Indian Journal of Orthopaedics Surgery 2023;9(3):201–205

Content available at: https://www.ipinnovative.com/open-access-journals

Indian Journal of Orthopaedics Surgery

Journal homepage: https://www.ijos.co.in/

Case Report

# Firecracker (Sutli Bomb) explosion in hand and Diwali celebration: A unique case

**Ravi Sauhta[1], Dheeraj Makkar[2,*]**

[1]*Artemis Hospital, Gurugram, Haryana, India*
[2]*NC Medical College, Panipat, Haryana, India*

ARTICLE INFO

*Article history:*
Received 09-05-2023
Accepted 19-06-2023
Available online 04-09-2023

*Keywords:*
Fire crackers
Debridement
Flap
JESS

ABSTRACT

This case report focuses on the management and treatment of a ten-year-old boy who suffered extensive hand injuries from a live firecracker explosion during Diwali celebrations. The purpose of the report is to highlight the importance of caution when handling fireworks and to present the approach taken in managing the patient's injuries.

The patient underwent a comprehensive assessment, and a treatment plan was formulated. The plan included exploration and debridement, conservative management, thumb and index finger fixation, posterior interosseous flap surgery, and wrist stabilization with JESS. Additionally, a contracture release procedure was performed to address finger contracture. The patient received physical rehabilitation for hand functionality restoration.

The case report emphasizes the significance of handling fireworks with care and the need for immediate medical attention in the event of injuries. The successful outcome achieved through the implemented treatment plan underscores the importance of prompt and appropriate management in fireworks-related accidents.



## 1. Introduction

Fireworks play a prominent role in a wide range of ceremonial practices like weddings, festivals, and national celebrations observed in diverse cultures worldwide. These pyrotechnic spectacles, characterized by vibrant displays of light, color, and sound, hold significant cultural and symbolic value. In India, during the festival of Diwali, fireworks illuminate the sky. Children injured by firecrackers can suffer extensive burns and bodily harm, leaving them permanently disabled, both physically and emotionally. The impact is profound when the injuries involve hands, eye or the oral and maxillofacial area.

We report a case involving a ten-year-old male who sought immediate medical attention at our hospital's emergency department subsequent to an inadvertent detonation of a firecracker held in his hand.

Following the successful attainment of consent from the parents and assent from the child involved, we obtained the permission to publish both the case report and accompanying images.

## 2. Case Report

A ten-year-old male was presented to the emergency unit of our hospital, referred from a district hospital, with a chief complaint of injury to the right hand resulting from a live firecracker (sutli bomb in local parlance) explosion while playing on Diwali night. The patient experienced an unfortunate incident wherein the firecracker malfunctioned and on being lifted for inspection: detonated in their hand.

* *Corresponding author*.
*E-mail address*: makkardheeraj@gmail.com (D. Makkar).

https://doi.org/10.18231/j.ijos.2023.039

A comprehensive assessment involving both primary and secondary surveys was conducted to evaluate the patient's condition. The primary focus was placed on securing and maintaining an unobstructed airway, monitoring regular breathing patterns, and providing appropriate circulatory support. Given the considerable force exerted on the hand, the presence of concurrent internal organ injuries is a plausible concern. We promptly established intravenous access and initiated fluid resuscitation to optimize central and peripheral circulation.

## 3. On Examination

### *3.1. Inspection*

The left hand sustained severe damage as a result of a blast. Specifically, the thenar eminence of left hand on the volar aspect was devitalized and ripped. Notably, there was active bleeding emanating from a sizable 2 cm by 6 cm laceration in the thenar eminence. (Figure 1) Traumatic amputation of the ring finger occurred at the proximal interphalangeal joint, while the thumb showed tip showed blackening. Another laceration was present on the volar surface in the fourth web space between ring finger and little finger. Concurrently, the dorsal aspect of the hand manifested noticeable swelling. In addition to these injuries, the patient did not suffer any facial laceration.

**Fig. 1:** The initial damage to hand due to fire cracker (Sutli Bomb)

### *3.2. Palpation*

The movements and sensation of index finger, middle fingers were preserved but painful. The capillary refill of finger and thumb was less than 2 sec indicating intact radial and ulnar artery. Dorsal aspect was tender.

X-ray of left hand was normal and showed the traumatic amputation of the ring finger (Figures 2 and 3). CT scan of the head was normal.


**Fig. 2:** X-ray of the patient showing traumatic amputation of the ring finger


**Fig. 3:** X-ray of the hand showing traumatic amputation from oblique view

The proposed treatment plan entailed a systematic approach to address the patient's condition:

1. Complete exploration and debridement: A meticulous evaluation was conducted under general anesthesia to thoroughly assess the affected area, followed by the meticulous removal of any necrotic or non-viable tissue through debridement. This procedure aimed to establish a healthy wound bed conducive to optimal healing and stay sutures were placed to retain as much skin as possible.
2. Conservative management: Subsequent to debridement, a conservative approach was adopted, focusing on non-surgical interventions such as regular dressing changes, appropriate wound care, and diligent monitoring for signs of infection. This conservative management strategy aims to promote natural wound healing processes while minimizing the need for surgical intervention.
3. Posterior interosseus flap under general anesthesia:
4. Freshening of the first web space: The first web space, which had developed an adduction contracture, did undergo a surgical procedure to meticulously excise scar tissue or adhesions responsible for the contracture. This process restored normal anatomical alignment and improved functional outcomes. (Figure 4)
5. Fixation of the thumb and index finger: To ensure the maintenance of the corrected position and facilitate functional hand movements, the thumb was immobilized in abduction, away from the palm, while the index finger will be positioned in the pincer grasp posture using K-wires. This internal fixation technique with K-wires provides stability during the healing process and promotes optimal alignment of the digits. (Figure 5)
6. Harvesting and suturing of a posterior interosseous flap: A posterior interosseous flap, sourced from the forearm, was harvested for subsequent transplantation into the first web space. The harvested flap was meticulously sutured in place, facilitating wound healing and reconstructing the first web space, thereby restoring proper anatomical architecture and enhancing functional recovery.(Figure 5)
7. Wrist stabilization with a Jess frame type external fixator: The wrist will be stabilized in a cock-up position utilizing a Jess frame type external fixator and a harvested posterior interosseus flap was sutured in the first web space. This device provides mechanical support and immobilization, aiding in maintaining the desired wrist position during the healing phase. The frame was removed after four weeks. (Figure 6)
8. The contracture that manifested in the ring finger subsequent to the initial laceration, following the removal of the external fixator, was addressed through a surgical intervention known as contracture release. Under general anesthesia, Z-plasty was employed to achieve the desired outcome. This technique involves carefully planned incisions in a Z-shaped pattern to release the contracture and improve range of motion.

**Fig. 4:** Showing development of adduction contracture offirst web space and blackening of distal aspect of thumb

### *3.3. Post operative management*

The sutures were removed after a twelve-day interval subsequent to the contracture release procedure. The wound displayed uneventful healing, and the patient received recommendations for engaging in physical rehabilitation to fully regain hand functionality, which ultimately led to a remarkable outcome at the six-month, follow up after the surgery.(Figure 5)

## 4. Discussion

The presented case report highlights a distressing incident involving a ten-year-old male who sustained severe hand injuries due to a firecracker explosion during the Diwali festival. Owing to the convective motion of flames, the anatomical regions most frequently affected are the face, upper extremities, and hands.[1] This discussion focuses on the management of such injuries and the potential impact on hand function and overall well-being.

The severity of the hand injuries sustained by the patient is evident from the extensive tissue damage, traumatic amputation of the ring finger, and the presence

**Fig. 5:** K-wire fixation done and posterior interosseus artery flap marked

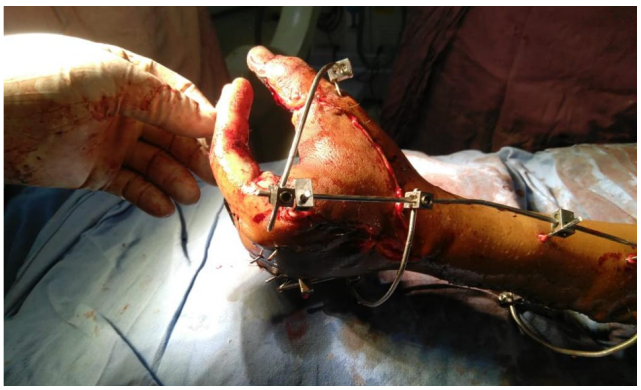

**Fig. 6:** Posterior inteosseous artery skin flap done to maintain the function of thumb. The thumb is held in abduction with k- wires

of lacerations. The patient experience a loss of the thumb which corresponds to a substantial decrease in hand function, estimated to be around 40%, along with a 25% decline in overall body function. Notably, the thumb assumes a crucial role in prehensile tasks that necessitate dexterity and precise manipulation, while the ulnar digits play a pivotal role in facilitating power grasps.[2] The primary goals of treatment were to promote wound healing, restore hand function, and minimize long-term functional impairment.

Immediate medical attention plays a crucial role in the management of firecracker-related injuries. Prompt arrival at the emergency department allows for a thorough assessment of the injuries and facilitates

**Fig. 7:** The healed flap and an excellent functional outcome

timely intervention.[3] The management of these injuries, regardless of their severity or unique characteristics, follows a standardized approach. The key parameters for successful outcomes encompass patient survival, limb preservation, restoration of limb function, and the subsequent reintegration into a meaningful lifestyle. Emphasizing patient survival constitutes the initial priority. Prior to undertaking any salvage procedure, it is imperative to stabilize the patient's hemodynamic status, ensuring optimal physiological conditions for subsequent interventions.[4] In this case, the comprehensive evaluation of the injuries ensured that appropriate care was provided to the patient.

The pivotal component of initial intraoperative management for firecracker-induced hand injuries involves the meticulous debridement and irrigation. The primary objective entails the thorough excision of extensively devitalized tissue. Pulsatile lavage irrigation was employed extensively to effectively eliminate debris and eradicate bacteria from contaminated wound site.[5] Particular emphasis was placed on preventing further damage to critical structures, including nerves, arteries, tendons, and bones, which inherently possess vital viability. The debridement process necessitated a judicious approach, aiming to optimize tissue viability and facilitate subsequent therapeutic interventions.[6]

Surgical intervention, including debridement of necrotic tissue, is essential in promoting wound healing and preventing infection.[4] Similar to the case report by Neumeister. Et al. we performed debridement as it removes non-viable tissue and creates an environment conducive

to optimal healing. We placed stay sutures as per Chase principles to retain as much healthy skin as possible, facilitating successful wound closure as described by.[3,6]

Conservative management is often preferred when feasible, as it supports natural wound healing processes and minimizes the need for additional surgical interventions.[4] Regular dressing changes, meticulous wound care, and close monitoring for signs of infection are important aspects of conservative management.[4]

Reconstructive techniques, such as the utilization of a posterior interosseous flap, play a vital role in restoring hand function.[7] We used the flap as described by Zancolli et al. for the reconstruction of the first web space to reestablish proper anatomical architecture and improve functional recovery. Fixation of the thumb and index finger using K-wires provided stability during the healing process and facilitated optimal alignment and functional hand movements.

Postoperative rehabilitation and physiotherapy are crucial for maximizing functional recovery.[8] The patient underwent comprehensive rehabilitation program involving hand exercises, range of motion training and strengthening exercises is essential for optimal hand function restoration.

It is important to acknowledge the potential psychological impact of traumatic hand injuries, especially in young patients. Children may experience emotional distress, anxiety, and a need for additional psychological support during their recovery process. Providing counseling and psychological services to both the child and their family can facilitate coping mechanisms and aid in the adjustment to any functional limitations.[9]

Preventive measures and public awareness campaigns are crucial in reducing the incidence of firecracker-related injuries in children. Emphasizing firecracker safety, responsible handling, and promoting alternative forms of celebration can significantly reduce the occurrence of such accidents. Collaborative efforts between government bodies, communities, and educational institutions are necessary to raise awareness and ensure the safety of children during festive occasions.[10]

## 5. Conclusion

In conclusion, the management of severe hand injuries resulting from firecracker explosions requires a multidisciplinary approach encompassing prompt medical attention, surgical intervention, wound care, rehabilitation, and psychological support. These may need multiple surgeries and rehabilitation but do have a good functional outcome. Preventive measures and public awareness campaigns are essential in reducing the incidence of such accidents and protecting children from harm during celebratory events. Further research and collaboration are warranted to develop effective strategies for injury prevention and optimize the outcomes of individuals affected by firecracker.

## 6. Source of Funding

No funding was provided to the author(s) of this article during its research, writing, or publishing.

## 7. Statement of Potential Conflicts of Interest

The authors have stated that they have no competing interests related to the study, writing, or distribution of this paper.

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## Author biography

**Ravi Sauhta,** HOD

**Dheeraj Makkar,** Assistant Professor

**Cite this article:** Sauhta R, Makkar D. Firecracker (Sutli Bomb) explosion in hand and Diwali celebration: A unique case. *Indian J Orthop Surg* 2023;9(3):201-205.