

Suppurative arthritis

Acute bacterial infection of a synovial joint

Pathogenesis • pathology • diagnosis • clinical consequences

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Learning objectives

- Trace the routes by which bacteria reach the joint cavity.
- Link host factors and clinical setting to likely etiologic organisms.
- Recognize the joint-threatening clinical syndrome and diagnostic priorities.
- Interpret synovial findings without relying on a single exclusion threshold.
- Explain why prompt identification and treatment protect cartilage.

Definition: An infected joint space

Suppurative arthritis denotes direct bacterial infection of the joint space.

- It is a destructive form of infectious arthritis; The term septic arthritis is commonly used clinically.
- The defining abnormality is infection within articular structures—not merely inflammation near a joint.

Suppurative arthritis within infectious arthritis

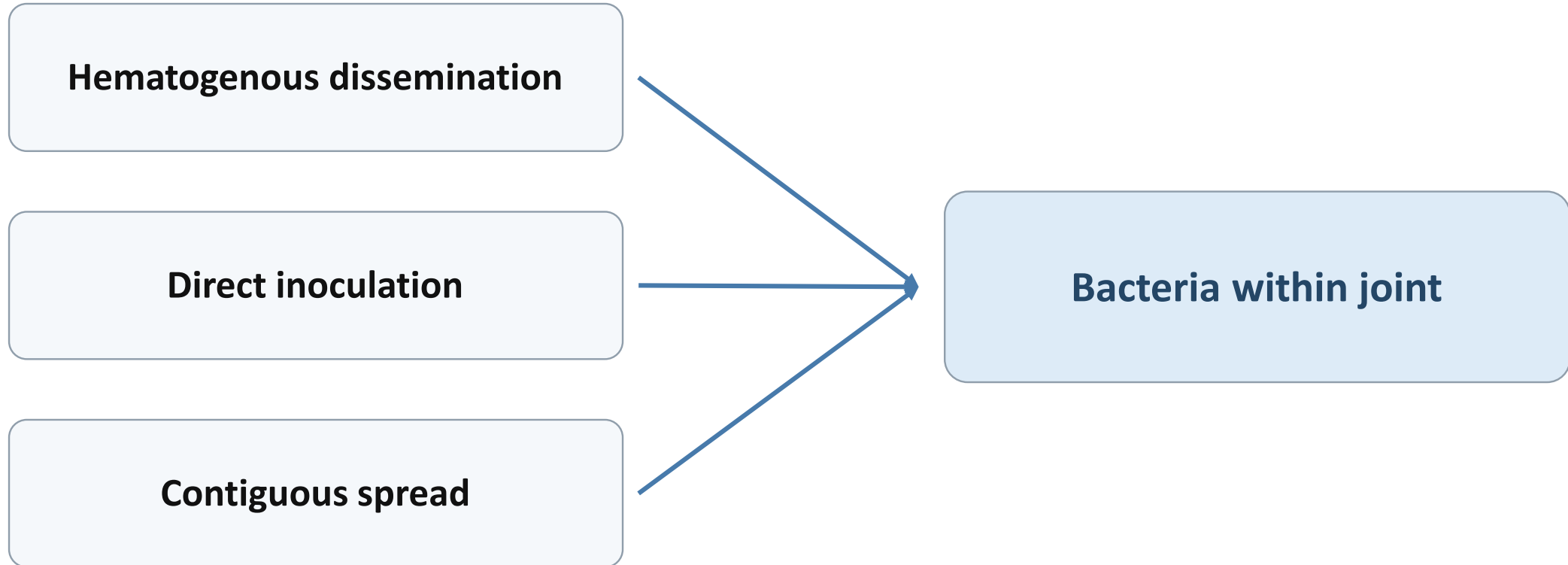
Bacterial suppurative arthritis

- Usually acute in onset
- Organisms directly infect the joint cavity
- Rapid articular destruction is possible

Other infectious arthritides

- Tuberculous arthritis: Typically chronic and progressive
- Viral arthritis: Distinct infectious causes
- Lyme arthritis: Borrelia-associated course

Three routes to joint infection

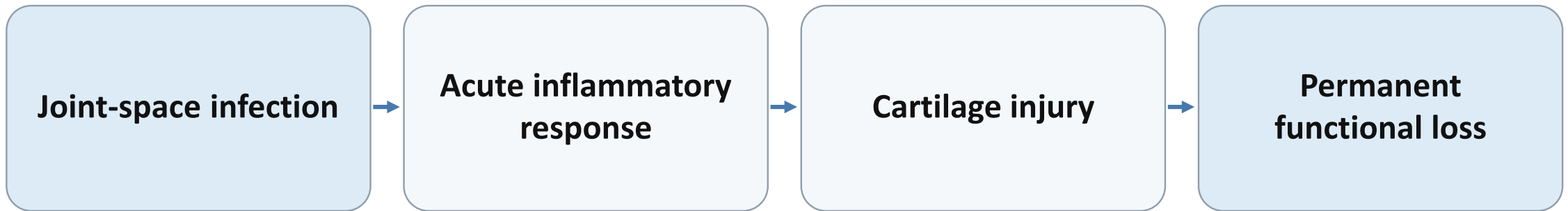


Alternative routes; Not successive phases.

Hematogenous dissemination is the usual route

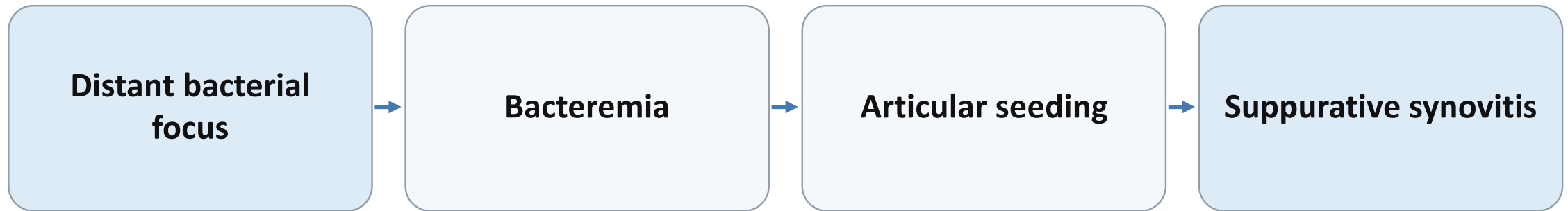
- Microorganisms may circulate from an infection at a distant site.
- Bacteria seed articular structures during bloodstream dissemination.
- The entry route may be occult even when the joint symptoms dominate.
- A joint presentation therefore warrants consideration of bacteremia.

Why septic joints are vulnerable



Schematic pathway — processes may overlap clinically.

Hematogenous entry: A causal sequence

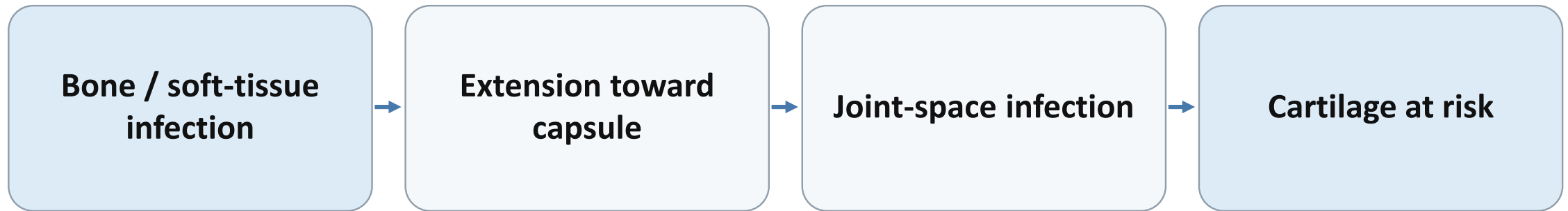


Schematic pathway — processes may overlap clinically.

Direct inoculation: When barriers are breached

- A penetrating injury can introduce organisms into articular tissue.
- Diagnostic or therapeutic instrumentation may provide a direct route.
- Native-joint infection should be differentiated from infections involving joint prostheses.
- Recognizing a direct route guides the clinical history and sampling strategy.

Contiguous spread from adjacent infection



Schematic pathway — processes may overlap clinically.

Neonatal vulnerability: Epiphyseal osteomyelitis

- Underlying epiphyseal osteomyelitis may extend into an adjacent joint.
- Neonatal group B streptococcal infection is a recognized cause.
- Bone and joint infection may form a contiguous disease process.
- The major consequence is destruction of developing articular structures.

Staphylococcus aureus: Principal organism

- S. Aureus as the most common cause across age groups in the United States.
- Its predominance is described in the context of routine H. Influenzae vaccination.
- Etiologic probability still depends on patient age and clinical setting.
- Organism identification remains necessary rather than presumed.

Impact of *Haemophilus influenzae* vaccination

Before widespread vaccination

- *H. Influenzae* was a significant cause of bacterial arthritis.
- Age-specific pathogen patterns were different.

After effective vaccination

- *H. Influenzae* arthritis became less frequent.
- *S. Aureus* became the leading organism in the USA.

Neonates: Organism and anatomic route

Host context

- Neonatal age
- Underlying epiphyseal osteomyelitis

Etiologic implication

- Group B Streptococcus is an important pathogen.
- Direct extension from bone is an important route.

Sickle cell disease: Salmonella association

- Patients with sickle cell disease are predisposed to Salmonella infection.
- The association is relevant at any age.
- The clinical history changes the organism differential.
- Association does not replace microbiologic confirmation.

Terminal complement deficiency: Gonococcal risk

- The membrane attack complex comprises complement components C5–C9.
- Deficiency predisposes to disseminated *Neisseria gonorrhoeae* infection.
- Gonococcal dissemination can involve synovial joints.
- Host immune defects therefore modify the etiologic differential.

Host and organism: A pattern matrix

Clinical context	Organism / route emphasized	Interpretive point
All age groups (USA)	<i>S. aureus</i>	Most common cause in source context
Neonate	Group B Streptococcus; adjacent epiphysis	Consider osteomyelitis
Sickle cell disease	<i>Salmonella</i>	Age does not remove association
C5–C9 deficiency	Disseminated gonococcal infection	Complement-related susceptibility
Vaccinated populations	Reduced <i>H. influenzae</i> arthritis	Historical shift in etiology

Additional predisposing host conditions

- Congenital or acquired immunodeficiency.
- Debilitating systemic illness.
- Prior joint trauma or preexisting chronic arthritis.
- Intravenous substance use.
- Risk factors reinforce suspicion but are not prerequisites for infection.

Why a chronically abnormal joint matters

Chronic arthritis is a predisposing condition for suppurative infection.

- New abrupt monoarticular pain should not automatically be attributed to the known rheumatologic disorder.
- An established joint diagnosis does not exclude superimposed infection.

Typical distribution: One joint predominates

- The classic bacterial presentation is monoarticular.
- The knee is an especially common site.
- Hip, shoulder, elbow, wrist and sternoclavicular joints may also be involved.
- A single affected joint is a pattern—not a mandatory criterion.

Anatomic sites of disease

Typical large / peripheral sites	Additional emphasized site
Knee; hip	Sternoclavicular joint
Shoulder; elbow	Axial joints in injected-substance users
Wrist	Site-specific aspiration challenges

Injected-substance use and axial joints

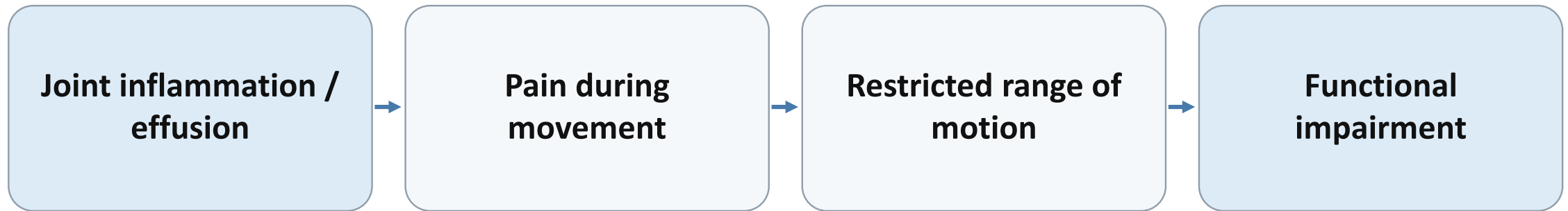
- Axial joint involvement most frequently in injected-substance users.
- Sternoclavicular involvement is among possible affected sites.
- The distribution should prompt consideration of the full exposure history.
- Clinical site and host exposure are complementary clues.

Classic clinical syndrome

Sudden onset of a markedly painful, swollen joint.

- Range of motion becomes restricted.
- The presentation reflects an acute articular process that requires urgent evaluation.

Why joint motion is restricted



Schematic pathway — processes may overlap clinically.

Systemic inflammatory findings

- Fever frequently accompanies acute suppurative arthritis.
- Peripheral leukocytosis and increased C-reactive protein are common.
- These tests support inflammation, not bacterial identification.
- Absence of a typical laboratory response does not safely rule out disease.

Clinical recognition: Combine multiple domains

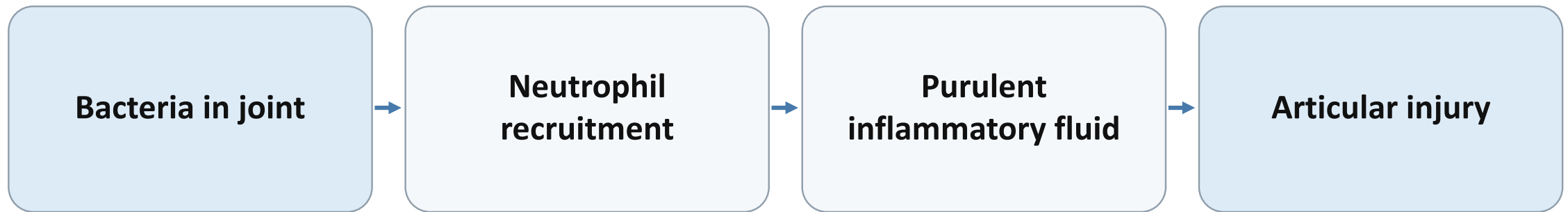
Local evidence

- Acute pain and swelling
- Restricted mobility
- Often a single joint

Systemic and contextual evidence

- Fever / inflammatory markers
- Predisposing host conditions
- Possible bacteremic source

The cellular hallmark of acute suppuration



Schematic pathway — processes may overlap clinically.

Neutrophils: Defense and collateral injury

- Neutrophil recruitment is central to defense against invading bacteria.
- Inflammation can simultaneously damage vulnerable intra-articular tissues.
- The host response helps explain destructive progression in septic joints.
- Killing microbes and preventing structural damage are related but distinct goals.

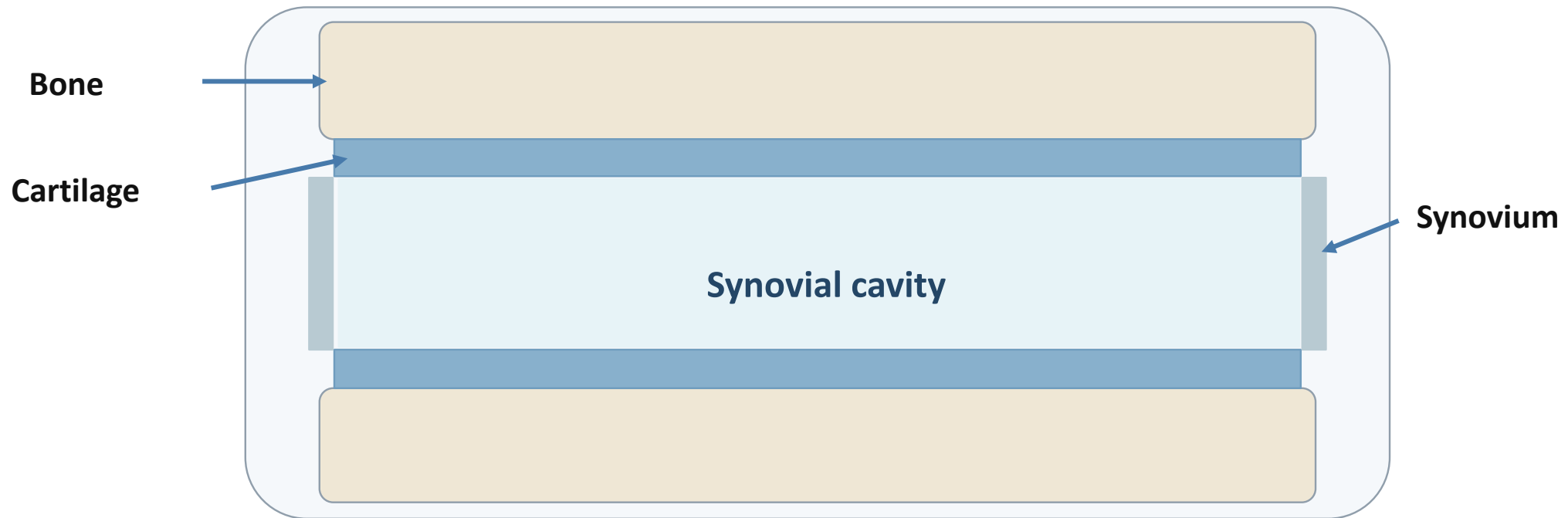
Sequence of destructive joint pathology



Schematic pathway — processes may overlap clinically.

Native synovial joint: Simplified anatomy

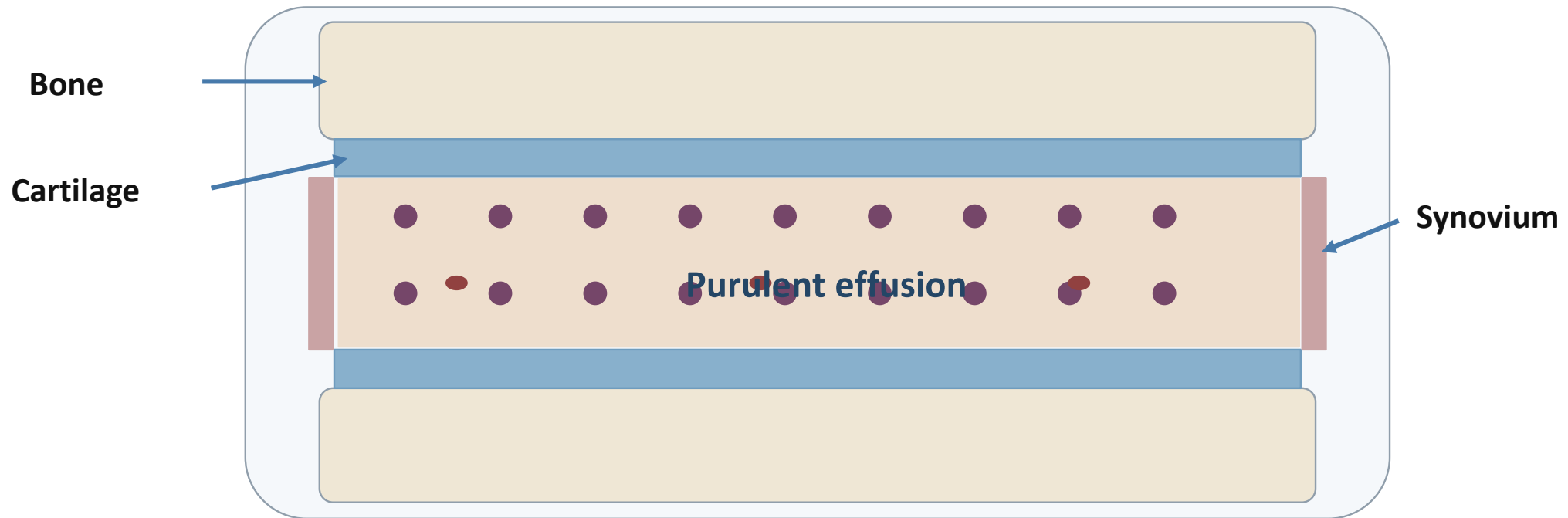
Simplified normal synovial joint



Original schematic; Not a specimen or a to-scale anatomical reconstruction.

Suppurative joint: Original schematic

Infected native joint



Original schematic; Not a specimen or a to-scale anatomical reconstruction.

Why cartilage loss can be permanent

- That cartilage has limited regenerative capacity relative to bone.
- Acute septic destruction can produce lasting structural deformity.
- Preventing damage requires action before advanced articular injury.
- Residual disability is a pathology consequence, not simply a symptom.

Arthrocentesis provides direct evidence

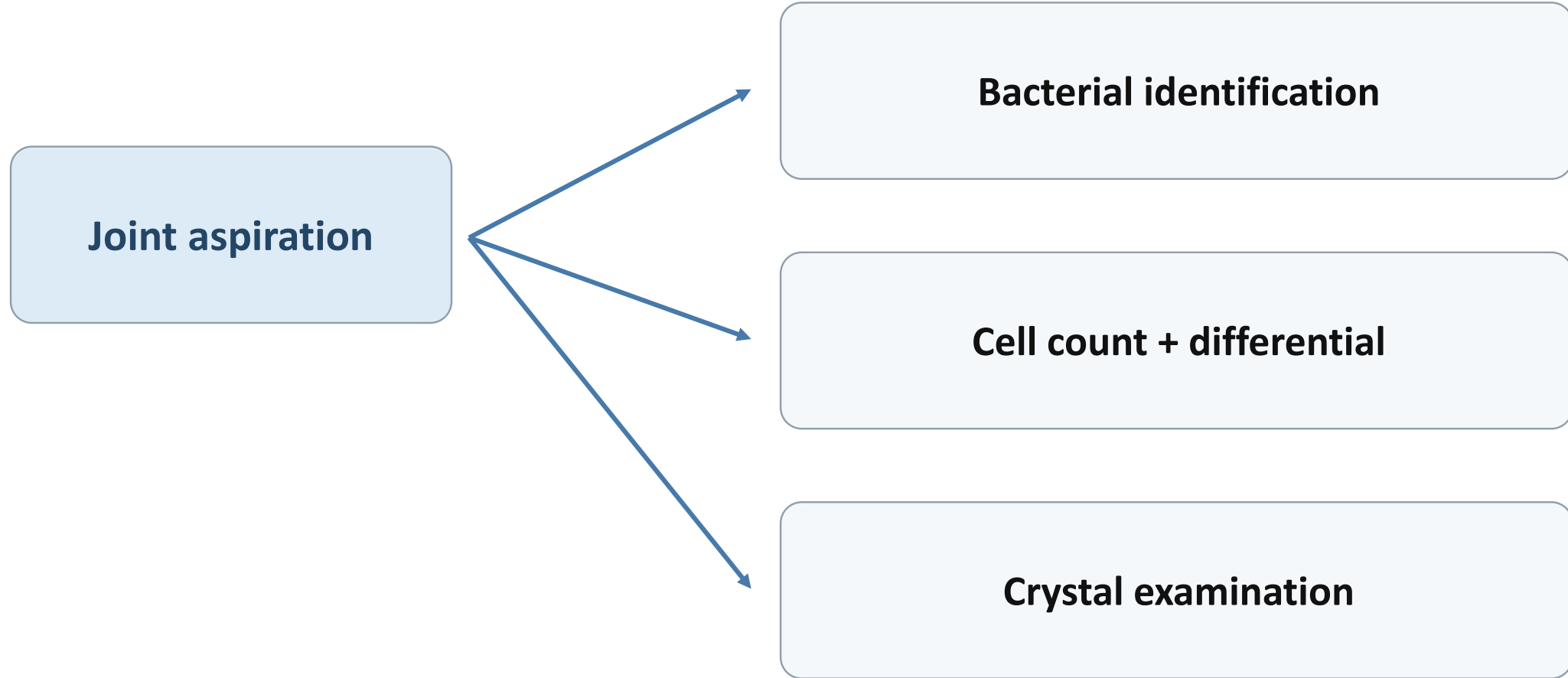
Joint aspiration is central when bacterial arthritis is suspected.

- Purulent aspirate with identification of the infectious organism as diagnostic.
- Clinical appearance alone cannot establish the causative pathogen.

Aspiration should not be delayed

- The SANJO guideline recommends synovial aspiration as quickly as possible when native-joint infection is suspected.
- Sampling enables organism identification and guides appropriate treatment.
- Escalate simultaneously if systemic sepsis or shock is present.

Synovial specimen: Core laboratory workup



Parallel analyses, prioritized by available fluid volume.

Sampling priorities when fluid is limited

- Priority 1: Bacterial identification.
- Priority 2: Synovial leukocyte count with differential.
- Priority 3: Crystal analysis.
- Prioritize microbiology rather than exhausting a small sample on ancillary tests.

Synovial leukocyte count: Supportive, not absolute

A leukocyte-rich aspirate increases suspicion, but there is no single count that independently confirms or excludes septic arthritis.

- The diagnostic question remains whether bacteria are present in the joint.
- Clinical setting and microbiological testing determine interpretation.

High cell counts cannot prove infection

- SANJO: >50,000 synovial WBC/ μ L is suggestive.
- This count by itself is insufficient for definitive diagnosis.
- Crystal arthritis can also produce intensely inflammatory fluid.
- An elevated count must be interpreted alongside Gram stain and cultures.

Low cell counts cannot exclude infection

- SANJO: <25,000 synovial WBC/ μ L lowers post-test probability.
- A low count does not exclude septic arthritis.
- Typical cutoffs may be less applicable in immunosuppressed patients.
- Do not use a count threshold as a stand-alone discharge decision.

Finding crystals does not end the workup

Crystal-positive aspirate

- May explain an acute painful joint.
- Can show very high inflammatory cell counts.

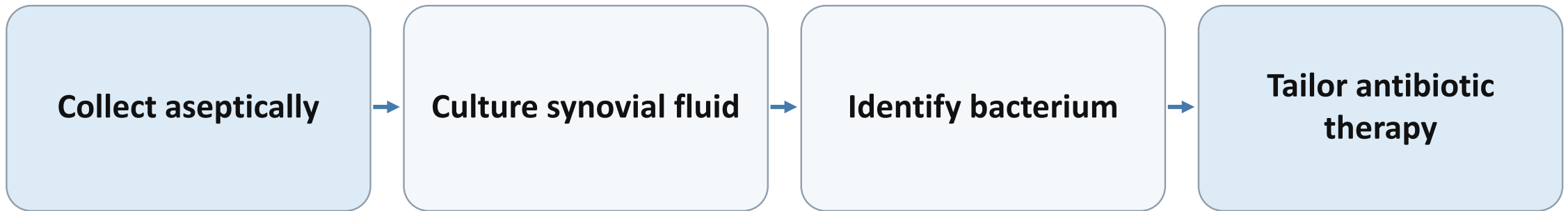
Potential coexistent infection

- Crystals do not rule out bacteria in the same joint.
- Maintain the microbiological investigation.

Gram staining: An early, imperfect test

- Perform Gram staining on aspirated fluid when possible.
- A positive stain gives early evidence of bacterial Gram reaction and morphology.
- Sensitivity is limited: A negative stain does not exclude infection.
- Culture and clinical assessment remain essential.

Synovial culture: Organism-directed diagnosis



Schematic pathway — processes may overlap clinically.

Blood cultures: Systemic microbiology

- Obtain blood cultures when the patient is febrile.
- Blood cultures are also indicated when bacteremia or sepsis is suspected.
- Cultures may help establish the causative organism outside the joint sample.
- Sampling decisions must not delay urgent sepsis treatment.

When aspirate cultures are negative

- Reassess whether clinical suspicion remains high.
- Consider antecedent antibiotics or difficult-to-culture organisms.
- SANJO recommends considering synovial-fluid PCR in selected culture-negative/high-suspicion settings.
- Negative culture is not, by itself, proof of a noninfectious cause.

Synovial tissue biopsy: Selected indications

- A synovial biopsy is not the first test for every uncomplicated joint effusion.
- Biopsy material may be obtained during surgical intervention.
- Culture and histopathology are useful if tuberculosis is suspected.
- Tissue diagnosis is particularly relevant when the clinical course is atypical.

Plain radiography: What it contributes

- Radiographs help identify preexisting fracture, osteoarthritis or other structural disease.
- They can identify changes suggesting adjacent osteomyelitis.
- They also provide a baseline for subsequent assessment.
- A normal early radiograph does not replace aspiration.

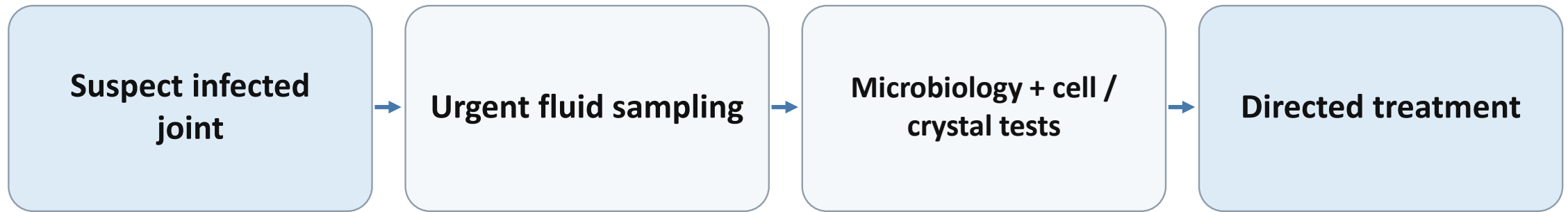
Ultrasonography: Effusion and access

- Ultrasonography can demonstrate joint effusion.
- It may identify a surrounding collection.
- It can guide aspiration of difficult or deep joints.
- Imaging supports sampling; It is not a microbiological diagnostic test.

MRI: Looking beyond the joint cavity

- MRI may help detect adjacent osteomyelitis or soft-tissue extension.
- It can be particularly useful for selected anatomically difficult joints.
- Imaging complements the clinical examination and aspirate.
- Choice depends on location and diagnostic question.

Clinical diagnostic pathway



Schematic pathway — processes may overlap clinically.

Antibiotic timing: Sampling versus sepsis

Stable patient without sepsis

- Obtain synovial fluid and indicated blood cultures before empirical antibiotics.
- Protect microbiological yield.

Sepsis or septic shock

- Initiate urgent antibiotics according to sepsis protocols.
- Do not withhold life-saving treatment to await sampling.

Antimicrobial selection is context-dependent

- Empirical choice considers local pathogen prevalence and resistance.
- Gram stain and host-specific risks contribute to initial coverage.
- Modify treatment when microbiology and susceptibility become available.
- Prompt, effective antimicrobial therapy to prevent destruction.

Joint drainage is part of infection control

- SANJO supports surgical lavage, especially for larger infected native joints.
- The procedure may be arthroscopic or open according to pathology and surgical assessment.
- Drainage addresses purulent fluid and infectious burden.
- Antibiotics and appropriate source control are complementary.

After acute control: Protect function

- Persistent inflammation may lead to adhesions and contracture.
- SANJO advises mobilization when infection is controlled and drains are removed.
- The objective is to limit long-term movement restriction.
- Mobilization must be coordinated with clinical and surgical management.

Monitor the response, not just one test

- Reassess pain, swelling and joint mobility.
- Follow systemic status and inflammatory markers such as CRP.
- Failure to improve requires reevaluation for persistent infection.
- SANJO calls for early recognition of treatment failure and possible repeat revision.

Differential: Acute crystal-induced arthritis

Suppurative arthritis

- Bacteria present within joint.
- Potential rapid cartilage injury.
- Microbiological sampling is central.

Gout / CPPD disease

- Crystal-driven inflammatory response.
- May clinically mimic infection.
- Crystals do not exclude coexistence.

Differential: Tuberculous arthritis

Suppurative bacterial arthritis

- Often sudden, acute painful monoarthritis.
- Prompt action prevents rapid destruction.

Mycobacterial arthritis

- Typically chronic and progressive.
- Insidious increase in pain.
- Consider biopsy and mycobacterial tests.

Differential: Sterile inflammatory arthritis

Acutely infected joint

- Direct microbial invasion.
- Urgent aspiration and organism testing.

Inflammatory arthritis flare

- Can cause swelling and restricted movement.
- An underlying diagnosis does not exclude superinfection.

Applied case: Neonate with hot swollen hip

A neonate with suspected adjacent epiphyseal osteomyelitis develops an acutely swollen hip.

Teaching question

Which route and etiologic association should be prioritized?

Interpretation

Contiguous extension from epiphyseal infection; Group B Streptococcus is an important neonatal pathogen.

Applied case: Sickle cell disease

An individual with sickle cell disease presents with an acutely painful, swollen knee.

Teaching question

What additional organism association modifies the differential?

Interpretation

Salmonella infection is a recognized association in sickle cell disease, at any age; Aspirate culture is still essential.

Applied case: Complement deficiency

A patient with a known deficiency of terminal complement components has suspected septic arthritis.

Teaching question

Which disseminated infection deserves particular consideration?

Interpretation

Disseminated *Neisseria gonorrhoeae* infection in C5–C9 membrane-attack-complex deficiency.

Applied case: Crystals identified

A swollen, painful knee yields highly inflammatory fluid with crystals on microscopy.

Teaching question

Can the bacterial workup be discontinued?

Interpretation

No. Crystal disease and septic arthritis may coexist; Organism identification must still be pursued when clinically suspected.

Applied case: Low synovial cell count

A high-risk patient has a suspicious acutely swollen joint, but synovial WBC is below 25,000/ μ L.

Teaching question

Does this result exclude septic arthritis?

Interpretation

No. A lower count decreases probability but cannot exclude infection, particularly in immunosuppressed patients.

Applied case: Sepsis and septic joint

A patient presents with an acute swollen joint together with signs of systemic sepsis.

Teaching question

Should empirical treatment wait for joint aspiration?

Interpretation

No. Give urgent antimicrobials under the local sepsis protocol; Collect diagnostic specimens as promptly as feasible without delaying treatment.

Five pathology-to-practice conclusions

Underlying pathology	Immediate clinical implication
Bacteria occupy a joint space	Aspirate for microbiological identification
Hematogenous seeding is common	Consider systemic infection and blood cultures
Host factors influence pathogens	Use clinical context; do not guess organism
Cartilage repairs poorly	Recognition and treatment are time-sensitive
Inflammation overlaps with crystals	No single cell count or crystal result excludes sepsis

References and source boundaries

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