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# Grinder Induced Hand Injuries: Management Using USG Guided Regional Anaesthesia: A Case Series

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**Abstract:** ***Grinder machine injuries represent a significant proportion of occupational and domestic hand trauma, often involving deep lacerations, tendon exposure, neurovascular compromise, and contamination, requiring prompt and meticulous management. Effective anaesthetic technique is essential for thorough wound exploration and precise repair. This case series includes six patients managed with ultrasound-guided regional anaesthesia (brachial plexus and wrist blocks), all completed without conversion to general anaesthesia. Haemodynamic stability was maintained, with 6-12 hours of postoperative analgesia and no major complications. These findings highlight the superiority of regional anaesthesia in complex upper limb trauma, offering improved comfort, reduced opioid use, and optimal surgical conditions.***

**Keywords:** Grinder hand injury; Regional anaesthesia; Brachial plexus block; Ultrasound guidance; Upper limb trauma; Postoperative analgesia; Supraclavicular block; Infraclavicular block; Axillary block; Hand surgery

## 1. Introduction

Grinder machines are widely used in industrial and domestic settings, and related injuries form a significant subset of hand trauma. These high-speed devices can cause deep lacerations, bone exposure, tendon and nerve injury, and contamination, requiring prompt assessment, debridement, and early surgical intervention. Anaesthetic technique is crucial for optimal surgical conditions and patient outcomes. While general anaesthesia was traditionally used, its risks have led to increasing preference for regional anaesthesia in upper limb procedures. Ultrasound-guided brachial plexus blocks (supraclavicular, infraclavicular, and axillary) provide reliable anaesthesia with improved safety, prolonged analgesia, and reduced opioid use. This case series presents six patients with grinder-related hand injuries successfully managed using tailored regional anaesthesia, demonstrating effective intraoperative conditions and favourable postoperative outcomes.

## 2. Methodology

This prospective case series was conducted at the emergency operating theatre of a tertiary care hospital. Six consecutive patients with grinder-related hand injuries, presenting over the study period were included. Informed consent was taken from all these patients. All patients underwent a comprehensive pre-anaesthetic evaluation encompassing pain assessment using the Numerical Rating Scale (NRS), haemodynamic status, degree of wound contamination, bleeding severity, and neurovascular integrity of the affected limb. Patients with injuries extending proximal to the elbow, those with coagulopathies, or those who were uncooperative or severely anxious were excluded from regional anaesthetic management and considered for general anaesthesia.

For these patients, ultrasound-guided brachial plexus block was performed as the primary anaesthetic technique. The choice of approach– supraclavicular, infraclavicular, or axillary– was determined by the anatomical level of the injury. Distal forearm and wrist injuries were managed with wrist blocks. All patients received pre-procedural sedation with intravenous midazolam (0.5 mg/kg) and fentanyl (20–30 mcg) to ensure anxiolysis, comfort, and optimal conditions for block placement. All blocks were performed using 0.75% ropivacaine, with volumes adjusted according to the targeted plexus level and patient weight. Standard intraoperative monitoring including electrocardiography (ECG), non-invasive blood pressure (NIBP), and pulse oximetry ($SpO_2$) was maintained throughout each procedure. Strict aseptic precautions were observed during block performance. Intravenous dexamethasone 8 mg was administered following each block as an adjuvant to prolong analgesia and reduce the incidence of postoperative nausea and vomiting (PONV). Intralipid was kept readily available prior to each block as a precautionary measure for the prompt management of local anaesthetic systemic toxicity (LAST).

Surgical procedures performed included wound debridement, tendon repair, and primary skin closure. A tourniquet was applied in one palmar laceration case, providing a bloodless field, improving visualization, and aiding precise surgical repair. The following parameters were recorded for each patient: type and extent of injury, block technique employed, onset time of sensory and motor blockade, intraoperative haemodynamic stability, quality and duration of postoperative analgesia, and any block-related or procedural complications. Data were compiled and analysed descriptively.

## 3. Results and Discussion

### 3.1 Results

A total of six patients with grinder-induced hand injuries were included in this case series. The nature of injuries, anaesthetic techniques employed, and clinical outcomes are summarised in Table 1. All surgical procedures were completed successfully under regional anaesthesia. No patient required conversion to general anaesthesia. Intraoperative haemodynamic parameters remained stable across all cases. Postoperative analgesia persisted for a duration ranging from 6 to 12 hours, with an average block duration of approximately 9 hours. Patient comfort levels and surgeon satisfaction were consistently rated as high in all cases. No major complications related to block performance were recorded.

**Table 1:** Summary of Cases – Injury Type, Regional Block, Onset, and Outcomes

| S.No. | Type of Injury | Block Given | Onset | Intraoperative Stability | Postop Analgesia | Complications |
|---|---|---|---|---|---|---|
| 1 | Deep palmar laceration with tendon exposure | Supraclavicular block | 10 min | Stable | 10 hrs | None |
| 2 | Dorsal hand cut with soft tissue loss | Supraclavicular + Axillary block | 8 min | Stable | 9 hrs | None |
| 3 | Multiple finger lacerations | Axillary block | 12 min | Stable | 6 hrs | None |
| 4 | Thumb laceration – amputation | Wrist block | 10 min | Stable | 2 hrs | None |
| 5 | Thumb laceration – reimplantation | Supraclavicular block | 10 min | Stable | 10 hrs | None |
| 6 | Volar forearm extension injury | Infraclavicular block | 15 min | Stable | 8 hrs | None |

### 3.2 Discussion

The findings of this series corroborate established literature endorsing regional anaesthesia as the preferred modality for upper limb surgery. Compared to general anaesthesia, brachial plexus blocks confer superior intraoperative analgesia, haemodynamic stability, avoidance of airway instrumentation, and markedly reduced postoperative nausea- advantages that are especially critical in emergency hand trauma.

Ultrasound guidance was central to the precision and safety achieved across all cases. Real-time visualisation of the brachial plexus enabled accurate needle placement, ensured optimal perineural spread, and mitigated risks of pneumothorax and intravascular injection- consistent with the standards advocated by Neal et al. and Tran et al.

Block selection was dictated by injury distribution: supraclavicular blocks for palmar and dorsal hand injuries, axillary blocks for isolated finger lacerations, infraclavicular blocks for proximal forearm extension, and a combined supraclavicular-axillary approach for extensive soft tissue loss. A wrist block sufficed for the isolated thumb injury, where proximal blockade was disproportionate.

Postoperative analgesia ranged from 2 to 10 hours, with shorter duration in the wrist block case- attributable to lower ropivacaine volume and greater distance from the nerve target. Prolonged analgesia reduced opioid consumption and facilitated earlier rehabilitation- a significant benefit in settings where respiratory depression and delayed ambulation carry substantial risk. Critically, no major complications- including pneumothorax, systemic toxicity, or neurological deficit- were recorded, affirming the safety of this approach when delivered by experienced practitioners with appropriate monitoring.

## 4. Conclusion

This case series shows that ultrasound-guided regional anaesthesia provides excellent conditions for managing complex grinder-related hand injuries. Tailored brachial plexus blocks ensured effective anaesthesia, haemodynamic stability, and prolonged analgesia, with no complications.

Regional anaesthesia offers a superior, patient-centred approach, reducing reliance on general anaesthesia and opioids while improving surgical precision. Wider adoption is encouraged, with larger studies needed for validation.

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