



### Case Report

## Ayurvedic Management of a Firecracker-Induced Paediatric Burn Injury with Early Rehabilitation: A Case Report

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### Abstract

**Introduction:** Firecracker-related burns affect approximately 7 per 100,000 people annually in India, frequently causing deep partial-thickness injuries that risk pain, infection, contractures, and long-term functional and cosmetic sequelae, particularly in children. This case attempts to evaluate an Ayurvedic treatment protocol for a paediatric firecracker burn of the hand, aimed at preventing wound infection, promoting healing, restoring finger range of motion and grip strength, and minimising cosmetic and functional sequelae. **Methods:** A 12-year-old boy presented with 2.5% total body surface area deep partial-thickness burns of the right hand following a firecracker explosion on Diwali (31 October 2024, assumed date). Treatment comprised Guggulu-sesame oil (*Commiphora mukul*) dressings for four days, desloughing on day 5, followed by Yashtimadhu Taila and Jatyadi Taila dressings, oral Mahamanjishthadi Kashaya and Sukshma Triphala with adjunctive hepatoprotective, haematopoietic and immunomodulatory formulations, dietary modification, and structured rehabilitation progressing from immobilisation (days 1–4) through early mobilisation (days 7–10) to intensive loading (days 10–45). **Results:** Pain fell from Visual Analogue Scale (VAS) 9/10 to 2/10 within two hours and to 1/10 by day 5. The wound remained infection-free throughout and achieved complete closure by day 18. Full range of motion, grip strength and functional independence were restored by week 4, and pigmentation had returned to approximately 95% of baseline by six months, with minimal, mature scarring. **Conclusion:** In this single case, a structured Ayurvedic protocol combined with early rehabilitation was associated with rapid pain relief, infection-free healing, and favourable functional and cosmetic outcomes. As a single, uncontrolled case, these observations are hypothesis-generating only; controlled comparative studies are required before efficacy claims can be generalised.

**Keywords:** Firecracker burn, Burn management, Vrana, Picchu, Dagdha, Wound regeneration.

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## Introduction

Burn injuries remain a major global health concern, with flames alone causing over 300,000 deaths annually.(1) In a 5-year review from a tertiary burn centre in North India, Diwali-related firecracker burns accounted for 67% (n=330) of 567 burns during the 3-day festival window.(2) Firecracker-burn injuries strike ~7 per 100,000 Indians, mainly males aged 5–30 years.(3) These

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injuries present therapeutic challenges, causing life-long disability, mainly involving functional disability (contracture restricts movements and joint functions) and cosmetic damage (disfigurement, hypo/hyperpigmentation). Early burn management critically determines prognosis, healing rate, and complications. Diagnosis depends on the burn's causative agent and depth, (4) but treatment varies, as modern burn protocols address pathologies via targeted agents—IV opioids for pain, silver sulfadiazine/antibiotics for infection. (5) Ayurveda counters pathology with antagonistic drugs (counteracting the causative agent's properties), (6) yielding pleiotropic analgesic, antimicrobial, nutritive, and healing effects, minimising polypharmacy.

In this case report, the burn was diagnosed as "Ruksha Durdagdha" as per Ayurvedic texts, based on the causative factor and depth, which is contact with a heated dry substance

(firecracker). (7) The treatment stated in the text recommends drugs with unctuous properties opposite to the dry property of the causative agent, comprising wound cleansing, oleaginous dressings, desloughing, oral medications, and diet restrictions. This report aims to evaluate Ayurvedic therapy as a key approach to prevent burn wound infection, promote healing, restore finger function by improving range of motion/grip, and minimise cosmetic/functional sequelae. This report has been prepared with reference to the CARE (CAse REport) guidelines for transparent and complete case reporting.

Materials and Methods

This is a single case report. Informed consent was taken in the patient's language before commencement of treatment.

Case Presentation

Patient information and clinical findings

A 12-year-old right-hand-dominant male experienced a firecracker explosion during the Diwali festival (31 October 2024), sustaining deep partial-thickness burns across the dorsum and digits of the right hand. Initial assessment documented severe pain (Visual Analogue Scale 9/10),(8) large, tense intact blister formation measuring 3 x 3.5 cm and 2 cm elevated, a small intact blister over the middle finger measuring 1.3 x 0.8 cm with marked swelling of the entire hand and fingers with stretched, shiny skin surface, black discolouration with dry, leathery appearance on the fingers and nail beds, reduced range of motion, and complete inability to perform activities of daily living. Vital signs revealed tachycardia (heart rate 110 bpm) and mild tachypnoea (respiratory rate 24/min). Blood pressure was 100/65 mmHg. Temperature was 99.8°F (37.6°C). General nutrition appeared adequate with no signs of dehydration, systemic infection, or associated injuries. The psychological state was initially disturbed, but good baseline psychological resilience was observed.

Constitutional analysis revealed Vata-Pitta Dosha predominant Prakriti with acute Vata-Pitta Dosha vitiation over the burn area, manifesting as severe pain and inflammatory response. Height: 145 cm and weight: 38 kg. Upon examination, the patient revealed no dietary sensitivity. Ashtavidha Pariksha (Eight-fold Examination) revealed medium build, Pitta–Vata predominant pulse (110/min, regular), normal appetite, thirst, and touch, normal vision with mild pain-induced lacrimation, speech initially distressed but clear when calm, regular satisfactory motions, normal clear yellow urine, slightly white-coated tongue, hot and tender affected skin with blister formation, while unaffected areas showed slightly increased temperature 99.8°F (37.6°C) with normal elasticity.

Examination of Burn

Examination revealed deep partial-thickness burns of the right hand, consistent with second-degree thermal injury. The paediatric-modified Lund-Browder chart (9) estimated 2.5% TBSA, comprising the entire dorsum of the right hand (1.25% TBSA), dorsal aspects of all five digits (0.75% TBSA), and partial thenar/hypothenar regions (0.5% TBSA). The burn showed uniform deep partial-thickness injury with intact light touch sensation, tense blisters, erythema extending 1–1.5 cm beyond burn margins with mild oedema. Functional assessment revealed complete inability to flex or extend digits due to pain and protective splinting, unmeasurable grip strength, hyperalgesia in burned areas with intact protective sensation peripherally, palpable radial and ulnar pulses with normal Allen's test, (10) no evidence of inhalation injury, clear lung fields, and no systemic or associated injuries.

The diagnosis was established as Ruksha Durdagdha: deep partial-thickness (second-degree) thermal burn of the right hand involving 2.5% TBSA from a firecracker explosion, showing Vata-Pitta Dosha aggravation, with features matching the Durdagdha type of burn described in Ayurvedic literature. (7)

Treatment Protocol

Table 1: Wound Management Protocol

| Phase                                          | Component                                | Details                                                                                                                                                                                                                                                                                                                                         | Date (2024)    |
|------------------------------------------------|------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| Phase 1: Immediate Wound Management (Days 1–4) | Vrana Karma (Wound Management)           | Gentle wound cleansing with medicated oil (Commiphora mukul-enriched sesame oil)                                                                                                                                                                                                                                                                | 31 Oct – 3 Nov |
|                                                | Picchu Dharan (Sterile cotton bandaging) | Thick cotton layers (Picchu) saturated with Guggulu (Commiphora mukul) medicated oil were applied loosely directly to burn areas, secured with Patta Bandhan (sterile cotton bandage). Dressings were changed every 24 hours under aseptic conditions.(11)                                                                                      | 31 Oct – 3 Nov |
| Phase 2: Desloughing (Day 5)                   | Procedure                                | Under aseptic conditions, the upper layer of dead tissue was removed using a scalpel and forceps with minimal bearable pain and discomfort. Clear to pale-yellow serous fluid was evacuated without purulent discharge. As the patient reported minute pain (VAS 1/10) on examination before the procedure, local anaesthesia was not required. | 4 Nov          |
|                                                | Findings                                 | Desloughing revealed a clean wound bed (Shudha Vrana) with healthy bleeding tissue, minimal patient discomfort, (12) and no signs of infection (Dushta Vrana).                                                                                                                                                                                  | 4 Nov          |
| Phase 3: Post-debridement Care (Days 5–11)     | Picchu Dharan                            | Equal quantities of Yashtimadhu Taila and Jatyadi Taila applied as Picchu dressing.                                                                                                                                                                                                                                                             | 4 – 10 Nov     |

**Table 2: Ayurvedic Oral Medications**

| Day 1 to Day 17                                                          |               |             |                |          |                                                                         |
|--------------------------------------------------------------------------|---------------|-------------|----------------|----------|-------------------------------------------------------------------------|
| Formulation                                                              | Dose          | Time of     | Vehicle        | Duration | Rationale                                                               |
| 1. Mahamanjishthadi decoction                                            | 10 ml TDS     | After meal  | Lukewarm water | 17 days  | Rakta-Pitta shodhana (blood purification), Vrana ropana (wound healing) |
| 2. Tab. Sukshma Triphala (2 g)                                           | 2 tablets BD  | After meal  | Lukewarm water | 17 days  | Tridosha shamana, Rasayana (rejuvenative)                               |
| 3. Tab. Raktapachak Vati (250 mg) + Tab.                                 | 1-1 tablet BD | After meal  | Lukewarm water | 17 days  | Rakta-dushti hara, systemic metabolic support                           |
| 4. Prawala Pishti (100 mg) + Godanti Bhasma (150 mg) + Kamdudha (250 mg) | 500 mg BD     | Before meal | Lukewarm water | 17 days  | Pitta shamana, calcium-mineral supplementation                          |
| Day 18 to Day 45                                                         |               |             |                |          |                                                                         |
| Formulation                                                              | Dose          | Time of     | Vehicle        | Duration | Rationale                                                               |
| 1. Tab. Sukshma Triphala (2 g)                                           | 1 tablet BD   | After meal  | Lukewarm water | 28 days  | Tridosha shamana, Rasayana (rejuvenative)                               |
| 2. Arjuna Churna (2 g) + Lodhra Churna (2 g)                             | 4 g BD        | Before meal | Lukewarm water | 28 days  | Rakta-stambhana, circulatory support                                    |
| 3. Mahamanjishthadi Kashaya                                              | 10 ml BD      | Before meal | Lukewarm water | 28 days  | Rakta-Pitta shodhana (blood purification), Vrana ropana (wound healing) |
| 4. Sarivadya Asava                                                       | 10 ml BD      | After meal  | Lukewarm water | 28 days  | Rakta shodhana, fermented drug delivery                                 |

From Day 46 to Month 6, no further oral Ayurvedic medication was administered; only topical Manjishthadi Taila was continued, with clinical follow-up at Week 8, Week 12, and Month 6.

**Table 3: Rehabilitative Care**

| Phase                                 | Details                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|---------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Immediate Phase (Days 1–4)            | Hand and finger immobilisation was initially advised to prevent mechanical trauma. Thumb metacarpal and carpometacarpal stiffness was noted by day 6 (post-debridement), characterised as pain-free but functionally limiting.                                                                                                                                                                                                                                              |
| Activation Phase (Days 7–10)          | Gentle range-of-motion exercises were initiated for the digits and wrist to prevent adhesion formation. In line with standard occupational-therapy principles for hand-burn rehabilitation, elevation and gentle active exercise were used for oedema control, and positioning/splinting principles were followed to counter the intrinsic-minus (claw) posture typical of dorsal hand burns.                                                                               |
| Intensive Rehabilitation (Days 10–45) | Structured exercise programme including thumb opposition, abduction, and extension movements performed 5–6 times daily. Progressive increase in range and duration was implemented based on patient tolerance. Scar-management measures (gentle massage and, once epithelialised, sun protection) were incorporated in line with published hand-burn rehabilitation guidance. Complete restoration of range of motion was achieved by week 4 with full functional recovery. |
| Dietary Modifications                 | Complete avoidance of salt, spices, and sour foods. Emphasis on Madhura (sweet) and Tikta (bitter) tasting foods, including ghee, homemade butter, and non-spicy, nutritive broths, for one month.(13)                                                                                                                                                                                                                                                                      |

**Table 4: Assessment and Outcomes**

| Parameter             | Day 1<br>(31 Oct)  | Day 5<br>(4 Nov)      | Day 18<br>(17 Nov) | Week 4<br>(27 Nov) | Day 45<br>(14 Dec) | Week 12<br>(22 Jan 25) | Month 6<br>(~30 Apr 25) |
|-----------------------|--------------------|-----------------------|--------------------|--------------------|--------------------|------------------------|-------------------------|
| Pain Scale (VAS 0–10) | 9/10               | 1/10                  | 0/10               | 0/10               | 0/10               | 0/10                   | 0/10                    |
| Wound Healing Stage   | Acute inflammatory | Ready for debridement | Complete closure   | Maturation         | Maturation         | Remodelling            | Remodelling complete    |
| Infection Signs       | Absent             | Absent                | Absent             | Absent             | Absent             | Absent                 | Absent                  |

|                         |                          |                     |                    |                   |                   |                            |                            |
|-------------------------|--------------------------|---------------------|--------------------|-------------------|-------------------|----------------------------|----------------------------|
| Blister Status          | Multiple tense blisters  | Debrided            | Resolved           | Resolved          | Resolved          | Resolved                   | Resolved                   |
| Granulation Tissue      | Not assessed             | Minimal             | Healthy dark       | Mature            | Mature            | Complete epithelialisation | Complete epithelialisation |
| Oedema (0–3 scale)      | 2+ (moderate)            | 1+ (mild)           | 0 (none)           | 0 (none)          | 0 (none)          | 0 (none)                   | 0 (none)                   |
| Range of Motion (%)     | 0% (complete limitation) | 10% (minimal)       | 40% (limited)      | 100% (full)       | 100% (full)       | 100% (full)                | 100% (full)                |
| Grip Strength           | Unmeasurable             | Unmeasurable        | Weak               | Normal            | Normal            | Normal                     | Normal                     |
| Functional Independence | Complete dependence      | Complete dependence | Partial assistance | Independent       | Independent       | Independent                | Independent                |
| Pigmentation Status     | Normal baseline          | Post-inflammatory   | 80% hypopigmented  | 50% hypopigmented | 40% hypopigmented | 15% hypopigmented          | 5% hypopigmented           |
| Scar Formation          | Not applicable           | Not applicable      | Minimal            | Flat, soft        | Flat, soft        | Minimal, mature            | Minimal, mature            |
| Patient Comfort         | Severe distress          | Mild discomfort     | Comfortable        | Comfortable       | Comfortable       | Comfortable                | Comfortable                |

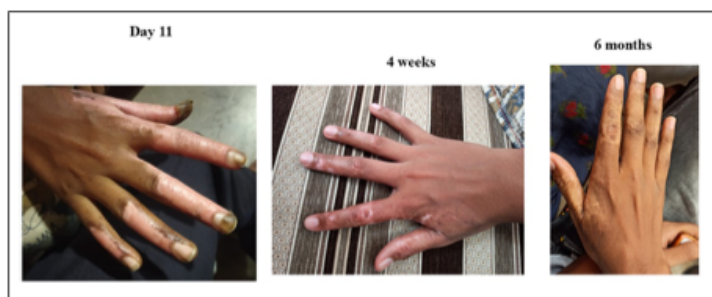
**Figure 1: Observations on Day 1 and Day 4**



**Figure 2: Observations Post Debridement**



**Figure 3: Observations of further follow ups**



## Discussion

As the patient was a 12-year-old child, the most critical early priorities in this case were pain control, limiting the burning sensation, and preventing infection. Direct-layer dressing with Commiphora mukul-enriched sesame-oil-soaked sterile gauze (days 1–4) was associated with rapid symptomatic relief: the patient stopped crying within 1 hour as pain became tolerable, and pain stabilised to VAS 2/10 by 2 hours. Experimental studies suggest that guggul-sesame oil combinations may inhibit bacterial growth and colonisation partly through the mildly acidic pH of the preparation (reported as 5.52), (16,17) which could plausibly support a favourable wound environment, though this was not independently verified in this patient's wound fluid. The Ayurvedic dressing (Picchu) used in this case shares the moist, non-adherent principle common to these newer dressings, which may explain the atraumatic dressing changes observed, rather than representing an advantage unique to Ayurvedic therapy over silver sulfadiazine specifically.

Guggulsterones (E and Z) in guggul (Commiphora mukul) have been reported in pre-clinical studies to exhibit anti-inflammatory and analgesic activity via NF- $\kappa$ B pathway modulation, reducing pro-inflammatory cytokines (TNF- $\alpha$ , IL-1 $\beta$ , IL-6) and showing antimicrobial activity in vitro.(17) Similarly, experimental work suggests that sesame oil's sesamin, sesamol, and tocopherols may quench reactive oxygen species and support a moist wound environment conducive to autolytic debridement.(18) These mechanistic findings are drawn from cell- and animal-based research; the present case did not include biomarker testing, so their relevance to this patient's clinical course remains inferential.

On day 5, the blister remained intact but non-tender, without infection and with minimal pain on touch (VAS 1/10). Desloughing was performed with tolerable pain and revealed a healthy wound bed (Fig. 1). To promote granulation and healing, a blend of Yashtimadhu Taila (19) and Jatyadi Taila (20) was applied for up to 11 weeks. Pre-clinical studies of these oils' constituents suggest antioxidant, pro-angiogenic and anti-inflammatory activity (via TNF- $\alpha$ , COX-2, IL-8, and NF- $\kappa$ B modulation); (19,20) clinical correlation in this patient was based on visual wound assessment rather than biomarker confirmation.

Between day 46 and month 6, systemic medications were discontinued and only topical Manjisthadi Taila application continued, with skin texture assessed as approaching normal appearance by six months (Fig. 3).

A comparable Ayurvedic contact-layer dressing approach (Patoladi Vikeshika) has been reported in a case series of second-degree burns with favourable wound outcomes,(15) and a case series using Manjistadi Vikeshika in first- and second-degree burns reported similarly encouraging cosmetic results;(21) The outcomes in the present case are broadly consistent with, though not more definitive than, those earlier reports, and larger comparative series would be needed to establish relative efficacy against standard modern dressings.

The structured rehabilitation programme addressed tissue healing and functional restoration through initial immobilisation (days 1–4) for primary repair, early mobilisation (days 7–10) with thumb opposition and web-space stretching, and intensive rehabilitation (days 10–45), with full range of motion achieved by 4 weeks. This staged approach is consistent with published occupational-therapy principles for hand-burn rehabilitation, which emphasise early, graded mobilisation, oedema control through elevation, positioning to counter the intrinsic-minus posture common after dorsal hand burns, and scar management once the wound is closed. A validated scar outcome tool such as the POSAS was not used in this case but is recommended for future reports to allow standardised comparison of cosmetic outcomes across studies.

Dietary modifications avoided Lavana (salty), Katu (spicy), and Amla (sour) tastes while emphasising Madhura (sweet) and Tikta (bitter) tastes, with ghee and butter intended to provide fatty acids for membrane repair and anti-inflammatory prostaglandin synthesis.

Oral medications: Mahamanjishthadi Kashaya is traditionally used for blood-purifying and wound-healing effects; Sukshma Triphala is used to balance Vata, Pitta and Kapha and for its rejuvenating properties;(22) Raktapachak Vati is used for haematopoietic and anti-inflammatory support; Pravala Pishti and Godanti Bhasma are proposed to provide bioavailable calcium for cellular membrane integrity;(23) Arjuna (*Terminalia arjuna*) is reported to support circulation;(24) Lodhra Churna (*Symplocos racemosa*) is reported to strengthen capillaries and reduce inflammatory exudation;(25) Kamadudha is used for Pitta vitiation;(26) Chandraprabha Vati is reported to provide broad-spectrum support for tissue regeneration and metabolic function;(27) and Sarivadya Asava is proposed to enhance bioavailability of saponins, tannins, and flavonoids for blood purification.(28)

Without relying on opioids, systemic antibiotics, or anaesthetics, this Ayurvedic protocol was associated with rapid pain relief, infection-free healing, and good functional recovery in this child.

This case report has several limitations. As a single, uncontrolled case, no causal inference can be drawn between the Ayurvedic protocol and the observed outcomes, since spontaneous healing, natural resolution of oedema, and the effects of concurrent supportive care and rehabilitation cannot be excluded. Functional and cosmetic outcomes were assessed by non-standardised clinical observation rather than validated, internationally recognised instruments such as the Vancouver Scar Scale, the Patient and Observer Scar Assessment Scale (POSAS), or hand-function measures like the DASH/QuickDASH, which future reports should incorporate for cross-study comparability. This single case suggests a possible role for integrative Ayurvedic approaches in paediatric burn care that merits further evaluation; it does not, on

its own, establish superiority over, or a substitute for, standard evidence-based burn management, and should be interpreted as hypothesis-generating pending controlled comparative studies.

## Conclusion

In this single paediatric case, an Ayurvedic management protocol combined with structured early rehabilitation was associated with rapid pain relief, infection-free wound healing, complete wound closure by day 18, full range-of-motion restoration by week 4, and near-normal pigmentation by six months, without the use of opioids, systemic antibiotics, or anaesthetics. These findings are encouraging and hypothesis-generating for the role of integrative Ayurvedic care in paediatric hand-burn management, but as a single, uncontrolled, polypharmacy case report, they cannot establish causality or efficacy. Controlled, comparative studies with standardised, internationally recognised outcome measures are needed to confirm these observations before broader clinical recommendations can be made.

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## Ethical Considerations

Written informed consent was obtained from the patient's guardian for publication of this case report and accompanying images.

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## Conflicts of Interest

The authors declare no conflicts of interest related to this case report.

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