

US-guided interventional joint procedures in patients with rheumatic diseases - When and how we do it?

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1. Purpose / Introduction

To describe the main indications and the technical steps to perform ultrasound guided procedures in patients with rheumatic diseases. To access procedures accuracy, safety and effectiveness.

INTRODUCTION

Ultrasound (US) guided interventional techniques are the most reliable way to access safely, quickly and accurately all the joints in the appendicular skeleton. In several cases rheumatic diseases need the help of ultrasonography to achieve a confident diagnosis characterizing the affected joints and evaluating disease activity. In a few cases the rheumatic disorder is only diagnosed by synovial biopsy or by joint fluid chemical and culture tests.

During chronic therapy rheumatic diseases course with acute exacerbations that must be promptly treated. During systemic therapy some joints also fail to respond and thus they benefit from intra-articular corticosteroid injections. Because US findings like synovial thickening, the presence of Power-Döppler signal [[PW Dop MTF](#)] ([Figure 1](#)) or US-contrast enhancement indicate active synovitis [[CEUS Knee](#)] ([Video 1](#)) and are well correlated with patient symptoms.

US evaluation of the symptomatic joints improves therapeutic effectiveness of US-guided therapy by choosing the right place for injection.

When tenosynovitis is present a corticosteroid instillation in the tendon sheath can also reduce synovial inflammation and improving symptoms [[Tenosynovitis](#)] ([Video 2](#)).

Yttrium-90 radiation synovectomy or radiosynoviorthesis (RSO) is a therapeutic technique based on an intra-articular image-guided infusion of a radionuclide. It intends to block intra-articular inflammation, reducing effusion, improving pain and joint swelling and thus restoring articular mobility [[RSO Knee](#)] ([Figure 2](#)).

Described techniques involve approach with ultrasound guidance to place the needle intra-articularly. The following procedures also require a thorough knowledge of ultrasound anatomy to decide the optimum intra-articular site to perform the technique.

This exhibit describes intra-articular techniques guided by ultrasound at shoulder, elbow, wrist, metacarpophalangeal, knee, ankle and metatarsophalangeal joints.

2. Material and Methods

Patient selection

27 patients with pain related to articular complications of rheumatic diseases and according to previous radiographic or US exam were submitted to the following US-guided procedures.

42% of patients (n=11) had rheumatoid arthritis, 11% (n=3) spondyloarthropathies, 18% (n=5) psoriatic arthritis, 15% (n=4) undifferentiated arthritis, 3% (n=1) Sjögren syndrome and 11% (n=3) had gout.

Procedures, Articular puncture and Joint specific features

1. Synovial biopsy was made in 3 patients
2. Arthrocentesis / Cysts Drainage was made in 8 patients
3. Corticosteroid injections in 12 patients

4. Radiation synovectomy (Yttrium-90) – US guided in 4 patients

All the procedures were done under strict aseptic conditions. It is very important to use all ultrasound anatomical landmarks.

Local skin anesthesia was performed almost in all procedures, particularly in the synovial biopsy. A lidocaine solution (1%) was injected under the skin without air bubbles in the syringe to avoid ultrasound artifacts.

The articular space is very wide in the knee, shoulder and elbow and relatively small in the wrist and phalangeal joints.

We used a 21 gauge X 40mm needle in the knee, elbow and in the ankle and a 23 gauge X 25mm needle in the wrist, metacarpophalangeal and in the metatarsophalangeal joints. In the shoulder was used a spinal needle (21 gauge X 70mm).

Yttrium-90 radiosynoviorthesis was only made in the knee.

Corticosteroids used were:

1. Triamcinolone hexacetonide is a relatively insoluble corticosteroid with a prolonged effect on tissue at the local injection site and the duration usually ranging from a few weeks to several months.
2. Methylprednisolone acetate was used for short-term administration and to tide the patient over an acute episode or exacerbation.

Indications and Techniques

1. Synovial biopsy

The main indications to synovial biopsy are:

- To distinguish an inflammatory from an infectious arthropathy, particularly when there is an oligoarthritis [\[Synovial biopsy knee\] \(Video 3\)](#).
- To make the differential diagnosis from other synovial thickening conditions like pigmented villonodular synovitis (PVNS) or a metabolic arthropathy (crystal deposition disease) [\[Syn bio foot\] \(Video 4\)](#).

Material used:

- Sterile gloves, surgical gauze and drapes
- Cleaning fluid – alcohol or iodine solution
- 18-gauge thru-cut needle
- 10mL bottle of 0,9% sodium-chloride solution
- 10mL bottle of formaldehyde solution
- Two 50mL recipients for samples (one for sodium-chloride and other for formaldehyde solution)

2. Arthrocentesis / Cysts Drainage

The main indications of guided arthrocentesis are [\[Athrocentesis knee\] \(Video 5\)](#):

- To characterize the aetiology of a monoarthritis, particularly when there is a small amount of fluid.
- To complement synovial biopsy in the study of an oligoarthritis (for chemical and culture tests of

the synovial fluid).

- To drain synovial cysts.
- To relief related symptoms.

Material used:

- Sterile gloves, surgical gauze and drapes
- Cleaning fluid – alcohol or iodine solution
- 21 or a 23-gauge needle according to the joint
- 5mL syringe(s)
- 50mL sterile recipient for fluid

3. Corticosteroid injections

The main indications of intra-articular corticosteroid injections are [\[Corticosteroid injection knee\]](#) [\(Video 6\)](#):

- Symptomatic relief during joint acute exacerbations.
- To treat synovial proliferation when it fails to respond to systemic therapy and thus reducing early joint destruction.
- To reduce relapsing effusions and to prevent synovial cysts recurrence.

Material used:

- Sterile gloves, surgical gauze and drapes
- Cleaning fluid – alcohol or iodine solution
- 21 or a 23-gauge needle according to the joint
- One 2mL syringe
- 40 mg of metilprednisolone (80mg in bigger joints) or 20mg of triamcinolone hexacetonide (40mg in bigger joints)

4. Radiosynoviorthesis - US guided

The main indications for RSO-Y90 are:

- Persistent mono or oligoarthritis unresponsive to medical treatment over the last 6 months
- Intolerance to medical treatment
- Absence of response to an effective dose of intra-articular steroids
- Absence of any absolute contraindication (pregnancy, lactation after pregnancy, skin infection, articular infection, bone fracture, popliteal cyst with rupture signs, severe hemarthrosis).

Material used:

- Sterile gloves, surgical gauze and drapes
- Cleaning fluid – alcohol or iodine solution
- 10mL bottle of 0,9% sodium-chloride solution
- 1mL syringe (for Yttrium) and two 5mL syringes (for sodium-chloride solution and for steroid)
- 21G needle
- 3-way stopcock with a 10cm extension tube [\[RSO Mat\]](#) [\(Figure 3\)](#)
- Yttrium-90 solution of 185 MBq with isolating material around syringe [\[Y90\]](#) [\(Figure 4\)](#)
- 40 mg of metilprednisolone (administered to reduce flare after radionuclide infusion)

Clinical evaluation

When a therapeutic procedure like corticosteroids injections or radiation synovectomy was made patients were evaluated by two rheumatologists. Patients were evaluated at 3 weeks and 6 months. The clinical effect was assessed by evaluating stiffness, swelling, effusion, spontaneous and mechanical pain. A questionnaire scale was also applied - for pain [\[VAS pain\] \(Figure 5\)](#).

3. Results

Procedure details

With patient positioned on the ultrasound examination table and using an aseptic technique the surface puncture was cleaned (with alcohol or iodine solution).

To the intra-articular placement of the needle all ultrasound anatomical landmarks were used, avoiding vessels, tendons or ligaments. Once the joint was entered and little resistance to injection was felt intra-articular placement was achieved.

Because of the radiopharmaceutical drug (Yttrium-90) synovectomy required specific features for radiation protection.

SHOULDER

Patient was placed seated with the shoulders adducted in neutral position. A posterior approach was used [\[Shoulder\] \(Figure 6\)](#). The US-probe was placed parallel to infraspinatus tendon with the tip of the needle advanced to the humeral head just laterally to the posterior labrum [\[US shoulder\] \(Figure 7\)](#).

ELBOW

Patient was placed seated with the elbow slightly extended. The probe was placed longitudinally showing anterior joint recess [\[elbow\] \(Figure 8\)](#). The tip of the needle advanced to the humeral trochlea [\[Cor inj elbow\] \(Video 7\)](#) [\[Elbow injection\] \(Video 8\)](#) [\[Cor inj elbow\] \(Video 9\)](#).

WRIST

Patient was placed seated with the elbow extended and wrist pronated on a table. Radiocarpal compartment was always used. The probe was placed longitudinally along the articular space along de radius and scapholunate space with the needle making a proximal tilt of approximately 10°-30° and between the extensor pollicis longus and extensor digitorum communis [\[Wrist\] \(Figure 9\)](#) [\[Needle wrist\] \(Video 10\)](#) [\[Cor inj wrist\] \(Video 11\)](#).

METACARPOPHALANGEAL JOINTS

Patient was placed seated with the elbow extended, wrist pronated and fingers extended on a table. The probe was place in a longitudinal dorsoradial or dorsoulnar position along the articular space [\[MCP joint\] \(Figure 10\)](#). The needle was advanced avoiding extensor tendons. A subtle traction in opposite direction of the needle was helpful to slightly open the joint space [\[Cor inj MCF\] \(Video 12\)](#).

KNEE

Patient was placed seated on an examination table with the knee flexed (30°) and ankle extended. According to the procedure lateral [\[RSO knee\] \(Figure 11\)](#) [\[RSO\] \(Figure 12\)](#) [\[Synovial biopsy knee\] \(Video 3\)](#), anterior (above patella) [\[knee\] \(Figure 13\)](#) [\[Corticosteroid injection knee\] \(Video 6\)](#) or posterior approaches were used. When anterior approach was needed the needle was inserted into the soft tissue directed to the supra-patellar recess or when a posterior approach was needed the needle was directed to the popliteal cyst [\[Popliteal cyst\] \(Video 13\)](#).

ANKLE

Patient was placed seated on an examination table with the knee flexed (45°) and ankle extended. Placing the transducer probe longitudinally along the tibia and the talus, anteromedial approach was used with the needle between the anterior tibialis tendon and the medial malleolus [\[ankle\] \(Figure 14\)](#).

METATARSOPHALANGEAL JOINTS

Patient was placed seated on an examination table with the knee flexed (45°), ankle and fingers extended. The probe was placed in a longitudinal dorso-lateral or dorso-medial position along the articular space [\[MTP\] \(Figure 15\)](#). The needle was advanced avoiding extensor tendons. A subtle traction in opposite direction of the needle was helpful to slightly open the joint space [\[Cor inj. MTF\] \(Video 14\)](#).

Technical outcome

The overall success rate was 100% (n=27). In all cases success was achieved with correct needle placement inside the joint.

No complications occurred in the infusion or within follow-up period as vasovagal reactions or joint infection.

Clinical outcome

All patients (n=27) improved their status solving swelling and tenderness, with improvement in VAS for pain.

No short-term clinical adverse side effects were noted.

No complications were recorded during the follow-up period of 6 months.

4. Discussion / Conclusion

US-guidance is very reliable to afford a safety procedure always checking the injection, biopsy or aspiration.

Guided-biopsy has high success rates obtaining several samples.

Thus is also possible to safely use more powerful/long acting therapeutic drugs aggressive to extra-articular structures like Triamcinolone or Yttrium-90.

In clinical terms, therapeutic procedures under US-guidance, are short-term useful and very safe options in persistent synovitis unresponsive to conventional therapy.

5. References

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6. Mediafiles

Athrocentesis knee



Video 5 - Athrocentesis - Patient with an undifferentiated oligoarthritis. US shows the needle entering the the supra-patellar recess to aspirate fluid.

CEUS Knee



Video 1 - Contrast Enhanced US (CEUS) of the supra-patellar recess showing early synovial enhancement and thus diagnosing active synovitis (Sjögren syndrome). Enhancement time is displayed in the right inferior corner of the image.

Cor_inj_MCF



Video 12 - Corticosteroid injection (methylprednisolone) - Patient with a late Rheumatoid arthritis. US shows an injection in the 1st metacarpophalangeal joint.

Cor_inj_MTF



Video 14 - Corticosteroid injection (methylprednisolone) - Patient with a Psoriatic arthritis. US shows an injection in the 2nt metatarsophalangeal joint.

Cor_inj_elbow



Video 7 - Corticosteroid injection - Patient with a Psoriatic arthritis. US shows marked synovial thickening and the tip of the needle in the anterior joint recess.

Cor_inj_elbow



Video 9 - Corticosteroid injection (triamcinolone) - Patient with chronic Gout. US shows an injection in the anterior recess of the elbow.

Cor_inj_wrist



Video 11 - Corticosteroid injection (methylprednisolone) - US shows an injection in the radiocarpal compartment of the wrist in a patient with Rheumatoid Arthritis.

Corticosteroid injection knee



Video 6 - Corticosteroid injection (triamcinolone) - Patient with an undifferentiated oligoarthritis. US shows the needle entering the supra-patellar recess and bubbling effect of the drug.

Elbow injection



Video 8 - Corticosteroid injection - Patient with a Psoriatic arthritis. US shows marked synovial thickening in the anterior joint recess. US shows injection of triamcinolone.

Joint fluid



Synovial fluid inside syringes and after drainage

MCP joint



Figure 10 - US-probe position to puncture a metacarpophalangeal joint (3rd finger).

MTP



Figure 15 - US-probe position to puncture a metatarsophalangeal joint (1st finger shown).

Needle_wrist



Video 10 - Patient with a late Rheumatoid arthritis. US shows the needle advancing through the radiocarpal compartment of the wrist (right superior side in this video).

PW_Dop_MTF

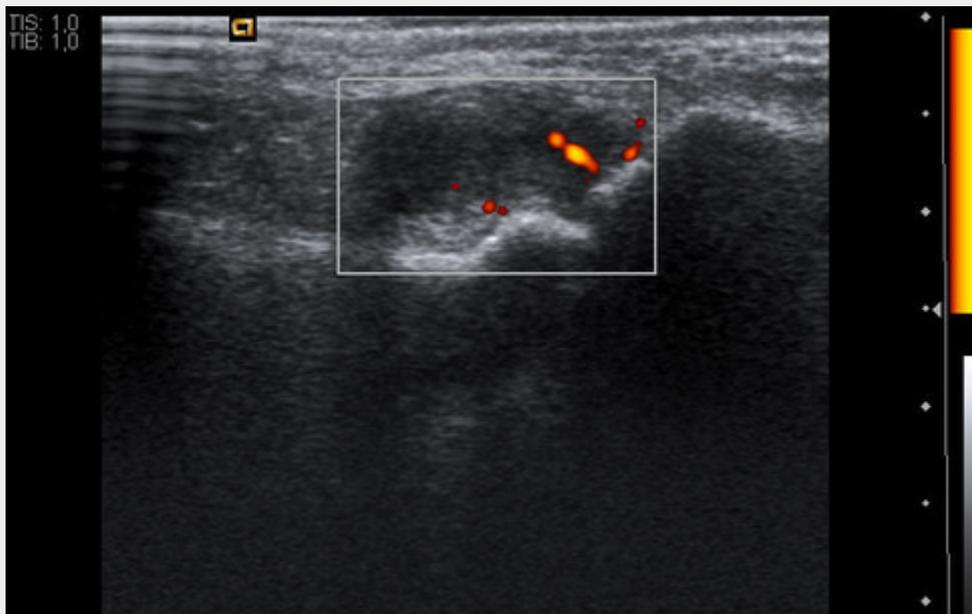


Figure 1 - Power-Doppler US - Metatarsophalangeal joint showing synovial thickening and Doppler signal indicating active synovitis (Psoriatic arthritis).

Popliteal cyst



Video 13 - Corticosteroid injection - Patient with Rheumatoid arthritis. US shows a popliteal cyst being injected with methylprednisolone after drainage.

RSO



Figure 12 - Radiosynoviorthesis (RSO) procedure. Material used for radiation protection.

RSO Knee

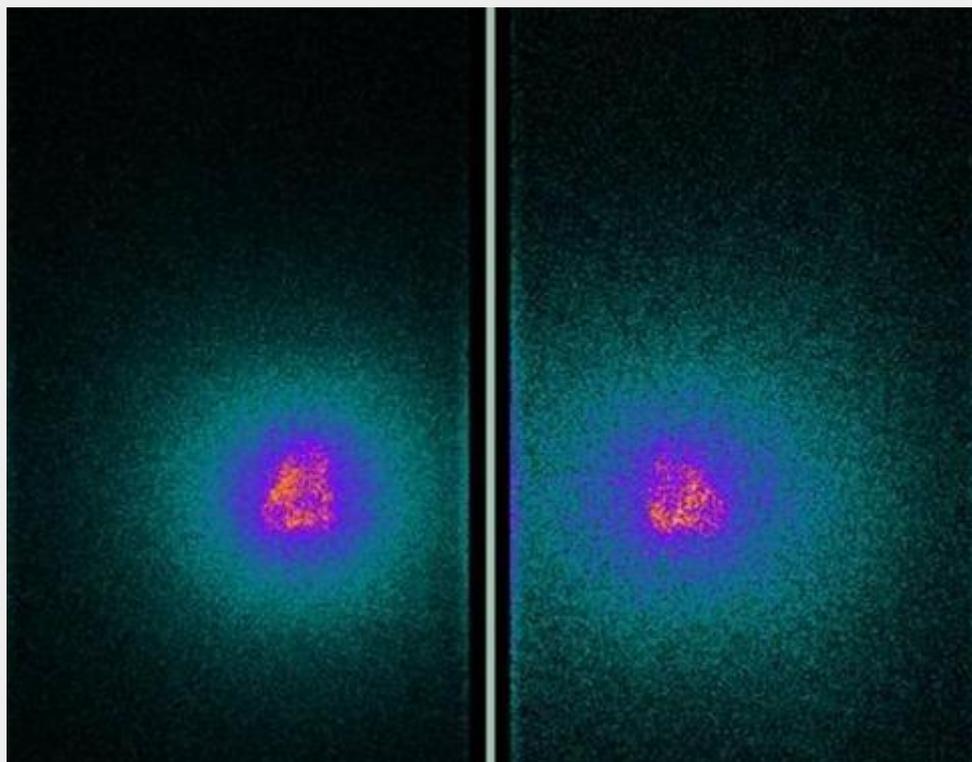


Figure 2 - Knee scintigram after injection of Yttrium-90 (anterior and posterior views).

RSO_Mat



Figure 3 - Material used for Radiosynoviorthesis (RSO).

RSO_knee

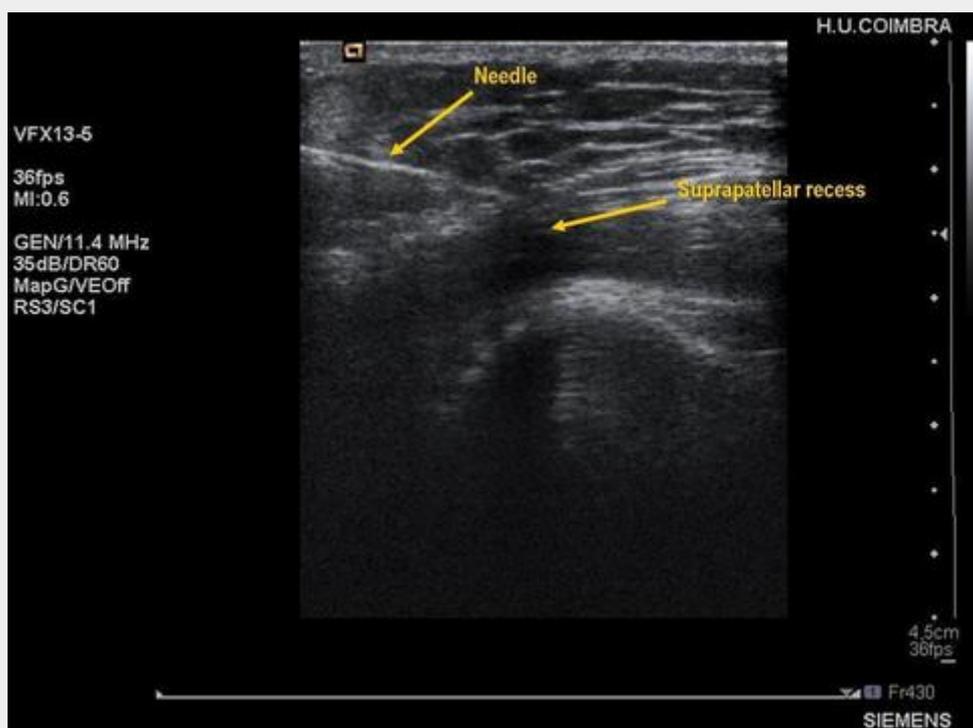


Figure 11 - Radiosynoviorthesis (Yttrium-90). US image shows the needle in the supra-patellar joint recess.

Shoulder



Figure 6 - US-probe position to puncture shoulder joint. A skin mark indicates puncture site to enter the gleno-humeral joint.

Syn_bio_foot



Video 4 - Synovial biopsy - US-guided biopsy of an area of synovial thickening in the dorsum of the foot in a patient with a spondylarthropathy. Histologic exam revealed PVNS (Pigmented Villonodular synovitis).

Synovial biopsy knee



Video 3 - Synovial biopsy - Patient with an undifferentiated oligoarthritis. US shows the needle entering the thickened synovium in the supra-patellar recess.

Tenosynovitis



Video 2 - Corticosteroid injection - Patient with early Rheumatoid arthritis. US shows tenosynovitis in the tibialis posterior tendon. Methylprednisolone is being injected in the tendon sheath.

US shoulder

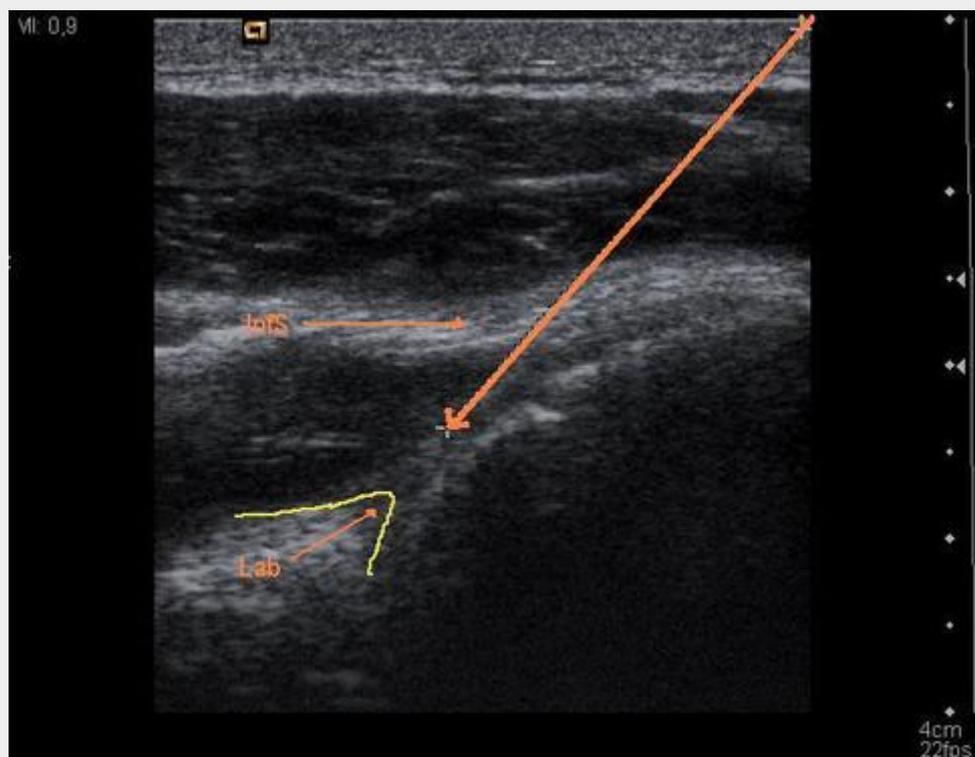


Figure 7 - US image shows the direction of the needle to enter the joint space between the humeral head and the labrum. Infraspinatus tendon (InfS) and Glenoid labrum (Lab).

VAS pain

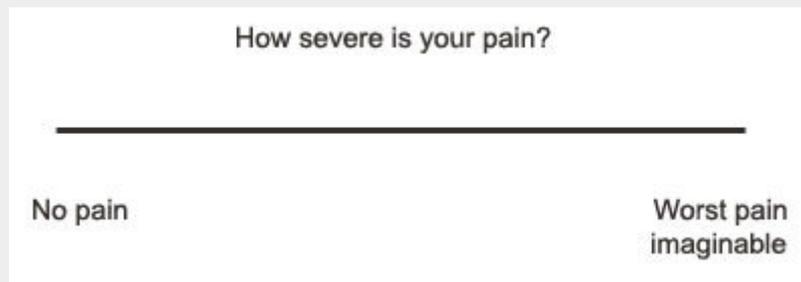


Figure 5 - Visual Analog Scale (VAS) for pain

Wrist



Figure 9 - US-probe position to enter the wrist joint space (radiocarpal compartment).

Y90



Figure 4 - Aspiration of Yttrium-90 from container. Isolating material around syringe.

ankle



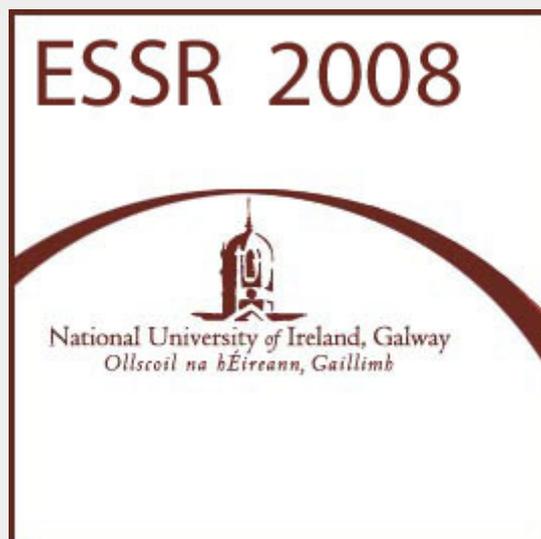
Figure 14 - US-probe position to enter the ankle joint space. A skin mark indicates puncture site.

elbow



Figure 8 - US-probe position to enter the anterior recess of the elbow joint space.

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knee



Figure 13 - US-probe position to enter the knee joint space (supra-patellar recess). A skin mark indicates puncture site.