

Water slide injuries in Jamaica

Cary K Fletcher,¹ Derrick McDowell²

¹Department of Orthopaedic,
St Ann's Bay Regional
Hospital, St Ann's Bay, Jamaica
²St Ann's Bay Regional
Hospital, St Ann's Bay, Jamaica

Correspondence to

Dr Cary K Fletcher; c.
fletcher30@yahoo.com

The paper has been presented
at the following conferences:

1. 14th Annual Caribbean
Neurosciences Symposium
2. 21st Jamaica Orthopaedic
Association Annual
Orthopaedic Conference
2016e000008

Received 16 April 2016

Revised 18 May 2016

Accepted 14 June 2016

ABSTRACT

Background Patients are presented in this study to describe injuries, each of which have not been previously described in the literature, as a result of a specific mechanism of injury on a water slide. Some of these injuries are potentially fatal and are usually the result of a very high energy mechanism of injury. All injuries occurred in a 6-week time span in the summer of 2015.

Method Injuries arising from water slides and their definitive treatment were documented. All of the cases presented to Saint Ann's Bay Hospital in Saint Ann's Bay, Jamaica. The mechanism of injury was analyzed with a view to implement preventative measures.

Results Three cases had open book pelvic injuries and one of them also had a vaginal tear. All of the open book injuries occurred after the patron's thighs violently abducted despite adhering to the recommended starting position that suggested patrons cross their legs. The fourth case was of a 25-year-old man who sustained a posterior shoulder dislocation as a result of his arms flailing despite attempting to adhere to the rule recommending that the patron place his arms across his chest. The final case was of a 14-year-old boy who was involved in an atypical collision injury, resulting in the boy sustaining a displaced distal femoral fracture.

Conclusions Modern water slides will expose patrons to more frequent and severe injuries from atypical mechanisms of injuries. Risk factors for injury must be factored into preventative measures. Improved surveillance strategies to monitor these injuries are suggested.

BACKGROUND

Internationally, there has been a significant increase in water parks in the past two decades. Their introduction has been associated with increased numbers of traumatic cases involving different categories of injuries. These include: waterslide injuries, slips and falls on wet surfaces, and swimming pool accidents.¹ The potential for waterslide injuries tends to be underestimated by physicians and dentists until an outbreak occurs in a community.² The focus in this case series is to describe injuries that have not previously been described, secondary to a specific mechanism of injury from a waterslide.

METHOD

A variety of injuries occurring on a specific water slide at a popular water park in Jamaica were documented. All cases presented to the Saint Ann's Bay Regional Hospital.

RESULTS

Case 1: A 35-year-old man presented to our institution, with anterior pelvic pain after descending on a thrill slide at a water park. He was assisted out of the water and was unable to weight bear thereafter.

Significant positive examination findings were moderate painful distress, pubic tenderness and a mobile pelvis on compression. Vital signs were normal. X-rays demonstrated an 8 cm pubic diastasis (see figure 1). He was managed definitively with an external fixator (see figure 2).

Cases 2 and 3: Two women, one 23 years old and the other 37 years old, suffered the same open book injury with the same clinical features as the case 1 patron, but with one important exception—the 37-year-old also presented with bleeding per vagina. The Gynecology team diagnosed an associated vaginal laceration, which had to be repaired emergently in the operating theatre. The 23-year-old woman was transferred to another institution for private care. The other woman was managed definitively with open reduction, and plate and screw fixation (see figure 3).

Case 4: A 25-year-old man had significant flailing of his upper limbs during descent on a slide, and reported moderate left shoulder pain and an inability to move the shoulder. He was neither actively nor passively able to externally rotate the arm. X-rays confirmed a posterior shoulder dislocation (see figure 4). He was emergently managed with closed reduction under conscious sedation in the emergency room.

Case 5: A 14-year-old boy went down a slide uneventfully and then turned back to retrieve his goggles at the base of the slide. Another patron came down the slide at that time and collided with him. The boy had pain, swelling and deformity to the right thigh. His relatives took him out of the water. X-rays revealed a completely displaced distal femoral Salter-Harris II physeal fracture (see figure 5). He was definitively managed with closed reduction and K wiring (see figure 6).

All of these patients described feeling a 'thrill' as they accelerated suddenly at a particular point during descent. This portion of the slide was



Figure 1 Case 1 AP pelvis injury film. AP, anteroposterior.

To cite: Fletcher CK, McDowell D. *Trauma Surg Acute Care Open* Published Online First: [please include Day Month Year] doi:10.1136/tsaco-2016-000008



Figure 2 Case 1 post closed reduction and external fixation.



Figure 3 Post open reduction and internal fixation.

significantly vertical. The sensation at the thrill point was from hitting a bump on the slide and suddenly being propelled into the air, which led them to unintentionally lose control of their limbs whereby the thighs violently abducted and the upper limbs flailed before the patrons hit the water. Prior to going onto the slide, they were all instructed by park officials to place their arms across their chest and to cross their legs throughout descent until they hit the water. All of the above injuries took place in a span of 6 weeks.

DISCUSSION

A waterslide is a stationary recreational device designed to provide descent on a flowing water film into a splash down body of water at the base of the slide. Approximately 86% of reported water park injuries involve water slides and are usually due to the high velocity gained on a slippery slide.³ Exit velocities may potentially cause catastrophic injuries.⁴ The cases



Figure 4 Case 4 AP left shoulder injury film. AP, anteroposterior.

presented above all occurred on the same slide at a popular amusement park that has six slides. It is the largest and highest velocity slide at the park. Its dimensions are 35 feet high and 120 feet long. Generally, a thrill ride has been defined as one that attempts to fool our brain into thinking that the body is in mortal danger, which causes a considerable surge in epinephrine levels.³

The literature on waterslides is scant as well as outdated. This is especially significant considering that modern rides potentially expose patrons to more frequent and severe injuries.¹ In a prospective observational study by Soyuncu *et al*,¹ 23 waterslide injuries included 26% cases of head trauma (including 1 death), 26% spinal injuries, and 52% extremity injuries. Malpass *et al*² reported the following rates of waterslide injuries, patients sustained: lacerations (53%), contusions/abrasions (25%), fractures (7%), sprains (7%), broken teeth (6%) and concussions (3%). Most injuries occurred in the head first position. The ratio of fiberglass slides to concrete slides was 12:1.

A Washington DC amusement park reported that, from 13 July to 31 August 1984, 65 persons sought medical care in local physicians' offices and emergency rooms.⁵ These cases were reported to the County Emergency Medical Service. The rate of injury recorded by the slide operators was 8.1 per 10 000 rides, and the rate of medically treated injuries was 3.0 per 10 000.⁵ Patrons aged 5–14 years, 15–24 years, and 25 years or older, were fairly evenly distributed. The most common injuries were fractures, concussions, abrasions, sprains, and strains. Most persons were aged 15 years or older for all injuries except concussions.⁵



Figure 5 Case 5 oblique right knee injury film.



Figure 6 Case 5 post closed reduction and K-wiring AP right knee. AP, anteroposterior.

Detailed, constant computerized surveillance systems involving health centers, private practices and all hospital emergency rooms are currently not in place in Jamaica, making completely accurate injury rates and hospital admission rates a challenge. The National Electronic Injury Surveillance System Accidents Records in the USA, in 2006, recorded only one pelvic injury—a contusion.⁵ The majority of the lower limb injuries were strains and contusions.

The most common mechanism of injury in waterslides involves hitting the floor of the pool or the opposite wall as a result of entering the water at unfavorable speeds and/or positions.¹ Davis⁶ described coming down a slide rapidly, aquaplaning and hitting the opposite wall, fracturing his femur. Disobeying water park rules, for example, sliding headfirst and sliding immediately after the previous patron without an appropriate waiting period, are the other possible injury mechanisms.¹

The literature did not have any data on risk factors for injuries until the study by Paulozzi *et al*,³ where the authors found that obesity and tandem riding were major risk factors. They postulated that overweight individuals were inactive, resulting in weak musculature and leading to decreased control in their momentum. It was also noted that design changes in the slide subsequently resulted in fewer injuries.³ Of note, our patient with the open book injury and vaginal laceration was obviously overweight.

To the best of authors' knowledge, no other report in the literature describes an open book pelvic injury from a water slide. When a pelvic injury is suspected, the necessary equipment required includes a pelvic splint, scoop stretcher, and a spinal board.⁷ This was unavailable at the facility.

Lawal *et al*⁸ described a case of a 72-year-old man who was standing with his hips partially abducted while bending down—his

legs split uncontrollably after slipping. He fell and suffered anterior pelvic pain and an inability to weight-bear. The case was the first of its kind in the literature. Lawal *et al*⁸ theorized that the mechanism of injury may have been secondary to external leg rotation and abduction, or was perhaps the result of a fall leading to a significant impact exerted by the patient's body weight. It is plausible that the patients in our series had a similar mechanism of injury with one exception—the force imparted on the pelvis was due to a high velocity entry into water as opposed to the body weight in Lawal's case.

There have been very few case reports describing vaginal lacerations resulting from water slide injuries.^{9 10 12} The authors are unaware of any reports in the literature of a pelvic injury in combination with a vaginal laceration as a result of a waterslide injury. Vaginal laceration is due to very high entry impact into water. It is imperative that emergency room physicians be aware of this potential mechanism of injury because it is not uncommon for vaginal lacerations to occur without significant external injury.¹⁰ Changes in swimsuit design have been a suggested intervention in reducing genital lacerations at water parks.

Posterior shoulder dislocations are rare injuries, accounting for <2% of all shoulder dislocations.¹² The patient who suffered a posterior shoulder dislocation also lost control of his limbs once he hit 'the bump'. To the best of the authors' knowledge, this is the first recorded posterior dislocation due to a water slide injury.

Our teenage patient was the victim of a collision accident that was a bit different from the standard collision mechanism, which is generally due to a patron descending the slide too early and colliding with the patron who previously descended. The park in question did have warning signs as to appropriate behavior, appropriate conduct, and the proper starting position on the slide—protocol to be maintained throughout descent. The entry procedure is, once the lifeguard at the lower end of the

slide yells 'go', the lifeguard at the entry allows the next patron to enter. In this case, when the lifeguard yelled 'go', his head was turned away from the patron who was retrieving his goggles, at which point the patron was hit.

Ball¹³ conducted a study aimed at ascertaining the causes of interpersonal collisions on a water slide as well as to determine the adequacy of control systems and potential legal liability via a site investigation. This investigation included assessment of a traffic light controlled system, closed circuit TV, warning notices, part time supervision and patron behavior. It was concluded that, although the vast majority of patrons obeyed the safety rules, the risk of injury was still relatively high, making the facility operators vulnerable to a court ruling against them due to a failure in their duty of care. Cautious patrons may actually increase their friction thus lowering the exit velocity.⁴ These findings are particularly interesting in light of the fact that the park in Ball's study had significantly superior control systems than the park in this current case series.

Guidelines for future slides include frequent inspections and maintenance programs based on manufacturer recommendations of the slide entry, landing pool, water flow and run out levels. Appropriate staff training should be mandatory to ensure proper removal of injured patrons out of the water. Optimal dispatch time is important; therefore there must be an efficient communication system between the slide attendant and the lifeguard. Patrons must also avoid rides that are beyond their physical capability.

As a result of the increase in injuries at the park in this report, improved vigilance in terms of the nurse on duty reporting to transferred health facilities and various health facilities reporting to the regional health authority, has been put in place. Also, there are increased visitations at the park by representatives of the regional health authority. Park officials are currently trying to determine an appropriate weight limit as well as to get the offending slide assessed by international engineers specializing in water slides to determine a design modification to make the slide safer while maintaining the thrill.

CONCLUSION

With the advent of more advanced, complex rides, awareness must be increased because injuries from atypical mechanisms will occur. Improved surveillance strategies and preventative measures are of utmost importance.

Competing interests None declared.

Provenance and peer review Not commissioned; externally peer reviewed.

Open Access This is an Open Access article distributed in accordance with the Creative Commons Attribution Non Commercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited and the use is non-commercial. See: <http://creativecommons.org/licenses/by-nc/4.0/>

REFERENCES

- 1 Soyuncu S, Yigit O, Eken C, et al. Waterpark injuries. *Ulus Travma Acil Cerrahi Derg* 2009;15:500–4.
- 2 Malpass CA Jr, Schuman SH, Sobczyk R. Waterslide injuries. *Ann Emerg Med* 1981;10:36.
- 3 Paulozzi LJ, Mcknight B, Marks SD. A cluster of injuries at a water slide in Washington State. *Am J Public Health* 1986;76:284–5.
- 4 Blitvich JD, McElroy GK. Waterslide exit velocities, user behaviors and injury prevention. *Int J Inj Contr Saf Promot* 2007;14:54–6.
- 5 Centres for Disease Control. Injuries at a water slide-Washington. *MMWR Morb Mortal Wkly Rep* 1984;33:379–87.
- 6 Davies PD. Water slide aquaplaning injury. *BMJ* 1990;300:1401.
- 7 Lee C, Porter K. The prehospital management of pelvic fractures. *Emerg Med J* 2007;24:130–3.
- 8 Lawal KO, Clayson AD, Charalambous CP. Open book injury secondary to doing the splits. *BMJ* 2013;2013:pil: bcr-2012-007870.
- 9 Kosola S, Rouche H, Molander P. Vaginal water pressure injury. *Duodecim* 2010;126:181–2.
- 10 Kunkel NC. Vaginal injury from a water slide in a premenarcheal patient. *Ped Emerg Care* 1998;14:210–11.
- 11 Niv J, Lessing JB, Hartuv J, et al. Vaginal injury resulting from sliding down a water chute. *Am J Obstet Gynecol* 1992;166:930–1.
- 12 Cicalak N. Posterior dislocation of the shoulder. *J Bone Joint Surg Br* 2004;86:324–32.
- 13 Ball DJ. Some observations on waterslide injuries. *Inj Prev* 1998;4:225–7.