Case Report

Complex Pediatric "Spin Dryer" Injuries – An Uncommon Mechanism and Pattern of Synchronous Upper Limb Fractures

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Abstract

Ipsilateral humerus and forearm fractures, or 'floating elbow,' are high-energy injuries, uncommon in children and usually due to falls or motor vehicle accidents. Early models of washing machines were associated with various reports of upper extremity injuries in children, mostly occurring when the child attempted to remove clothes from a spinning machine. Some of these accidents resulted in serious injuries, including amputation, but have become considerably less common with the introduction of improved safety features in modern appliances.

We describe the successful management of a child with multiple complex upper limb fractures caused by a modern washing machine.

Keywords: Outcome of treatment, paediatric, pattern of injury, segmental fracture, washing machine

Introduction

When referring to a joint, the term 'floating' indicates a simultaneous skeletal discontinuity both proximally and distally. In the elbow, this implies a fracture of the humerus and either one or both of the ipsilateral radius and ulna. The paediatric floating elbow, first described in 1980 by Stanitski *et al*., is an uncommon injury.[1] These are high-energy injuries, usually due to falls or motor vehicular accidents, and frequently associated with neurovascular damage or compartment syndrome.

Spin dryer injuries are rare and peculiar accidents associated with old non-automated washing machines, generally resulting in shear or crush damage to the tissues. Enhanced safety features in newer models of washing machines have resulted in fewer injuries. Deliberately disabling these safety mechanisms to facilitate continuous spin function will likely result in injury, as was the case with this patient.

We report the case of a child who sustained a unique pattern of complex upper limb fractures caused by a washing machine.

Case Report

A 6-year-old boy presented to the Paediatric Emergency Department with a swollen and deformed right upper limb as a result of thrusting his hand into a functioning washing machine (Whirlpool Washer Machine Model LSQ9645KQ1, Whirlpool Corporation Benton Harbor, MI, USA) during the spin-drying cycle. Clinical examination demonstrated no neurovascular deficits, and radiographs revealed a right-sided segmental humeral fracture with associated ipsilateral segmental radius and comminuted ulna fractures [Figure 1].

He was taken to the operating theatre and using fluoroscopic control, his fractures were treated by first stabilising his humerus with a 3.0 mm flexible intramedullary nail (FIMN) introduced via the distal-lateral cortex in a retrograde fashion [Figure 2]. Attention was then directed to his radius and ulna, which were treated with 2.5 mm FIMNs. The ulna stabilised via an olecranon entry point followed by retrograde placement of the FIMN to stabilise the radius using a radial styloid entry point just proximal to the growth plate [Figure 3]. Finally, we applied a light back slab from the shoulder to the wrist to increase stability and reduce the chance of re-displacement.

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Postoperatively, he was monitored for compartment syndrome. He recovered without incident and was discharged to the outpatient clinic (OPC). At 6 weeks, radiographs demonstrated good callus formation, and under local anaesthesia, all implants were gently removed in the OPC, the patient tolerating the procedure well.

At 1 year from injury, the patient had a full range of joint movement, and radiographs showed complete healing of all fractures [Figures 4-6].

Parental informed consent was obtained for the anonymised use of the child's information in this case report.

Discussion

Most ipsilateral humerus and forearm fractures in the paediatric population are high-energy injuries, with a significant risk of neurovascular complications. These are uncommon injuries, although the true incidence remains unknown.

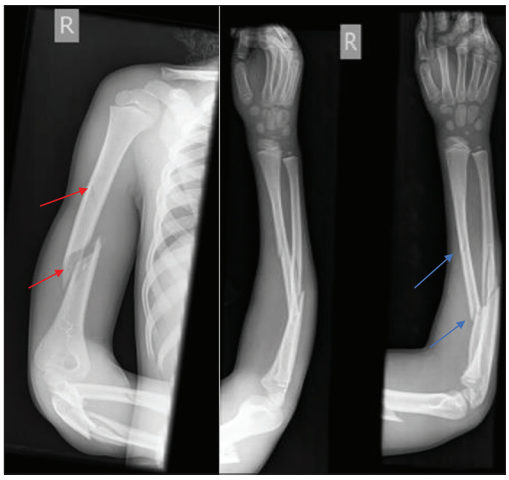


Figure 1: Initial radiographs showing fractures of the humerus and both forearm bones. Red arrows indicate the segmental humerus fracture; blue arrows-indicate the segmental radius fracture

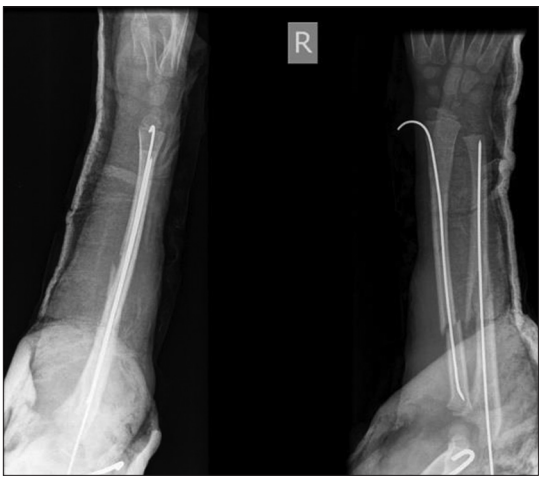


Figure 3: Orthogonal radiographs of the radius and ulna stabilised with flexible intramedullary nail

The two largest reviews on this injury, which included 31 patients in each group, indicated that most patients are male with an average age of 8.9 years (range: 2–14 years).[2,3]

Management depends on the fracture pattern and the presence of complications. Most authors recommend early operative stabilisation of the fractures, starting with the humeral injury, and report low complication rates with excellent outcomes.[2-5]

The index case fits the demographics of the classic patient with a paediatric floating elbow, although there are distinct differences in the fracture pattern that should be acknowledged. Most cases of paediatric floating elbow consist of an ipsilateral supracondylar fracture and a fracture to the distal one-third of one or both forearm bones. Our patient's injury consisted of the following: (i) segmental spiral midshaft fracture of the humerus, (ii) segmental short oblique midshaft fracture of the radius and (iii) a comminuted middle one-third fracture of the ulna. There is one single case report with an injury pattern that is similar to our case. Joshi reported a segmental fracture of the humerus (distal one-third and supracondylar) with an ipsilateral Salter–Harris II fracture of the radius and ulna.[6]



Figure 2: Orthogonal radiographs of the humerus stabilised with a flexible intramedullary nail



Figure 4: Clinical photographs demonstrating excellent restoration of forearm rotation

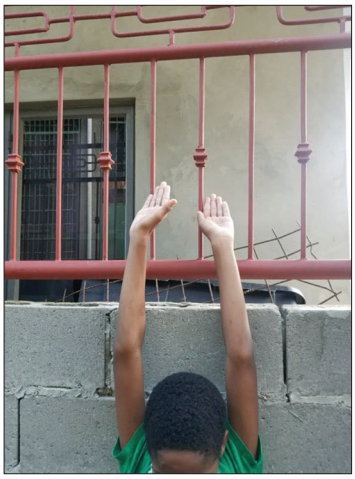


Figure 5: Clinical photograph demonstrating full abduction at the shoulder joint



Figure 6: Radiographs of the humerus and radius and ulna 1-year post injury show healing of all fractures in an acceptable position

We could find no previous reports of a case with the unique combination of fractures as seen in our patient.

Paediatric floating elbow injuries have been explained by Templeton *et al*., who postulated that based on the mechanism of injury, fractures in the proximal or middle third of the forearm would not create a sufficient moment of force to result in a fracture of the ipsilateral humerus.[7] Hence, most floating elbow injuries are a combination of distal forearm fractures and distal humerus fractures. Our case, which combines a segmental midshaft humeral fracture with a segmental fracture of the radius and middle-third ulna fracture, defies this theory. We believe that it can be attributed to the peculiar mechanism of injury, one of pure uni-directional torque associated with both direct and indirect forces as would occur when the child plunged his upper limb into the washing machine.[8,9] Reed and Apple postulated that the energy of injury is dissipated to both the bone and soft tissues. In our patient, the skeletal component of the injury was immense, resulting in multiple fractures in several bones. This may have protected the soft tissues from serious damage, reducing the possibility of neurovascular injury and compartment syndrome.[10]

A case series by Galasko in the British Medical Journal in 1972, and a commentary of support by Vickers, emphasised the risk of unrecognised soft-tissue trauma from spin dryer injuries.[8,11] Several authors have also reported the potentially devastating consequences of these injuries, including compartment syndrome, nerve injuries and amputation.[12] Our patient sustained moderate soft-tissue damage, and at no time did he exhibit any signs of acute vascular injury or impending compartment syndrome.

Modern washing machine injuries are rare, as updated safety features stop the tub from spinning when the lid is opened. In developing nations like ours, poverty and naivety can mean that safety is ignored, and appliances are often modified in violation of the manufacturers' recommendation. This is commonly found in the agricultural industry in Trinidad and Tobago, and Naraynsingh and Ramdass have reported a vascular injury caused by a missile expelled from an unshielded 'weedwacker'.[13] A top-loading washing machine was the cause in this case. The child's parent removed the cover of a top-loading washing machine and disabled the usual safety mechanism, which immediately stops tub rotation when the machine is opened. This resulted in injury to the child as he attempted to remove the clothes. Warner *et al*. analysed 496 washing machine-related injuries concluding that parental negligence was a major contributing factor; the authors advocated for better supervision of children when in areas where washing machines are in use as well as increased education of parents regarding household appliances.[14]

To the best of our knowledge, this is the first reported case of a complex paediatric upper limb injury caused by a washing machine and highlights a unique fracture pattern. The case illustrates a preventable childhood injury with possible severe and devastating consequences.

Conclusion

Domestic washing machines are superficially benign household appliances that may be associated with serious injuries in children. The pre-adolescent age group is most vulnerable. Disabling the integral safety features found in washing machines and the lack of parental supervision are major risk factors resulting in injury.

Recommendation

Modern washing machines should be tamperproof with easily visible warnings about the dangers of attempting to disable their safety features. There is also the need for parenting groups to educate parents on the dangers of leaving children unsupervised within the laundry area.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have

given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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