1. Cervical and upper back pain.
2. Low back pain.
3. Strains and sprains of the calf muscles.
4. Achilles and Patella tendinitis.
5. Strains of the quadriceps and hamstring muscles (Welch 2015).

However, among the bicycle injuries there is a special category – *damage, which are obtained when leg of a child falls between wheel and fork*. This damage occurs when adult driving on a utility bike. A child gets injured while riding on the frame or the trunk without special seat. Not only extensive damage but fractures of the long bones



**Figure 1.** Photographs and X-rays which present the typical damages in bicycle-wheel injuries.

occur (Figure 1). In recent years, the number of such injuries has increased significantly and amounted to 8% of all bicycle relates injuries.

#### Aim

The aim of our study was to determine the prevalence and importance of the bicycle-wheel injury among other injuries in children.

#### Materials and methods

In our study we used data received from Emergency Department and Department of Orthopaedic and Traumatology on the base of Mogilev Regional Children's Hospital.

Mogilev region population is about 1 million people. Children (N=428) with different bicycle-related injuries were turned to the emergency room in April – September of 2015 in sum.

We analyzed 20 cases of specific wheel-leg trauma that were treated in orthopaedic and traumatology department in 2015, 8 boys and 12 girls (40% and 50%). The average age was 4.4, 65% families lived in Mogilev, other – in Mogilev district and Mogilev region (Table 1).

**Table1.** Patients distribution by gender, age and dwelling place (preliminary sample).

Patient	Gender	Age	Address
1.	Female	4	Mogilev
2.	Male	3	Mogilev
3.	Female	4	Mogilev
4.	Female	3	Mogilev district
5.	Female	4	Mogilev
6.	Male	4	Mogilev
7.	Female	3	Mogilev
8.	Male	3	Mogilev
9.	Male	5	Mogilev region
10.	Male	4	Mogilev
11.	Female	8	Mogilev
12.	Female	8	Mogilev
13.	Female	4	Mogilev
14.	Male	4	Mogilev district
15.	Female	4	Mogilev
16.	Female	4	Mogilev region
17.	Female	5	Mogilev region
18.	Male	5	Mogilev
19.	Male	4	Mogilev region
20.	Female	4	Mogilev region
<b>Average</b>		<b>4.35</b>	



## Results

In 80% of cases damage was on the external surface of the ankle, in 20% – on internal, and in 50% – on the posterior surface of the heel. In most cases besides the main damage multiple compressions of the leg and foot were observed. Forty five percent of children had fractures of the leg in the lower and middle third. Eight fractures of tibia, 7 fractures of fibula. One child had compression fracture of the heel.

Cast with padding used in treating all fractures (Figure 3). “Window” in the cast needed for dressing. Ointment dressings were applied on the soft tissue damage. Necrectomy was performed in 8 cases, skin grafting was not need. In 1 case we used closed reduction and pin fixation of tibia fracture. In the second case (Figure 4) we used skeletal traction for treating displaced comminuted fractures of the tibia and fibula. In other cases displaced fractures treated by



**Figure 2.** Extensive soft-tissue damage and fracture of the tibia.

Case 14. Patient R., boy, 4 y.o., his right leg felt between wheel and fork while riding on the bicycle trunk. Extensive soft-tissue component on the external and posterior surface of the ankle. Oblique fracture of the tibia at the lower third with satisfactory standing fragments. Duration of treatment in department – 21 day.

closed reduction and plaster cast fixation (Table 2).

Case 20. Patient U., boy, 4 years old. His right leg felt between wheel and fork while riding on the bicycle frame. Soft-tissue component on the external surface of the leg, comminuted displaced fracture of the both bones (Figure 4, left picture). Skeletal



**Figure 3.** Cast with padding and „window” in it.



**Figure 4.** Soft-tissue damage, tibia and fibula fractures. Treating by skeletal traction.

**Table 2.** Soft-tissue damage characteristic.

Patient	Soft tissue damage				Bone fracture		Necrectomy
	Intenal	External	Posterior	Tibia	Fibula	Heel	
1.	-	+	+	-	-	-	+
2.	-	-	+	-	-	-	-
3.	-	+	+	+	+	-	+
4.	+	+	-	-	-	-	-
5.	-	+	+	-	-	-	+
6.	-	+	-	-	-	-	-
7.	-	+	-	-	-	-	+
8.	-	-	+	-	-	-	-
9.	+	+	+	+	-	-	+
10.	-	+	-	+	-	-	-
11.	+	-	-	+	+	-	-
12.	-	+	+	-	-	-	+
13.	+	-	+	-	-	-	-
14.	-	+	-	+	+	-	-
15.	-	+	+	-	-	-	+
16.	-	+	-	+	+	-	-
17.	-	+	+	-	+	+	+
18.	-	+	-	-	-	-	-
19.	-	+	-	+	+	-	-
20.	-	+	-	+	+	-	-
<b>Total</b>	<b>4</b>	<b>16</b>	<b>10</b>	<b>8</b>	<b>7</b>	<b>1</b>	<b>8</b>

traction was used. Duration of treatment in the department – 24 days. Displacement of fracture was reduced (right picture).

### Discussion

In literature there are a lot of information about falling from bicycle, collisions with motor vehicles, bicycle-related head injuries, overuse injuries (Powell *et al.* 1997; Ng *et al.* 2001; Hansen *et al.* 2005; Moyes *et al.* 2006; Shah *et al.* 2007; Kaushik *et al.* 2015). But there is no information about special category of damage, which we wrote about earlier. We believe that it should be a separate category in the classification of injuries because it has its own peculiarities and cannot be attributed to other categories.

When an experienced surgeon finds characteristic skin lesions in the ankle and foot, signs of damage to the ligaments, and the age of a child is from 3 to 5, it can immediately determine the mechanism of injury.

The scratches are much more severe than those obtained by other way. Diagnosis “Scratch” in this case does not reflects the severity of the injury.

The average duration of treatment in the hospital with this pathology greatly exceeds average duration of treatment with other trauma. Common average duration

of treatment with trauma in 2015 – 9.2 days and with this pathology – 14.3 days. (Table 3).

Total in Belarus there are about 1.6 million bike owners. In the capital of our country – Minsk – about 430 thousands bikes and number of bikes is growing. According to estimates by 2017 the number will rise to 500 thousand in Minsk.

**Table 3.** Duration of treatment (preliminary sample).

Patient	Duration of treatment (days)
1.	12
2.	15
3.	16
4.	13
5.	10
6.	15
7.	11
8.	13
9.	13
10.	16
11.	12
12.	14
13.	14
14.	21
15.	9
16.	14
17.	17
18.	13
19.	14
20.	24
<b>Average</b>	<b>14.3</b>

### Conclusions

Minimal changes in the social sphere can lead to appear of new types of injuries or to increasing the number of infrequently occurring injuries. The number of bicycle-wheel injuries has increased in recent years. This damage needs a long-term treatment. It requires active preventive measures.

Many bicycle-related injuries are preventable (Selbst *et al.* 1987). A children's bicycle seat is a saddle that is designed to be put on a bicycle for children to be transported in. The most common place for child bicycle seats are in the rear of the bicycle. This seat allows preventing injury mechanism we have described as the child's feet are fixed with a special device. But the price of these seats is not small. We believe that it is necessary to inform people about the consequences of children riding without these devices. This can be done by speaking on television, publishing articles in newspapers and magazines, placing information posters in public places, etc.

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