
THE SAN DIEGO KNEE CLINIC

**ASPIRATION OF THE KNEE JOINT
& SYNOVIAL FLUID ANALYSIS**

We will be offering counseling on diet and exercise. If interested, please contact my office and schedule a medically supervised *Health and Orthopedic Fitness* assessment appointment which will include a spine and joint health assessment evaluation. This assessment will not be covered by health insurance.

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Because the knee joint is the largest synovial cavity in the body, it is the easiest to aspirate. The aspiration of fluid from a tense knee effusion not only relieves pain, but also can render valuable diagnostic information. Additionally, aspiration can drain an infected joint, as well as permit instillation of medication, such as a corticosteroid agent, into the synovial cavity. Aspiration of the joint should never be performed when the presence of intervening infected tissue is suspected or in the patient with a severe clotting disorder (Kalore, 2011).



Figure 1.

Prior to performing needle aspiration of the knee joint, we ask the patient about any allergies, we explain the procedure thoroughly, and obtain an informed consent. The equipment and materials required to perform the procedure include:

- Sterile gloves
- Surgical soap
- Povidone-iodine solution (Betadine) or antibiotic spray (with allergies)
- 1 to 2 mL 1% lidocaine hydrochloride (HCl) (Xylocaine). The use of local anesthesia is dependent upon the degree of potential patient discomfort.
- 18-gauge and 25-gauge needles, both 1 in and 1 ½ in.
- 2-mL and 50-mL syringes
- Gauze sponge
- Adhesive-backed dressing



Figure 2. Introduce the needle on the anterolateral aspect of the knee, proximal to or at the superior pole of the patella. Direct the needle cephalad to avoid contact with the undersurface of the patella.

The patient should lie on the examining table in the supine position with the knee fully extended. In the presence of significant effusion, the knee may rest in 10° to 15° of flexion, supported by a pillow or folded sheet. Encourage the patient to relax the quadriceps muscle. Tension can move the patella posteriorly, forcing it toward the underlying femur which can inhibit proper placement of the needle. Apply the povidone-iodine solution at the anterolateral knee just inferior or superior to the patella.

Anesthetize the skin with .5% lidocaine HCl, using the 25-gauge needle on a 2-mL syringe on the anterolateral aspect of the knee proximal to or at the superior pole of the patella. Introduce the 18-gauge, 1 ½ inch needle on the 50 mL syringe, directing the needle tip cephalad to avoid contact with the undersurface of the patella.

Entry into the suprapatellar pouch is indicated by the return of synovial fluid. Gently draw back on the syringe and aspirate as much fluid as possible. The larger 18-gauge needle facilitates the aspiration of more viscous fluid from within the joint. The flow of fluid may be impeded by folds of synovium. In such a situation, turn the needle or change the direction or depth of the needle to dislodge it.

Having aspirated as much fluid as possible from the joint, next externally rotate the leg at the hip and “milk” any excess fluid toward the lateral side by palpating the medial side of the joint above and below the patella.

Following aspiration of the fluid, withdraw the needle entirely. Pressure should be applied to the puncture site with a gauze sponge. Ask the patient to hold the sponge against the puncture site for a few minutes, then cover the site with an adhesive-backed bandage. Caution the patient against activity for 24 hours. For the first 24 to 36 hours following knee joint aspiration, the patient may experience mild-to-moderate discomfort. If the patient is uncomfortable, application of an ice pack or an over-the-counter analgesic medication may provide relief. If the patient experiences swelling, pain, redness, or heat, a physician should be contacted immediately (Douglas, 2014).

Table 1. Significance of Findings from Gross Examination

Characteristics	Significance
Clear or straw-colored fluid	Normal
Green or purulent fluid	Examine with Gram's stain
Bloody aspirate or hemarthrosis	Indicates major injury within the knee
Fat droplets	Indicates an intra-articular fracture

Visual examination of the aspirate may reveal various signs of injury (TABLE 1). In patients in whom diagnosis remains inconclusive, laboratory analysis provides additional diagnostic information. Each laboratory has independent requirements for storage and transport of fluid. The physician should be familiar with the guidelines from his or her laboratory and should follow the required techniques to ensure accurate examination of synovial fluid.

Needle aspiration of the knee joint is a common procedure. Also, fluid that is taken from the joint offers the patient relief from pain and discomfort. Any knee aspirate of significance should be thoroughly evaluated both macroscopically and analytically to make the correct diagnosis. When dealing with infection, a corresponding venipuncture should be performed with a CBC with a differential, chemistry panel and cultures and sensitivities to eliminate the possibility of infection.

Synovial fluid that is aspirated during the procedure frequently provides diagnostic information (Pascual, 2009) about the cause of pain, swelling, joint inflammation, and fluid accumulation, etc. If left untreated, the symptoms may lead to one of the following four disease categories, causing joint abnormalities and excess synovial fluid: inflammatory diseases, degenerative diseases, bleeding, and infectious diseases.

A **synovial fluid analysis** is ordered by the physician to initially analyze the physical characteristics of the synovial fluid sample. During joint inflammation, the synovial fluid sample will be less viscous. When it is cloudy it may indicate the presence of microbes, crystals, white blood cells (WBCs), or red blood cells (RBCs). Since an individual patient may exhibit multiple physical characteristics, the physician orders both chemical and microscopic analysis.

Table 2. Significance of Findings from Synovial Analysis

Significance	Color/clarity	Viscosity	WBCs (per \timesL)	RBCs
Normal	Clear straw	Viscid (high)	200 +/- 25	0
Traumatic	Amber to bloody/hazy to bloody	High	1,500 +/- 40	Few to many
Degenerative joint disease	Yellow to straw/clear to slightly hazy	High	800 +/- 20	Rare
Gout	Yellow to milky/cloudy to turbid	Decreased to low	20,000 +/- 75	Rare
Rheumatoid arthritis	Yellow to greenish/cloudy to turbid	Decreased to low	20,000 +/- 75	Rare
Infectious arthritis	Grayish creamy to bloody/turbid	Low	50,000 +/- 90	Few to many

Synovial fluid with significantly lowered blood glucose level is a sign of infection or inflammation. Furthermore, if the patient has gout, the test will indicate higher than normal levels of uric acid. If the chemical test reveals increased protein concentration, it

is an indication of bacterial infection in the synovial fluid, which requires surgery. Frequently, with increased protein additional tests are ordered. Gram stain test for example, allows detection of fungi or bacteria in the synovial fluid. If bacteria are present, culture and susceptibility tests are performed to identify the types of microbes present. To learn whether there are any mycobacteria (associated with tuberculosis), the AFB test is ordered by the physician.

Finally, if the synovial fluid does not contain microbes or crystals, a total cell count is performed to detect deviation in numbers of WBCs and RBCs. Elevated levels of WBC is a sign of rheumatoid arthritis, infection, or gout. Moreover, the WBC differential determines the concentration of various types of WBCs. Specifically, the percent of neutrophils, which when elevated indicates bacterial infection. Increased eosinophils may reveal that the patient has either Lyme disease, rheumatoid arthritis, tubercular arthritis, or parasitic arthritis.

The microscopic examination also helps in detecting calcium pyrophosphate crystals, which are the indication of pseudogout, or the needle-like monosodium urate crystals, which are an indication that the patient has gout.

Aspiration of the knee joint is a rather simple technique. However, attention to detail is paramount. Anytime a needle is inserted into the joint, there is a slight risk of infection. Thus the technique must be performed sterilely with the placement of the aspiration site in the area of the knee that avoids injury to the articular cartilage.

REFERENCES:

Amer, H., Swan, A., Dieppe, P. *The utilization of synovial fluid analysis in the UK.* Rheumatology (Oxford) (2001) 40 (9): 1060-1063.

Balakrishnan, L., et al. *Differential proteomic analysis of synovial fluid from rheumatoid arthritis and osteoarthritis patients.* Clinical Proteomics 2014, 11:1. Web. <http://www.clinicalproteomicsjournal.com/content/11/1/1>

Baughner WH. White GM. *Primary evaluation and management of knee injuries.* Orthop Clin North Am 1985; 16(2):315.

Carpenter, CR., Schuur, JD., Everett, WW., Pines, JM. *Evidence-based Diagnostics: Adult Septic Arthritis.* Acad Emerg Med. 2011 Aug; 18(8): 781–796.

Douglas, RJ. *Aspiration and injection of the Knee Joint: Approach Portal.* Knee Surgery and Related Research. 2014 Mar; 26(1): 1–6.

Kalore, NV., Gioe TJ., Singh, JA., *Diagnosis and Management of Infected Total Knee Arthroplasty.* The Open Orthopaedics Journal. 2011; 5: 86–91. Web. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3092427/>

Leversee JH. *Aspiration of joints and soft tissue injections.* Office surgery. Primary Care 1986; 13(3):579.

Pascual, E., Doherty, M., *Aspiration of normal or asymptomatic pathological joints for diagnosis and research: indications, technique and success rate.* Annals of the Rheumatic Diseases. 2009;68:3-7. Web. <http://ard.bmj.com/content/68/1/3.abstract>

Shearn MA, Engleman EP. *Arthritis and allied rheumatic disorders.* In: Krupp MA, Charton MJ, eds. Current medical diagnosis & treatment. Los Altos, Calif: Lange Med Pubs, 1984;499.

Synovial Fluid Analysis. Lab Tests Online. Empower Your Health Understand Your Tests. 2016. Web. <https://labtestsonline.org/understanding/analytes/synovial/tab/test/>