



AN ANALYTICAL STUDY OF “THE THUMB AND WEB BURST” IN CRACKER BURNS INJURY OF HAND

Plastic Surgery

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ABSTRACT

Cracker burst injuries to the hand are common during the festivals and funeral processions in Tamil Nadu. In this study we are reporting cracker burst injuries sustained by the hand with more emphasis on the thumb and first web space burst injuries.

The thumb can sustain different patterns of blast injuries: Thumb web muscle injury, thenar muscle injury, CMC (carpo-metacarpal) joint dislocations, metacarpal fractures, distal thumb amputations, nerve and tendon avulsion or total thumb amputation. This typical injury occurring in cracker burst is due the fact that when the cracker held by grasp bursts, the thumb receives the force of the blast wave to pass through. During this process the thumb CMC joint also is injured. When the injury is severe it produces amputation of the thumb. In our center, such severe thumb injuries are managed in stages and stepwise manner so as to bring the best functional outcome for the patient's dexterity.

KEYWORDS

Cracker Burst Injuries, Burns, Hand Injuries, Hand Reconstruction, Microvascular Reconstruction, Fire Crackers.

INTRODUCTION

Fire crackers are a part and parcel of our culture in India especially in Tamil Nadu where they use fire crackers in funeral processions and Diwali festivals. The injuries can be minor from superficial burns and lacerations to complete burst injuries of hand. The thumb is the most affected part in the hand following cracker burst injuries (1). Its vulnerability is due to its important function of grasping a cracker against the rest of the hand which poses direct blast injuries to the first web space and the thumb itself.

AIM

To study the patterns and mechanism of the thumb and first web space burst injury in cracker burst injuries of the hand and to devise a protocol for their management.

METHODOLOGY

A retrospective study of 15 patients with accidental cracker burst injuries of hand, presented to the department of Plastic Surgery at Madras Medical College with a follow up period of 6 months duration were included over 2 years duration (June 2017-June 2019).

In our study we included only those cases with cracker bursts injury involving the thumb and the first web space of the hand. A detailed history taken and thorough examinations were performed. The hand was assessed with regard to vascular status, degree of contamination, severity of tissue loss. Skeletal assessment was done with plain X-rays of the wrist and hand. The patients were then classified into 4 grades based on our “Institutional scoring system for cracker burst injuries of the hand”:

Grade 1: Skin and subcutaneous injuries alone

Grade 2: Thumb web muscle injury, thenar and hypothenar muscle injury.

Grade 3: Fingers or distal thumb amputations, CMC joint dislocations, phalangeal and metacarpal fractures; nerve and tendon injury.

Grade 4: Total thumb amputation through CMC joint, finger amputation proximal to MP joint, carpal or forearm bone fractures and proximal level amputations.

Thorough wound irrigation and wound debridement followed by exploration was done under tourniquet control. Skeletal stabilization, musculo-tendinous and nerve repair was done. Joint disruptions and fractures were managed with K-wire fixation, definitive wound closure was done in majority of cases. Few cases underwent serial debridement followed with definitive flap coverage by groin,

abdominal or free microvascular flap. The primary aim of management was maximum preservation of function. Effective physiotherapy was started at appropriate time with splinting.

The outcome of our management was measured by using the quick DASH score at 6 months post-surgery (2) (3) and Grip strength was evaluated with a Jamar hand grip dynamometer.

RESULTS

Demographics

A total of 36 patients of cracker burst injuries presented to our department over two years. Of these 15 patients had thumb and first web space burst injuries. 100% were male with an average age of 26.5 years. 40 % of the subjects were laborers, 33% were students, 14% did office work and 13% were retired men. 40% of the patients sustained the cracker burst injuries under the influence of alcohol (Table 1)

The mechanism of injury to the thumb and the first web space is seen in the majority of patients as due to grasping the explosives in the dominant hand (60%) compared to the non-dominant hand (40%).

All the injuries were due to low intensity explosives with factory made fire crackers of 87% and country made of 13 %. Majority of cracker burst injuries occurred during Diwali festival (46.66%), funerals (33.33%) followed by religious processions (20%).

It was seen that the average time interval between sustaining the hand injuries and presentation to our tertiary health center was 19 hours (2 hours -72 hours).

Grade 1 injuries were 20%; Grade 2 was 46.66%; 20% of Grade 3 and Grade 4 with 13.33% (Figure 1). The first web space was significantly injured and destroyed by the fire crackers held in hand with carpo-metacarpal (CMC) joint dislocation and sometimes amputation of the thumb itself at the metacarpophalangeal (MCP) joint and interphalangeal (IP) joint (13%). Such amputated thumbs could not be salvaged by immediate microsurgical replantation due the extensiveness of the injuries and destruction of tissues. Hence both cases of Grade 4 injuries were terminated with amputation. The defects were resurfaced with abdominal flap (13.33%), groin flap (7%), free antero-lateral thigh flap (7%) and free gracilis flap (7%). Fractures of the metacarpal bones, carpo-metacarpal disarticulations, and avulsions of the hand at the wrist were less common. The fractures and joint dislocation were reduced and fixed with K-wire.

Clinical outcome

The patients were followed up for a period of 6 months. The primary endpoint in our study was Quick DASH (0-100, 0 is best). The patients

underwent an extensive physiotherapy and rehabilitation program. The patients had a trend towards good hand function with Q-DASH of 2 (in four patients) and only 2 patients with a score of 20.

Grip strength measured by Jamar dynamometer (4) shows towards normal trends with reference for age.

Near normal function resulted in many of the Grade 1 to Grade 2 injuries. Stiffness and restricted range of motion resulted in many patients of Grade 2 and Grade 3. Return to work with good hand function could be achieved in Grade 1 and 2 within 6 months period.

Table 1: Demographic patterns of cracker bursts injuries of hand. N=15

No.	Age	Sex	Dominant Hand	Hand Injured	Grade Of Injury	Type Of Fire Cracker	Occasion Of Injury	Time interval between injury and presentation	Definitive Management
1	12	M	R	L	2	Factory made	Diwali	12	Free gracilis flap
2	13	M	R	L	2	Factory made	Religious procession	24	Primary closure
3	15	M	R	R	4	Factory made	Diwali	12	Shortening closure and amputation
4	15	M	L	L	3	Factory made	Diwali	8	Primary closure with first web space release
5	15	M	R	R	2	Factory made	Diwali	6	Free ALT flap
6	16	M	R	L	2	Factory made	Diwali	6	Primary closure
7	18	M	R	R	4	Country made	Diwali	2	Shortening closure and amputation
8	20	M	R	R	2	Factory made	Funeral	24	Primary closure
9	24	M	R	R	1	Country made	Funeral	48	Primary closure
10	35	M	R	L	2	Factory made	Funeral	4	Primary closure with first web space release
11	37	M	R	L	1	Factory made	Funeral	72	Primary closure
12	38	M	R	R	1	Factory made	Funeral	48	Primary closure
13	46	M	R	R	2	Factory made	Diwali	12	Groin flap
14	50	M	R	R	3	Factory made	Religious procession	4	Abdominal flap
15	52	M	L	R	3	Factory made	Religious procession	4	Abdominal flap

Complications

The complications noted in our patients are deep wound infections (12%) managed with antibiotics and wound debridement. Patients who presented late, more than 24 hours after the cracker bursts tend to have more chances of deep wound infections (60%).

DISCUSSION

All the patients with cracker burst injuries were males. Diwali is the main festival where we have such injuries with the majority of patients being students. Such injuries can be prevented by educating the students in classrooms before the start of the festival, about the safety and precautions in burning fire crackers. The other target population are the laborers who burn crackers during funeral processions.

Majority of these people are not much educated and are ignorant about firing crackers in bare hands. They should be made aware of the dangers of cracker burst injuries of the hand which can cost them their livelihood.

The mechanism of grasping of the cracker against a closed fist with maximum injury to the thumb, thenar muscles (Figure 2) and first web space and sparing of the hypothenar muscles is seen in all our cases.

In addition, the terminal parts fingers get injured depending on the power of grip that is present during the explosion. Irrespective of the hand dominance the injury can be in any hand in which the person holds the cracker when the other hand holds the lighter.



FIGURE 1: Institutional scoring system for cracker burst injuries of the hand

The factory and country made crackers available in the local market are very powerful causing extensive injuries to the hand ranging from Grade 1 to 4.

Different Grading and classification systems exist for cracker bursts hand injuries (4) (1) (5). We are following our "Institutional scoring system for cracker burst injuries of the hand". Hazani et al (1) identified palmar hyperextension, hyperabduction of thumb and fingers, hyperextension of IP and MCP and dorsal dislocation of web spaces. Many a times most of the injuries we encountered might not fall into a particular Grade due to the mixed pattern of injuries in one hand.

Tissue replantation of amputated parts have been described in the literature (6). Our patients with Grade 4 had very badly crushed and mangled thumb that were not amenable for microvascular

reconstruction. In one of our patients who sustained a Grade 3 Cracker burst injury of dominant right hand (Figure 3) presented to the emergency within 4 hours of injury. Thorough wound debridement with FPL tendon repair was done. CMC joint dislocation was managed by open reduction and fixation with K-wire. Primary closure of wound was achieved. 3 months post-operative the patient is showing a satisfactory result (Figure 4). Hence with timely and well-planned reconstructive procedures we could bring about the best result in this patient with Grade 3 cracker burst injury.

CONCLUSION

The patterns and mechanism of the thumb and first web space burst injury in cracker burst injuries of the hand are studied.

Cracker bursts injuries of the hand are preventable. Children need to be

educated in classrooms before the start of festivals and awareness programs are to be conducted to educate the lay public.

Once injured, timely intervention with well-planned protocol for management, followed by vigorous physiotherapy, we can restore the hand function to the cracker burst victims.



FIGURE 2: The grasping of the cracker against a closed fist causes maximum injury to the thumb, thenar muscles and first web space.

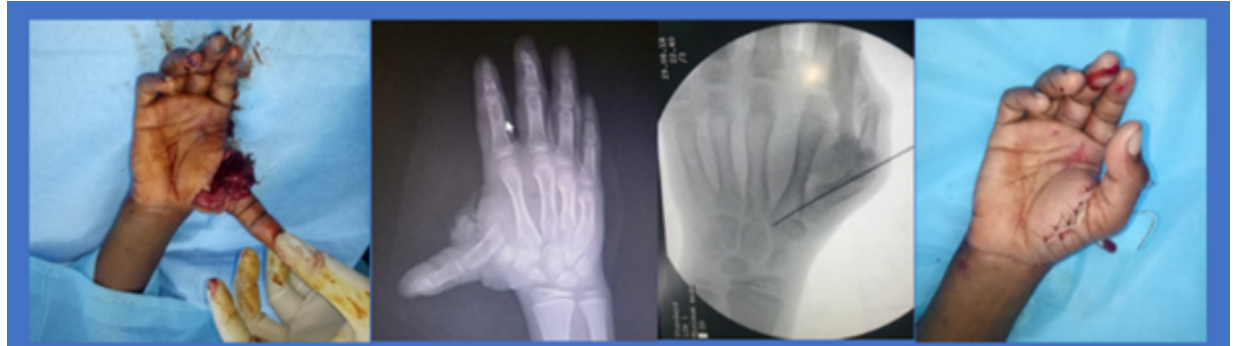


FIGURE 3: Grade 3 injury with CMC joint dislocation and web burst. K- wire fixation for joint dislocation and primary repair of Flexor Pollicis Longus tendon.



FIGURE 4: 3 months post-operative with good hand function.

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