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Tapping into a valuable diagnostic and treatment resource

Joint aspiration and injection: A look at the basics

ABSTRACT: Joint aspiration may be used for diagnosis or for relieving pressure, and joint injection may be used for treatment. Physicians can easily become proficient in aspiration and injection techniques. Indications for aspiration include both acute and chronic arthritis; there are few absolute contraindications. Intra-articular injections of medication usually are an adjunct to other treatment modalities. Indications for corticosteroid injections include acute crystal-induced arthritis; complications are rare. Less soluble agents remain in a joint space longer than more soluble agents and should have a longer duration of action. Physicians should perform injections wearing gloves and using aseptic technique. No one technique has proved to be optimal. After an aspiration or injection, the patient should be given detailed instructions. (J Musculoskel Med. *2007;24:31-37)*

Two primary indications call for inserting a needle into a joint: (1) aspiration of fluid for diagnostic purposes or for relieving pressure within a swollen joint and (2) injection of medications. Joint aspiration and intra-articular injection are useful and somewhat safe procedures that physicians who treat patients with musculoskeletal conditions can perform readily at the bedside. Clinicians usually can learn and become proficient in aspiration and injection techniques in a limited amount of time. In appropriate cases, joint injections are a valuable adjunct to medical therapies, rehabilitation, and surgery.

In this article, we address the indications and contraindications for joint aspiration and intra-articular injection. We also discuss the potential complications, available therapies, and technical aspects of injection.

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Indications and contraindications for joint aspiration

The indications are listed in Table 1. It could be argued that joint aspiration should be performed in any patient who presents with a painful joint or joints and evidence of effusion of unknown causes. Synovial fluid analysis is one of the most sensitive and inexpensive investigations for differentiating various pathologies, including infection, immune-mediated inflammation, crystal-induced inflammation, trauma, and neoplasm. The gross appearance and viscosity of the synovial fluid and, most important, the total white blood cell count with differential can reliably determine the inflammatory or noninflammatory nature of the underlying condition (Table 2).

In addition, crystalline arthritis (gout or pseudogout) may be readily confirmed by examining the fluid under a compensated, polarizing microscope, and a Gram stain and culture of the fluid may be diagnostic for septic arthritis. Removal of fluid temporarily alleviates acute symptoms and improves joint mobility by reducing intra-articular pressure. However, it probably will not provide prolonged relief unless targeted therapy is used for the underlying condition.[1]

There are few if any absolute contraindications for simple aspiration of a joint. A joint should not

be aspirated if the overlying skin has a large purulent ulcer; however, cellulitis overlying a swollen joint is not a contraindication. The risk of introducing infection by aspirating the joint through cellulitic skin is far less than the risk of septic arthritis going unmanaged.

In addition, a major coagulopathy (eg, hemophilia) is not an absolute contraindication for aspiration of a swollen joint, because if left unmanaged, a hemarthrosis can rapidly destroy a joint. It can lead to intra-articular damage caused by toxic effects of blood products, resulting in synovial hypertrophy, fibrosis, and impaired joint movement. Repeated attacks or persistent hemorrhage for more than 6 months leads to chronic disabling arthropathy. These situations require physicians to pay careful attention to aseptic precautions and hemostasis achieved through adequate pressure, respectively.

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For patients who are receiving long-term anticoagulation therapy, the international normalized ratio (INR) should be within their ideal therapeutic range before joint aspiration. One study described patients as being at low risk if their INR was lower than 3.7.[2] If possible, avoid using a needle larger than 22 gauge in patients who are receiving anticoagulation therapy.

Table 1 – Indications for joint aspiration

Diagnostic
Acute arthritis
Sepsis
Crystal arthritis: monosodium urate, calcium pyrophosphate, basic calcium phosphates (eg, hydroxyapatite), oxalate, cholesterol
Hemorrhagic: trauma
Chronic arthritis
Inflammatory: crystal arthritis, rheumatoid arthritis, spondyloarthritis
Noninflammatory: osteoarthritis, avascular necrosis
Treatment
Reduce intra-articular pressure
Injection of medication
Local anesthetic
Corticosteroids
Hyaluronic acid
Others: radioisotopes (eg, yttrium), infliximab
Repeated aspiration for sepsis
Saline

Injection therapy: General principles

Intra-articular injections of medication usually are an adjunct to other specific treatment modalities for joint diseases. Generally, a joint should be aspirated for the presence of fluid before injecting any medication. Aspiration of pus (purulent effusion) should prompt an immediate evaluation by Gram stain and culture and, therefore, prohibit an injection. In daily clinical practice, a physician may not wait for the final culture results, depending on the clinical scenario and how well he or she knows the patient. However, routinely sending the fluid for culture could avoid potential future complications.

The variety of available intra-articular therapies includes local anesthetics; several types of corticosteroids; hyaluronic acid preparations; and radionucleotides, such as yttrium. Immediate pain relief after local anesthetic injections may confirm a joint to be the source of pain (this "diagnostic test" usually is used when pain originating in a deep-seated joint, such as the hip or sacroiliac joint, is suspected) as well as the proper place for the injection.[3]

Injection therapy: Corticosteroids

Indications for corticosteroid injections include treatment of acute crystal-induced arthritis as well as a "flare" of chronic inflammato-

Table 2 – Synovial fluid analysis

Characteristic/ Nature of arthropathy	Normal	Noninflammatory	Inflammatory	Septic
Volume	Low	High	High	High
Appearance	Clear	Clear	Cloudy	Cloudy
Viscosity	High	High	Low	Low (?)
WBC count (μL)	< 200	200 - 2000	2000 - 7500	> 50,000
% PMN leukocytes	< 25%	< 50%	> 75%	> 90%
Crystals	Negative	Negative (?)	Negative/positive	Negative (?)
Culture	Negative	Negative	Negative	Positive

WBC, white blood cell; PMN, polymorphonuclear.

ry arthritis, such as rheumatoid arthritis (RA). Treatment of knee osteoarthritis (OA) probably is the most common and the best studied use of intra-articular corticosteroid injections, although the role of inflammation in OA remains controversial.

Two recent meta-analyses found a favorable effect on pain in patients with OA after intra-articular corticosteroid injections.[4,5] However, the symptomatic improvement was short-term (1 to 4 weeks); by 8 weeks, there was no difference in target pain reduction between the treatment and control groups.[5] The types and dosages of the corticosteroid preparations used, removal of excess fluid, injection technique, and adherence to a postinjection rest period all may have accounted for these differences.[1]

Systemic bacteremia or suspected septic arthritis is an absolute contraindication to intra-articular corticosteroid injections. Corticosteroids should not be injected into an unstable joint or into a prosthetic joint; finger joints have such inherent instability—being supported by only a few tenuous ligaments—that they should not receive repeated injections. In addition, patients should not receive repeated injections if previous injections resulted in a poor response. A poor clinical response to 2 previous injections in the same joint 3 months apart would constitute a relative contraindication for a third injection in that joint.

Injection complications

Proper informed consent—including a discussion about potential risks, complications, alternatives, and outcomes—should be obtained from each patient and then documented in the record before arthrocentesis or joint injection is performed. Complications of intra-articular corticosteroid injections are rare (Table 3). The risk of causing septic arthritis is extremely low; however, this condition remains the most feared complication.

Gray and Gottlieb[6] reported 2 cases of infection in more than 100,000 injections, and Hollander[7] described 18 cases in more than 250,000 injections. A postinjection flare, thought to be a result of corticosteroid crystal-induced inflammation, may occur in up to 15% of patients[8]; it may be confused with the occurrence of septic arthritis. Septic arthritis usually appears 3 to 4 days after arthrocentesis; in contrast, a postinjection flare tends to occur within the first 24 hours and dissipates, on average, within 3 days.

Although there is some evidence of systemic corticosteroid absorp-

Table 3 – Potential complications of corticosteroid injections

- Joint infection
- Subcutaneous fat atrophy
- Skin atrophy or depigmentation
- Asymptomatic pericapsular calcification
- Facial flushing
- Postinjection flare

Table 4 – Injectable corticosteroids

Solubility/ Generic name	Effect onset	Large joint dose (mg)	Small joint dose (mg)
Somewhat insoluble			
Triamcinolone acetonide	Variable	5 - 40	2.5 - 5
Triamcinolone hexacetonide	Variable	10 - 40	2 - 6
Slightly soluble			
Methylprednisolone acetate	Very slow	20 - 80	4 - 10
Triamcinolone diacetate	Variable	20 - 40	2 - 5
Soluble (not preferred for joints)			
Dexamethasone sodium phosphate	Rapid	2 - 4	0.8 - 1
Combination			
Betamethasone sodium phosphate and betamethasone acetate	Rapid	6 - 12	1.5 - 3

tion after intra-articular injection, it probably will not be of major clinical significance.[8] Occasional use of intra-articular corticosteroids does not appear to contribute to osteoporosis because they have little impact on bone resorption.[9]

The impact of corticosteroids on glucose control might be another concern. However, a small study in which patients with diabetes mellitus received soft tissue injections of methylprednisolone acetate did not detect a significant effect on blood glucose levels.[10]

Local adverse reactions to injection are minor and reversible. Subcutaneous fat and skin atrophy and depigmentation may occur, especially at superficial sites. Skin atrophy often reverses over subsequent months but may persist. A rare complication of repeated injections, pericapsular calcification, has been seen on x-ray films. The clinical significance of this finding is unknown. Flushing may occur shortly after corticosteroid injection but usually is self-limited.

Use of intra-articular corticosteroid injections has raised concerns about more joint degradation resulting from increased use of a less painful but diseased joint. Although rabbit studies have reported that use of intra-articular corticosteroids resulted in degeneration of mature cartilage cells,[11] this finding has not been supported by studies on primate joints.[12]

In clinical practice, repeated knee injections with corticosteroids do not appear to result in joint destruction or accelerated deterioration.[13] In fact, one study demonstrated a chondroprotective effect of intra-articular corticosteroids that reduced osteoarthritic changes.[14] The mechanism of this chondroprotective action remains uncertain.

Table 5 – Necessary supplies for intra-articular corticosteroid injection

- Patient table
- Gloves
- Antiseptic swabs: alcohol, topical iodophor microbicide, chlorhexidine gluconate
- Sterile needles (19, 21, 22, and 25 gauge)
- Sterile syringes (1, 3, 6, 10, and 20 mL)
- Sterile gauze pads
- Single-dose sealed vials of corticosteroid
- Single-dose sealed vials of anesthetic (lidocaine 1%)
- Sterile test tube or container for synovial fluid culture
- Test tube with sodium heparin for synovial fluid white blood cell count
- Slide with cover slip
- Nail polish (to seal edges of cover slip to view slide at a later time)
- Hemostat

Available products

Corticosteroid preparations differ in their solubility, potency, and crystalline structure (Table 4). In a survey of American College of Rheumatology (ACR) members, methylprenisolone acetate was reported to be the most commonly

used injectable corticosteroid, followed by triamcinolone hexacetonide and triamcinolone acetonide.[15] Less soluble agents (eg, triamcinolone hexacetonide) remain in a joint space longer than more soluble agents (eg, betamethasone sodium phosphate) and, in theory, should have a longer duration of action or prolonged effect.[16]

This does not always seem to be the case, however, as shown in a clinical trial of patients with OA. In one study, methylprednisolone acetate had a prolonged clinical effect on pain when compared with triamcinolone hexacetonide, a less soluble compound.[17] Less soluble, fluorinated agents generally are used for joint injections only and should be avoided in soft tissue injections because they have higher potential for causing tissue atrophy, tendon rupture, and depigmentation.

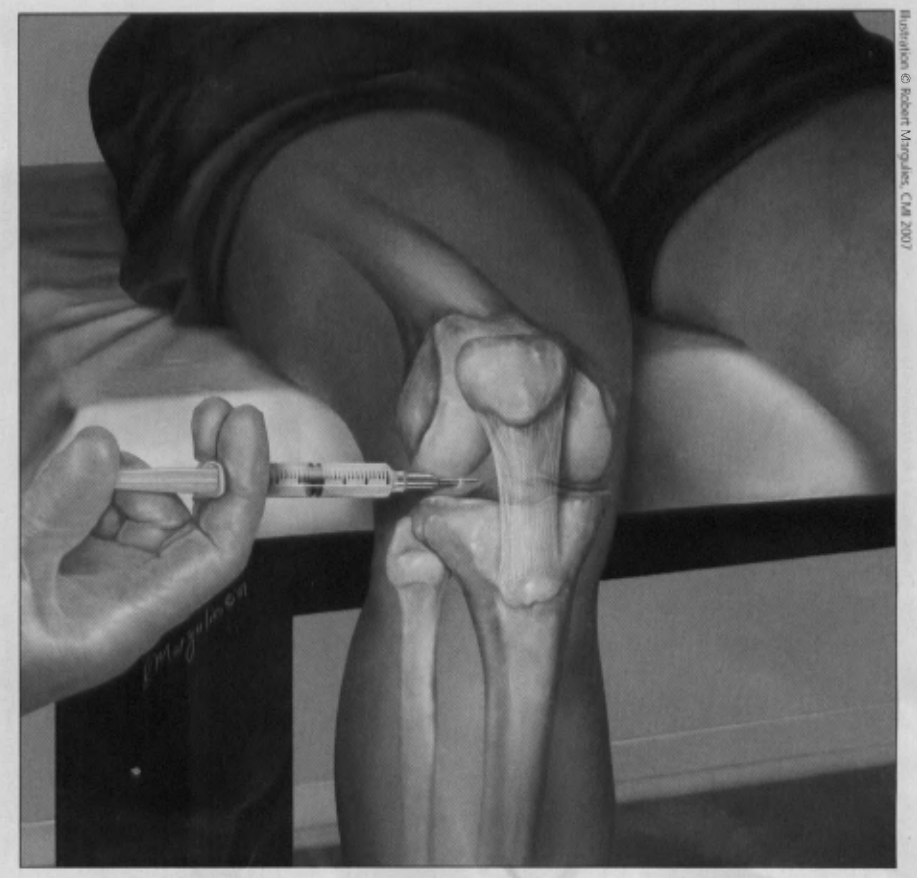

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Figure 1 – *The "sitting down" approach to knee injection is easy to do and convenient. The patient sits in a chair with the knee at a right angle. The patella is "pulled up" on the femur and the leg hangs because of gravity; therefore, the knee joint is "opened up." In that position, it can be injected by entering on the medial or lateral side of the patellar tendon. The needle is positioned parallel to the ground.*

Dosage and injection technique

Physicians should perform all joint and soft tissue injections wearing gloves and using aseptic technique. Although sterile gloves and sterile precautions often are used,[18] the gloves need not be sterile if the approach is a "no-touch" technique. In this approach, once the injection site is cleaned with antiseptic solutions, it should not be touched or palpated for anatomic landmarks. The operator enters the needle through the cleaned skin without touching that skin. The dose of the corticosteroid and its potential effect are influenced by various factors, including the size of the joint, choice of corticosteroid preparation, and severity of inflammation (Table 4).

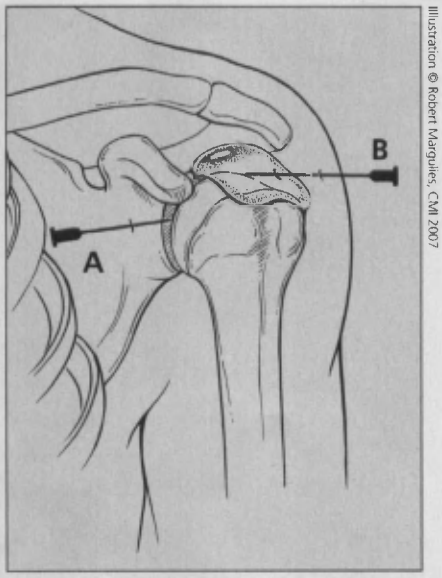
The necessary supplies are listed in Table 5. Surface anatomy and joint landmarks should be identified, and the point of entry can be marked before skin cleansing with a small indentation from a needle cap or thumbnail.

Aspiration of large joints, such as the knee (Figure 1) and shoulder (Figure 2), should be performed with a 20- or 21-gauge needle; if purulent fluid is present, a larger-gauge needle may be used. After joint aspiration is complete, the same needle may be used for in-

Therapeutic agents mentioned in this article:

- Betamethasone acetate
- Betamethasone sodium phosphate
- Dexamethasone sodium phosphate
- Hyaluronic acid
- Infliximab
- Methylprednisolone acetate
- Triamcinolone acetonide
- Triamcinolone diacetate
- Triamcinolone hexacetonide
- Yttrium

Figure 2 – *The shoulder may be aspirated from a medial approach. The physician holds the needle horizontally and inserts it just medial to the humeral head and below the tip of the coracoid process (A). The needle is inserted laterally under the acromion and directly into the bursa to inject the subacromial bursa (B).*



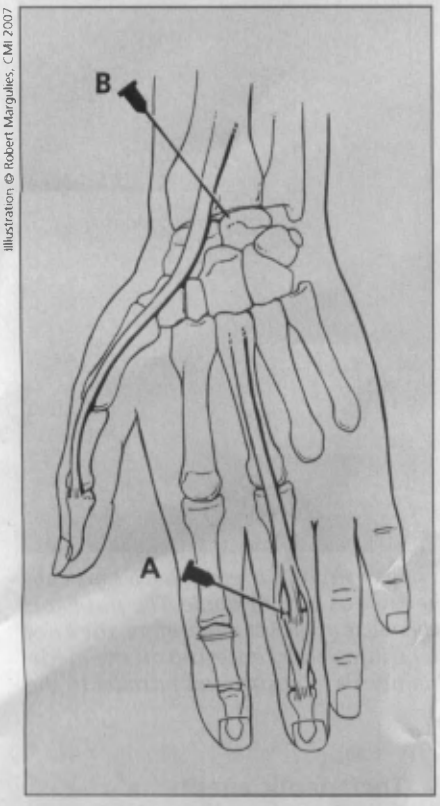


Figure 3 – *In hand injection, the interphalangeal joints are approached from either the superolateral or superomedial aspect, midway between the digital vessels and the extensor tendon (A). In wrist injection, a dorsal approach is used to minimize the potential for intersecting critical structures (B). The needle is introduced into the joint cavity on the ulnar side of the extensor pollicis longus tendon, or dorsal border of the anatomic snuffbox (the triangular depression formed on the radial aspect of the wrist when the thumb is extended and abducted), and immediately distal to the radius.*

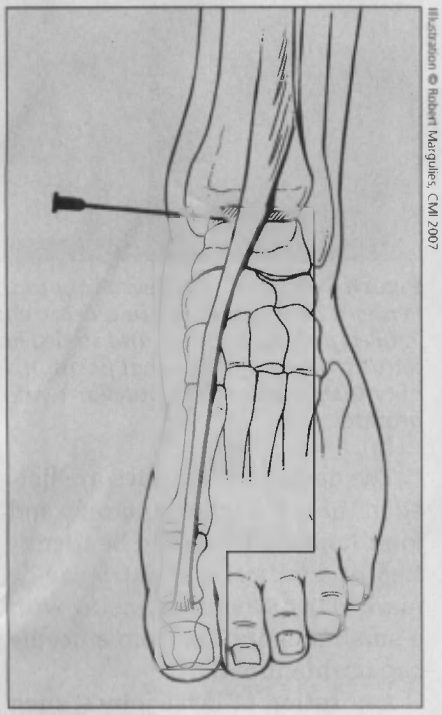


Figure 4 – *In ankle injection, the tibiotalar joint is approached from the anteromedial surface. The needle is inserted in the hollow area just medial to the extensor hallucis longus tendon and below the medial malleolus. The tip must penetrate about 3 cm before it enters the joint space.*

jections (changing the syringe but leaving the needle in place). For planned joint injections without aspiration, a 22- or even a 25-gauge needle is appropriate, depending on the size of the joint.

The choice of syringe size is based on the size of the effusion. Smaller syringes tend to be easier to use for aspiration than larger syringes and often are easier to disengage and reuse.

Most injections may be performed with a needle 1½ inches long, although a ⅝-inch needle often is used for the small joints of the hands (Figure 3) and feet (Figure 4). Small-joint injection also may be very useful in RA when there is chronic synovitis of a single or maybe 2 small joints. A 3-inch needle may be required in a deeper joint, such as the hip. Hip aspirations are almost always done with fluoroscopic guidance.

Some physicians use a "2-step" technique: they use a 25-gauge needle to inject the skin or surrounding tissue with local anesthetic and then inject a corticosteroid (alone or mixed with an anesthetic) with a separate needle and syringe into the target joint.[16] Others use a "1-step" method of injecting a local anesthetic/corticosteroid mixture into the selected area; although the skin is not anesthetized, the needle enters the target site directly.

Mixing an anesthetic with the corticosteroid in a syringe may allow for better dispersion of the mixture into the joint space. Mixing lidocaine with some corticosteroid preparations may result in a visible precipitant in the syringe that is thought to occur in the presence of paraben preservatives;