The Journal of Emergency Medicine, Vol. 47, No. 3, pp. 259–267, 2014

0736-4679/$ - see front matter

ELSEVIER

http://dx.doi.org/10.1016/j.jemermed.2014.04.028

Original Contributions

EMERGENCY DEPARTMENT MANAGEMENT AND FOLLOW-UP OF CHILDREN WITH BICYCLE SPOKE INJURIES

Gordon Chu, MSC,* Laura Vlok, BSC,* Carlijn Zwaag-Pijls, MD,* Christine M. Houser, MD, MPHIL,† and Bas de Groot, MD, PHD*

*Leiden University Medical Centre, Leiden, the Netherlands and †Erasmus Medical Center, Rotterdam, the Netherlands
Reprint Address: Bas de Groot, MD, PHD, Department of Emergency Medicine, Leiden University Medical Centre, Albinusdreef 2, Postbus 9600, RC Leiden 2300, the Netherlands

□ **Abstract—Background: Evidence for a standard x-ray study and cast immobilization in emergency department (ED) management and follow-up of children with bicycle spoke injury (BSI) is absent. Objective: To describe the injury pattern and outpatient follow-up and care of ED patients with BSI. In addition, patient characteristics predicting the presence of a fracture and long-term follow-up were assessed. Methods: This was a retrospective study including BSI patients < 9 years of age. Kruskal-Wallis test was used to compare groups with a fracture, soft tissue injury, and mild skin abrasion. Multivariable logistic regression analysis was used to identify independent predictors of a fracture and long-term outpatient follow-up. Results: Twenty-three percent of 141 included patients had a fracture, with a median (interquartile range) follow-up of 27 (23–40) days. For soft tissue injury and mild abrasions this was 9 (6–14) and 7 (5–9) days, respectively ($p < 0.001$). No clinical variables could predict a fracture. Fifty-six (40%) patients required no further care after the first outpatient visit at ~1 week. Triage category yellow and swelling were independent predictors for more than one outpatient visit, besides presence of fracture. Corrected odds ratios (95% confidence interval) were 2.42 (0.99–5.88) and 4.76 (1.38–16.39), respectively. Only 12% of 141 patients had none of these predictors at ED presentation. Conclusions: A quarter of ED patients with BSI have a fracture with no clinical signs that could predict the presence of a fracture, justifying a standard x-ray study in ED management. Only 12% of ED patients with BSI have no fracture and no signs that predict long-term follow-up. In this group, further studies are warranted to investigate the benefit of cast immobilization for fractures and soft tissue injury.** © **2014 Elsevier Inc.**

□ **Keywords—spoke injury; cast immobilization; outpatient follow-up; outpatient visits**

INTRODUCTION

Bicycle spoke injuries (BSIs) are commonly seen in nations with significant bicycle riding, such as the Netherlands, China, and India (1–6). These injuries are less often seen in nations with lower rates of bicycle ridership, but still represent an important injury category because some level of recreational and practical-use bicycling is seen throughout the world, and a similar injury pattern is seen with motorcycle riding. More importantly, BSI is thought to represent a specific injury category with its own management implications (1,4,6).

BSIs occur when the foot or heel is caught between the spokes and frame of a bicycle, that is, if a child sits on the backseat of a bicycle (1). It is almost exclusively seen in young children with legs long enough to be caught between the spokes. In older children and adults, BSIs rarely occur because leg size makes entrapment unlikely and older riders usually do not sit on the backseat, but ride the bicycle themselves instead.

There are typically three aspects to the trauma of BSI: 1) Laceration of the tissue from the knife-like action of

RECEIVED: 28 May 2013; FINAL SUBMISSION RECEIVED: 3 February 2014;
ACCEPTED: 28 April 2014

the spokes, 2) crushing from the impingement of the wheel and frame of the bicycle, and 3) shearing injury from the coefficient of these two forces (7). In the Netherlands, 4200 children younger than 13 years of age are treated annually in the emergency department (ED) for BSI, correspondent with an incidence of ~25 per 100,000 Dutch citizens per year, which comprises 53% of all traffic accident-related ED visits in this age category. The financial burden is 2.7 million euros annually (3).

Current ED management of BSI in the Netherlands generally consists of clinical evaluation, an x-ray study of the ankle/foot and lower leg, and a plaster splint for at least 1 week, regardless of injury severity and x-ray study results. However, this management is based on studies with a limited level of evidence and sometimes, only expert opinion (1–8). To the best of our knowledge, common practice in other health care systems is largely undescribed. The rationale behind the management is that the splint will reduce pain and swelling, and support healing of Salter Harris 1 fractures, if present (9). Only one equine animal study, however, suggests that wounds heal faster when immobilized with a cast as opposed to a bandage (10). Some experts believe casting with the foot at 90° is also important to prevent development of a pes equinus.

Although it is possible that the current ED management has its merits, it has several disadvantages as well. In addition to the associated costs, x-rays can be harmful, especially in children. Plaster casts of the lower leg are uncomfortable and could be a source of infection, deep vein thrombosis, atrophy, dehabilitation, and extended time until regaining functional capacity as well (10–15). Furthermore, caretakers have trouble with hygiene and transport of the child, and need to take work leave for outpatient follow-up appointments, especially in countries where distances to hospitals are substantial. Consequently, acquisition of x-ray studies, application of plaster splints, and significant follow-up should be utilized only in patients with a clear evidence-based indication for this management.

Due to this lack of evidence of management of BSI, the present study aimed to provide a detailed description of Dutch ED management of BSI in a university medical center, as a first preliminary step to finding opportunities for a more structural and evidence-based approach to this specific type of injury, which could then be investigated in future studies. For example, a randomized controlled trial evaluating the efficacy of the strongly embedded current ED management is not likely to receive medical ethics approval unless the present study demonstrates that subgroups exist in whom it would be ethical to investigate various management strategies.

Sufficient numbers of BSIs make the Dutch health care system suitable for collection of evidence, which would be beneficial for other countries with BSIs.

The purpose of the present study is twofold. First, to familiarize health care providers in EDs with limited exposure to BSI with the injury patterns and currently performed care for those injuries, and secondly, to identify objective clinical signs that predict the presence of a fracture and long-term follow-up.

MATERIALS AND METHODS

Study Design and Setting

This was a retrospective chart review study in the ED of a University Medical Centre. The ED has an annual census of approximately 30,000 patients.

Study Population

All ED patients younger than 9 years old who had a lower leg, ankle, or foot x-ray study in the period January 1, 2009 to January 1, 2011, were screened for eligibility, because these were expected to represent the majority of patients with this specific type of injury in the Netherlands (3).

In addition, as a double check, all ED patients younger than 9 years of age with a diagnosis code of wound, contusion, and distortion of the foot or ankle were screened for eligibility.

The patient records were evaluated from the initial ED visit until final completion of care in the outpatient department. Approval from the University Medical Centre ethics committee was not required due to the observational character of the chart review.

Data Collection and Measurements

Data were collected from the digital hospital information system (Chipsoft, Amsterdam, Netherlands) and written patient files. A medical student was trained prior to data extraction in how to collect the data: a standard collection sheet was developed in Excel (Microsoft Office 2003; Microsoft Corporation, Redmond, WA) with the definition of the variables that had to be extracted from the medical files (see below for exact variable definitions). During the data collection process, the study coordinator (BdG) and the medical student (LV) weekly discussed the progress with data extraction, and it was checked if data were still collected according to predefined variable definitions, by analysis of a sample of charts together with the medical student. Due to the largely descriptive nature of the study, the medical student was not blinded to the study question. One additional independent data abstractor (GC) reviewed 42 of the included patients to assess inter-rater variability.

Independent Variables

Demographic data, triage category, and clinical and radiological data were collected as described below, in addition to the