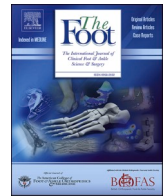




Contents lists available at ScienceDirect

The Foot

journal homepage: www.elsevier.com/locate/foot

Case Report

Reconstruction of post-osteomyelitis 1st ray phalangeal loss by reverse dermis cross toe flap and fibula bone grafting: A rare case report

Gaurav Gupta^{a,1}, Maulin M. Shah^{b,*}, Santosh Raibagkar^c, Ankit Shah^c, Qaisur Rabbi^{a,2}

^a OrthoKids Clinic, Ahmedabad, Gujarat, India

^b OrthoKids Clinic, 7th Floor, Golden Icon, Opp. Medilink Hospital, Near Shivrangini Flyover, Satellite, Ahmedabad 380015, India

^c Sushruta Plastic Surgery Hospital, Shivam Building 1st Floor, Jalaram Mandir Road Paladi, Ellisbridge, Ahmedabad 380006, India

ARTICLE INFO

Keywords:

MRSA
Phalangeal loss
Osteomyelitis
MTP Fusion
Reconstruction
Amputation

ABSTRACT

Osteomyelitis is defined as infection of the bone and its marrow. It is more common in children due to growing bones and rich blood supply. Although long tubular bones are most common to get involved, no bone is exempted from acute hematogenous osteomyelitis and metatarsals account for 2% of all cases of acute hematogenous osteomyelitis. A rare case of Community Acquired-Methicillin Resistant Staphylococcus Aureus (CA-MRSA) osteomyelitis of great toe with complete sequestration of proximal phalanx in an adolescent managed with reverse dermis cross-toe flap and inter-positional fibular grafting is presented. On the basis of our experience with this case, it is also concluded that post infective phalangeal loss with significant soft tissue necrosis does not necessarily entails amputation. With a staged soft tissue coverage and bone loss management, a good clinical, cosmetic and functional outcome can be achieved.

1. Introduction

Osteomyelitis is defined as infection of the bone and its marrow. It is more common in children due to growing bones and rich blood supply [1]. The incidence of bone and joint infections in India is approximately 1 in 1500 live births [2]. Although long tubular bones are most common to get involved, no bone is exempted from acute hematogenous osteomyelitis. Metatarsals account for 2% of all cases of acute hematogenous osteomyelitis [3]. *Staphylococcus aureus* is the most common causative organism of acute hematogenous osteomyelitis in otherwise healthy children, responsible for 70–90% of cases [4,5]. Kini et al. calculated the prevalence of CA-MRSA (Community Acquired-Methicillin Resistant Staphylococcus Aureus) to be 55% in bone and joint infections of Indian children [6]. They also supported previous study by Hawkshead et al. that MRSA (Methicillin Resistant Staphylococcus Aureus) associated paediatric osteomyelitis cases were significantly more severe than MSSA (Methicillin Sensitive Staphylococcus Aureus), leading to increased need of multiple surgical interventions, increased hospital stay, greater morbidity, more incidence of soft tissue affection and increased chances of disability [7]. These are many case reports of severe life threatening

CA-MRSA infections with around 64% fatality rate and 40% rate of significant disabilities in the survivors [8]. This case presents our experience of successfully managing a rare case of aggressive CA-MRSA osteomyelitis of the great toe with complete sequestration of the proximal phalanx and loss of overlying soft tissue in an 11 year old girl.

2. Case Report

An 11-year-old girl presented with a non-healing ulcer over the first ray of left foot and a fully exposed proximal phalanx. She had presented with acute onset cellulitis to a local orthopaedic surgeon with dull pain along the left great toe before a month. There was no history of local trauma, bug-bite or foreign body impaction. After 3 days, she developed swelling over the dorsum of left great toe for which oral antibiotics were started by a local orthopaedic surgeon. Four days later, she developed a pustule over the same site along with high grade fever. Fever subsided after 2 days and pustule ruptured, discharging frank pus and leaving an ulcer which increased in size despite regular antibiotics, non-steroidal anti-inflammatory drugs (NSAID) and wound care. There was persistent purulent discharge from the wound and patient was referred to us

* Corresponding author.

E-mail addresses: gauravgupta5038@gmail.com (G. Gupta), maulinmshah@gmail.com (M.M. Shah), sraibagkar@yahoo.com (S. Raibagkar), ankitshah852002@gmail.com (A. Shah), qaisur@gmail.com (Q. Rabbi).

¹ Address: K-50E, Sheikh Sarai Phase-2, New Delhi 110017.

² Address: House# 12, Road# 10, Block# L, South Bonosree, Khilgaon, Dhaka 1219.

<https://doi.org/10.1016/j.foot.2021.101782>

Received 19 August 2020; Accepted 22 January 2021

Available online 4 February 2021

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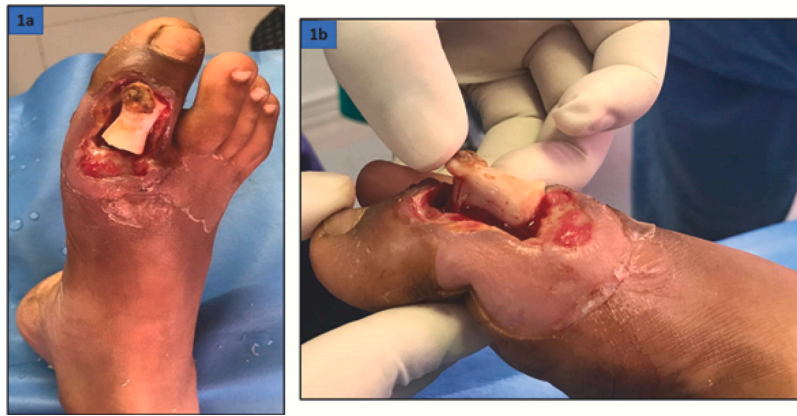


Fig. 1. a and b: Clinical images of the patient at first presentation showing complete sloughing of dorsal skin and soft tissue cover over the left great toe with necrotic patch over the proximal phalanx and near total sequestration of proximal phalanx.

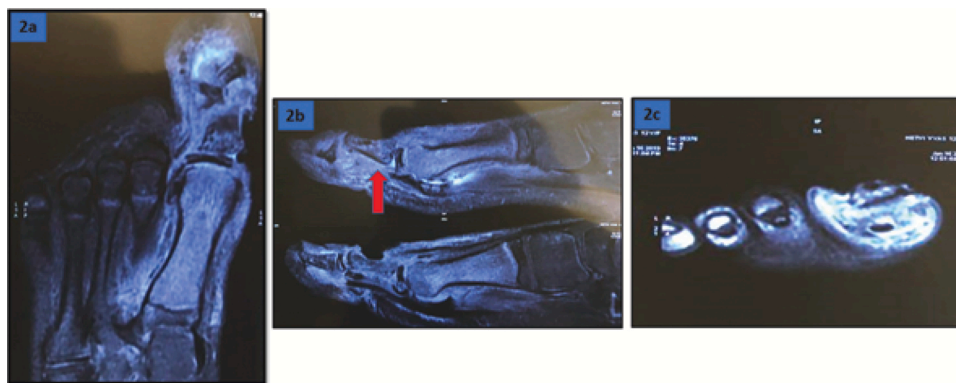


Fig. 2. a–c: Various sections of MRI left foot showing dorsal skin defect, soft tissue and bone marrow edema with necrotic proximal phalanx. Physeal separation of proximal phalanx (red arrow) with dislocation of the pip joint is clearly evident on the sagittal sections.

for further management.

On local examination, there was an ulcer of size 3 by 2.5 cm with loss of dorsal skin, subcutaneous tissue, and extensor tendon along with the periosteum over proximal phalanx of great toe. Proximal phalanx was found separated from its physis and there was pus collection in 1st MTP (Meta-Tarso-Phalangeal) joint. Proximal phalanx was completely sequestered except by very small soft tissue band on plantar side (Fig. 1). There were changes of cellulitis along the surrounding dorsal foot area. She had intact sensation along the great toe tip with adequate capillary

refilling. Her general physical examination was normal. There was absence of any other infective foci. Her blood investigations showed neutrophilic leucocytosis with raised C-Reactive Protein (CRP) [CRP 182 mg/L, Total leucocyte count (TLC) of 20,500/cubic millilitre and neutrophil count of 82%]. X rays revealed physeal separation with complete sequestration of proximal phalanx. MRI (Magnetic Resonance Imaging) was suggestive of pus pocket around the wound and along the first MTP joint (Fig. 2). Bone marrow edema was evident in the first metatarsal. Pus culture grew Methicillin Resistant Staphylococcus

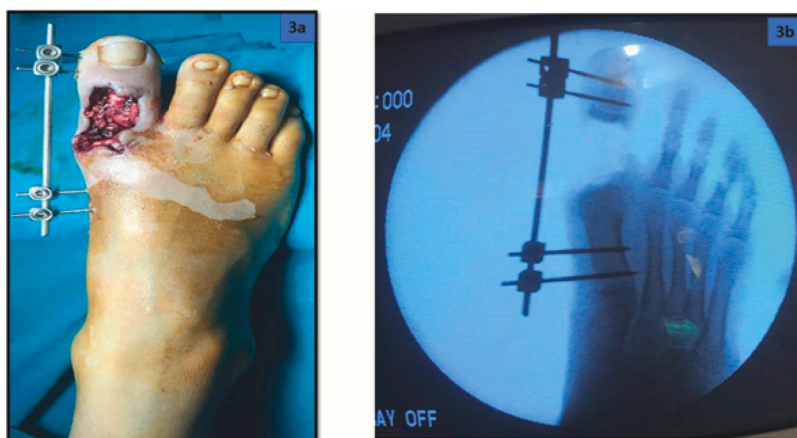


Fig. 3. a and b (First stage): Clinical and radiological images immediately after debridement. All necrotic soft tissue along with sequestered proximal phalanx were removed and a mono-lateral external fixator was applied.

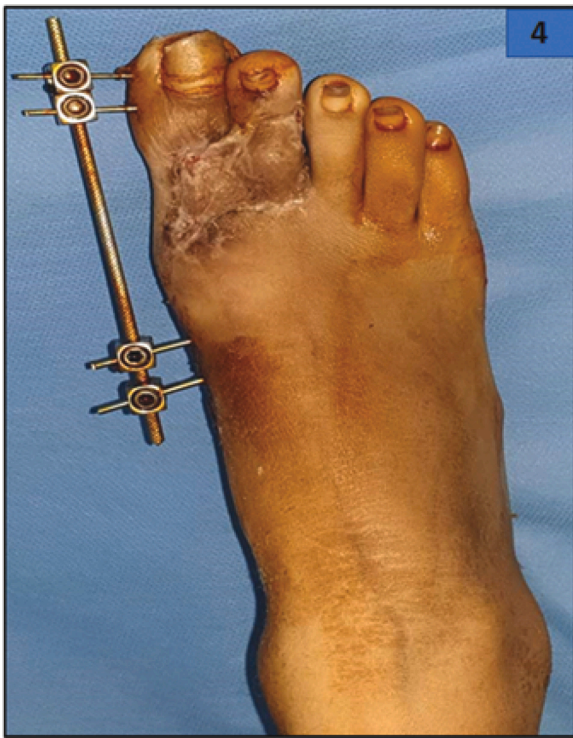


Fig. 4. (Stage 2): Clinical image showing healed reverse cross-toe flap.

Aureus (MRSA) which was sensitive to Linezolid and Vancomycin.

Treatment options were either doing a partial first ray amputation or salvaging the first ray through staged procedure. Both these options with their expected course, complications and time required were discussed with the family in great details and they consented for staged reconstruction.

2.1. Stage 1: Debridement and external fixator application

Under the cover of culture sensitive intravenous antibiotics, a thorough debridement of wound was done, necrosed soft tissue and sequestered proximal phalanx was removed. Length of the first ray was maintained by placing a monolateral mini external fixator (Fig. 3). A below knee plaster splint was applied. Intravenous antibiotics were continued till the CRP normalised and it was followed by oral antibiotics for total 4 weeks. Wound was dressed regularly. TLC and CRP normalised in 10 days and second stage was planned after 3 weeks of the initial surgery.

2.2. Stage 2: Reverse dermis cross toe flap

A reverse dermis cross-toe flap [9] was done after 3 weeks of initial surgery, when there was no evidence of local infection (Fig. 4). Under tourniquet control, defect was measured, marked and planning in reverse was done. Flap was raised, the portion of flap covering the defect was deepithelialised and placed over the defect. Skin graft was applied over the flap and the donor site.

2.3. Stage 3: Fibular interposition grafting

Four weeks after the second stage, the third stage was considered.



Fig. 5. a–d (Stage 3): Intraoperative clinical and radiological images showing inter-positional fibular grafting supported with intramedullary k wire and monolateral external fixator.



Fig. 6. a–c: Final follow up images at 2.5 years showing well healed soft tissue, complete incorporation of the fibular interpositional graft with arthrodesed 1st mtp and pip joints of the left great toe.

Distance between the bone ends was measured to be 3 cm. Ipsilateral midshaft fibula was retrieved without periosteum. Flap was opened from medial aspect of first ray. Cartilage of distal phalanx and Metatarsal head were denuded. Fibula was interposed and transfixed with a k-wire (Fig. 5). MTP joint was kept in 5° of valgus and 10° of dorsiflexion. External fixator was retained to provide added stability. A below knee plaster splint was applied. External fixator was removed after one month. K-wire removal was done after radiological evidence of healing of proximal and distal fusion site, which took three months from the first surgical intervention. Child was given a walking cast for one more month and a toe supporting ankle foot orthosis was prescribed thereafter. Flap division was deliberately delayed till complete radiological union and was done at 8 months of the last surgery.

At final follow up of 2.5 years, wound is completely healed, patient is able to walk with solid bony arthrodesis of the first proximal interphalangeal (PIP) joint and metatarso-phalangeal (MTP) joint radiologically (Fig. 6).

3. Discussion

The most probable route of osteomyelitis in children is hematogenous. As per the bone bruise theory, bacteraemia with disruption of bone micro-architecture due to minor and often unrecalled trauma sets the stage for bacterial lodgement and proliferation in the bone leading to hematogenous osteomyelitis. This bacterial proliferation along with inflammation increases the intraosseous pressure leading to compromised intramedullary blood supply. Further increase in pressure can rupture/perforate the weak metaphyseal cortex leading to subperiosteal collection compromising the remaining periosteal blood supply of bone. This leads to bone necrosis and sequestration. Collection of pus then penetrates the periosteum leading to local soft tissue disruption including necrosis of tendons, muscles, subcutaneous tissues and sloughing of surrounding skin [10]. The pathophysiology in our case is the same as described by Faville [10].

There is a plenty of adult literature regarding management of diabetic/traumatic/animal bite wounds around the first ray with and without destruction of the underlying bones and joints. Majority of them focussed on partial or complete excision of first ray, extrusion of only the involved segment of bone with shortening and fixation/arthrodesis in a single stage, maintaining the length using external fixators, cement spacers followed by interpositional bone grafting with fibrous/bony arthrodesis in the second stage [11–14]. All of them have their specific indications and risks involved.

Through an extensive search of the English literature, not a single case was found of CA-MRSA osteomyelitis with complete sequestration of proximal phalanx in the adolescent age group managed with reverse dermis cross-toe flap and inter-positional fibular grafting.

In one of the largest series of first ray amputation by Murdoch et al., 71 patients underwent 1st MTP disarticulation or more proximal amputation as the primary procedure. Forty (56%) out of them required a revision amputation proximally within 10 years of the primary surgery [5]. Majority of studies concluded good results and better patient satisfaction with reconstruction, whether single or multiple staged in comparison to first ray amputation [15,16]. In our case, the age of the patient, intact neurovascular status along with no comorbidities were a few factors to attempt salvage and reconstruction in comparison to first ray amputation.

As per Bowker's study, first ray amputation has disastrous effects on normal foot function due to loss of medial column, necessary for stance and forward progression [17,18]. Preserving the first ray also helps in maintaining medial buttress effect of great toe and thus preventing varus angulation of 2nd MTP joint due to imbalance of forefoot intrinsic musculature. Other advantages include no requirement of filler prosthesis, better cosmesis and shoe fitting as compared to first ray amputation. Considering these facts, we attempted salvage and reconstruction in spite of significant infection and complete necrosis of proximal

phalanx. However, parents were explained regarding amputation as the "last resort" in case of failed reconstruction.

1st MTP fusion should be done in about 5° valgus and 10° dorsiflexion to prevent abnormal biomechanics across the 1st ray [19]. Ideally a small plate or cross k-wires are used to provide desired fusion position. Due to the lack of dorsal skin & the fragility of bony architecture, we preferred trans-fixing k-wire and mono-lateral fixator was also retained to add to the stability. While this is not the optimum method, it was considered based on the local bony architect.

Limited flap options are available for reconstruction of soft tissue defect over dorsal aspect of proximal phalanx of great toe [9]. Amongst them local flap options are not feasible because of local infective etiology. For free micro vascular flap, defect is small and there were no certainty about available vasculature of great toe. Hence, the authors thought of doing reverse dermis cross toe flap, applying same technique of reverse dermis cross finger flap in upper extremity. The only difference in this particular case, is that the flap was divided very late, only after confirming bony consolidation radiologically and when the patient started bearing full weight over the first ray and foot.

Salvage and reconstruction have its own demerits including long recovery time, multiple surgeries and financial burden to the family. Fusion of both first MTP and proximal phalanx disturbs the push off and windlass mechanism leading to impeded cadence for life [20].

Our study is limited by only one case, no comparison with other methods of reconstruction or amputation and so further prospective, comparative studies should be done. But we think it is an important addition to the literature as there is no similar case report till date in this age group as per our knowledge.

4. Conclusion

Phalangeal loss with significant soft tissue necrosis due to infection does not necessarily entails amputation. This case report demonstrates that with a staged soft tissue coverage and bone loss management, a good clinical, cosmetic and functional outcome can be achieved.

Authors contribution

Dr Gaurav Gupta: Study design, Performed measurements, Manuscript preparation.

Dr Maulin M Shah: Study design, Performed measurements.

Dr Santosh Raibagkar: Study design, Performed measurements, Manuscript preparation.

Dr. Ankit Shah: Study design, Performed measurements, Manuscript preparation.

Dr Qaisur Rabbi: Manuscript preparation.

Conflict of interest

None.

Source(s) of support

None.

Presentation at a meeting

None.

Acknowledgements

We would like to acknowledge Dr Atul Bhaskar and Dr Rajiv Shah for helping us in preparing this manuscript.

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