Firework and sparkler burns in paediatric patients

Daniel Ricciardello MBBS MS,1 Nam Kyu Yang MBBS,1 Kira Chamberlain MPH,1 Andrew JA Holland MBBS PhD FRACS(Paed)1,2

1 The Children’s Hospital at Westmead
Westmead, New South Wales
AUSTRALIA
2 The University of Sydney
Camperdown, New South Wales
AUSTRALIA

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Correspondence
Name: Daniel Ricciardello
Address: Burns Unit
The Children’s Hospital at Westmead
Cnr Hawkesbury Road and Hainsworth Street
Westmead, New South Wales, 2145
AUSTRALIA
Email: dricciardello@gmail.com
Phone: +61 (0)2 9845 0000

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Section: Burns

Abstract

Background: While the consumer sale of fireworks is illegal in New South Wales, the sale of sparklers is legal—however, both still pose a significant risk of harm in the paediatric population. Anecdotally, burns services are aware that the misuse of sparklers can result in burns but there appears to be a paucity of studies examining this incidence in the paediatric population in Australia.

Method: A retrospective review of all burns related to the use of fireworks or sparklers referred to the Children’s Hospital at Westmead (CHW) Burns Unit (BU) from January 2004 to December 2019. This study was approved by the Sydney Children’s Hospital network Human Ethics Research Committee reference 2020/ETH00398.

Results: During the 16-year study period, 96 patients were referred to the CHW BU with a burn as a result of a firework or sparkler. Sparklers accounted for 72 per cent (69) of burns, compared with 28 per cent (27) from fireworks. The mean age of those injured by sparklers was five years compared with eight years in the firework group. Average total body surface area (TBSA) affected for both mechanisms was similar—for sparkler burns (2.0%) firework burns (2.4%), with a range of 0.1–15 per cent. Hands were the most common area burnt in both groups comprising 59 per cent (41) of sparkler burns and 48 per cent (13) of firework burns. Twenty patients required a total of 32 visits to the operating theatre for acute management of their burns.

Conclusion: This study demonstrates the potential for significant injuries as a result of fireworks and sparklers. These findings can be used to raise awareness regarding their dangers, direct targeted educational campaigns and guide safety advice regarding their use.

Keywords: child, burns, burns prevention and control, explosive agents, wounds and injuries
Introduction

Fireworks and sparklers are defined as devices ‘designed for the purpose of producing a visible or audible effect by combustion, deflagration, or detonation’ and form a significant part of celebrations for many cultures around the world. Given Australia’s multicultural society these times of celebration include New Year’s Eve, Diwali and Chinese New Year. Concerns over safety have led to tight controls on the sale of fireworks to the public, with Western Australia the first state to ban the consumer sale of fireworks in 1967. This was followed by Queensland in 1972, Victoria in 1985, New South Wales in 1987, South Australia in 2001 and the Australian Capital Territory in 2009. Tasmania allows the public to purchase fireworks with a licence, and the Northern Territory allows the public sale of consumer fireworks on Territory Day without a licence. Despite this regulation, firework-related burns continue to occur in New South Wales as a result of illegally obtained fireworks in 1967. This was followed by Queensland in 1972, Victoria in 1985, New South Wales in 1987, South Australia in 2001 and the Australian Capital Territory in 2009. Tasmania allows the public to purchase fireworks with a licence, and the Northern Territory allows the public sale of consumer fireworks on Territory Day without a licence. Despite this regulation, firework-related burns continue to occur in New South Wales as a result of illegally obtained fireworks, with a number of these injuries occurring in the paediatric population.

In contrast, sparklers are easily and readily available in New South Wales as their sale is permitted given their classification as ‘shop goods’. Sparklers are made from a steel wire that is dipped into pyrotechnic slurry typically made up of a metal fuel (such as aluminium), an oxidiser (such as potassium nitrate) and a binder (such as dextrin) before it is allowed to dry. The end result is sparklers that have been reported to burn at temperatures as high as 1100°C and that remain hot once they have ceased to ‘sparkle’, with the potential to cause significant harm, especially in children. While anecdotally burns services are aware that the misuse of sparklers can result in burns, there appears to be a paucity of studies examining the incidence in the paediatric population in Australia.

The aim of this study was to determine the incidence of firework- and sparkler-related burns, the pattern of injury and outcomes in children.

Method

A retrospective study was undertaken from January 2004 to December 2019 of children referred to the Children’s Hospital at Westmead (CHW) Burns Unit (BU) with burns related to the use of fireworks or sparklers. The study cohort comprised children under the age of 16 years and included those treated as inpatients and those treated in an ambulatory care setting. There were no exclusion criteria.

Data were entered prospectively into the New South Wales state-wide Burn Injury Service (NSW SBIS) database. Information collected included patient information (age and gender), mechanism of injury, location of injury, adequacy of first aid (defined as cool running water for 20 minutes within the first three hours of the injury), presence of parental supervision, percentage total body surface area (TBSA) affected and mode of treatment (surgical or non-surgical). Descriptive statistics were used for the majority of variables.
Analysis

During the 16-year study period, 96 patients were referred to the CHW BU with a burn as a result of a firework or sparkler (Table 1). Sparklers accounted for 72 per cent (69) of burns, compared with 28 per cent (27) from fireworks. The mean age of those injured by sparklers was five years compared with eight years in the firework group. Females accounted for 48 per cent (33) of sparkler burns and 26 per cent (7) of firework burns. On 11 occasions burns were a result of the use of multiple sparklers simultaneously. While the injuries were distributed throughout the calendar year, 26 per cent (25) occurred during the Christmas/New Year period (20 December to 3 January). There was a lack of parental supervision in almost all (90%) of cases.

Average TBSA for both mechanisms was similar for sparkler burns (2%) and firework burns (2.4%), with a range of 0.1–15 per cent. Hands were the most common area burnt in both groups, comprising 59 per cent (41) of sparkler burns and 48 per cent (13) of firework burns, followed by the head and neck, lower limbs, upper limbs and trunk.

A total of five patients (three firework, two sparkler) required admission to ICU on initial presentation, with three requiring intubation (two firework, one sparkler). Twenty patients required a total of 32 visits to the operating theatre for acute management of their burns. Eleven of these visits were for debridement and dressing changes and the remaining 21 were for skin grafting. One patient required partial amputation of their left middle finger as a result of a firework injury. Another patient required a further 19 visits to the operating theatre in the five years following their burn for scar management.

Figure 1 illustrates the progression of a hand burn sustained when a two-year-old male picked up a lit sparkler from the ground. Following initial debridement, the burn healed with regular dressings 18 days after the initial injury. The patient required regular follow-up for scar management, which involved stretching, compression and silicon dressings for approximately two years following the burn.

Discussion

Despite the ban on consumer sales of fireworks in New South Wales since 1987, this study shows that as a result of their illegal use, burn injuries have continued to occur in the paediatric population.

Fig 1. (a) The right hand of a two-year-old patient who sustained a burn after picking up a lit sparkler from the ground. (b) The same burn following debridement under sedation. (c) Progress of the burn at dressing change (remained unhealed). (d) Full re-epithelisation.
Unsurprisingly, burns as a result of sparklers, which are legal and readily available, occur at a much higher rate. This pattern reflects findings of a recent study of the adult population in New South Wales where it was found that sparklers were responsible for 65 per cent of all firework- or sparkler-related burns over a similar time period. In Australia, sparkler packaging recommendations for minimum age suitability range from three to eight years old. Despite this, the median age of those burnt by sparklers in our cohort was two years old. This is similar to a previously reported series indicating that more than 65 per cent of all patients with sparkler burns are younger than five years old. Further packaging recommendations include that users must be under close adult supervision and that only one sparkler should be used at a time—both recommendations are regularly ignored, based on our cohort. This highlights a misconception that sparklers are safe for children and emphasises the need to raise awareness in the community regarding their potential for harm.

Consistent with previous studies, males accounted for the majority of all firework-/sparkler-related burns. The higher incidence in males has been reported in both adult and paediatric populations and previously has been attributed to possible higher levels of risk-taking behaviour in males. Given the hands are generally exposed in igniting and handling fireworks or sparklers, it is unsurprising that they are the most common area of the body affected in our study. This corresponds with other studies from Australia and overseas. As maintaining hand function is of particular importance following burns, the immobilisation and rehabilitation often required following the acute healing must be acknowledged when appreciating the significance of these burns.

An interesting finding is the high proportion of burns over the Christmas and New Year period. This is consistent with previous published data in New South Wales regarding firework injuries and reflects similar patterns in Australia and several other countries where a spike in firework injuries during periods of celebrations such as Territory Day in the Northern Territory, Independence Day and Halloween in the United States, Guy Fawkes Night in the United Kingdom and the Diwali festival of light in India. With the median age of burns victims being younger than school age it is important that education and awareness campaigns extend beyond the school setting and into the community. Kidsafe and the Australian and New Zealand Burn Association (ANZBA) have well-established roles in injury prevention, for example in the areas of hot water and friction burns from treadmills, which could be used as a basis for similar campaigns for sparkler and firework injuries.

As we are unable to compare our data set with any pre-legislation data, the impact of current firework legislation in New South Wales could not be evaluated. Evaluation of legislation in Italy, the United Kingdom and Denmark has been shown to substantially reduce the number of firework-related injuries. While this supports the current firework legislation in New South Wales, it does suggest that restrictions need to be implemented on the sale of sparklers in order to minimise their potential harm.

**Conclusion**

The findings of this study demonstrate the potential for significant injuries as a result of the use of fireworks and sparklers. This information can be used not only to raise awareness regarding their dangers but also to direct targeted educational campaigns in the lead-up to particular events and guide safety advice regarding their use. Furthermore, it highlights that the introduction of restrictions on the sale of sparklers could potentially reduce the risk they currently pose to children.

**Ethics approval**

The Sydney Children's Hospital network human ethics research committee approved this study (HREC Reference 2020/ETH00398).
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Disclosure
The authors have no financial or commercial conflicts of interest to disclose.

References


