The Jet Ski Open-Book Pelvic Fracture: Diagnosis with Multidetector CT

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I. ABSTRACT

A 10-year-old girl sustained a traumatic open-book pelvic fracture from a straddle injury in a jet ski accident. Plain films and computed tomography (CT) both demonstrated diastasis of the symphysis pubis and bilateral widening of the sacroiliac joints. The open-book fracture resulted from the patient striking the steering column of the watercraft during a deceleration accident. The unusual cause of this injury is of clinical interest because with increasing popularity of personal watercraft and changes in the design of these vehicles, the incidence and prevalence of this type of injury may increase in the future.

Key words: Open-book pelvic fracture; diastasis of pubic symphysis; personal watercraft; CT; 3DCT.

II. INTRODUCTION

Personal watercraft are involved in a higher percentage of reported boating accidents than drunk drivers are in car accidents. Equally surprising, these watercraft are involved in 55% of all reported collisions between boats even though personal watercraft account for less than 10% of all water vehicles. These and other staggering statistics regarding personal watercraft safety were reported in Hostile Waters: The Impacts of Personal Watercraft Use on Waterway Recreation [1]. This report is a comprehensive study by the American Canoe Association which analyzed water vehicle accident data collected between 1996 and 2000 by the United States Coast Guard and the state boating agencies.

The increasing use of personal watercraft by novices such as tourists and youths is apt to cause an increase in accidents in the day-to-day operation of such vehicles. In this communication, we report a case of an open-book pelvic fracture sustained by a 10-year-
old girl in her first outing on a jet ski.

III. Case Report

A 10-year-old girl vacationing with her family was injured in a deceleration accident involving a jet ski. On her first attempt to ride the vehicle, her personal watercraft struck a boulder. She was reported to be riding at approximately 30 miles per hour at the time of the crash. The force of the impact propelled her forward toward the steering column. With her legs astride, the anterior aspect of her pelvis struck the steering column bending the column while her head struck the handle bars. She was not thrown from the vehicle and she did not lose consciousness. She was initially taken to a small community hospital where her chief complaint was pelvic pain. Plain films and CT scans of the abdomen and pelvis revealed a pelvic fracture. A pelvic binder was applied, and she was flown by helicopter to our Level 1 Trauma Center.

On physical exam, she was afebrile with a pulse rate of 91 beats per minute, a blood pressure of 116/56 mmHg, a respiration rate of 20 breaths per minute, and an oxygen saturation level of 100% on room air. She was alert and oriented to time, place, and person. Head and neck examination showed a right supraorbital laceration with non-tender cervical spine. The abdomen was soft, non-distended with mild suprapubic tenderness. The pelvis was unstable and very tender to palpation, but no lacerations were noted. She had decreased rectal tone and was guaiac negative. No deformities or abnormalities were noted on the extremities. Femoral pulses were 2+ bilaterally. Her Glasgow Coma Scale was 15. The patient’s white blood count was 21.6 th/cmm and her hematocrit was 29.4%.

Initial radiographic examination included a trauma series which showed a normal cervi-
cal spine and a normal anteroposterior (AP) chest radiograph. The AP view of the pelvis (Fig. 1) demonstrated diastasis of the symphysis pubis and widening of the sacroiliac joints bilaterally. There was irregular lucency in the inferior pubic rami bilaterally, consistent with fractures. A right acetabular fracture can also be seen. Contrast material is seen within a tear-drop shaped bladder from intravenous contrast given prior to this examination at the referring hospital. The tear-drop shaped bladder resulted from the bilateral pelvic hematoma that she suffered.

To further characterize the extent of the injury, the patient underwent CT examination of the abdomen and pelvis with GE Lightspeed multidetector CT scanner (GE Medical Systems, Milwaukee, Wisconsin). The patient was given oral but not intravenous contrast because the patient had already received intravenous contrast several hours prior to the study at the referring hospital. The protocol for the study was as follows: 4 × 2.5 mm detector configuration with 5 mm thick slices at 5 mm intervals. The data was then reformated to 2.5 mm thick slices at 1 mm intervals for coronal and sagittal reformations. These images were reviewed on PACS.

The axial CT images (Fig. 2) showed bilateral inferior pubic ramus fractures, a fracture of the anterior right acetabulum, and a more subtle fracture of the left acetabulum. There was widening of both sacroiliac joints and of the pubic symphysis by 2.3 cm. Extensive pelvic retroperitoneal hematoma was also noted. A coronal reformation (Fig. 3) shows another view of these injuries.

To definitively rule out bladder rupture, a CT cystography was performed with retrograde instillation of bladder contrast. No bladder injury was identified. Head CT showed no evidence of skull fracture or intracranial hemorrhage.
The patient was taken to the operating room where her pelvis was externally fixed. Subsequent to the operation, she developed a large left vulvar hematoma which was evacuated. Otherwise, the patient progressed well after the surgery with only an occasional development of a high temperature and few bouts of urinary incontinence which did not appear to be due to compression of nerve roots controlling urinary function and bowel function. She was discharged to a rehabilitation center where physical therapy was to be continued.

IV. Discussion

In 1974, Kawasaki Motor Corporation introduced the personal watercraft under the name "jet ski". At the time of the introduction, these jet skis were fitted with propellers, powered by 32 horsepower engines, and capable of attaining speeds of 30 miles per hour. At that time, the design of these vehicles required the users to stand upright during operation. Now with the advent of improved technology, the designs and the capabilities of the personal watercraft have changed dramatically. Latest personal watercraft are equipped with dual gasoline driven water pumps for propulsion. With engines capable of 135 horsepower, the latest personal watercraft can achieve speeds in excess of 60 miles per hour. The majority of all personal watercraft now are the sit-down variety in which the operator rides seated much like riding a motorcycle. This new design requires less coordination and reduces the skill and training necessary to operate these vehicles. These improvements coupled with the increasing popularity of personal watercraft lead to increased use of these vehicles by inexperience individuals. Hence, it is not surprising that the incidence of personal watercraft accidents resulting in physical injury is increasing with associated
changes in the pattern of injury. We believe that one of these changes in injury pattern
is a potential increase in the incidence of pelvic fractures due to the increased number
of sit-down personal watercraft. The new design of the watercraft and the deceleration
accidents that these vehicles cause give rise to the open-book variety of the pelvic fracture.

Diastasis of the pubic symphysis is a relatively uncommon pelvic fracture caused by an
anterior compression force. The force tends to open the pelvis at the symphysis pubis
and fractures the pubic ramus in a sagittal plane. Additionally, this force causes either
unilateral or bilateral disruption of the sacroiliac joints. Widening of the sacroiliac joints
usually indicates pelvic instability. This type of injury is often referred to as the open-book
pelvic fracture [2].

Diastasis of the pubis is usually seen in unrestrained passengers in head-on
automobile collisions and in pedestrians struck from the front. However, accidents that
force the separation of the legs and the ischial tuberosities have also been recognized as
causes of this type of injury. Flynn [3] and later Mulhall et. al. [4] both described
diastasis of the pubic symphysis in horse riders who landed on the pommel of the saddle
after being thrown vertically by the bucking of the horse. Motorcyclists have also been
reported to sustain this same type of pelvic injury after hitting the petrol tank during
sudden deceleration of the motorcycle [5]. An illustration of the mechanism of this type
of pelvic injury in personal watercraft operators is shown in Fig. 4.

The patient described in this communication was a young girl who was given the oppor-
tunity to propel a vehicle through the water at 30 miles an hour. It would not appear
to have been a wise decision that a 10-year-old girl be permitted access to such a powerful
and potentially dangerous vehicle.
V. Figure Legends

**Fig. 1** AP portable pelvis radiograph from initial trauma series. The findings, widening of the pubic symphysis, bilateral inferior pubic ramus fractures, and right acetabular fracture, are indicated by arrows. The pubic symphysis measured 2.3 cm. Contrast material is seen within a tear-drop shaped bladder from intravenous contrast administered at the referring hospital several hours prior to this examination. The tear-drop shaped bladder reflects the presence of bilateral pelvic hematoma.

**Fig. 2** Axial CT scans of the pelvis at two different levels. The anterior right acetabulum fracture and a more subtle fracture of the left acetabulum are shown in (a). Bilateral inferior pubic rami fractures are shown in (b).

**Fig. 3** A coronal CT reformation of the pelvis showing an anterior right acetabulum fracture, a subtle left acetabulum fracture, and widening of pubic symphysis.

**Fig. 4** This illustration shows the mechanism of an open-book pelvic injury in a personal watercraft collision. The high-energy mechanical force is applied to the pelvis by the steering column.
REFERENCES


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