

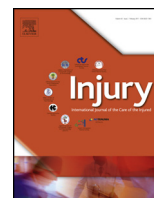


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## Major genitourinary-related bicycle trauma: Results from 20 years at a level-1 trauma center

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### ABSTRACT

**Background:** Epidemiological studies have shown that bicycle trauma is associated with genitourinary (GU) injuries. Our objective is to characterize GU-related bicycle trauma admitted to a level I trauma center.

**Materials and methods:** We queried a prospective trauma registry for bicycle injuries over a 20-year period. Patient demographics, triage data, operative interventions and hospital details were collected. **Results:** In total, 1659 patients were admitted with major bicycle trauma. Of these, 48 cases involved a GU organ, specifically the bladder (n = 7), testis (n = 6), urethra (n = 3), adrenal (n = 4) and/or kidneys (n = 36). The median age of cyclists with GU injuries was 29 (range 5–70). More men were injured versus women (35 versus 13). GU-related bicycle trauma involved a motor vehicle in 52% (25/48) of injuries. The median injury severity score for GU-related bicycle trauma was 17 (range 1–50). The median number of concomitant organ injuries was 2 (range 0–6), the most common of which was the lungs (13/48, 27%) and ribs (13/48, 27%). The majority of GU injured cyclists were admitted to an ICU (15/48, 31%) or hospital floor (12/48, 25%). Operative intervention for a GU-related trauma was low (12/48, 25%). The most common GU organ injured was the kidney (36/48, 75%) however most were managed nonoperatively (33/36, 92%). Bladder injuries most often required operative intervention (6/7, 86%). Mortality following GU-related bicycle trauma was low (2/48, 4%).

**Conclusions:** In a large series of bicycle trauma, GU organs were injured in 3% of cases. The majority of cases were managed non-operatively and mortality was low.

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### Introduction

Bicycle riding is associated with numerous health benefits including improvement in cardiovascular health, diabetic glucose control and depression [1,2]. Recreational cycling, bike-sharing programs, and commuter-cycling have all recently increased [3].

Nationally, 1% of the country utilizes a bicycle to commute to work [4]. Within San Francisco, over 3% of inhabitants cycle daily [5]. This is in part due to improvements in cycling infrastructure and community support. Many cyclists, however, are inhibited from daily riding due to heavy automobile traffic and a lack of bike lanes [6].

As society works to improve sustainability for cycling nationwide, a better understanding of the health and safety of cyclists is warranted. In 2013, there were 743 cyclists killed in the United States (U.S.), which is a 19% increase in fatality since 2010 [7]. In the same year, it was estimated that 48,000 cycling injuries were associated with a motor vehicle [8]. As a result, hospital admissions for bicycle injuries have increased by 120% from 1998 to 2013 [9] and cycling is 12 times more fatal compared to automotive riding [10]. An estimated \$4 billion dollars per year is spent on healthcare associated with bicycle injuries [11]. Consequences of bicycle

**Abbreviations:** ZSFG, Zuckerberg San Francisco General; GU, genitourinary.  
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injuries include persistent disability, cognitive and behavioral changes, and prolonged leaves of absence from work [12]. Cycling injuries do not spare single organs and are associated with multiple traumatic orthopedic and intra-abdominal injuries, including gastrointestinal, reproductive, and genitourinary injuries [13]. Bicycle-related trauma is the most common cause of genitourinary (GU) injury presenting to U.S. Emergency Departments (ED) [14].

Given the increasing popularity of cycling and the associated increased risks of injury, we aim to characterize GU cycling injuries presenting to a single-center, inner-city, Level 1 trauma center. To date, only national data sets have explored GU-related cycling injuries and fail to report on specific, patient-centric details such as operative interventions and outcomes. Our objective is to characterize the management of GU-related bicycle trauma admitted to Zuckerberg San Francisco General (ZSFG) over a 20-year period.

**Materials and methods**

*Population and study design*

ZSFG is San Francisco’s only Level I trauma center for the city of San Francisco and Northern San Mateo county. All trauma patients who are admitted to ZSFG are entered into a prospective, longitudinal trauma disease registry [5]. We performed a retrospective chart review of cases that involved a bicycle injury. These cases were identified using International Classification of Diseases–9th Revision (ICD-9) external cause of injury codes which included: (810.6, 811.6, 812.6, 813.6, 814.6, 815.6, 816.6, 817.6, 818.6, 819.6, 826.1) to select for bicycle injuries. GU cases were identified using ICD-9 codes for the kidney (866), ureter (867.2, 867.3), bladder and urethra (867.0, 867.1), penis (878.0, 878.1), and testes and scrotum (878.2, 878.3). From January 1995 to March 2015, 32,250 trauma patients were admitted to ZSFG and 1659 had major bicycle trauma. Of these, 48 (3%) cases involved a GU organ. (Fig. 1) The Institutional Review Board at the University of California San Francisco approved this study.

*Definitions of variables*

Variables collected included demographic, triage data, operative interventions and hospital course details. Specifically, we recorded patient age, date of accident, location of accident (street versus sports-related/recreational), helmet usage (yes versus no) and pre-hospital transportation mode (ambulance versus walk-in). Helmet usage was consistently recorded during the primary trauma survey and in patient transfer from ambulance to trauma bay. External cause of injury codes were utilized to classify how

cyclists were injured: (813.6—motor vehicle versus pedal cyclist or 826.1—road versus pedal cyclist).

On arrival to the ED, initial vital signs, Injury Severity Scores (ISS), Glasgow Coma Scales, and transfusion requirement(s). Hospital admission was defined as greater than 23-h length of stay.

Renal injuries were graded according the American Association of the Surgery of Trauma (AAST) staging system [15]. We collected intraoperative details for all surgical cases including the type of surgery performed (e.g. primary repair versus removal of affected organ). Bladder injuries were categorized as intraperitoneal or extraperitoneal and testicular injuries were categorized if violation of the tunica albuginea occurred. The associated concomitant injuries were also recorded (e.g. lung, ribs, liver, pelvis, spine, spleen, brain, and bowel).

Patient outcomes including postoperative disposition (e.g. intensive care unit, step down unit, or floor), date of discharge, and length of hospital stay were tabulated. The location(s) of hospital discharge (home, hospital transfer, skilled nursing facility, or rehabilitation facility) were also captured. We recorded if patients died secondary to their trauma within 30 days of injury. Comparisons were made between patients who had a GU injury and underwent operative intervention versus those that were managed conservatively.

*Statistical analysis*

We used descriptive statistics to report frequencies and prevalence of GU-related bicycle injuries. All analysis was performed using STATA v11 (College Station, TX, USA).

**Results**

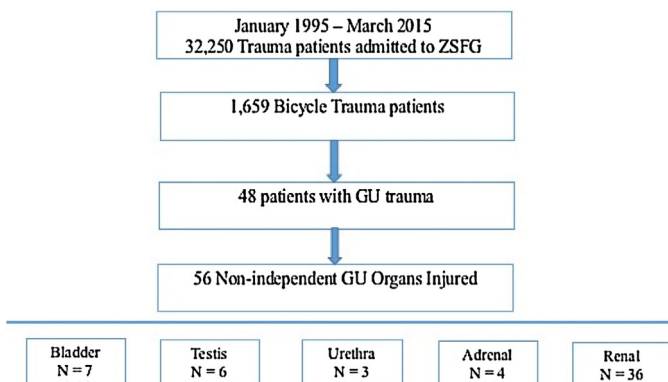
*Baseline demographics of GU-related bicycle trauma*

Of the 48 GU-related bicycle traumas admitted to the hospital, the kidneys (n = 36), bladder (n = 7), testis (n = 6), urethra (n = 3), and/or adrenal (n = 4) were involved. The demographic data of patients with GU-related bicycle trauma is shown in Table 1. The median age of cyclists with GU injuries was 29 (range 5–70). There were 4 pediatric patients under 18 years.

More men were injured versus women (35 versus 13). All GU-related bicycle trauma occurred on a street meanwhile only 29% (14/48) of riders reported wearing a helmet. GU-related bicycle trauma involved a motor vehicle in 52% (25/48) of injuries. The median ISS for our cohort was 17 (range 1–50). The median ISS for pediatric patients was 29.5 (range 14–45). The median number

**Table 1**  
Baseline Demographic Features of GU Injuries Associated with Cycling Admitted to ZSFG; January 1995–March 2015.

	GU Injuries
	N = 48 (%) or (median (range))
Age	29 (5–70)
Gender	
Male	35 (73)
Female	13 (27)
Type of Accident	
Cyclist vs. Car	25 (52)
Isolated cyclist	23 (48)
Accident site	
Street	46 (100)
Recreation/Sport	0
Helmet worn	
Yes	14 (29)
Injury Severity Score (median, range)	17 (1–50)



**Fig. 1.** GU-related bicycle trauma presenting to ZSFG.

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