

Skin & Soft tissue, Bone & Joint and Anaerobic infections



FLORIAN MERKLE
MARKETA TOLAROVA

CHARLES UNIVERSITY
2ND FACULTY OF MEDICINE



Skin & Soft Tissue Infections

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Skin & Soft Tissue Infections

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- **Impetigo**
 - red sore > breaks and leaks pus/fluid > honey coloured scab > heals without scar formation.
 - always bacterial; *S. aureus*, *S. pyogenes*.
 - commonly only in children and highly communicable.
 - local nodes may be involved, systemic signs are uncommon, secondary dermal spread is typical. > 2nd ary Infection.
 - specifics: SSSS, bullous impetigo.
 - Diagnosis by eye, Lab diagnosis is difficult due to commensal flora.
 - Treatment: topical ABs, systemic or large area involved oral/IV ABs.



Skin & Soft Tissue Infections

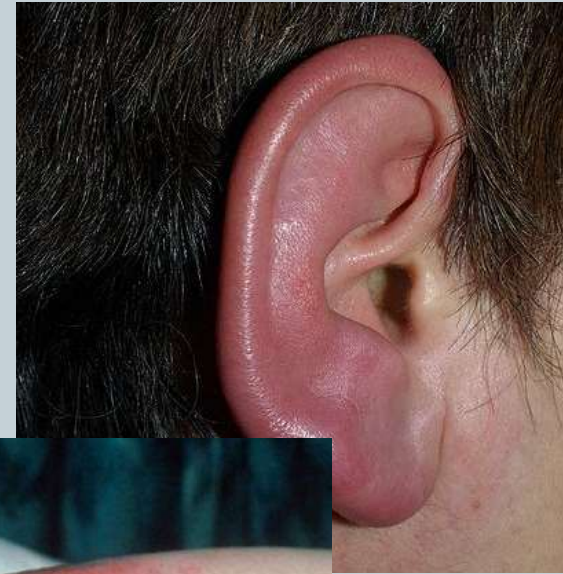
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- **Impetigo epidemiology**
 - Wherever kids are close together
 - Wherever kids play contact sports
- **Impetigo treatment**
 - If Strep only: Penicillin G/V, Erythromycin
 - If Staph possible: Penicillinase resistant Penicillins, 1st Gen. Cephalosporins
 - If MRSA: Vancomycin, Clyndamycin.



Skin & Soft Tissue Infections

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Skin & Soft Tissue Infections

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- **Erysipelas**
 - red sore with localized pain and inflammation, raised skin.
 - always bacterial; *S. pyogenes*, less common Group B,C&G.
 - commonly only in children and older people.
 - lymph node enlargement and systemic signs.
 - Diagnosis by eye, Lab diagnosis is difficult due to commensal flora unless sepsis.
 - Treatment: oral/IV ABs.



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- Erysipelas epidemiology
 - Immunocompromised and patients with impaired lymph drainage are at increased risk.
- Erysipelas treatment
 - Penicillin G/V



Skin & Soft Tissue Infections

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- **Cellulitis**
 - involves skin and deeper subcutaneous tissue.
 - always bacterial; *S. pyogenes* and Staph.
 - especially immunocompromised people
 - local and systemic signs.
 - Diagnosis by eye, history and Lab.
 - Treatment: oral/IV ABs.



Skin & Soft Tissue Infections

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- Cellulitis epidemiology
 - Immunocompromised and patients with venous insufficiency, varicose veins.
- Cellulitis treatment
 - If Strep only: Penicillin G/V, Erythromycin
 - If Staph possible: Penicillinase resistant Penicillins, 1st Gen. Cephalosporins
 - If MRSA: Vancomycin, Clyndamycin.



Skin & Soft Tissue Infections

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Skin & Soft Tissue Infections

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- **Staphylococcal TSS**
 - abrupt onset, fever, hypotension, rash > multiple organ failure.
 - believed to be restricted to *S. aureus*
 - especially immunocompromised people
 - mainly systemic signs.
 - Diagnosis by eye, history and Lab.
 - Treatment: IV ABs. Penicillinase resistant Penicillins, 1st generation Cephalosporins, Clindamycin.



Skin & Soft Tissue Infections

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- **Streptococcal TSS**
 - slow onset, fever, pain and chills. As disease progresses > organ failure
 - *S. pyogenes*
 - especially immunocompromised people
 - mainly systemic signs.
 - Diagnosis by eye, history and Lab.
 - Treatment: IV ABs. Penicillin G, Erythromycin, etc.



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- **Necrotizing Fasciitis**
 - starts superficially and then spreads to deep subcutaneous tissues and along fascial planes > multiorgan failure.
 - *S. pyogenes*, *S. aureus*, *C. perfringens*, Enterobacteriaceae, etc.
 - especially immunocompromised people, post surgery.
 - local and systemic signs.
 - Diagnosis by eye, nose, history and Lab.
 - Treatment: IV ABs. depending on offending agent, surgical debridement.



Skin and Soft Tissue Infections

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- Staphylococcal Scalded Skin Syndrome – *S. aureus*
 - Induced by exotoxin **exfoliatin** → protease that breaks down desmoglein-1 (anchor between *s. granulosum* and *s. spinosum*) → desmosome breakdown → epidermal detachment.
 - **Signs:** widespread formation of thin walled, easily ruptured blisters. Can be Nikolsky sign + (rubbing of skin → exfoliation/blistering)
 - **Ritter's Disease of the Newborn:** mc in children under 6. Most severe form of SSSS.
 - Clinically similar to **toxic epidermal necrolysis** but spares mucous membranes (TEN does not).
 - ✦ TEN can be caused by e.g. NSAIDs, corticosteroids, antiretrovirals or BMT. Infectious causes include: *M. pneumoniae*, herpes virus.



Skin & Soft Tissue Infections

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- **Fungal infections – Cutaneous**
 - **Tinea versicolor** (*Malassezia furfur*) → damaged melanocytes → patches of hypo and/or hyperpigmentation.
 - ✦ **Dx:** “spaghetti and meatballs” appearance in KOH prep. Fluorescent activity under Wood’s light. **Tx:** Selenium sulfide, topical ketoconazole.
 - Other tinea: pedis, cruris, corporis, capitis, unguinum.
 - ✦ Pruritic lesions with central clearing; ring-like appearance. Dermatophytes (*Microsporum*, *Trichophyton*, *Epidermophyton*).
 - ✦ **Dx:** mold hyphae in KOH prep, not dimorphic.
 - **Sporotrichosis** (*Sporothrix schenckii*) Spores traumatically introduced into skin (e.g. thorn) → local pustule/ulcer, nodules along draining lymph nodes (ascending lymphangiitis), Can disseminate!
 - ✦ **Dx:** culturing from skin, sputum. **Tx:** itraconazole or potassium iodide.



Skin and Soft Tissue Infections

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Tinea Versicolor



**tinea
pedis**



Sporotrichosis



Skin & Soft Tissue Infections

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- **Fungal Infections – Systemic**
 - **Blastomycosis:** *Blastomyces dermatitidis*. Mc presents as pneumonia (70%) but can disseminate to skin (ulcerated dermal lesions) and bone (osteomyelitis).
 - ✦ **Dx:** broad based budding organism in sputum or tissue sample. KOH prep, cytology, histology. Culture is definitive dx standard.
 - Tx:** oral Itraconazole, Ketoconazole, Amphotericin B (immunocompromised pts who are critically ill)
 - **Coccidioidomycosis:** *Coccidioides immitis*. Causes pneumonia/meningitis; can disseminate to bone and skin. Erythema nodosum, arthralgias.
 - ✦ **Dx:** body fluid/exudate/sputum sample, microscopic ID with Papanicolaou or Gomori stain. Spherules filled with endospores.
 - ✦ **Tx:** Itraconazole in bone/joint involvement.



Bone and Joint Infections

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• Osteomyelitis

- hematogenous, local infection extension, trauma, iatrogenic → bone
- **Signs:** acute systemic illness (malaise, fever, leukocytosis, localized pain) – can be only unexplained fever (infants) or localized pain (adults)
- **Dx:** characteristic radiologic finding (destructive lytic focus + edema + sclerotic rim), blood culture, biopsy/bone culture for definitive dx.
- **Tx:** ATBs + surgical drainage. Up to a quarter of cases do not resolve → chronicity.

Age group	Most common organisms
<4 months	<i>S. aureus</i> , <i>Enterobacter</i> , <i>Streptococcus</i> group A and B
4 mo – 4 yr	<i>S. aureus</i> , group A strep, <i>h. influenzae</i> , <i>enterobacter</i>
4 yr - adult	<i>S. aureus</i> (80%), group A strep, <i>h. influenzae</i> , <i>enterobacter</i>
Adult	<i>S. aureus</i> . Occasional <i>enterobacter</i> or <i>streptococcus</i>
Sickle cell anemia patients	<i>Salmonella</i> species



Bone and Joint Infections

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- **Tuberculous Osteomyelitis**
 - Complication of estimated 1-3% of cases of pulmonary TB.
 - Usually hematogenous spread but can be from focus of infection, e.g. mediastinal node → vertebrae.
 - Long bones and vertebrae most commonly affected.
 - Often solitary lesions but can be multifocal esp. in immunodeficiency.
 - Synovium often site of initial infection due to higher O₂ pressures (M. tuberculosis = microaerophilic)
 - **Pott disease:** vertebral tuberculous osteomyelitis → deformity, collapse, displacement → neurological deficits. extension into adjacent soft tissue → psoas muscle abscesses.



Bone and Joint Infections

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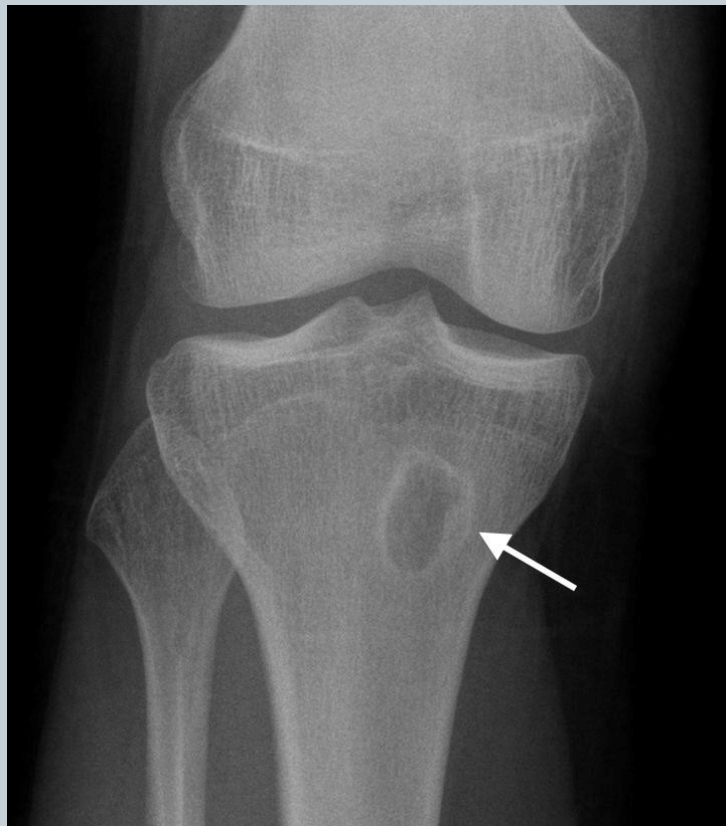
- Risk Factors for Causative Agents of Osteomyelitis

Risk Factor	Cause
Assumed if no other information available	<i>S. aureus</i> (most common overall)
Sexually active	<i>Neisseria gonorrhoeae</i> (rare), septic arthritis more common
Diabetics, IV drug users	<i>Pseudomonas aeruginosa</i> , <i>Serratia</i>
Sickle cell	<i>Salmonella</i>
Prosthetic joint replacement	<i>S. aureus</i> , <i>S. epidermidis</i>
Vertebral involvement	<i>Mycobacterium tuberculosis</i> (Pott disease)
Cat and dog bites	<i>Pasteurella multocida</i>



Bone and Joint Infections

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Bone and Joint Infections

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- **Infectious Arthritis**

- *S. aureus* (mcc in adults), streptococcus, *N. gonorrhoeae* (older adolescents, young adults), *H. influenzae* (mcc in children < 2 yrs).
- hematogenous dissemination, direct inoculation, contiguous spread from osteomyelitis or soft tissue abscess.
- Sudden onset of pain, red/swollen joint, restricted motion, fever, leukocytosis. Gonococcal tends to be subacute.
- 90% of nongonococcal involve just single joint (knee, hip, shoulder...)
- **Dx:** joint fluid aspiration, culture and gram staining.

- **Reactive Arthritis (Reiter syndrome)**

- AI but TRIGGERED by previous infection.
- Shigella, Salmonella, Yersenia, Campylobacter, Chlamydia, Gonorrhoea.
- **Signs:** conjunctivitis and anterior uveitis, urethritis, arthritis.
- “can’t see, can’t pee, can’t climb a tree”



Anaerobic Infections

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- Many medically important anaerobes are part of the normal human flora; disease occurs when they leave their normal habitat.
- Exceptions: *Clostridium botulinum*, *Clostridium tetani* (both soil organisms)
- *C. perfringens* is found in the colon and in the soil.
- Characterized by abscesses
 - Brain, lungs, female genital tract, biliary, other intra-abdominal sites.
- Suspicious findings on physical exam:
 - Foul smelling discharge
 - Gas in tissue
 - Necrotic tissue
- Infections in setting of pulmonary aspiration, bowel surgery, abortion, cancer, or human/animal bites frequently involve anaerobes.

Morphology	Gram Stain	Genus
Spore-forming rods	+	<i>Clostridium</i>
	-	None
Non-spore-forming rods	+	<i>Actinomyces</i> , <i>Bifidobacterium</i> , <i>Eubacterium</i> , <i>Lactobacillus</i> , <i>Propionibacterium</i>
	-	<i>Bacteroides</i> , <i>Fusobacterium</i>
Non-spore-forming cocci	+	<i>Peptococcus</i> , <i>Peptostreptococcus</i> , <i>Streptococcus</i>
	-	<i>Veillonella</i>



Anaerobic Infections

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- **Laboratory Diagnosis**

- Obtaining appropriate specimen – one that does not contain members of normal flora (can confuse interpretation)
 - ✦ Good specimen: Blood, pleural fluid, pus and transtracheal aspirates
 - ✦ Bad specimen: Sputum, feces
- Rapidly transporting specimen under anaerobic conditions
- In lab: handle/incubate under anaerobic conditions
- Gram stain, morphology, biochemical testing, gas chromatography (measurement of organic acids e.g. formic, propionic and acetic)

- **Treatment Principles**

- Surgical drainage of abscess + antibiotics
- Penicillin G, chloramphenicol, clindamycin, metronidazole
- Exception: many isolates of *B. fragilis* produce alpha lactamase and are thus resistant to penicillin.



Anaerobic Infections

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- Clostridia (with exotoxins)
 - Gram positive, spore-forming, obligate anaerobic bacilli.

TABLE 17-3 Important Features of Pathogenesis by *Clostridium* Species

Organism	Disease	Transmission/ Predisposing Factor	Action of Toxin	Prevention
<i>Clo. tetani</i>	Tetanus	Spores in soil enter wound	Blocks release of inhibitory transmitters (e.g., glycine)	Toxoid vaccine
<i>Clo. botulinum</i>	Botulism	Exotoxin in food is ingested	Blocks release of acetylcholine	Proper canning; cook food
<i>Clo. perfringens</i>	1. Gas gangrene 2. Food poisoning	Spores in soil enter wound Exotoxin in food is ingested	Lecithinase Superantigen	Debride wounds Cook food
<i>Clo. difficile</i>	Pseudomembranous colitis	Antibiotics suppress normal flora	Cytotoxin damages colon mucosa	Appropriate use of antibiotics



Anaerobic Infections

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- **Clostridium tetani**
 - Motile obligate anaerobe
 - **Transmission:** wound (e.g. rusty nail → introduction of spores). Neonatal transmission via umbilical cord and transmission during circumcision are common in developing countries.
 - **Tetanospasmin:** exotoxin causing tetanus. Protease that cleaves releasing proteins for neurotransmitters → blocks glycine and GABA release.
 - **Clinical:**
 - ✦ Spastic paralysis/tetany (strong muscle spasms)
 - ✦ Trismus (lockjaw)
 - ✦ Risus sardonicus
 - ✦ Opisthotonos
 - **Laboratory:**
 - ✦ No microbiological or serological diagnosis
 - ✦ Organisms rarely isolated from wound – tennis racket shape if visualized
 - **Treatment:** tetanus antitoxin (immunoglobulin), role of ATBs uncertain but if used, penicillin G and metronidazole. Benzodiazepines for spasm. Respiratory support!



Anaerobic Infections

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- **Clostridium botulinum**
 - Motile anaerobe
 - **Transmission:** ingestion of food/honey infected with preformed toxin or spores respectively.
 - Preformed, heat-labile toxin inhibits ACh release at NMJ → botulism.
 - **Wound botulism:** spores contaminate a wound, germinate, produce toxin at site.
 - **Infant botulism:** organisms grow in gut and produce toxin there. Floppy baby syndrome.
 - **Clinical:**
 - ✦ Descending paralysis
 - ✦ Diplopia, dysarthria, dysphagia
 - ✦ Respiratory muscle failure
 - **Laboratory:**
 - ✦ Usually not cultured. Toxin demonstrable in uneaten food, or “mouse protection test”.
 - **Treatment:** trivalent antitoxin (A, B, E) + respiratory support.
 - ✦ Antitoxin made in horses → serum sickness in about 15% of recipients.



Anaerobic Infections

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Sir Charles Bell's portrait of a soldier dying of tetanus. The characteristic rigidity of the body is referred to as opisthotonos and risus sardonicus. Original in the Royal College of Surgeons of Edinburgh, Scotland.





Anaerobic Infections

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- **Clostridium perfringens**
 - NONmotile
 - Present naturally in soil, colon and vagina.
 - **Gas gangrene** (myonecrosis, necrotizing fasciitis)
 - ✦ Associated with war wounds, car/motorcycle accidents, septic abortions
 - ✦ **Alpha toxin (lecithinase)** → damage of cell membranes including RBCs (→ hemolysis)
 - ✦ Degradative enzymes → gas in tissues.
 - ✦ **Clinical:** pain, edema, cellulitis, necrosis (gangrene), hemolysis, jaundice, blood tinged exudates. High mortality rates.
 - ✦ **Lab:** tissue/exudate smears show large gram positive rods. Anaerobic culture + ID via sugar fermentation reactions/organic acid production. ***C. perfringens* colonies show double zone of hemolysis on blood agar. Egg yolk agar to prove lecithinase.**
 - ✦ **Treatment:** Pen G, wound debridement. Hyperbaric O₂.
 - **Food poisoning**
 - ✦ Spores in soil can contaminate food, heat resistant, can survive cooking and germinate. Growth in reheated foods (especially meat dishes).
 - ✦ Enterotoxin acts to cause diarrhea; similar mode of action as *S. aureus* (e.g. **superantigen**)
 - ✦ **Clinical:** 8-10hr incubation → watery diarrhea + cramps → resolves in 24hrs.
 - ✦ **Lab:** usually unnecessary due to self-limited infection.



Anaerobic Infections

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- **Clostridium difficile**
 - Motile
 - **Toxin A:** enterotoxin that binds to brush border in gut.
 - **Toxin B:** cytotoxin that causes cytoskeletal disruption through actin depolymerization → pseudomembranous colitis → diarrhea.
 - Causes antibiotic associated (**clindamycin**) pseudomembranous colitis.
 - Most common nosocomial cause of diarrhea.
 - **Transmission:** carried in GIT in ~3% of population and 30% of hospitalized. Fecal-oral route.
*hands of hospital personnel are important intermediaries!
 - **Clinical:**
 - ✦ Pseudomembranes on colonic mucosa
 - ✦ Non-bloody diarrhea
 - ✦ Fever, abdominal cramping
 - ✦ Toxic megacolon can occur
 - **Lab:**
 - ✦ ELISA using known antibody to exotoxins (rapid but low sensitivity).
 - ✦ Cytotoxicity test: human cells in culture exposed to exotoxin in stool filtrate, their death is observed. More sensitive and specific, but needs 1-2day incubation.
 - ✦ PCR can also be used.
 - **Treatment:** withdraw causative ATB. Oral metronidazole or vancomycin, fluid replacement.



Anaerobic Infections

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Anaerobic Infections

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- **Actinomyces** – *Actinomyces israelii*
 - Anaerobe
 - Part of normal flora of oral cavity.
 - Local trauma (broken jaw, dental extraction) → tissue invasion, formation of filaments, areas of inflammation
 - **Clinical:**
 - ✦ Hard, nontender swellings that develop slowly
 - ✦ Head + neck (50%), chest, abdomen
 - ✦ Eventually drain pus through sinus tracts
 - ✦ Hard yellow granules (sulfur granules) made up of filamentous mass formed in pus.
 - **Lab:**
 - ✦ Gram positive branching rods
 - ✦ Presence of sulfure granules
 - ✦ Growth when pus or tissue cultured under anaerobic conditions
 - ✦ ID via immunofluorescence
 - **Treatment:** prolonged use of pen G + surgical drainage.



Anaerobic Infections

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- **Bacteroides** – *Bacteroides fragilis*
 - Anaerobic, non-spore-forming, gram negative rods.
 - Found in the colon and in the vaginas of 60% of women.
 - Infections are endogenous, usually from break in mucosal surface. Not communicable.
 - **Virulence:**
 - ✦ Capsule (host response to capsule → abscess formation)
 - ✦ Enzymes: hyaluronidase, collagenase, phospholipase
 - ✦ Enterotoxin producing strain → diarrhea
 - **Predisposing factors:** surgery, trauma, chronic disease, local necrosis.
 - **Clinical:**
 - ✦ Intra-abdominal infections (peritonitis, localized abscesses)
 - ✦ Pelvic abscesses, necrotizing fasciitis, bacteremia
 - **Lab:**
 - ✦ Anaerobic isolation on blood agar plates containing kanamycin and vancomycin.
 - ✦ Biochemical reactions (sugar fermentations, organic acid production)
 - **Treatment:** resistant to penicillins, first-gen cephalosporins, aminoglycosides. Use Metronidazole to treat (alternatives: clindamycin, chloramphenicol)



Anaerobic Infections

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Gram stain of *Actinomyces israelii*

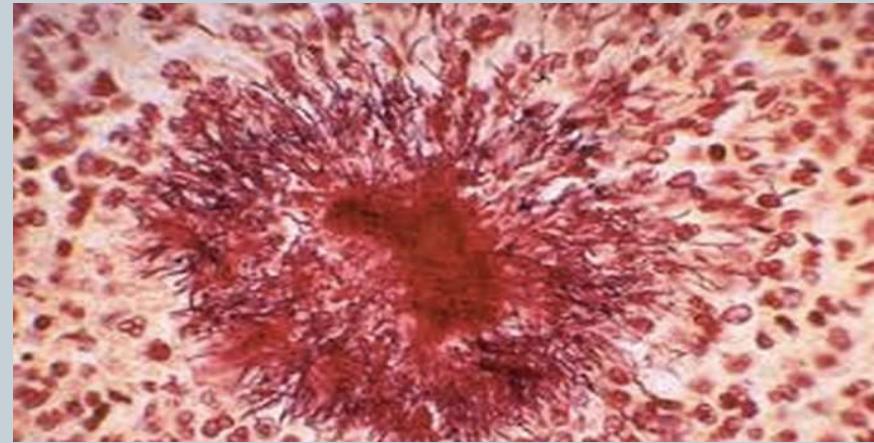


FIGURE 1.—Actinomycosis, jaw, observed at Letterman General Hospital, San Francisco, Calif., in a sergeant who had punctured the floor of his mouth with a weed stem while picking his teeth.



Sources

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