

Acute hand and wrist injuries sustained during recreational mountain biking: a prospective study

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Abstract

Background Recreational mountain biking continues to increase in popularity and is a significant source of traumatic injury, including injuries to the hand and wrist.

Methods A prospective survey of all hand and wrist injuries sustained while participating in recreational mountain biking presenting to the emergency department at the Municipality of Whistler and the District of Squamish was conducted over a 12-month consecutive period.

Results An analysis of 765 unique emergency department visits with 1,079 distinct injuries was performed. Of these injuries, 511 were sustained to the upper limb. Injury to the metacarpal and metacarpal phalangeal joints was the most common hand injury (52) followed by proximal phalanx and proximal interphalangeal joint (20).

Conclusions Mountain biking is a frequent source of a variety of upper limb trauma, and preventative efforts are necessary to minimize the burden of these injuries.

Keywords Mountain biking · Injury · Trauma · Sports

Introduction

Since the late 1800 s, cyclists have taken their modified bicycles off-road for recreation. Mountain biking remained a fringe sport until the mid-1970s when the first production

mountain bike was sold which catapulted the sport into popularity. According to the National Bike Dealers' Association, 28.5 % of the 18.5 million bicycles sold in the USA were mountain bikes in 2008 (National Bicycle Dealers Association Annual Report).

As mountain bike technology has improved, riders and trail designers have continued to push the limits of human athleticism by building steeper trails with more obstacles, bigger jumps, and more acrobatic stunts. Not surprisingly, the sport generates a wide array of traumatic pathology. Injuries to the head, neck, dentition, spinal cord, and upper extremities have been most commonly reported [4–7, 13]. These injuries are a result of the most common fall mechanism whereby the bicycle suddenly decelerates as the front end contacts an irregularity in the trail, causing the rider to vault off the bicycle [4, 9, 11]. Excluding abrasions and contusions, fractures were the most commonly reported injuries [7–9, 11]. While the clavicle is reported to be the most frequently injured structure, the radius, scaphoid, metacarpal, and phalanges are also commonly involved [6, 7, 9].

Although there is some well-documented literature on mountain biking traumatology [2, 3, 10], most previous reports are retrospective reviews of injuries incurred in both competitive [12] and recreational participants [14]. Only recently has the issue been investigated prospectively [1]. The purpose of this investigation was to prospectively collect data on the hand and wrist injuries incurred in recreational mountain bikers.

Methods

This study was conducted at two emergency departments located in the Municipality of Whistler and the District of Squamish during 12 consecutive months. These two emergency departments were selected because of their proximity to hundreds of kilometers of cross-country, freeriding, or downhill public and fee-based off-road trails for riders of all

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abilities. A prospective survey was designed and administered to all patients presenting to the hospital emergency departments, and those sustaining hand and wrist injuries while participating in recreational mountain biking were included in the survey. The survey collected personal demographics (age, sex, experience, skill level), equipment specifics (bike type, helmet use, armor use, equipment failure), and accident mechanism (activity type, location of fall, speed, fall direction, hours of riding). Following informed consent, injury details were obtained from the chart including acuity, location, and nature of injuries. Injuries were categorized as primary, secondary, and tertiary by the attending physician correlating to the number and severity of injuries in a given patient.

At the conclusion of the 1-year period, all surveys and charts were reviewed and data was tabulated. All injuries involving the hand and wrist were examined and reported. For the purpose of categorization, “wrist” was defined as the distal ulna, distal radius, carpal bones, and associated joints. “Hand” was defined as the carpal–metacarpal joints and all structures more distal. The data was recorded counting each acute emergency visit as its own entry. Several participants had several separate incidents resulting in more than one visit to the department. Chronic injuries and re-aggravations, as well as injuries involving cars were excluded from our study. Data was summarized and reported as proportions when appropriate.

Results

During the study period, there were 765 unique emergency visits which yielded a total of 1,079 injuries. The average age of participants was 29.3 (range 16–64) years and 86 % were male. A total of 511 upper limb injuries were recorded including 114 hand and 103 wrist injuries. The 217 hand and wrist

injuries occurred in 207 patients. Self-reports of skill level resulted in 42 % self-identifying as having intermediate skills followed by 40 % as experts and 18 % as beginners. Patients had an average of 6.4 years of mountain biking experience.

The majority of mountain bikers were on full suspension downhill bikes (50 %) followed by front suspension bikes (29 %), full suspension cross-country bikes (16 %), and no suspension (3 %). Ninety-six percent of participants were wearing a helmet, and just over half (51 %) were wearing armor on their arms. Equipment failure was reported in 5 % of accidents.

Injuries occurred in the mountain bike park 73 % of the time followed by trails (18 %) and hills (5 %). At the time of accident, most riders were riding downhill (60 %). Less commonly, riders were jumping (20 %), biking on the level (10 %), doing a trick (5 %), or riding uphill (4 %). Forward falls (70 %) were most prevalent followed by sideways (24 %) and backward (2 %). The average duration of riding before injury was 2 h and 10 min.

The triage acuity score was 4 in 76 % of riders assessed. The most commonly injured hand structures were the metacarpal and metacarpal phalangeal joint (MCP) accounting for 52 of 114 injuries. The second most frequently injured hand structure was the proximal phalanx and proximal interphalangeal joint (PIP) where 20 injuries were reported. In the wrist, the scaphoid was the most common site of injury accounting for 47 of 103 injuries followed by the distal radius (26/103).

Generally, fractures were the most common diagnosis in both the hand (46/114) and the wrist (56/103). Sprains, strains, contusions, abrasions, and lacerations collectively accounted for 59/114 injuries in the hand and 46/103 injuries in the wrist. Of interest, nine dislocations were reported in joints of the hand (DIP, PIP, and MCP) while there was only one dislocation (lunate) reported in the wrist. The most common injuries

Table 1 The most common injuries for the wrist and the hand

Anatomical region	Injury type	Number of injuries	Percentage of total
Hand (<i>n</i> = 114)	Metacarpal fractures	28	26 %
	Metacarpal phalangeal joint strains	14	12 %
	Abrasion	13	11 %
	Contusion	12	11 %
	Proximal phalanx fractures	11	9 %
	Other	36	32 %
Wrist (<i>n</i> = 103)	Scaphoid fracture	25	24 %
	Distal radius fracture	14	14 %
	Sprain	12	12 %
	Combined distal radius and ulna fracture	10	10 %
	Proximal interphalangeal joint dislocation	6	6 %
	Triquetrum fracture	5	5 %
	Other	31	30 %

for the wrist and the hand are detailed in Table 1. There were also 22 patients with snuff box tenderness that had negative findings on subsequent radiographs.

Nine participants had more than one hand and wrist injury. Interesting injury combinations included one scaphoid/triquetrum fracture with a proximal phalanx fracture, one scaphoid fracture with a distal radius fracture, one combination distal radius/ulna fracture with a scaphoid fracture, one radius fracture with a triquetrum fracture, one proximal phalanx fracture with radius fracture, and one patient with bilateral scaphoid fractures.

Discussion

Mountain biking is a relatively young sport that is continually expanding in both its scope and ridership. It follows that the medical community is still working to describe and understand the injury patterns resulting from off-road accidents.

Previous retrospective studies of heterogeneous designs and study samples reported upper extremity injury rates between 24 and 45.8 % [6, 8, 11]. The predisposition for upper extremity trauma in mountain biking is further supported by our data set. We found that 511 of 1,079 (47 %) injuries involved the upper extremity. Our data also confirmed the most common mechanism to be a forward fall over the handlebars (70 %) usually while riding downhill (60 %). This mechanism of injury has been reported previously and supports our data. Multivariate analysis of factors significantly associated with the incidence of injury revealed that individuals riding uphill were 76 % less likely to sustain a traumatic injury than those riding on level or downhill courses [11]. This analysis focused on the 103 wrist and 114 hand injuries incurred by our sample of mountain biking enthusiasts over a 1-year period.

In the wrist, the scaphoid was the most commonly injured structure followed by the distal radius. An impressive 25 scaphoid fractures, 14 isolated distal radius fractures, and 10 combined distal radius and ulna fractures were reported. The high incidence of scaphoid and distal radius injuries relates to the fall mechanism. As the rider falls forward, the natural instinct is to protect ones head and neck by breaking the fall with the hands in the outstretched position. The so-called “fall on outstretched hand” or “FOOSH” mechanism is widely accepted as a common etiology of both scaphoid and distal radius fracture. Wrist injuries included the other carpal bones as well, including five isolated triquetrum fractures and one trapezium fracture. Additionally, there were several distal radius fractures that had associated carpal fractures. The presence of these multifocal injuries must be met with an increased index of suspicion for clinicians to ensure that all clinically significant injuries are identified.

A multitude of hand injuries were reported. The high proportion of fractures or dislocations including metacarpal fractures (28/114), proximal phalanx fractures (11/114), and PIP dislocations (6/114) are further evidence of the considerable forces placed on the hands during mountain bike accidents. The irregular, often rocky, trail surfaces likely contribute to the high incidence of hand injuries as the hand makes impact with the ground while the rider attempts to ease their fall. Intuitively, the use of protective gloves is sensible but no scientific data currently exists. The relatively low number of abrasions (13/114) and lacerations (5/114) probably reflects the prevalent use of protective gloves.

A review of the relevant literature estimates fracture rates between 5 and 45 % [4, 6–8, 11] of all acute mountain bike injuries. In our data set, fracture rates were higher than expected in the hand and wrist (40.4 and 54.4 %, respectively). The significant proportional representation of fractures must alert primary care physicians to the high incidence of serious hand and wrist pathology. A large number of these injuries require assessment and treatment by a physician with expertise in management of hand and wrist injuries.

Conclusion

Mountain biking has evolved to become a very popular recreational activity in many parts of the world. The exciting nature of the sport coupled with its versatility appeals to a varied population. Our study focused on the variety of injuries sustained in the hand and wrist. In our population, injuries to the distal radius, scaphoid, and metacarpal were more prevalent than expected. Fractures were the most common type of diagnosis. A high index of clinical suspicion for physicians assessing mountain bikers presenting with acute hand and wrist pain is recommended. Emphasis was also placed on the incidence of multiple clinically significant injuries found in individual patients. We advocate for the use of protective garments and the need for further research and development of equipment to reduce injury.

Conflict of interest None of the authors have any conflicts of interest to declare.

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Statement of human and animal rights

This study does not involve experimental intervention in humans or animals.

Statement of informed consent

Informed consent was obtained before any information was collected from study subjects.