PUNCTURE WOUNDS & BITES

PUNCTURE WOUNDS:

- *A wound whose depth exceeds the diameter of the visible surface injury.*
- Most commonly involve the plantar surface of the foot
    - The relatively innocuous-appearing skin wound belies the potential for infection and injury to underlying structures
- Puncture wounds caused by high-pressure injection equipment, animal bites and those involving exposure to body fluids each have potential for unique complications

PATHOPHYSIOLOGY:

- In puncture wounds, shear forces between the penetrating object and tissue result in tissue disruption, producing haemorrhage and devitalisation.
- Inoculation of organisms (from object or skin surface) followed by relatively rapid closure creates an environment for the development of infection.
    - Rates of infected plantar puncture wounds of ~6-11%
    - *Staph aureus* predominates.
- Puncture wounds over joints can penetrate the joint capsule and produce septic arthritis, whereas penetration of cartilage, periosteum and bone can lead to osteomyelitis.
    - *Pseudomonas* is the most frequent pathogen isolated from plantar puncture wound-related osteomyelitis esp. if acquired through rubber soles of athletes shoes.
- Most literature points to the FOREFOOT as the higher risk area for puncture wounds due to risk of deep penetration
- Risk factors for complications outlined below:

Table 50-1 Risk Factors for Puncture Wound Complications

Patient characteristics
Elderly
Immunocompromised (diabetes, acquired immunodeficiency syndrome, steroids, chemotherapy)
Peripheral vascular disease
Wound characteristics
Contaminated with soil or debris
Containing foreign body
Occurring outdoors
Occurring through a shoe and/or sock
Occurring >6 h before evaluation
Deeper penetration (jumping, falling, running)

CLINICAL FEATURES:

- Important historical features:
    - Time of injury
    - Report of high-pressure injection, falling or jumping onto an object = *deeper injury*
    - Footwear or clothing through which penetrating object passed
    - Host factors predisposing to infection
- Characteristics of the penetrating object are important to predicting risk of retained FB and post-injury infection.
- Examination --> function of underlying structures.
    - Patients w/ puncture wounds may not present until infection is present with progressive pain, swelling, erythema, warmth & fluctuance.

DIAGNOSIS:

- Plain film radiographs will detect >90% radioopaque foreign bodies >1mm.
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- Most organic substances cannot be detected reliably with plain film x-ray and consider US.
- CT or MRI should be considered w/ deep-space infection & persistent pain
- Indications for imaging outlined below:

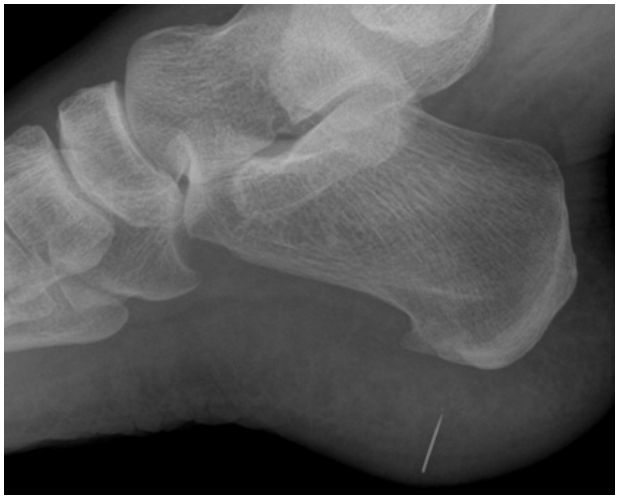


Table 50-2 Indications for Imaging in Puncture Wounds
Plain radiographs
Suspicion of fracture
Infected wound
Wound caused by materials prone to fragment (wood, glass, etc.)
Foreign body sensation reported by patient
CT or MRI
Suspected deep-space infection
Persistent pain after injury
Failure to respond to treatment

TREATMENT OF PUNCTURE WOUNDS:

- Treatment recommendations for puncture wounds are largely based on anecdotal evidence and reviews of uncontrolled cases series
    - more aggressive wound debridement and irrigation has been advocated
- Uncomplicated punctures that appear clean and presenting within 6 hours of injury require superficial wound cleansing and tetanus prophylaxis as indicated.

- The greatest controversy concerns the ROLE OF PROPHYLACTIC ANTIBIOTICS FOR PLANTAR PUNCTURES.
    - NO PROVEN BENEFIT, although its use is recommended in high risk patients with impaired host defences
    - Cephalosporins, anti-Staph penicillin or macrolide all reasonable choices.

COMPLICATIONS OF PUNCTURE WOUNDS:

- Include skin tattooing, cellulitis, localised abscess, deep soft tissue infection or osteomyelitis
    - THE HALLMARK OF ALL THESE COMPLICATIONS IS **PERSISTENT PAIN**
- Any patient with pain >48 hours post-injury should undergo evaluation for retained foreign body or infection.
- Standard incision and drainage is curative for most localised abscess
- For deep soft tissue infection, treatment is parenteral antibiotics with surgical exploration and drainage of puss, excision of necrotic tissue and irrigation of infection areas
- Patients with osteomyelitis usually present later (often 7 days down the line) --> surgical referral and IV antibiotics

DISPOSITION & FOLLOW-UP.

- Cellulitis & localised abscesses can be managed as an outpatient.
    - oral ABx & review in 48 hours to gauge progress.
- Systemic illness, extensive infection, co-morbidities or unreliable patients should be admitted for IV ABx.
    - Deep space infection & osteomyelitis require admission, surgical intervention & IV ABx also.

SPECIAL CONSIDERATIONS IN PUNCTURE WOUNDS:

NEEDLE STICK INJURIES:

- Common among health care professionals
- Major concern are risk of infection with hepatitis and HIV
    - Risk of clinical infection after an inadvertent needle stick from an INFECTIOUS SOURCE has been estimated to be:
        - Negligible for hepatitis A
        - 6 % for hepatitis B
        - 2% for HCV
        - 0.3% for HIV
- Post-exposure prophylaxis is available for HIV/HBV

Hepatitis B

General principles:

- If the source is HBsAg-negative, and unlikely to be in the window period, no further follow-up testing is required of source or health care worker. The health care worker should have full HBV immunisation, if this has not already happened. It should be commenced as soon as possible, preferably within 24 hours.
- If hepatitis B immunoglobulin (HBIG) is indicated, it should be given as soon as possible, and preferably within 24 hours of exposure. Efficacy of HBIG more than 7 days after exposure is unknown.

Hepatitis C

General principles:

- If the source is HCV antibody negative, and unlikely to be in the window period, no further follow-up testing is required of the source or health care worker.
- Follow-up testing of the health care worker should be done in all other circumstances, and should include HCV RNA testing at 4 to 6 weeks, and HCV antibodies and ALT at 4 to 6 months.
- There is no effective passive or active immunoprophylaxis. Early therapy if seroconversion occurs should be considered (see Acute hepatitis C).

Human immunodeficiency virus

General principles:

- If the source is HIV antibody negative, and unlikely to be in the window period, no further follow-up testing is required of the source or health care worker.
- In all other circumstances, the health care worker should have follow-up HIV antibody testing at 6 weeks and 3 months, and up to 6 months, along with tests for other blood-borne viruses as above.
- If occupational postexposure prophylaxis (PEP) against HIV is indicated, it should be commenced as soon as possible after exposure. It is substantially less effective in animal studies when started more than 24 to 36 hours after exposure, but the interval after which no benefit is gained is unknown.
- Recommendations for occupational PEP include a basic regimen of two nucleoside/nucleotide reverse transcriptase inhibitors for most HIV exposures, and an expanded regimen with the addition of a third drug when the exposure poses an increased risk for transmission. The choice of drugs will also be influenced by the likelihood of drug resistance in the source (if known).
- Expert advice from an HIV physician or adherence to local agreed guidelines is essential before occupational PEP against HIV infection is initiated.

For lower-risk exposures (mucous membrane or intact skin exposures, superficial scratches, injuries involving solid needles, low HIV viral load in the source), a common regimen is:

1 **emtricitabine+tenofovir 200+300 mg orally, daily for 4 weeks [Note 1]**

OR

1 **lamivudine+zidovudine 150+300 mg orally, 12-hourly for 4 weeks [Note 1].**

For higher-risk exposures (percutaneous injury with hollow blood-containing needle, deep injury, high viral load or late-stage disease of source), to the above regimen, **add**:

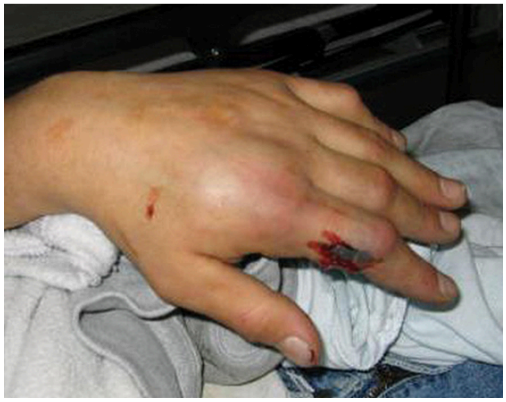
lopinavir+ritonavir 400+100 mg orally, 12-hourly for 4 weeks [Note 1].

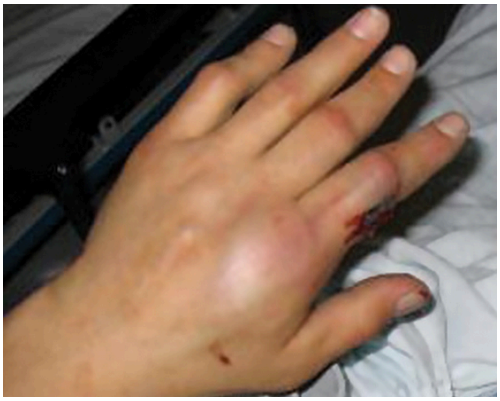
If there is exposure to drug-resistant HIV or there are adverse effects to drugs in the above regimen, expert advice should be sought.

For more information, see the World Health Organization guidelines on postexposure prophylaxis to prevent HIV infection. [PDF]

HIGH-PRESSURE INJECTION INJURIES:

- Caused by industrial equipment designed to force liquids through small-diameter holes
    - High pressure penetrates intact skin and forces the material deep into the underlying structures that can spread deeply along fascial planes, lacerating skin and fracturing bones





- The type, amount & viscosity of material injected will determine the degree of tissue inflammatory response.
    - In less distensible tissue compartments; sudden pressure elevations that can produce vascular injuries, ischaemic necrosis and gangrene
- The injury may initially cause little pain and possess a relatively innocuous appearance leading to under-appreciation of the extent of injury
    - W/in hours, pain typically becomes severe and evidence of ischaemia or widespread inflammation is manifest.
    - THE LACK OF SIGNS OF EXTERNAL INJURY CAN BE MISLEADING & THE HISTORY OF HIGH PRESSURE INJECTION IS CRUCIAL
- The risk of subsequent amputation is reduced if wide surgical debridement is performed within 6 hours of the injury, especially in cases of organic solvents --> INVOLVE YOUR HAND SURGEONS EARLY.

ADRENALINE AUTO-INJECTOR INJURIES:

- Patients present with pain due to the needle stick, paraesthesiea & adrenaline-induced vasospasm to the injected area
- In the extreme, the entire digit can be blanched and cold
    - The intensity of digital ischaemia and response to treatment can be assessed using PULSE OXIMETRY of the involved finger
- Natural history of this injury is SPONTANEOUS RESOLUTION and there is no clear evidence that active treatment is better than observation alone
    - The only thing proven to reverse digital ischaemia is SUBCUT INJECTION OF PHENTOLAMINE into the affected area
- Once ischaemia has resolved, the patient can be discharged as relapse is very unlikely

MAMMALIAN BITES:

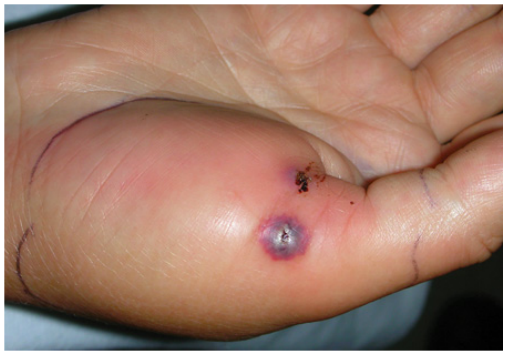
GENERAL PRINCIPLES:

- Considerations in patients with bite injuries:
    - Injury inflicted by the bite
    - Prevention or treatment of local bacterial infection
    - Prevention, recognition & management of systemic illness.
- Assess initially for presence of life-threatening injury (esp. in little children or mauling by large animal)
    - Vascular damage and blunt or penetrating trauma is possible
    - STANDARD ASSESSMENT & RESUSCITATION IN THESE CASES
- Meticulous examination & cleansing measures include aggressive irrigation and debridement of de-vitalised tissue are important.
    - Determine the extent of underlying tissue damage with special attention to the potential for penetration into joint spaces and tendon sheaths.
- Some bite lacerations can undergo safe primary repair
    - Risk of post repair infection < 5%

Table 50-3 Indications for Primary Closure of Mammalian Bite Wounds
Location: face or scalp
Timing: within 6 h of injury (time dependent upon individual judgment)
Wound characteristics: simple and appropriate for single-layer closure, no devitalized tissue
Lack of underlying injury: no underlying fracture
Host: no systemic immunocompromising conditions

- Consider delayed primary closure for the management of contaminated bites, especially those areas away from the face.
- Current practice is to delay wound closure in immunocompromised patients
    - Case reports of sepsis & death due to Capnocytophaga canimorsus
- Bite wounds at high risk of infection, that will require re-evaluation in 24-48 hours include:

Table 50-4 Bite Wounds at High Risk of Infection
Cat or human
Livestock
Monkey bites
Deep puncture wounds
Hand or foot wounds
Bites in immunosuppressed patients



An infected cat bite wound that subsequently grew Pasteurella multocida

MICROBIOLOGY AND THERAPY INFECTIONS FROM CAT AND DOG BITES:

- Mammalian saliva contains large concentrations of microorganisms and bite wounds should be considered to be contaminated with pathogenic bacteria
    - Bacterial proliferation in tissue can lead to serious cellulitis, tenosynovitis and septic arthritis.
- Only ~5% of dog bites become infected.
- CATS ARE MUCH HIGHER RISK
    - Due to their narrower, sharper teeth that give them the ability to deliver infectious agents deep into a small-bore puncture wound.
        - Up to 80% of cat bites will become infected.
    - Infection is often due to ***Pasteurella*** especially if the infection has rapid onset

Table 50-5 Common Bites and First-Line Treatment

Animal	Organism	First-Line Antibiotic
Cat	*Pasteurella multocida*	Amoxicillin-clavulanate
	Bartonella henselae (cat-scratch fever)	Azithromycin
Dog	*Pasteurella*, streptococci, staphylococci, *Capnocytophaga canimorsus*	Amoxicillin-clavulanate
Human	*Eikenella*, staphylococci, streptococci	Amoxicillin-clavulanate
	Herpes simplex (herpetic whitlow)	Acyclovir or valacyclovir
Rats, mice, squirrels, gerbils	*Streptobacillus moniliformis* (North America) or *Spirillum minus/minor* (Asia)	Amoxicillin-clavulanate
Livestock, large game animals	Multiple organisms	Amoxicillin-clavulanate or specific agent for disease
	Brucella, *Leptospira*, *Francisella tularensis*	
Bats, monkeys, dogs, skunks, raccoons, foxes (all carnivores and omnivores)	Rabies	Rabies immune globulin, rabies vaccine
Monkeys	Herpes B virus (Cercopithecine herpesvirus)	Acyclovir or valacyclovir
Freshwater fish	*Aeromonas*, staphylococci, streptococci	Fluoroquinolone or trimethoprim-sulfamethoxazole
Saltwater fish	*Vibrio*, staphylococci, streptococci	Fluoroquinolone

- The only evidence for prophylactic antibiotics is for dog or cat bites of the hands, in which the postbite infection rate may decrease to <2% when antibiotics are given
    - A prudent approach is to treat all infected wounds and to prescribe antibiotics for high-risk uninfected wounds
        - All cat bites
        - All bites in immunocompromised hosts
        - Deep dog bite puncture
        - Hand wounds
        - Any injury undergoing surgical repair

Infection not established

Low risk

Antibiotics may not be necessary for mild wounds not involving tendons or joints that can be adequately debrided and irrigated and that are seen within 8 hours.

High risk

Wounds having a high risk of infection include:

- wounds with delayed presentation (8 hours or more)
- puncture wounds unable to be debrided adequately
- wounds on hands, feet or face
- wounds with underlying structures involved (eg bones, joints, tendons)
- wounds in the immunocompromised patient.

Presumptive therapy is necessary; use:

amoxycillin+clavulanate 875+125 mg (child: 22.5+3.2 mg/kg up to 875+125 mg) orally, 12-hourly for 5 days.

If commencement of oral therapy will be delayed, give:

procaine penicillin 1.5 g (child: 50 mg/kg up to 1.5 g) IM, as a single dose, followed by amoxycillin+clavulanate as above.

For patients hypersensitive to penicillin, use one of the oral regimens recommended for established infection for 5 days.

Established infection

Infected tissue for Gram stain and aerobic and anaerobic cultures should be obtained before antibiotic therapy. Delaying primary wound closure should also be considered. For bites to the hand and face, early specialist surgical consultation is advised.

Use initially:

1 **piperacillin+tazobactam 4+0.5 g (child: 100+12.5 mg/kg up to 4+0.5 g) IV, 8-hourly**

OR

1 **ticarcillin+clavulanate 3+0.1 g (child: 50+1.7 mg/kg up to 3+0.1 g) IV, 6-hourly**

OR THE COMBINATION OF

2 **metronidazole 400 mg (child: 10 mg/kg up to 400 mg) orally, 12-hourly**

PLUS EITHER

1 **ceftriaxone 1 g (child: 25 mg/kg up to 1 g) IV, daily**

OR

2 **cefotaxime 1 g (child: 25 mg/kg up to 1 g) IV, 8-hourly.**

For patients with immediate hypersensitivity to penicillin (see Table 2.2), seek expert advice.

Change to oral therapy once patient is stable. If the infecting pathogen is uncertain, use:

amoxycillin+clavulanate 875+125 mg (child: 22.5+3.2 mg/kg up to 875+125 mg) orally, 12-hourly.

For patients with penicillin hypersensitivity (see Table 2.2), use:

1 **moxifloxacin 400 mg (child: 10 mg/kg up to 400 mg) orally, daily**

OR THE COMBINATION OF

2 **metronidazole 400 mg (child: 10 mg/kg up to 400 mg) orally, 12-hourly**

PLUS EITHER

1 **doxycycline 200 mg (child more than 8 years: 5 mg/kg up to 200 mg) orally, for the first dose, then 100 mg (child more than 8 years: 2.5 mg/kg up to 100 mg) orally, daily**

OR

2 **trimethoprim+sulfamethoxazole 160+800 mg (child more than 2 months: 4+20 mg/kg up to 160+800 mg) orally, 12-hourly.**

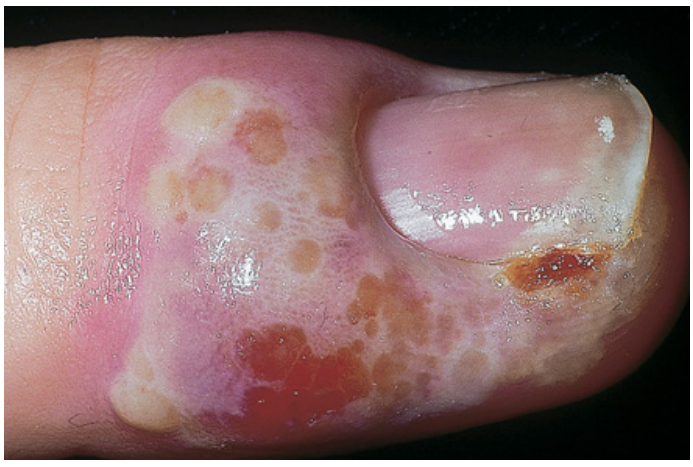
Modify therapy according to Gram stain and culture. For severe and penetrating injuries, treatment duration is usually a total of 14 days (IV + oral). Longer directed therapy is needed for injuries involving bones, joints and/or tendons; consider osteomyelitis (see Table 2.3 for duration) or septic arthritis (see Table 2.5 for duration).

SYSTEMIC BACTERIAL INFECTIONS AFTER DOG AND CAT BITES:

- Serious systemic infection after dog or cat bites is RARE but can develop days after the bite
- CAPNOCYTOPHAGA CANIMORSUS produces rare but fulminant bacteraemic illness after a dog bite that can cause fatal multi-organ failure, particularly in splenectomised patients.
    - Aggressive resuscitation and IV penicillin is necessary in all immunocompromised patients bitten by dogs.
- CAT-SCRATCH DISEASE a clinical syndrome of REGIONAL LYMPHADENOPATHY that develops 7-10 days after a cat bite or scratch that is caused by BARTONELLA HENSELAE.
    - Can result in painful, matted masses in lymph nodes.
    - About 10% will have evidence of other organ system involvement.
    - Most cases with isolated lymph node disease resolve in 2-5 months.
    - Large, painful LN can be aspirated but incision and drainage should be avoided due to scarring.
    - AZITHROMYCIN MAY SPEED RESOLUTION (cipro, bactrim or rifampicin are alternatives)

HUMAN BITES:

- Human bites tend to be more serious than bites form domestic animals
    - Usually due to nature of the event, location of the bite and potential bacteria inoculated into the wound
    - ALL human bites should be treated as contaminated wounds (& potentially polymicrobial)
- Should not undergo primary closure, with possible exception of wounds to the face
- AUGMENTIN RECOMMENDED AFTER ALL BUT THE MOST TRIVIAL BITES. FOR ESTABLISHED BITES, *USE TIMENTIN OR TAZOCIN*
- Herpes simplex virus can cause local infection after a human bite or contact with infected saliva (typically on the distal phalanx).
    - Vesicles resolve within 3-4 weeks
    - Oral aciclovir (7-10 days)



HSV infection with herpetic whitlow

RODENTS, LIVESTOCK, EXOTIC AND WILD ANIMALS:

- Patients often seek care after being bitten by a rodent, but most injuries are trivial, with low risk of local wound infections
- RAT-BITE FEVER POSSIBLE
    - MORTALITY IF UNTREATED INFECTION IS 10-15%
    - CAUSED BY STREPTOBACILLUS
    - CAN CAUSE PETECHIAL RASH
    - TREAT WITH PENICILLIN
- Livestock and large game animals can inflict serious tissue injury with their powerful jaws
    - Risk of wound infection is significant and systemic illnesses can follow injury
        - BRUCELLOSIS, LEPTOSPIROSIS OR TULARAEMIA
        - Prophylactic broad spectrum ABx
- FRESHWATER BITES
    - aeromonas
    - bactrim and fluoroquinolone cover
- SALTWATER BITES
    - coverage for vibrio species --> fluoroquinolone
- In South Asia, monkeys are presumed high risk for transmission of rabies !!