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in the hand of a non-debilitated,
immunocompetent woman*

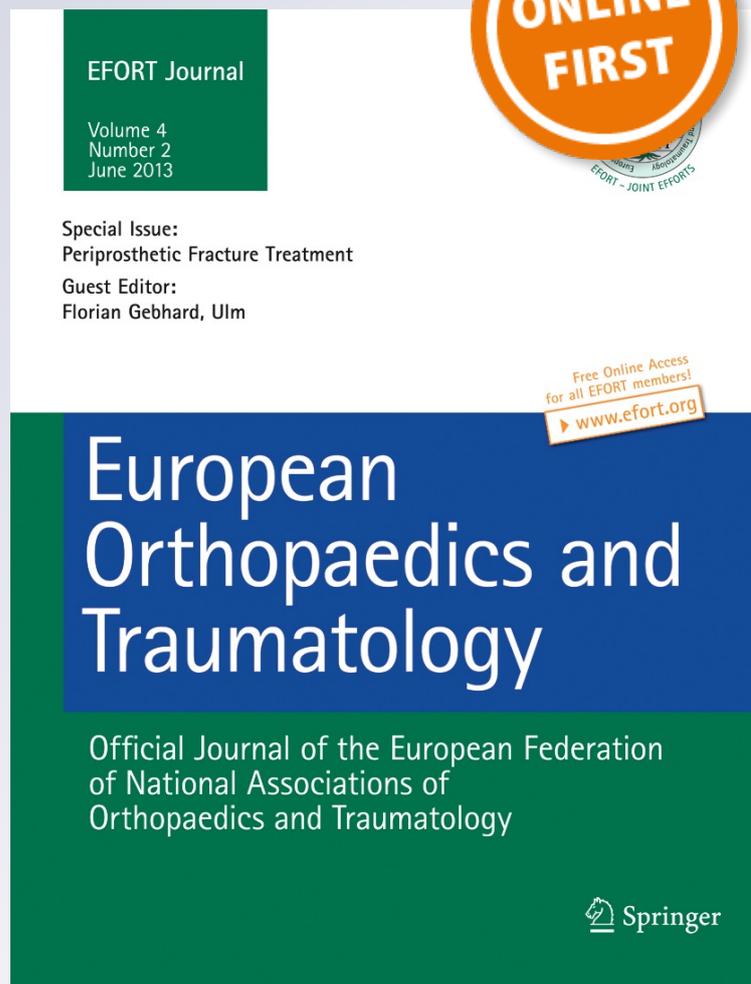
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Serratia marcescens osteomyelitis in the hand of a non-debilitated, immunocompetent woman

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Introduction

Serratia marcescens is an aerobic, gram-negative bacillus of the Enterobacteriaceae family that exists as a saprophyte in soil and environmental water sources. This bacterium colonizes the gastrointestinal, urinary, and respiratory tracts of humans and was long considered benign until the 1950s, when it was found to cause nosocomial infections in debilitated patients [1]. In the hospital setting, *S. marcescens* may contaminate saline bottles, intravenous solutions, hand lotions, and even disinfectants [1]. In debilitated and immunocompromised individuals, *S. marcescens* causes a wide variety of infections, including chronic osteomyelitis, septic arthritis, endocarditis, and meningitis [1–4]. In immunocompetent individuals, *S. marcescens* infections are uncommon and those involving the skin, soft tissue, and bone of the upper extremity are extremely rare. While acute osteomyelitis in the upper extremity has been observed in intravenous drug-abusing (IVDA) individuals, this condition has not been reported in healthy, non-IVDA individuals. Since *S. marcescens* is frequently multidrug-resistant, any infection with this bacterium is best treated with third- or fourth-generation cephalosporins.

Case report

A 24-year-old, right-handed woman sustained a traumatic left thumb amputation through the proximal phalanx in a rafting accident. She also sustained an open dislocation through the distal interphalangeal (DIP) joint of

the left index finger. The thumb was surgically reconstructed, and the DIP joint and terminal extensor tendon of the index finger were repaired and pinned (Table 1). Four weeks later, the pin was removed, and she was advised to start full range-of-motion exercises of her DIP and proximal interphalangeal (PIP) joint and massage the scar with cocoa butter. The patient was offered a stage 1 metacarpal lengthening and web space deepening for the thumb.

Two months later, she exhibited full PIP range of motion; however, she could not move the DIP joint actively or passively. At this time, she was advised to undergo an extensor tenolysis and manipulation of the index finger under anesthesia. Approximately 1 month later, she presented with swelling under the eponychial fold accompanied with cuticle loss and drainage. The patient was presumptively diagnosed with paronychia, but there was a defined abscess that could be drained. X-rays revealed joint space narrowing unchanged from her original films and no lytic lesions. She was prescribed soaks of the finger twice daily and amoxicillin/clavulanate (Augmentin®) 875 mg PO BID. Two days later, the eponychial drainage had not abated, and the patient was taken to the operating room. Sitting transversely under the eponychial fold was a hair measuring about 1 cm. There was no sign of infection when examining the nail plate and underlying subungual region. The eponychial fold was incised and drained, the wound was washed out and packed, and the oblique incisions were sewn with 6-0 PROLENE™ sutures (Fig. 1a). Two days later, the wound expressed slight drainage and was washed out and packed once more. Cultures of wound material at this time were negative.

Approximately 2 weeks later, she was continued on Augmentin® for ongoing eponychial drainage. Five days later, she experienced a significant increase in eponychial drainage as well as fluid tracking under the nail plate, resulting in the nail becoming soft. She was taken to the

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Table 1 Timeline of clinical events

Time	Surgery	Culture	Antibiotic
Initial presentation	Reconstruction of left thumb, repair and pinning of DIP joint and terminal extensor tendon of the left index finger	NA	NA
1 month	Removal of pin	NA	NA
2 months	Lysis of extensor tendon	NA	NA
3 months	Incision and drainage of eponychial abscess	ND	Augmentin® 875 mg PO BID × 14 days
3 months, 2 days	Incision and drainage of eponychial fold, washing and packing of wound	ND	As above
3 months, 4 days	Washing and packing of wound	Negative	As above
3 months, 14 days			Augmentin® 875 mg PO BID continued
3 months, 19 days	Removal of nail plate, drainage of subungual abscess		As above
3 months, 22 days		<i>S. marcescens</i>	Augmentin® IV
3 months, 23 days	Incision and drainage of subcutaneous abscess, removal of two Ethibond™ sutures, debridement of PIP joint, packing of wound		As above
3 months, 25 days			Cefepime IV
4 months, 4 days	Removal of sutures		Cefepime IV × 6 weeks via PICC line

NA not applicable, ND not done

operating room to have the nail plate removed and subungual abscess drained under local anesthesia. Three days later, there was increased eponychial drainage, suggesting the possibility of gangrene or osteomyelitis involving the distal end of the middle phalanx, the distal phalanx, and the DIP joint (Fig. 1b). An MRI showed a destruction of the DIP joint as well as osteomyelitis of the distal phalanx and subcutaneous fluid collections around the DIP joint (Fig. 1c). *S. marcescens* was cultured from the drainage. At this time, she was admitted to the hospital to receive Augmentin® intravenously and infectious diseases consultation. In the hospital, the patient was found to have a dorsal subcutaneous abscess extending to the PIP joint. On surgical exploration, two Ethibond™ sutures from a previous tendon repair were discovered and removed (Fig. 1d). After thorough debridement of the PIP joint dorsally,

the skin flaps were loosely closed and pack was placed. A wound care specialist applied wet-to-dry dressings soaked in Dakin's solution twice daily, and the patient continued receiving Augmentin® intravenously.

Once the *S. marcescens* isolate was found to be resistant to Augmentin®, this antibiotic was replaced with cefepime to which the *Serratia* isolate was sensitive. One week later, the drainage decreased and a compressive bandage was placed to help close the wound. Four days later, the sutures were removed and the top of the finger was found to be macerated but otherwise intact with adequate vascularity. A PICC line was placed for a 6-week course of cefepime to treat osteomyelitis. The wound healed uneventfully, and the nail plate began to grow. Five months post-operatively, the patient's finger was found to be completely healed with the growth of a healthy nail plate (Fig. 1e).

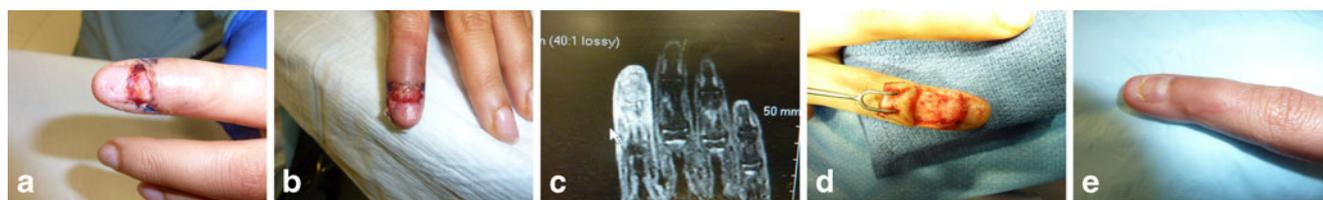


Fig. 1 Traumatic injury of the left index finger complicated by *Serratia marcescens* osteomyelitis. **a** Exposure of eponychial fold after incision and drainage. **b** Post-operative drainage suggesting osteomyelitis. **c** MRI showing destruction of the DIP joint and osteomyelitis of the

distal phalanx. **d** On surgical exploration, sutures from a previous tendon repair were removed. **e** Complete resolution of case with healthy nail plate growth

Table 2 *Serratia marcescens* infections of the skin, soft tissue, or bone in the upper extremity of immunocompetent, non-debilitated, and non-IVDA individuals

Year	Age	Sex	Location	Entry into body	Infection(s)	Antibiotics	Outcome	Reference
2012	24	F	Left index finger	UNK	Paronychia, osteomyelitis	Cefepime × 6 weeks	Complete resolution	Present report
2012	40	M	Left hand, dorsum	Previous injury with sharp object? Human bite	Multiple abscesses, cellulitis	Ciprofloxacin × 15 days, followed by TMP-SMZ × 3 months	Abscess recurrence, resolution in 1 year Death in 2 days	[5]
2011	37	M	Forearm, hand	Human bite	Puncture wound, necrotizing fasciitis, <i>S. pyogenes</i> co-infection	NR		[10]
2006	10	NR	Upper extremity	UNK	Granulomatous nodule	Ciprofloxacin	No relapses in 10 months	[8]
2000	86	F	Left hand, dorsum	UNK	Granulomatous ulcer	TMP-SMZ × 20 days	No relapses in 1 year	[9]
1999	8	M	Finger	Pet iguana bite	Cellulitis, <i>S. aureus</i> co-infection	Cephalexin, followed by Augmentin + gentamicin × 5 days, Augmentin	Patient's condition improved at the time of reporting	[6]
1998	21	F	Right ring and middle fingers	Contaminated therapeutic leech	Cellulitis	Ciprofloxacin	Patient's condition improved at the time of reporting	[7]

IVDA intravenous drug-abusing, UNK unknown, NR not reported

Discussion

To our knowledge, we report the first case of *S. marcescens* osteomyelitis in the upper extremity of a non-debilitated, immunocompetent individual. We identified only six other *S. marcescens* infections in the upper extremity of such individuals (Table 2). These include three cases of cellulitis [5–7], two cases of granulomatous lesions [8, 9], and one case of necrotizing fasciitis [10]. Four of these cases involved a traumatic event. The three cases of cellulitis were caused by: (1) a previous traumatic injury, (2) the bite from a pet iguana, and (3) the therapeutic use of contaminated leeches. The case of necrotizing fasciitis was caused by a human bite, with *S. pyogenes* co-infection the likely cause of death. No apparent trauma was reported in the two cases of granulomatous lesions. All of these patients, except for the one with necrotizing fasciitis, survived after appropriate antibiotics were administered. While many cases of *S. marcescens* osteomyelitis have been reported in premature neonates and infants, only two cases of osteomyelitis of the upper extremity have been previously reported in debilitated or immunocompromised adults: (1) a 26-year-old man with Crohn's disease and carpal scaphoid osteomyelitis resulting from an indwelling radial artery catheter [3] and (2) a 34-year-old man who sustained an open fracture of the forearm in a motorcycle accident [11].

The source of our patient's *S. marcescens* infection cannot be definitively established. Possible sources include: (1) exposure to river water at the time of the rafting accident, (2) nosocomial contamination of the sutures or Kirschner wire used in the pinning of the distal phalanx, and (3) patient contamination of the post-operative wound. The fact that she is involved in the care of two 3-year-old twins may be significant.

Conclusion

The vast majority of paronychia or “horseshoe” infections is caused by *Staphylococcus* or *Streptococcus* that respond readily to operative removal of all or part of the nail plate and opening of the affected nail fold, oral antibiotics, and local wound care. When the finger does not respond to these usual measures, one must be alert to the presence of an unusual microorganism and/or underlying osteomyelitis.

Conflict of interests All named authors hereby declare that they have no conflict of interests to disclose.

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