JOINT/SOFT-TISSUE
ASPIRATION AND INJECTION :
The Knee and Shoulder

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OUTLINE

- Indications
- Contraindications
- Benefits and efficacy of corticosteroid injection
- Risks
- Equipment
- Sequence of steps for arthrocentesis
- Patient Education and Documentation
- Synovial fluid analysis
- Steroid Selection and Dosage
- Anatomy
- Individual procedures
- References

Arthrocentesis: an intervention that can be both diagnostic and therapeutic. It has been called a “liquid biopsy of the joint.” It is absolutely essential when considering the diagnosis of a septic joint and can guide therapy in crystalline diseases. Steroid injections may improve quality of life by suppressing pain and inflammation, increasing function and making exercise regimens possible. In many instances, injection and aspiration can be done by primary physicians. It is absolutely essential to understand the anatomy of the area you want to inject to avoid major neurovascular structures.

INDICATIONS

1. Diagnostic
   a. Infectious arthritis
   b. Crystals (gout, CPPD, others)
   c. confirmation of diagnosis
      1) suspected soft tissue problems (i.e. epicondylitis) can be confirmed when symptoms improve after injection with local anesthetic
      2) suspected inflammatory arthritis can be confirmed (and infection ruled out)
   c. Others
      1) Hemorrhage (coagulation disorders, trauma, etc)
      2) PVNS
      3) Ochronosis

2. Therapeutic
   a. pain relief (both articular and nonarticular) when conservative measures have failed
   b. reduction of intraarticular pressure
   c. removal of damaging purulent fluid
   d. installation of medication (steroids)
CONTRAINDICATIONS (most are relative)
1. cellulitis of skin overlying joint
2. bleeding diathesis
3. bacteremia
4. corticosteroids into a septic or fractured joint
5. difficult anatomy
6. diabetes (corticosteroid may worsen serum glucose)
7. pre-existing tendon injury may be a contraindication to injecting that tendon

BENEFITS/EFFICACY OF CORTICOSTEROID INJECTION
1. Inflammatory synovitis of knee
   83% improved at 6 weeks
2. Rheumatoid arthritis of knee
   59% improved at 12 weeks
3. Osteoarthritis of knee
   78% improved at 1 week
   57% improved at 6 weeks
   authors noted that those with effusions were most likely to benefit

RISKS OF CORTICOSTEROID INJECTION
1. Pigmentation changes/cutaneous atrophy: 1-31% (frequency depends on preparation)
2. Bleeding/bruising: 2.6 -17% *
3. Post-injection flare: 2-5%
4. Infection: 0.072% - 0.0001% *
5. Tendon weakening and rupture
6. ? glucocorticoid arthropathy - “The concept of ‘glucocorticoid arthropathy’ is based largely on subprimate animal studies and anecdotal case reports. Studies of primate models have shown no long-term adverse effects on cartilage.” (McCarthy and McCarty)

Uncommonly seen:
8. Periarticular osteopenia
9. Nerve damage/atrophy
10. Soft-tissue calcification
11. Granuloma formation
12. Hypersensitivity (Pfenninger: “rare”)
14. Flushing sensation
   < 1% ? more with TH
15. others (paresthesias* , vasovagal reactions* , Charcot joints)

* seen with arthrocentesis alone

EQUIPMENT
1. Gloves: used for personal protection; use sterile if you anticipate touching the sterile field or equipment, otherwise nonsterile gloves are adequate
2. Iodine preparation: bactericidal upon air drying on skin
3. Isopropyl alcohol: iodine removal (second preparation)
4. Ball-point pen with retractable tip (use end of barrel with point retracted; press tip into skin leaving indentation; marks site throughout procedure)
5. Anesthesia
   Lidocaine (1% or 2% without epinephrine): local anesthesia of skin, subcutaneous tissue and joint capsule
   Skin Refrigerant spray (e.g. Ethyl Chloride): anesthesia for skin (may be associated with more skin pigmentation changes especially in those with darker skin)

6. Needles:
   #27-25 small
   #22-20 medium
   #18-16 large

7. Syringes: 1, 3, 5, 10, 20 and 50cc

8. Hemostat: can be used to hold base of needle for changing syringes

9. 2 x 2 gauze pads

10. Adhesive bandages

SEQUENCE OF STEPS (See appendix I)

INFORMED CONSENT AND DOCUMENTATION

Important principles include:
   Informed consent
   Complete documentation of procedures, outcomes and complications

For examples, see appendix II and III

SYNOVIAL FLUID ANALYSIS

INSPECTION (Inflammatory vs. noninflammatory vs. bloody)
   color
   clarity
   viscosity

CELL COUNT and differential

If infection suspected:
   Gram stain
   Culture (aerobic, anaerobic, blood agar if gonorrhea suspected...others as suspected)

If crystalline arthropathy suspected:
   Crystal exam under polarization microscopy with red compensator
   Look for intracellular crystals

PEARLS

Need to examine synovial fluids promptly after arthrocentesis
   1. WBC numbers decrease with time
   2. Calcium pyrophosphate (CPPD) crystals become harder to see with time
   3. artifactual crystals develop with time, confusing picture
   4. Monosodium urate (gout) remain detectable over time

Do not need to send fluid for glucose, lactate or protein determinations

Clean slides and coverslips with alcohol wipes and air dry to remove bits of debris
STEROID SELECTION AND DOSAGE

1. Solubility of steroid preparation is important; the more insoluble the preparation, the longer it will last and the more likely it will have cutaneous adverse affects; The corticosteroid preparations available here, arranged from least soluble to most soluble are: Triamcinolone hexacetonide > Triamcinolone acetonide > Methylprednisolone > Betamethasone; I use betamethasone (Celestone) for soft-tissue injections and triamcinolone hexacetonide (Aristospan) for intraarticular injections; others substitute methylprednisolone (Medrol) [nonfluorinated and may produce less cutaneous adverse effects] for betamethasone and triamcinolone acetonide (Kenalog) for triamcinolone hexacetonide.

2. Although package inserts caution against mixing corticosteroid preparations with local anesthetics containing methylparaben preservatives, most rheumatologists do so. There are several advantages to this practice: a) dilutes the steroid making chances for cutaneous adverse effects less, b) provides pain relief which can be used diagnostically to determine if placement is correct c) increases patient comfort, d) provides increased volume to loosen contracted soft tissues. Potential disadvantages are that the mixture may flocculate, causing post-injection flare.

3. When injecting, deposit the steroid as deep as possible and over a large area to minimize cutaneous adverse effects.

4. Generally, use larger bore needles to aspirate (to prevent plugging the needle with particulate matter) and use smaller bore needles to inject (more patient comfort)

5. Some authors recommend no more than 3 injections per year in the same area/joint. Data to support this is controversial.

6. Steroid Selection and Dosage (few studies to help with selection and amount)

My Choices:

<table>
<thead>
<tr>
<th>Structure</th>
<th>Needle Gauge (for aspiration)</th>
<th>Needle Gauge (for injection)</th>
<th>Dose of 1-2% lidocaine</th>
<th>Recommended corticosteroid and dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subdeltoid bursa</td>
<td>N/A</td>
<td>25 x 1.25 inches</td>
<td>5-9 ml</td>
<td>3-6 mg Beta* or 20 mg Methyl</td>
</tr>
<tr>
<td>Biceps Tendon Sheath</td>
<td>N/A</td>
<td>25 x 1.25 inches</td>
<td>1-2 ml</td>
<td>3-6 mg Beta or 20 mg Methyl</td>
</tr>
<tr>
<td>Rotator cuff Tendons</td>
<td>N/A</td>
<td>25 x 1.25 inches</td>
<td>5-9 ml</td>
<td>3-6 mg Beta or 20 mg Methyl</td>
</tr>
<tr>
<td>Shoulder joint</td>
<td>20-22 x 1.5-3 in</td>
<td>22-25 1.5-3 in</td>
<td>5-9 ml</td>
<td>20-80 mg Methyl</td>
</tr>
<tr>
<td>AC joint</td>
<td>N/A</td>
<td>25 x 1.25 inches</td>
<td>0.5-1 ml</td>
<td>10-20 mg Methyl</td>
</tr>
<tr>
<td>Anserine Bursa</td>
<td>N/A</td>
<td>25 x 5/8 - 1.25 inches</td>
<td>0.5 - 1 ml</td>
<td>3-6 mg Beta or 20 mg Methyl</td>
</tr>
<tr>
<td>Knee Joint</td>
<td>18-20 x 1.5 inches</td>
<td>22-25 x 1.5-3 inches</td>
<td>1-2 ml</td>
<td>20-40 mg Triam Hexacet</td>
</tr>
<tr>
<td>Prepatellar Bursa</td>
<td>20-22 x 1.5 inches</td>
<td>25 x 5/8 - 1.25 inches</td>
<td>0.5 - 1 ml</td>
<td>3-6 mg Beta or 20 mg Methyl</td>
</tr>
</tbody>
</table>

*Beta = betamethasone
Methyl = Methylprednisolone
Triam Hexacet = Triamcinolone Hexacetonide
ANATOMY

Know the following anatomic landmarks and structures of the knee and shoulder:

Knee:  
Femur  
Tibia  
Fibula  
Patella  
Medial Joint Line  
Lateral Joint Line  
Prepatellar Bursa  
Anserine Bursa  
Joint Capsule  
Medial Collateral Ligament  
Lateral Collateral Ligament  
Anterior Cruciate Ligament  
Posterior Cruciate Ligament  
Medial Meniscus  
Lateral Meniscus

Shoulder:  
Clavicle  
Acromion  
Acromioclavicular Joint  
Humerus  
Scapular Spine  
Joint Line (anterior and posterior)  
Joint Capsule  
Long head of Biceps Tendon  
Subacromial (Subdeltoid) Bursa  
Rotator Cuff muscle tendons  
Supraspinatus  
Infraspinatus  
Teres Minor  
Subscapularis

INDIVIDUAL PROCEDURES YOU SHOULD KNOW:

Shoulder:  
Glenohumeral joint  
Subacromial (Subdeltoid) bursa  
Long head of the biceps tendon (sheath)  
Acromioclavicular joint

Knee:  
Knee (tibiofemoral) joint  
medial approach  
lateral approach  
Prepatellar bursa  
Anserine bursa
REFERENCES

General Articles on Arthrocentesis and Soft-tissue injection


Articles on synovial fluid analysis


Appendices (following pages)

I. Sequence of Steps for Arthrocentesis

II. Sample Procedure Note

III. Sample Patient Information Handout
SEQUENCE OF STEPS FOR ARTHROCENTESIS

1) Plan the procedure before starting it, determining what information you wish to obtain. If medication is to be injected, determine the proper type. Discuss risks, benefits and alternative therapies with patient.

2) **Know the anatomy** of the structure you are approaching, the landmarks for identifying the puncture site, adjacent structures to be avoided (nerves, blood vessels, tendons), and the direction the needle is to take for a successful puncture.

3) Precisely identify the site for insertion of the needle and mark it (10-15 seconds of pressure with the small circular tip of a {retracted} ball point pen leaves a mark on the skin site which should last throughout the procedure).

   NOTE: Prep the skin appropriately (Step 4) **BEFORE** proceeding to set up your equipment (Step 5). This will allow the iodine or alcohol to air dry while you are preparing your syringes, etc.

4) Cleanse the skin at the puncture site using iodine and alcohol.

5) Draw up the lidocaine (and corticosteroid if used); prepare a syringe for aspiration; label specimen tubes, culture tube, etc. Then lay out equipment in the anticipated order in which you will use it, in a place where you can conveniently reach it during the procedure.

6) Glove yourself for your own protection. Use nonsterile gloves if you do not touch the prepped skin site (care to avoid touching the needle, the patient’s prepped skin, etc. ensures sterile technique). Use sterile gloves if you will touch the prepped site.

7) Spray the topical refrigerant until there is a light frost (usually only a few seconds) or Infiltrate lidocaine generously at the puncture site using a 27 or 25 gauge needle.

8) After a minute or two (to allow adequate anesthesia), perform the arthrocentesis and fluid aspiration. Gentle suction is advisable (it is less likely to result in the synovial membrane being sucked against the lumen of the needle). If the tip of the needle appears to be within the joint cavity and fluid is not obtained, rotate the syringe and needle sequentially 90° with gentle aspiration each time as this may free the needle from synovial plugging. If this does not result in successful aspiration, insert the needle a bit further and repeat. If still unsuccessful, withdraw the needle slightly and attempt again. In most instances, a 20-22 gauge needle is acceptable for aspiration. In some cases (aspirating a large volume, very viscous fluid, or fluid with particulate matter) a 16-18 gauge needle may be desirable. Once a flow of fluid from the joint is achieved, take care to not move the tip of the needle, else it may be withdrawn from the optimal site for aspiration.

9) Complete all aspiration and then inject medication (if indicated) without changing needles (using sterile technique simply disconnect the aspirating syringe from the needle hub and connect the syringe containing corticosteroid. In this way the needle tip will remain appropriately located within the joint space).

10) Thoroughly remove iodine from skin to avoid stains on the patient's clothing.

11) Apply a bandage to absorb blood or synovial fluid that might ooze from the puncture site. It is helpful to advise the patient that a small drop of blood may appear on the bandage during the subsequent hours and that this is no cause for alarm.
PROCEDURE NOTE

Indications, alternative therapies, risks and benefits of arthrocentesis and joint/soft-tissue injection were discussed with the patient who agrees to the procedure. The areas to be aspirated/injected were prepped with Betadine and alcohol swabs. Anesthesia used:

- Ethyl Chloride
- Xylocaine
- None

Information sheet given and reviewed with patient.

These areas were aspirated/injected:

<table>
<thead>
<tr>
<th>JOINT/SOFT TISSUE AREA</th>
<th>XYLOCAINE</th>
<th>CORTICOSTEROID (Circle agent)*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>%</td>
<td>mg TA TH B M</td>
</tr>
<tr>
<td></td>
<td>%</td>
<td>mg TA TH B M</td>
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<tr>
<td></td>
<td>%</td>
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</tr>
<tr>
<td></td>
<td>%</td>
<td>mg TA TH B M</td>
</tr>
</tbody>
</table>

SYNOVIAL FLUID:

- not applicable
- none obtained
- cc of ____________________________ fluid

Crystals: ____________________________

- Fluid sent for culture
- Fluid sent for cell count

There were _____ complications (any complications described below). The patient was instructed to rest (no heavy or excessive activity involving the involved joints/extremities). The patient was instructed to call me at the clinic or go to the emergency room for fever, increasing pain, redness, swelling or warmth, numbness/tingling or any concerning symptoms.

* TA = Triamcinolone Acetonide (Kenalog)
* TH = Triamcinolone Hexacetonide (Aristospan)
* B = Betamethasone (Celestone)
* M = Methylprednisolone (Medrol)
Corticosteroid Injections

About the medicine
Corticosteroid medications are similar to hydrocortisone, a hormone made by the body. They are used to help quiet inflammation and can be injected into joints, bursae and around tendons. Corticosteroids are not the same steroids used by bodybuilders and athletes.

Generally, these injections are very safe and effective. Corticosteroid injections should probably not be done in the same place more often than every 3-4 months.

Before having this procedure done
Tell me if you...
- are allergic to any medication, especially xylocaine or iodine
- have had a bad reaction to a steroid injection
- or anyone in your family has ever had any excessive bleeding

The procedure
- the area to be injected will be cleaned with an antiseptic solution
- the area can be made numb with a freezing spray or with an injection of a local anesthetic like xylocaine
- I will insert a needle, may try to withdraw fluid and will inject a solution of local anesthetic and corticosteroid.
- the needle will be withdrawn, any bleeding will be controlled and the area covered with a bandage

Precautions after the injection
- To get the most benefit from the medication, the area injected should be rested completely for 3-5 days.
- Be careful not to overuse the area for 2 weeks.
- Discuss your usual activities with me for more specific recommendations.

Possible side effects
- the injection may sting or be painful for a few seconds, especially in the small joints
- the injected area may be numb for 1-2 hours and may hurt when the anesthetic wears off
- infection is rare but can occur
- bleeding/bruising
- thinning of the skin or the underlying tissue
- an area of darker or lighter skin discoloration
- a lump or granuloma at the site of injection
- thinning of the bones around the joint injected
- early deterioration of the joint
- damage to nerves, tendons or muscles around the injection site
- pain and swelling in the joint for 24 hours after the injection

Call me if:
- you have a fever
- the area injected is red, warm or swollen
- anything concerns you