



# Pediatric Roller Shoes (Heelys) Injury in South Korea

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## Abstract

**Background:** Roller shoes (Heelys), which have one or more removable wheels embedded in each sole, allow the wearer to walk, run, or roll by shifting their weight to their heels.

**Objectives:** The aim of this study was to analyze pediatric roller shoe injuries in Korea.

**Methods:** Injury cases associated with roller shoes were collected from the consumer injury surveillance system of the Korea customer agency and analyzed.

**Results:** Questionnaire survey was conducted among 300 elementary school pupils. One hundred pediatric roller shoe wearers (RSWs) were assessed regarding whether they wore protective equipment. Among the 29 injury cases, 24 were safety accidents, and most of them were caused by falls while rolling. Hand and wrist injuries were the most common (25.0%), followed by injuries to the face, arm, and leg. Contusion was the most common type of injury (39.1%), followed by laceration and fractures. Among the 300 children surveyed, 23.0% had roller shoes. The minority of children (27.5%) reported using roller shoes alone. Most of the RSWs answered that they had the experience of rolling in multiuse facilities. The most frequently visited multiuse facilities were department stores (72.5%), followed by shopping malls, and food courts or cafes. Over half of RSWs answered that they had experienced rolling in danger zones for safety accident, and 47.8% reported experiencing accidents. About two-thirds of RSWs answered that they did not remove the wheel while walking. Most of RSWs (82.6%) indicated that they didn't wear protective equipment. Among the 100 children wearing roller shoes, 99 did not wear any kind of protective device; only one child wore a helmet, elbow protector, and knee protector.

**Conclusions:** RSWs are recommended to wear protective equipment and to be accompanied by parents. Inside commercial facilities, signs prohibiting the wearing of roller shoes should be affixed.

**Keywords:** Skating, Athletic Injuries, Accidents, Personal Protective Equipment

## 1. Background

Roller shoes (Heelys), which have one or more removable wheels embedded in each sole, allow the wearer to walk, run, or roll by shifting their weight to their heels. They were first patented in 1999, and were first launched in 2000 in the United States. Since then, they have become very popular among children all over the world (1).

In Korea, roller shoes became popular when the idolized singer Seven appeared wearing roller shoes and sang a song titled "Wajuo (please come)".

With the growing popularity of roller shoes, media reports began to raise awareness of the high risk of injury associated with this new and innovative type of shoes. However, only a few studies have investigated the injuries caused by roller shoes (1, 2).

## 2. Objectives

The aim of this study was to analyze pediatric roller shoe injuries in South Korea.

## 3. Methods

### 3.1. Analysis of Safety Accidents

From 2012 to May 2017, injury cases associated with roller shoes were collected from the consumer injury surveillance system (CISS) of the Korea customer agency and analyzed. The CISS receives data from 62 hospitals, 18 fire stations, and 1372 customer consultation networks on the basis of the framework act on customers.

### 3.2. Questionnaire Survey Among Children

A questionnaire survey was conducted among 300 elementary school pupils (152 boys, 148 girls) of year two, below the age of 8 years who lived in Seoul.

### 3.3. Inquiry Into the Wearing of Protective Equipment

At multiuse facilities in Seoul and Gyeonggi-do (department stores, parks, shopping malls), 100 children wearing roller shoes were assessed to determine whether they wore protective equipment.

## 4. Results

### 4.1. Analysis of Safety Accidents

From 2012 to 2015, no injury cases associated with roller shoes were reported. From January 2015 to May 2017, 29 injury cases were reported (5 events in 2015, 24 events in 2017).

Among them, 24 cases were safety accidents, and most of them were caused by falling while walking or rolling (23 cases, 95.8 %), as well as 1 case of collision (4.2 %). Hand and wrist injuries were most common (6 cases, 25.0 %), followed by injuries to the face (5 cases, 20.8 %), arm (4, 16.7 %), and leg (4, 16.7 %) (Table 1). Contusion was the most common type of injury (9 cases, 39.1 %), followed by laceration (6 cases, 26.1 %) and fractures (5 cases, 21.7 %) (Table 1).

**Table 1.** Location and Types of Injuries

	No. of Case(s)	Ratio (%)
<b>Location</b>		
Hand and wrist	6	25.0
Face	5	20.8
Arm	4	16.7
Leg	4	16.7
Head	2	8.3
Foot and ankle	2	8.3
Shoulder	1	4.2
Total	24	100.0
<b>Type</b>		
Contusion	9	39.1
Laceration	6	26.1
Fractures	5	21.7
Abrasion	2	8.7
Cerebral concussion	1	4.4
Total	23	100.0

**Table 2.** Places Where Roller Shoes Were Used

Place	No. of Response(s)	Ratio (%)
Park, playground	40	22.1
Shopping mall, department store	38	21.0
Apartment complex, near their home	33	18.2
Private institute	21	11.6
Food court	15	8.3
Parking lot	10	5.5
Subway station, railway station	7	3.9
School	4	2.2
Theater	3	1.7
Library	1	0.6
Other	9	4.9
Total	23	100.0

### 4.2. Questionnaire Survey Among Children

Of the 300 children, 69 (23.0 %) had roller shoes, and 231 (77.0 %) did not. Among the 69 children with roller shoes (roller shoe wearers; RSWs), 41 (59.4 %) were girls and 28 (40.6 %) were boys. Girls were significantly more likely to be RSWs than boys ( $P = 0.027$ , [Independent two samples t-test]).

The majority of children (39, 56.9 %) answered that they used roller shoes with their parents. However, 19 children (27.5 %) used them alone. The rest of them used them with their elder siblings (6, 8.7 %), or friends or younger siblings (5, 7.3 %). Most RSWs enjoyed rolling at the park or playground (40, 22.1 %), shopping mall or department stores (38, 21.0 %), and apartment complexes or near their home (33, 18.2 %) (Table 2).

Most of the RSWs answered that they had the experience rolling in multiuse facilities. The most frequently visited multiuse facilities were department stores (50, 72.5 %), shopping malls (34, 49.3 %), and food courts or cafés (39.1 %) (Table 3).

Over half of the RSWs answered that they had experienced rolling in danger zones for safety accident (crosswalk, 58 %; parking lot, 58 %; downhill, 34.8 %) (Table 4).

Among the 69 RSWs, 33 (47.8 %) answered that they had experienced safety accidents. The most frequent cause of accidents was loss of balance while rolling (14, 42.4 %), followed by slipping while walking (4, 12.1 %), and because of a wet floor (4, 12.1 %) (Table 5).

About two-thirds (45 of 69, 65.2 %) of RSWs answered that they did not remove the wheel while walking, and only one-third (24, 34.8 %) removed the wheel or pushed it into the shoes. The most frequent reason for not removing the wheel was the inconvenience of removing or attaching it

**Table 3.** Experiences of Rolling in Multiuse Facilities

Multiuse Facilities	No. (%) <sup>a</sup>		Total
	Experience	No Experience	
Department store	50 (72.5)	19 (27.5)	69 (100.0)
Shopping mall	34 (49.3)	35 (50.7)	
Food court, café	27 (39.1)	42 (60.9)	
Theater	17 (24.6)	52 (75.4)	
Subway station	12 (17.4)	57 (82.6)	
Art gallery, museum	8 (11.6)	61 (88.4)	
Railway station	7 (10.1)	62 (89.9)	
Library	6 (8.7)	63 (91.3)	

<sup>a</sup> N, number of response(s).

**Table 4.** Experience of Rolling in Danger Zones for Negligent Accident

Danger zone	No. (%) <sup>a</sup>		Total
	Experience	No experience	
Crosswalk	40 (58.0)	29 (42.0)	69 (100.0)
Parking lot	40 (58.0)	29 (42.0)	
Downhill	24 (34.8)	45 (65.2)	
Stair	18 (26.1)	51 (73.9)	
Escalator	16 (23.2)	53 (76.8)	
Roadway	12 (17.4)	57 (82.6)	
Moving walk	11 (15.9)	58 (84.1)	
Overpass	6 (8.7)	63 (91.3)	

<sup>a</sup> N, number of response(s).

**Table 5.** Cause of Accidents When Wearing Roller Shoes

Cause	No. of Response(s)	Ratio (%)
Loss of balance in rolling	14	42.4
Slip while walking	4	12.1
Wet floor	4	12.1
Sudden stop	2	6.1
Jammed pebble or sand in the wheel	2	6.1
Collided with a person	2	6.1
Rough floor, bumped into a stone	1	3.0
Could not slow down while going downhill	1	3.0
Other	3	9.1
Total	33	100.0

(12 responders), the inability to remove it alone (8), rolling while walking (4), and loss of the removing device (2).

Most of the RSWs (57, 82.6%) answered they did not wear protective equipment. Only 17.4 % (12 children) answered

that they wore protective equipment. The reasons for not using protective equipment were inconvenience (21, 36.8 %), lack of equipment (20, 35.1 %), and no reason (16, 28.1 %).

#### 4.3. Inquiry Into the Wearing of Protective Equipment

Among the 100 children wearing roller shoes, 99 % (99 children) did not wear any kind of protective device; only one child wore a helmet, elbow protector, and knee protector.

## 5. Discussion

To change from walking to rolling while using roller shoes, wearers place one foot in front of the other foot and shift their body weight backward over the wheels in the heels (crocodile stance). The skating position of roller shoes is a balanced position from which individuals tend to fall backward. This position can be maintained by contracting the hip extensors, flattening the lumbar lordosis, and pushing the shoulder and neck forward.

Hand and wrist injuries were most common (6 cases, 25.0 %), followed by injuries to the face (5 cases, 20.8 %), arm (4, 16.7 %), and leg (4, 16.7 %) (Table 1). Compared to previous studies, the present study had significantly less frequency than other studies ( $P < 0.05$ , [independent two samples t-test]) (Table 6, upper) (1-6).

In the present study, contusion was the most common type of injury (9 cases, 39.1 %), followed by laceration (6 cases, 26.1 %) and fractures (5 cases, 21.7 %) (Table 1). In most of other studies, fracture was the commonest injury caused by the roller shoes ( $P < 0.05$ , [independent two samples t-test]) (Table 6, middle) (1, 3-6).

Most RSWs enjoyed rolling at the park or playground (40, 22.1 %), shopping mall or department stores (38, 21.0 %), and apartment complexes or near their home (33, 18.2 %) (Table 2). Parks and playgrounds are used for practice because of their open spaces. Shopping malls and department stores have flat and smooth floors.

Most of the RSWs had engaged in rolling in multiuse facilities. The most frequently visited multiuse facilities were department stores (50, 72.5 %), shopping malls (34, 49.3 %), and food courts or cafés (39.1 %) (Table 4). Since many unspecified users are in multiple facilities, there is a high possibility of safety accidents, such as collisions with other pedestrians. When falling down in an indoor commercial facility, secondary damage may occur by knocking down items from a shelf. Overseas, some large markets and restaurants have signs prohibiting the wearing of roller shoes for the safety of pedestrians and children inside the facility. Crosswalks and parking lots are subject to traffic accidents due to heavy vehicular traffic. On downhill roads and stairs, slopes are steep and it is difficult to decelerate.

**Table 6.** Most Common Site, Proportion of Fractures, Wearing of Protective Equipment in Roller Shoes Injuries

Author	Year	Nation	Mean Age (y)	Area	%	No. of Children
<b>Most common site of injuries</b>						
Hwang	Present	Korea		Hand and wrist	25.0	6/24
Beach (3)	2009	USA	10.0	Upper extremity	57.3	75/131
Thing (4)	2008	UK	9.6	Hand	57.1	20/35
Aarons (5)	2008	USA	8.9	Upper extremity	94.1	16/17
Vioreanu (1)	2007	Ireland	9.6	Upper limb	86.6	58/67
Lenehan (6)	2007	Ireland	9.1	Upper limb	71.8	28/39
Oh (2)	2006	Singapore	8.8	Upper limb	97.3	36/37
<b>Proportion of fractures</b>						
Hwang	Present	Korea			21.7	5/23
Beach (3)	2009	USA	10.0		50.4	66/131
Thing (4)	2008	UK	9.6		48.6	17/35
Aarons (5)	2008	USA	8.9		100.0	17/17
Vioreanu (1)	2007	Ireland	9.6		73.1	49/67
Lenehan (6)	2007	Ireland	9.1		71.8	28/39
<b>Inquiry into the wearing of protective equipment</b>						
Hwang	Present	Korea			1.0	1/100
Thing (4)	2008	UK	9.6		0.0	0/35
Aarons (5)	2008	USA	8.9		30.8	4/13
Vioreanu (1)	2007	Ireland	9.6		0.0	0/67
Lenehan (6)	2007	Ireland	9.1		0.0	0/39

Approximately two-thirds (45 of 69, 65.2 %) of RSWs did not remove the wheel while walking, while only one-third (24, 34.8 %) removed the wheel or pushed it into the shoes. The most frequent reason for not removing the wheel was the inconvenience of removing or attaching it (12 responders), the inability of removing it alone (8), rolling while walking (4), and loss of the removing device (2).

Since roller shoes have a wheel on the heel that touches the ground, there is a high risk of falling backwards when unconsciously walking without removing the wheel. It is difficult to remove or attach the wheel using the appropriate tool or pushing the wheel while pressing the button. Therefore, it is necessary for the adult care provider to remove the wheel, not the children themselves.

Most of the RSWs (57, 82.6 %) answered they did not wear protective equipment. Only 17.4 % (12 children) claimed that they wore protective equipment. The reasons for not using protective equipment were inconvenience (12, 36.8 %), lack of equipment (20, 35.1 %), and no reason (16, 28.1 %).

Wearing protective equipment has not been emphasized in previous studies (Table 6, lower) (1, 4-6). In the

present study, among the 100 children wearing roller shoes, 99 % (99 children) did not wear any kind of protective device.

A case of extradural hematoma which required craniotomy and evacuation has been reported (6). Wearing protective gear is very important because it can prevent serious injuries in case of accidents.

It is thought that RSWs are less likely to buy protective equipment because they think of roller shoes as a kind of 'running shoes'. RSWs are recommended to wear protective equipment and to be accompanied by their parents. Inside commercial facilities, signs prohibiting the wearing of roller shoes should be affixed.

#### Footnote

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