Role of a Plastic Surgeon in the Management of Local Manifestations of Snakebite in a Tertiary Care Hospital: A Prospective Single-Center Case Series

Mir Mohsin[1] Haroon Rashid Zargar[1] Mir Yasir[1] Ankush Kaul[1] Bunny Sharma[1] Adil Hafeez Wani[1]

[1] Department of Plastic Surgery, Sher-I-Kashmir Institute of Medical Sciences, Srinagar, Jammu and Kashmir, India,

Indian J Plast Surg 2023;56:443–450.

Address for correspondence Mir Mohsin, MBBS, MS, MCh, DrNB, Department of Plastic Surgery, Sher-I-Kashmir Institute of Medical Sciences, Srinagar 190011, Jammu and Kashmir, India (e-mail: m_mohsin@rediffmail.com).

Abstract

Background There is a paucity of literature regarding the management of snakebite site complications. The wound complications can have debilitating sequelae, most of which may require reconstruction.

Methods This is a prospective single-institution observational study conducted from November 2019 to December 2021. Patient demographic characteristics and snakebite-related information, length of hospitalization, surgical lesions encountered, the type of treatment offered, and complications were recorded.

Results Fifteen patients (10 males and 5 females) with ages ranging from 10 to 53 years (mean: 36.5 years) were included in the study. Urgent fasciotomy was performed in three patients with compartment syndrome of the upper limb. Facial reconstruction was performed in one patient. One patient required distraction, cross-finger flap, and bone grafting of the index finger, while another patient required a pedicled groin flap for digital salvage. Below knee amputation was done for Marjolin's ulcer in a chronic snakebite case. Few patients required skin grafting. No major complications were encountered.

Conclusions Plastic surgeons play an important role in the management of bite site effects for restoration of form and function, which goes a long way in rehabilitating these patients back in the society. This case series presents a varied range of bite site complications and their management that would serve as a guide to plastic surgeons for better outcome.

Keywords
- snakebite
- local manifestations
- reconstruction
- flap
- distraction
- Marjolin's ulcer
- case series

Introduction

Most of the snakes found in Kashmir belong to the nonvenomous Colubridae family; however, the Levantine viper and the Himalayan pit viper are two fatally venomous snake varieties found here.[1]

Incidence of secondary complications following snakebite ranges from 10 to 44%.[2] The wound complications can have debilitating sequelae like muscle and tendon contractures, gangrenous and necrotic tissue, osteomyelitis, chronic wound infection, disfigurement, and deformities, most of which may require reconstruction.[2] Local tissue necrosis is

article published online
September 25, 2023

DOI https://doi.org/10.1055/s-0043-1774786.
ISSN 0970-0358.

Thieme Medical and Scientific Publishers Pvt. Ltd., A-12, 2nd Floor, Sector 2, Noida-201301 UP, India

caused by direct tissue toxicity or because of ischemia secondary to local vessel thrombosis.[3] Local tissue necrosis is more likely when the venom is trapped locally using a tourniquet.[4]

The priority in the treatment of snakebites is to manage systemic toxicity, but addressing local effects helps to further improve the overall management and the results in such cases.[2]

The three goals of surgical treatment of such wounds are, first, to reduce the total venom load; second, to prevent ongoing local tissue injury; and third, to treat established wound necrosis and long-term complications.[5]

Aims and Objectives

The aim of this study was to evaluate the clinical profile, acute, subacute, and chronic bite site manifestations of snakebite victims and the role of a plastic surgeon in their management.

Materials and Methods

This is a prospective single-institution case series conducted from November 2019 to December 2021 on consecutive cases in a teaching hospital.

Inclusion criteria:

1. Snakebite victims admitted under emergency medicine/pediatrics/critical care in which plastic surgery consultation was sought for bite site manifestations.
2. Snakebite victims referred from other hospitals for reconstruction.
3. Informed consent.

Exclusion criteria:
Refusal to participate in the study.

Patient demographic characteristics and the snakebite-related information like time and site of the bite, local bite site manifestations, features of compartment syndrome like (paresthesia, decreased capillary refill, pain to passive motion, or decreased pulses), length of hospitalization, surgical lesions encountered, coagulation profile, treatment offered, and complications were recorded. Complete blood count, coagulation profile, and liver and renal function tests were sought. Patients were followed till December 2022.

Ethical considerations: Ethics approval was obtained from the institutional ethics review committee. Written informed consent was obtained from the patients for the publication of the images. This case series has been reported in line with the PROCESS Guideline.[6]

Results

Fifteen patients (10 males and 5 females) with ages ranging from 10 to 53 years (mean: 36.5 years) were included. One patient was bitten on his face while sleeping on a cot in an open compound, while the rest of the patients were bitten while venturing outdoors. Only eight patients (53.3%) had seen the offender snakes and identified them as viper "Gunas." The lower extremity was the most common site involved in nine cases (60%) followed by the upper limb in five (33.3%) and the face in one case (6.7%). Acute snakebite cases were primarily managed by physicians and critical care specialists that included administration of antisnake venom (ASV) and supportive care till coagulogram normalized (international normalized rate [INR] <1.2). Seven patients (46.7%) had received polyvalent ASV and the time from the bite to the administration of ASV ranged from 3 to 24 hours. Five patients (33.3%) had gone to traditional healers and 6 patients (40%) had applied tourniquets for varying periods ranging from 1 to 3 hours before reporting to the nearest hospital for proper care. Most of the patients (8 [53.3%]) had coagulopathy revealed by their deranged coagulograms. Surgical procedures were performed only after coagulopathy was corrected with INR less than 1.2. The patients underwent various surgical procedures as described in ►**Table 1** (►**Figs. 1**–**6**).

Majority of the patients identified delay in treatment and timely referral to multiple reasons like lack of transport, lack of proper training of the local doctor in specialized wound care, nonavailability of a plastic surgeon in their nearby peripheral hospital, poor socioeconomic status, and failure to identify the gravity of the local complication in time.

Hospitalization ranged from 5 to 25 days. All patients adhered well to postoperative physiotherapy advices. No major complications were encountered. Minor complications included wound infection in two cases, which was managed conservatively with culture-specific antibiotics and dressings, besides conspicuous scarring at the bite site in one case. All the reconstructed wounds were stable at follow-up and patients returned to their normal routine by 2 to 3 months.

Discussion

Socioeconomic status and a lack of access to healthcare preclude timely treatment of snakebites in resource-limited countries resulting in higher rates of secondary complications as compared with developed countries necessitating even more the need for a plastic surgeon for management of the resulting sequelae.[2] Overall, the exact incidence of snakebites requiring some kind of formal reconstruction is unknown. In the large majority of snake envenomation cases, the services of a plastic surgeon are sought for assessment and management of the local complications of the bites for restoration of form and function.[2,4]

The first reported case of envenoming by the Levantine viper in India was a 33-year-old male soldier.[3] Most of the snakebite victims reported in the literature are children.[4] However, in the study of 158 patients by Kim et al, the authors encountered patients of all age groups with a majority of the patients in 40 to 70 year groups (102 males vs. 56 females).[7] Young males are affected more, being the predominant workforce outdoors for soldiering duties,

Table 1 Snakebite site, its local manifestations, and their management

Sl. no.	Site of bite	Surgical pathology	Management	Time from snake bite to treatment by plastic surgeon	Presentation Primary/ Secondary
1.	Hand	Compartment syndrome, soft tissue necrosis middle finger	Fasciotomy, debridement, and groin flap	28 hours	Primary
2.	Face	Necrotizing fasciitis face and chest wall	Debridement, temporary tarsorrhaphy, buccal myomucosal flap, split-thickness skin grafting, ectropion release with full-thickness grafting	7 days	Secondary
3.	Foot	Lower limb edema	Limb elevation, serial clinical monitoring	13 hours	Primary
4.	Calf	Lower limb edema, bite site necrosis	Debridement of necrotic tissue, serial clinical monitoring	32 hours	Secondary
5.	Thigh	Lower limb edema, minimal bite site necrosis	Limb elevation, topical antibiotic dressing, serial clinical monitoring	16 hours	Primary
6.	Hand (ring finger)	Compartment syndrome, blister, and localized necrosis ring finger	Upper limb fasciotomy, minimal debridement followed by skin grafting	18 hours	Secondary
7.	Ankle	Nonhealing ulcer in a post-snake bite scar (Marjolin's ulcer)	Below knee amputation	26 years	Secondary
8.	Hand (dorsum)	Compartment syndrome, minimal bite site necrosis	Fasciotomy, followed by healing by secondary intention	22 hours	Primary
9.	Leg	Lower limb edema, 15 cm^2 bite site necrosis	Debridement, split-thickness skin grafting	42 hours	Secondary
10.	Forearm	Progressive edema	Limb elevation (conservative management)	14 hours	Primary
11.	Thigh	Extensive skin and subcutaneous tissue necrosis of the thigh (necrotizing fasciitis)	Debridement, customized negative pressure wound therapy, split-thickness skin grafting	10 days	Secondary
12.	Calf	Significant lower limb edema, 6 cm^2 bite site necrosis	Debridement, limb elevation, topical antibiotic dressing, serial clinical monitoring	68 hours	Secondary
13.	Foot	Lower limb edema	Limb elevation (conservative management)	34 hours	Secondary
14.	Leg	Blister at bite site and limb edema	Blister debridement, limb elevation (conservative management)	23 hours	Secondary
15.	Hand (index finger)	Osteomyelitis with deformity of proximal interphalangeal joint	Debridement of osteomyelitic bone after distraction, cross-finger flap, and bone grafting	2 years	Secondary

farming, and outdoor activity and thus vulnerable to this occupational hazard.[8]

The most common area reported in the literature is the lower limb.[1,2,4] Besides this, head and neck,[1] upper limb,[3] penis,[9] and scrotum[10] have been reported as other bite sites. Feet and legs are the most accessible sites while working outdoors to any creeper for inflicting a bite, thus explaining the highest incidence of involvement.

Though their use is discouraged, a big number of snakebite victims still apply proximal tourniquets.[1,2] Antivenin therapy has been reported to be more effective in decreasing the incidence of local complications and the need for surgical interventions.[1,2,5]

Three patients (20%) with compartment syndrome following a bite on the right ring finger, left middle finger, and right-hand dorsum were identified based on clinical signs

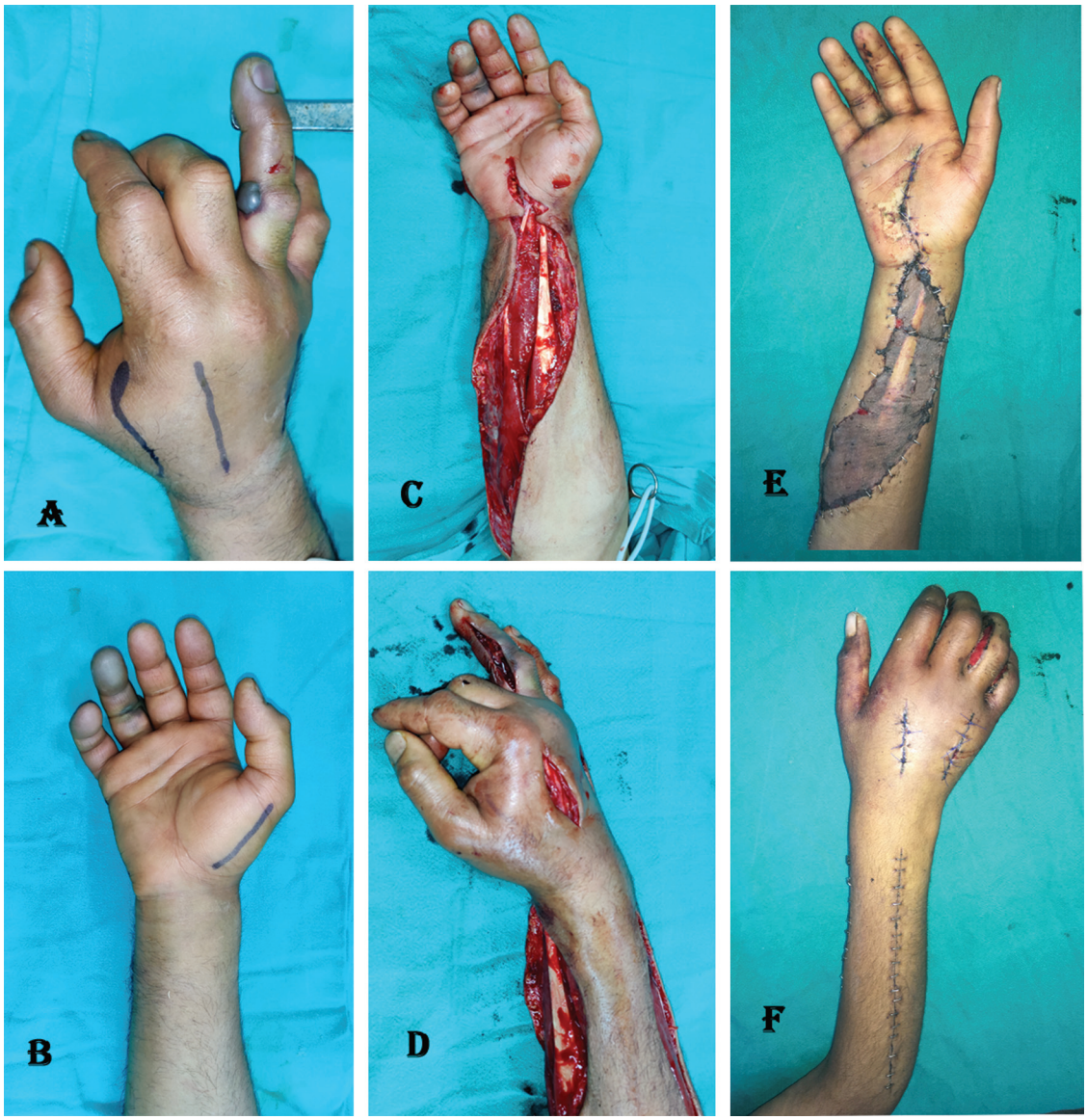

Fig. 1 (**A, B**) Snakebite right ring finger. (**C, D**) Fasciotomy wounds. (**E, F**) Secondary suturing and split-thickness skin grafting of wounds.

and symptoms and urgent fasciotomy was performed. All of them had applied tourniquets in the prehospital period. It is not necessarily recommended to measure intracranial pressure when the diagnosis is clinically evident.[11] Need for fasciotomies in snakebite victims, although rare, has still been performed wherever indicated more commonly in upper limbs where the venom is usually deposited deeper, thus leading to severe edema and resultant muscle ischemia in tight compartments.[7]

All three patients who underwent fasciotomy had used torniquet. Use of torniquet and delay in timely referral reported by the patients lead to such complications. Training of doctors working in peripheral hospitals in wound care, timely referral to centers offering plastic surgical services, and avoidance of torniquet use can reduce the incidence of such sequelae.

An algorithmic approach to the prevention of unnecessary fasciotomy in extremity snakebite has been proposed by Türkmen and Temel.[12] However, there are a few limitations of this study; first, the threshold pressure set is higher than conventional 30 mm Hg, second, the pressure readings are to be repeated thrice after every 2 hours making it 6 hours before a decision for fasciotomy is taken as compared with the conventional practice of a single reading.[2] We feel the high threshold and need for repeated readings leading to delayed fasciotomy could in all probability lead to ischemic changes and resultant sequelae in these cases. Third, snakebites are more common in developing countries where the equipment for compartment pressure measurement is not available commonly thus limiting the applicability of this protocol where it is required most. Fourth, since long term follow-up is missing, the number of patients out of the remaining 37 in whom fasciotomy was not done and from the 3 in whom fasciotomy was performed after delay of 6 hours from the first recording, which might have landed up with

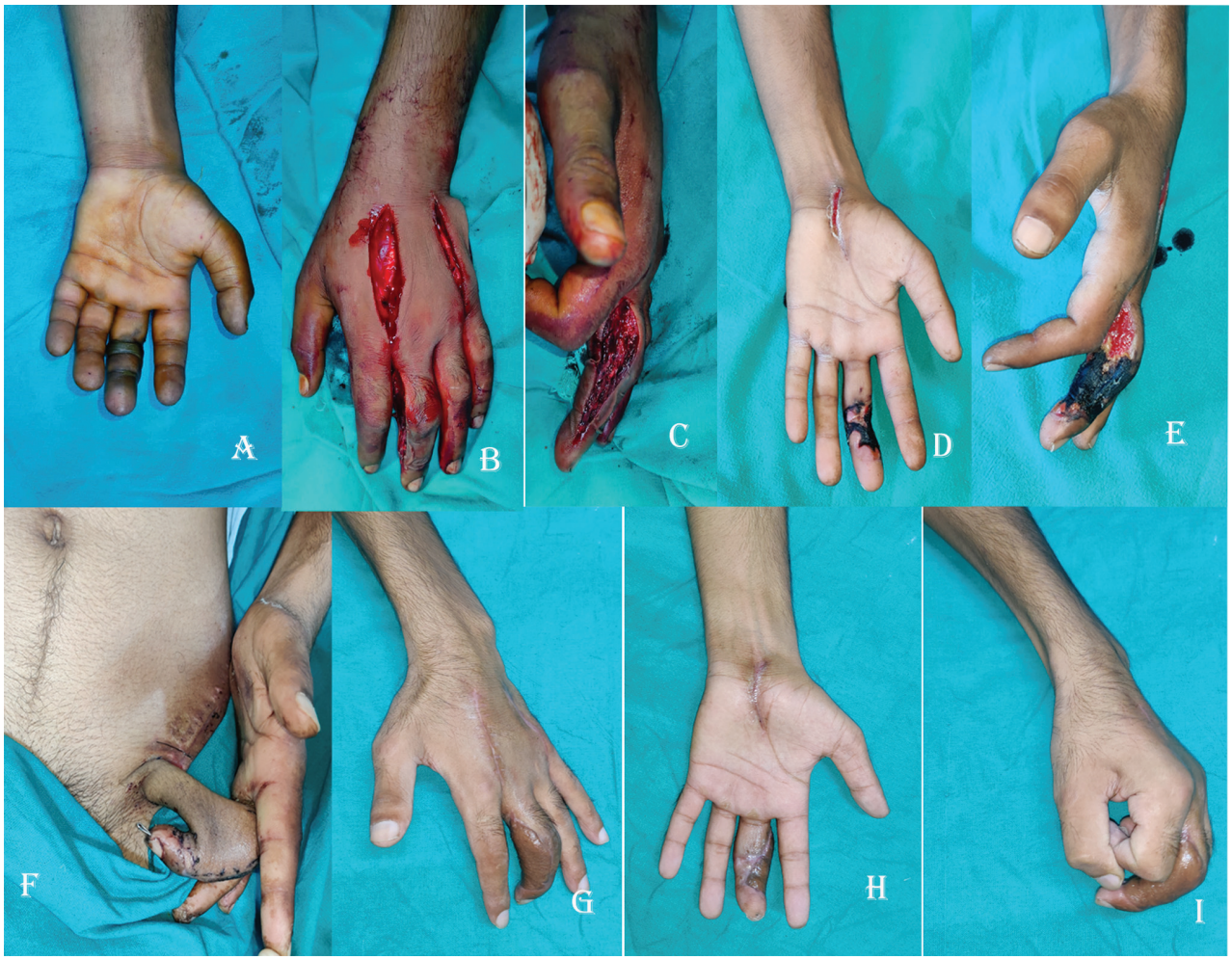

Fig. 2 (**A**) Snakebite left middle finger. (**B, C**) Fasciotomy wounds. (**D, E**) Skin and soft tissue necrosis at the bite site. (**F**) Pedicled left groin flap in situ after debridement and Kirschner wire fixation of the distal interphalangeal joint. (**G, H, I**) Groin flap well inset after detachment with the restoration of form and function.

Fig. 3 (**A**) Post-snakebite necrotizing fasciitis wounds after debridement. (**B**) Customized negative pressure wound therapy applied. (**C**) Split-thickness skin grafts well taken with residual intervening areas left to heal by secondary intention.

Fig. 4 (**A**) Snakebite face with skin and soft tissue necrosis involving the right forehead, periorbital area, cheek, root of nose, left infraorbital region, right supraclavicular, suprasternal area, and upper chest. (**B**) Gloved finger depicting an orocutaneous fistula in the right cheek. (**C**) Intraoperative picture of wounds following debridement. (**D**) Postoperative picture after reconstruction and residual right lower lid ectropion.

Volkmann's ischemic contractures and other sequelae are not known.

The patient with a facial snakebite had extensive necrosis involving the face and chest wall. After having been bitten on his face, the venom must have trickled down the tissue planes in his neck to the upper chest wall, leading to tissue necrosis involving the face, lower part of the neck, and upper chest with spared intervening areas in the neck. Snakebite envenomation of the face usually occurs in children or agricultural workers.[13] Envenomation of the face leads to tissue necrosis, and deformity necessitating reconstruction and may even lead to death if not dia gnosed and managed promptly.[14]

In our study, we encountered one case of Marjolin's ulcer in snakebite scar. Marjolin's ulcer developing in snakebite scar is very rare. One such case has been reported by Smith et al.[15]

The patient with osteomyelitis, dislocation of proximal interphalangeal joint and deformity of index finger following snakebite 2 years back was managed by staged reconstruction including debridement of the wound and osteomyelitic bone, distraction, cross-finger flap, and bone grafting. The finger was salvaged and he could use it reasonably well in his day-to-day activities. Osteonecrosis and dislocation of small joints of the fingers post-envenomation and their management by debridement and cross-finger flaps have been reported in rare cases.[2] In the study by Huang et al regarding hand deformities in snakebite victims, seven patients required skin grafts or flap cover, while one patient had proximal interphalangeal joint destruction and underwent ray amputation.[16]

The patient who was bitten on the middle finger progressed to soft tissue gangrene even after a timely

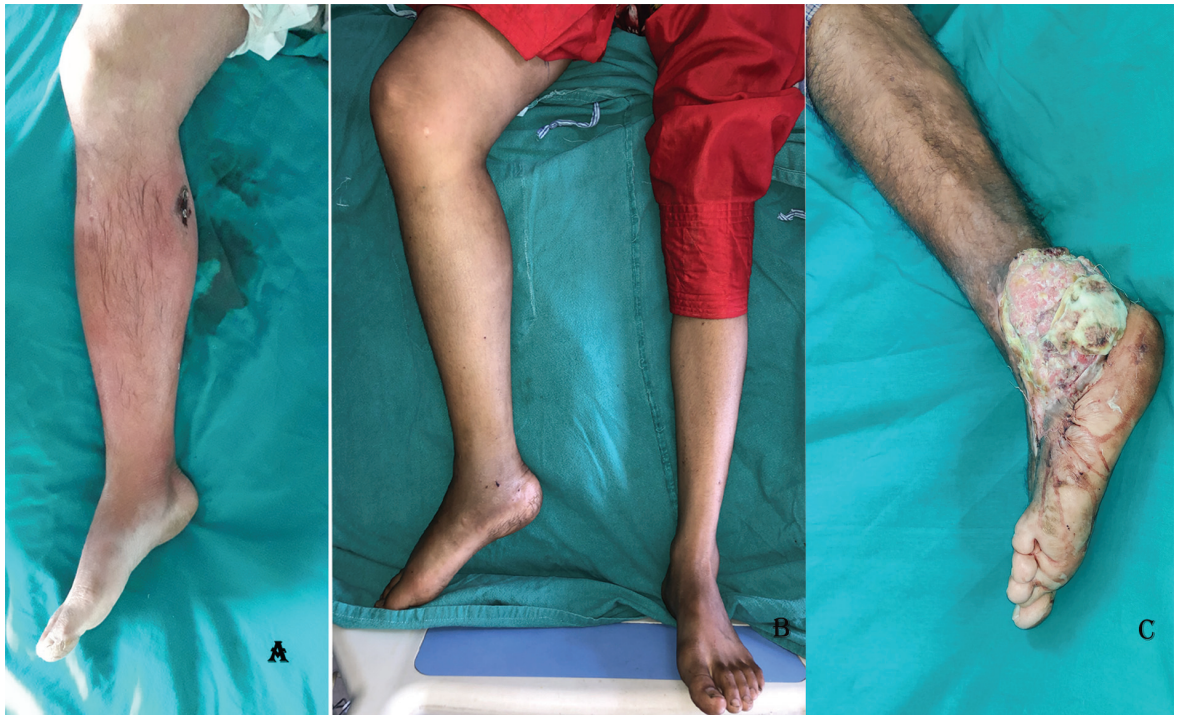

Fig. 5 (**A**) Snakebite right calf with minimal bite site necrosis. (**B**) Fang marks over the right ankle with lower limb edema in a young female. (**C**) Marjolin's ulcer over left ankle and foot in a chronic snake bite scar.

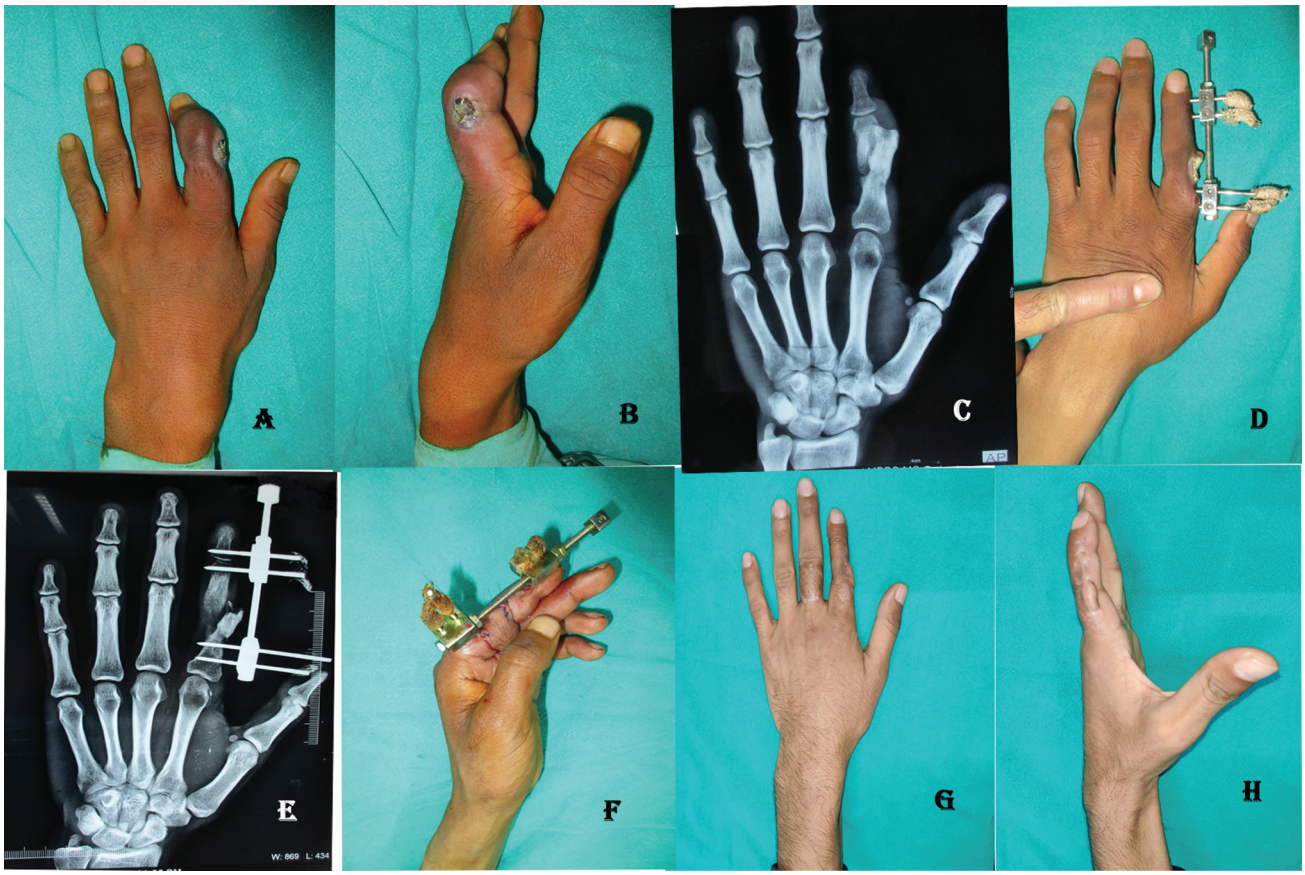

Fig. 6 (**A**, **B**) Chronic snakebite with deformity of left index finger. (**C**) X-ray revealing telescoping at proximal interphalangeal joint and osteomyelitis of the adjoining phalanges. (**D**) Uniplanar mini-distractor in situ after completion of distraction. (**E**) X-ray picture postdistraction. (**F**) Cross-finger flap from middle finger following debridement of osteomyelitic bone. (**G**, **H**) Flap well inset following bone grafting; restoring finger length and function.

fasciotomy. Debridement and reconstruction with an ipsilateral groin flap were done for the restoration of acceptable function, though the interphalangeal joints were stiff at follow-up. Groin flaps have been used for soft tissue reconstruction of hands in snakebite victims by Russel et al with good results.[2]

The plastic surgeon should be well versed in the acute and long-term management of such complex wounds, and the nuances involved in such reconstruction, allowing patients to regain their normal life. Disagreement and controversy regarding fasciotomy post-envenomation can result in severe consequences if true compartment syndrome is not acted upon in a timely manner. Amputations are most common in envenomation to the digits or toes. Reconstruction post-envenomation should be planned as any other soft-tissue defect, paying special attention to proper debridement. Envenomation of the lower extremity can be difficult for reconstruction because of paucity of tissues in the foot and lack of robust blood supply to utilize for local grafts and flaps. Envenomation to the face can cause tissue necrosis and deformity, making reconstruction essential but difficult. Envenomation of hand often requires a graft or flap to allow for the return of form and function. Role of free flaps should always be kept in mind in cases with paucity of locoregional options.[2]

Strength of the study: Uncommon and rarely reported bite site complications and their management.

Weaknesses of the study: Limited sample size.

Directions for future research: Multicenter studies with larger sample sizes for developing standardized treatment recommendations.

Conclusions

Snakebite victims should be referred promptly to the proper center, to avoid delay in treatment and possible complications. Awareness campaign regarding avoidance of torniquet should be generated. Plastic surgeons play an important role in the management of acute bite site effects and sequelae for restoration of form and function and should be an integral part of the core team involved in the management of snakebite victims and their rehabilitation.

Informed Consent

Written informed consent was taken from the patients.

Conflict of Interest

None declared.

Acknowledgment
We would like to thank the staff of our department who helped in conducting this study.

References

1 Yaqoob A, Ali Mufti S. A study on the clinical, epidemiological profile and the outcome of the snake bite victims in Kashmir valley. J Family Med Prim Care 2022;11(02):680–684
2 Russell JJ, Schoenbrunner A, Janis JE. Snake bite management: a scoping review of the literature. Plast Reconstr Surg Glob Open 2021;9(04):e3506
3 Sharma LR, Lal V, Simpson ID. Snakes of medical significance in India: the first reported case of envenoming by the Levantine viper (Macrovipera lebetina). Wilderness Environ Med 2008;19(03):195–198
4 Chattopadhyay A, Patra RD, Shenoy V, Kumar V, Nagendhar Y. Surgical implications of snakebites. Indian J Pediatr 2004;71(05):397–399
5 Penington A, Johnstone B. A case of local tissue necrosis following a bite by the Australian tiger snake Notechis scutatus. Aust N Z J Surg 1997;67(06):385–388
6 Agha RA, Sohrabi C, Mathew G, Franchi T, Kerwan A, O'Neill NPROCESS Group. The PROCESS 2020 Guideline: Updating Consensus Preferred Reporting Of CasESeries in Surgery (PROCESS) Guidelines. Int J Surg 2020;84:231–235
7 Kim YH, Choi JH, Kim J, Chung YK. Fasciotomy in compartment syndrome from snakebite. Arch Plast Surg 2019;46(01):69–74
8 Bhasker S. Prognostic indicators in snake bite: management and outcome study of snake bite cases in a zonal hospital in Jammu and Kashmir, India. Int J Sci Res 2017;6:35–37
9 Hussain T, Jan RA. Images in clinical medicine. A viper bite. N Engl J Med 2015;373(11):1059–1059
10 Arshad A, Azfar M, Munawwar H, Jawed UA. Snake bite on scrotum–a case report. Pan Afr Med J 2011;10:25
11 Dhar D. Compartment syndrome following snake bite. Oman Med J 2015;30(02):e082
12 Türkmen A, Temel M. Algorithmic approach to the prevention of unnecessary fasciotomy in extremity snake bite. Injury 2016;47(12):2822–2827
13 Dagar J, Jagtap A, Aundhakar C, et al. Rare case of snake bite on face. 2015;16(02):390–391
14 Ajay Kumar S, Vinay Kumar MS, Raghavendra Babu YP, Mahadeshwara Prasad DR. An unusual site for a snakebite. Med Leg J 2016;84(03):153–155
15 Smith J, Mello LF, Nogueira Neto NC, et al. Malignancy in chronic ulcers and scars of the leg (Marjolin's ulcer): a study of 21 patients. Skeletal Radiol 2001;30(06):331–337
16 Huang TT, Blackwell SJ, Lewis SR. Hand deformities in patients with snakebite. Plast Reconstr Surg 1978;62(01):32–36

