

# Comprehensive Management of a Mangled Hand - A Case Report

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**Abstract:** ***Introduction:** Crush injury of the hand involves damage to various structures, including tissue loss, injury to vascular structures, and possibly amputated digits. Critical elements of the initial surgery include meticulous and complete debridement, stabilization of bone, vascular reconstruction, and adequate soft tissue coverage if vessels are exposed. Operations that will enhance the functionality of the hands should be included in the follow - up surgery, including bone/skin grafting, bone transport, tendon repair, nerve repair/reconstruction, and flap debulking. For the aesthetic reconstruction of the hand, platelet - derived growth factor collagen granules can be incorporated to ensure adequate tissue granulation, followed by Split Skin Grafting. **Case report:** This case report discusses the comprehensive management of a 33 - year - old manual laborer who sustained a severe crush injury to his right hand from a stone crusher. Initial treatment included meticulous debridement, bone stabilization with K - wires, and vascular reconstruction. Due to the complexity of the wound, conventional VAC dressing and abdominal flap techniques were deemed unsuitable. Instead, platelet - derived growth factor PDGF ointment and collagen granules were utilized to promote granulation and bone healing. This approach facilitated successful split skin grafting and significant functional recovery, demonstrating PDGFs potential as an effective alternative in complex hand trauma cases. This case report highlights the potential of PDGF ointment and collagen granules as effective alternatives to conventional treatments for severe hand injuries, offering improved granulation and functional outcomes. **Conclusion:** The purpose of this case report is to detail an alternative approach to managing complex hand trauma using platelet - derived growth factor PDGF ointment and collagen granules for granulation and fracture healing.*

**Keywords:** Mangled hand, Platelet - derived growth factor, K - wire, Granulation, Early surgery

**Learning Point:** Platelet - derived growth factor ointments can be used in crush injuries or degloving injuries of the extremities for good granulation and fracture healing.

## 1. Introduction

Hand fractures and dislocations are among the most frequently encountered musculoskeletal injuries. Open injuries are very common in the hand damaging the muscles, tendons, bones, and other soft tissues. Open fractures with compromised tendons, muscles, and other soft tissues are commonly seen in manual laborers, heavy machine handlers, and in road traffic accidents. As hand does all the fine movements and works, it requires a good functional and gross outcome in case of combined injuries. Thin, flexible coverage of open hand trauma wounds can be achieved with thinner fascial flaps covered by a split - thickness skin graft or substantial Fascio cutaneous flap. For the above procedures, good granulation is required. Different modalities are available like VAC dressing, pedicled abdomen, and groin flaps for the coverage. Because of the drawbacks of awkward positioning, a two - step procedure, prolonged hospital stays, and postponed hand therapy results in stiffness hence, the abdominal pedicle flaps are cumbersome. Other alternatives like Platelet - derived growth factor ointment, collagen granules are used for granulation.

## 2. Case Report

A 33 - year - old man manual labourer by occupation came to our casualty with a history of allegedly letting his right hand

inside the stone crusher. Following that he was brought to our casualty with an open wound, profuse bleeding in the right hand not able to move the hand and fingers due to pain. First aid was administered in the ER, followed by X - rays of the right hand in AP, Lateral, and Oblique views, which revealed fractures at the base of the 3rd, 4th, and 5th metacarpals figure 5. Diagnosed as Open Right 3, 4 and 5th metacarpal fracture with reduced perfusion to the medial four fingers. The patient was examined and graded according to the Tscherne system<sup>2</sup> as Grade 3 Figures 1, 2, 3, indicating a fracture with severe soft tissue injury, neurovascular compromise, and potential compartment syndrome Figure 4. . Followed by patient was taken up for primary wound debridement (figure 6, 7, 8) and Open reduction internal fixation with “K” wires (figure 9) with adequate antibiotic cover. Physiotherapy was started to avoid the joint contractures prospectively. On the post operative day 2 we observed demarcation line over the palmar and dorsal aspect of the hand, and we waited for the maximum tissue take up in another 6 days we observed necrotic changes over the palmar and dorsal aspect (figure 10, 11). Then patient was taken up for secondary wound debridement (figure 12, 13). As the edges and surface of the wound was irregular VAC dressing was not possible and avoided abdominal flap as it is cumbersome for the patient and the surgeon due to the presence of “K” wires. The alternative was platelet derived growth factor ointment [PLERMIN] along with collagen granules was applied to the raw area. Over a period of 9 days

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there was good granulation tissue over the dorsal and volar aspect (figure 14, 15). Then split skin grafting was done after removing the obliquely passed K wire for better graft coverage, post operatively EOT (examination on table) was done 90% graft uptake was present (figure 16, 17). Serial X-rays were taken on POD12, POD 24, and POD 42 which showed good callus formation (figure 18) as PDGF acts as an adjuvant in bone healing. Then the K wires were extracted, and following that the patient improved both clinically, radiologically, and functionally (figure 19, 20) with residual stiffness in the Proximal interphalangeal joint of the ring finger and reduced power palmar flexion of the fingers.

### 3. Discussion

Crush injury of the hands are very common in heavy machine handlers, manual laborers and RTA (Road traffic accidents) 3. The crush injury of the hand is usually associated with fractures, tendon ruptures, neurovascular damage and poor soft tissue cover. Hence, they usually require surgical intervention. After the fracture fixation, reconstructing the vital structures like tendons, vessels and nerve, the soft tissue coverage remains a challenge for the surgeons. For which topical recombinant "platelet - derived growth factor" can be utilized for the granulation<sup>4</sup>. RPDGF has other properties like angiogenesis, osteogenic potential<sup>5</sup> which help in early callus formation. A plethora of cells in the granulation tissue stage of fracture healing expressed the "PDGF A gene" compared to "PDGF B", the signal levels for PDGF - A were notably greater. The notable abundance of cells expressing PDGF - A indicates that PDGF - AA is likely the most active isoform in this context<sup>6</sup>. Early physiotherapy is to be considered to prevent joint stiffness. Our patient's stiffness and power improved over a period of 3 months to near normal during the follow - up. Rehabilitation for crush injuries can be intricate and must be customized for each specific impairment. This can be influenced by various components, including the durability and reliability of bone stabilization, concurrent flexor and extensor injuries in the same digit, as well as repaired ligaments such as collateral ligaments<sup>7</sup>. On accounting the above advantages topical RPDGF can be used as an alternative for vac dressing and abdominal flap which has its own drawbacks like infection, failure of cover and other joint stiffness<sup>8</sup>.

### 4. Conclusion

Managing complex hand trauma is challenging due to the delicate nature of hand structures. This case report demonstrates that PDGF ointment and collagen granules can effectively promote granulation and fracture healing, providing a viable alternative to conventional methods. Early surgery and physiotherapy<sup>9</sup> are crucial for functional recovery, as evidenced by the significant improvement in our patients condition.

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### Figures







Examination findings:

Palmar surface:

- Irregular laceration extending from base of thumb to medial aspect of base of little finger 15cm x 3cm x 2cm.
- Active bleed (+)
- Tendons are intact.
- Thenar and hypothenar muscles are cut.
- Sensations are intact on the fingertips and dorsum of hand.
- ROM of wrist full and normal
- Capillary refilling time of all fingers >4 secs

Dorsal surface

- Abrasion of 8cm x 4cm extending till 3rd metacarpal to 5th metacarpal
- Linear laceration of 4cm over the 5th metacarpal
- Bleeding (+)









