신경과 진료에서 만날 수 있는 관절 질환의 초음파 소견

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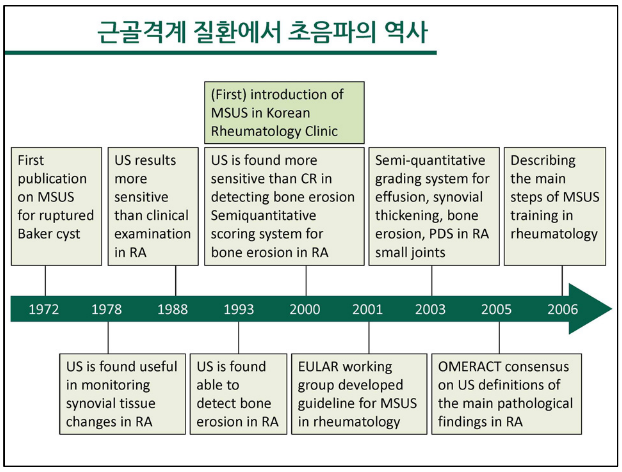
Agenda

- 관절 질환에서 초음파 검사의 의미와 역사
- 류마티스관절염
- 골관절염
- 통풍성 관절염
- 초음파 유도 하 관절내 주사
- 맺는말

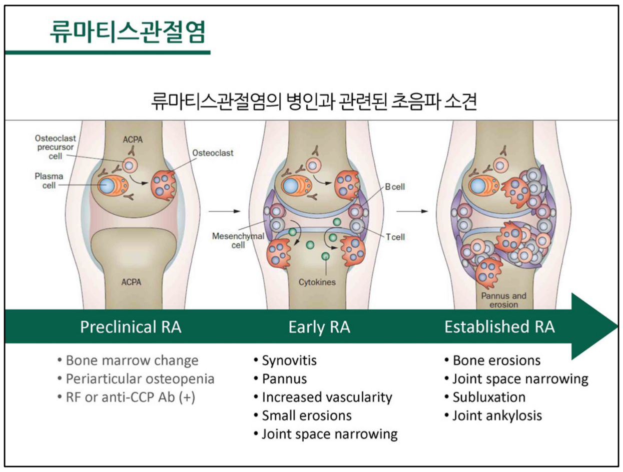
Introduction

- 류마티스 진료 영역에서 관절염의 진단에 초음파 검사는 조기진단, 질병활성도 평가, 예후 예측, 관절외 질환과의 감별 등에 큰 도움이 된다.
- 초음파는 (1) 저렴하고, (2) 간편하며, (3) 방사선 노출에 안전해 자주 촬영이 가능하고, (4) 진료의가 직접 검사를 하여 치료 계획을 바로 결정할 수 있고, (5) 동영상을 얻을 수 있고, (6) 관절 주사를 보조하여 정확성과 안전성을 높일 수 있어 류마티스 진료 영역에서 계속해서 사용이 증가하고 있다.
- 정확한 진단을 위해서는 자세한 병력 청취와 진찰이 선행되어야 하며, 질환의 병인과 해부학적 지식이 필요하다.



근골격계 질환에서 초음파의 역사

1972: First publication on MSUS for ruptured Baker cyst
1978: US results more sensitive than clinical examination in RA
1988: US is found useful in monitoring synovial tissue changes in RA
1993: US is found able to detect bone erosion in RA
2000: US is found more sensitive than CR in detecting bone erosion Semiquantitative scoring system for bone erosion in RA
2000: (First) introduction of MSUS in Korean Rheumatology Clinic
2001: EULAR working group developed guideline for MSUS in rheumatology
2003: Semi-quantitative grading system for effusion, synovial thickening, bone erosion, PDS in RA small joints
2005: OMERACT consensus on US definitions of the main pathological findings in RA
2006: Describing the main steps of MSUS training in rheumatology



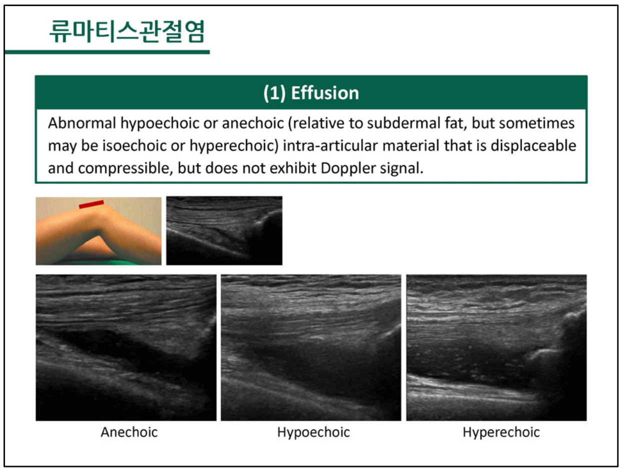
류마티스관절염

류마티스관절염의 병인과 관련된 초음파 소견

Preclinical RA
- Bone marrow change
- Periarticular osteopenia
- RF or anti-CCP Ab (+)

Early RA
- Synovitis
- Pannus
- Increased vascularity
- Small erosions
- Joint space narrowing

Established RA
- Bone erosions
- Joint space narrowing
- Subluxation
- Joint ankylosis

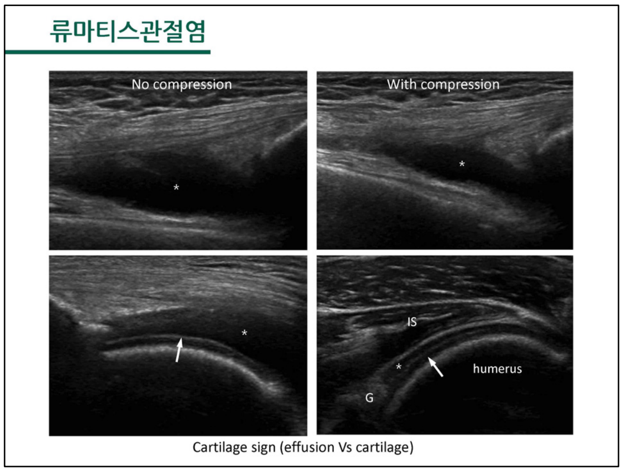


류마티스관절염

(1) Effusion

Abnormal hypoechoic or anechoic (relative to subdermal fat, but sometimes may be isoechoic or hyperechoic) intra-articular material that is displaceable and compressible, but does not exhibit Doppler signal.

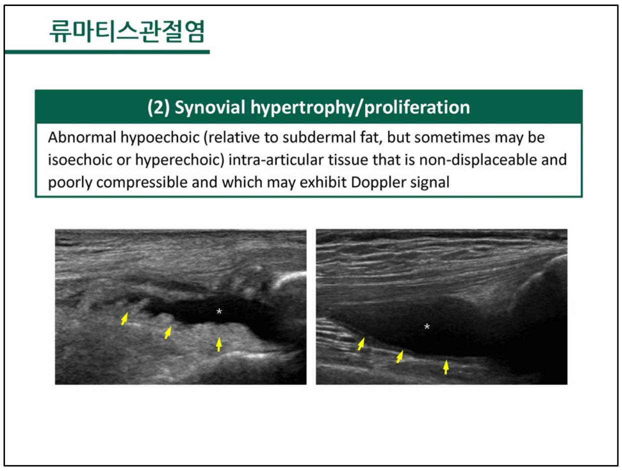
Anechoic Hypoechoic Hyperechoic



류마티스관절염

No compression With compression

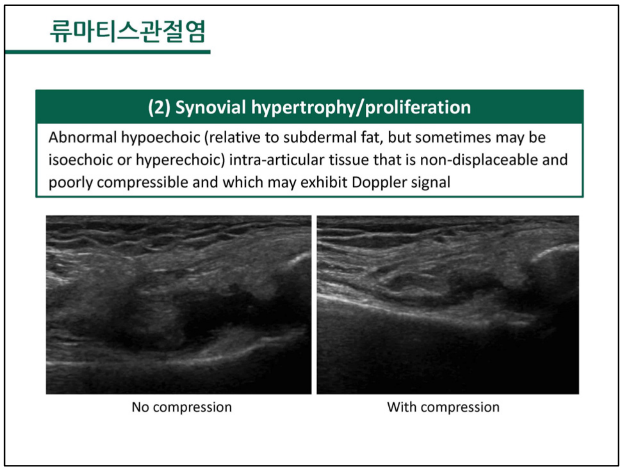
Cartilage sign (effusion Vs cartilage)



류마티스관절염

(2) Synovial hypertrophy/proliferation

Abnormal hypoechoic (relative to subdermal fat, but sometimes may be isoechoic or hyperechoic) intra-articular tissue that is non-displaceable and poorly compressible and which may exhibit Doppler signal



류마티스관절염

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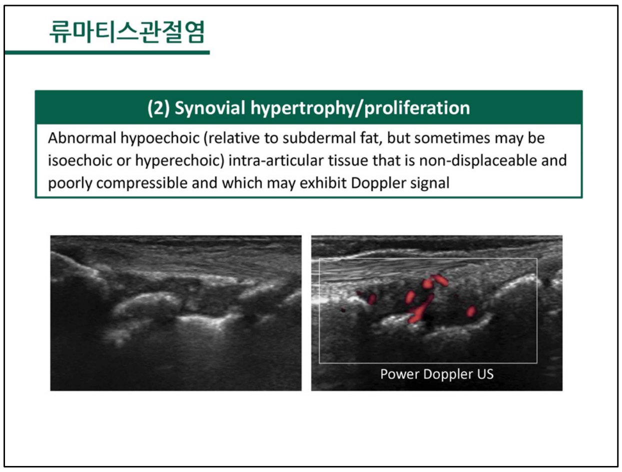
No compression With compression



류마티스관절염

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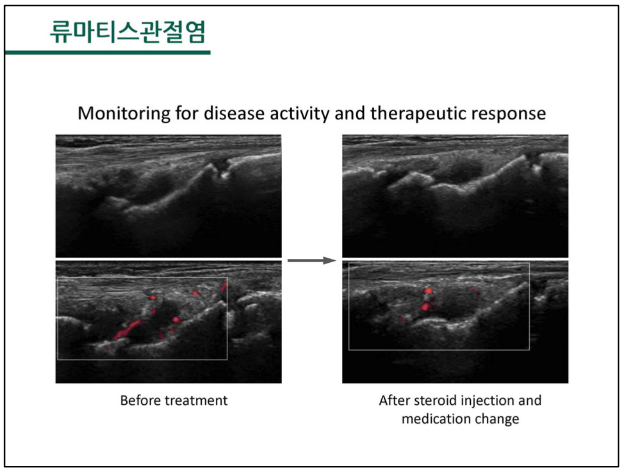
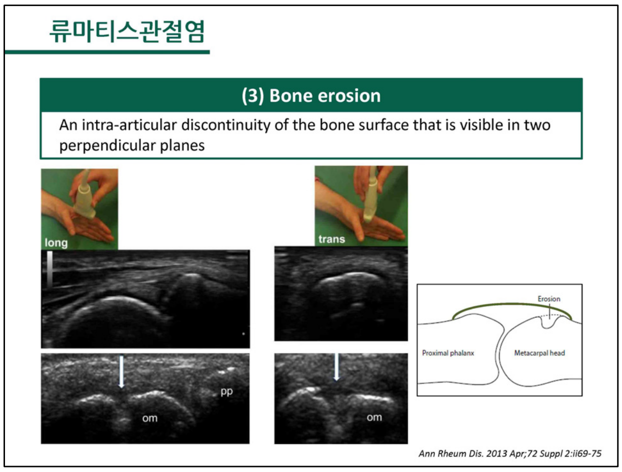


류마티스관절염

Monitoring for disease activity and therapeutic response

Before treatment

After steroid injection and medication change



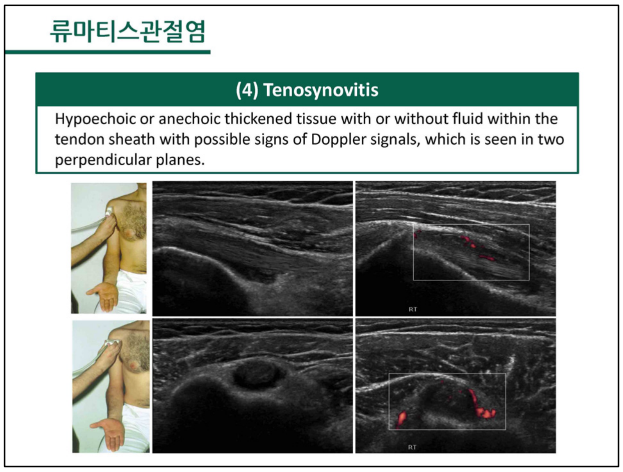
류마티스관절염

(3) Bone erosion

An intra-articular discontinuity of the bone surface that is visible in two perpendicular planes

long
trans
pp
om
om
Erosion
Proximal phalanx
Metacarpal head

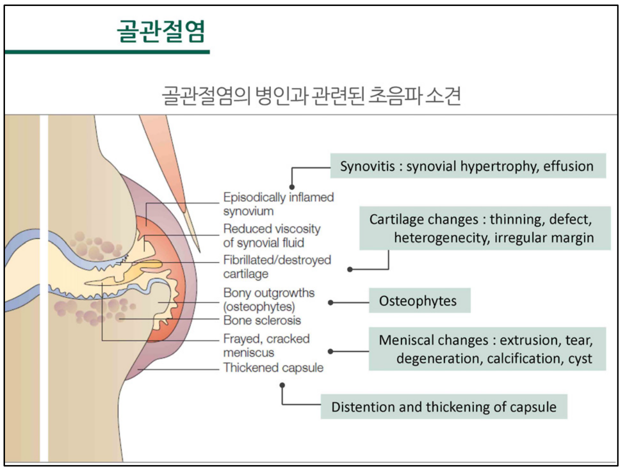
Ann Rheum Dis. 2013 Apr;72 Suppl 2:ii69-75



류마티스관절염

(4) Tenosynovitis

Hypoechoic or anechoic thickened tissue with or without fluid within the tendon sheath with possible signs of Doppler signals, which is seen in two perpendicular planes.



골관절염

골관절염의 병인과 관련된 초음파 소견

Synovitis : synovial hypertrophy, effusion

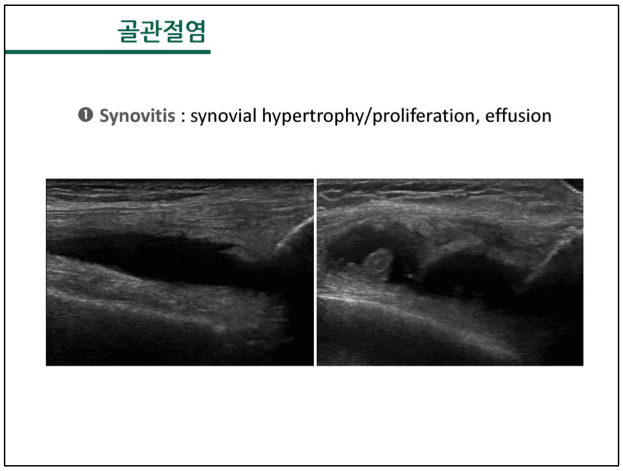
Cartilage changes : thinning, defect, heterogenecity, irregular margin

Osteophytes

Meniscal changes : extrusion, tear, degeneration, calcification, cyst

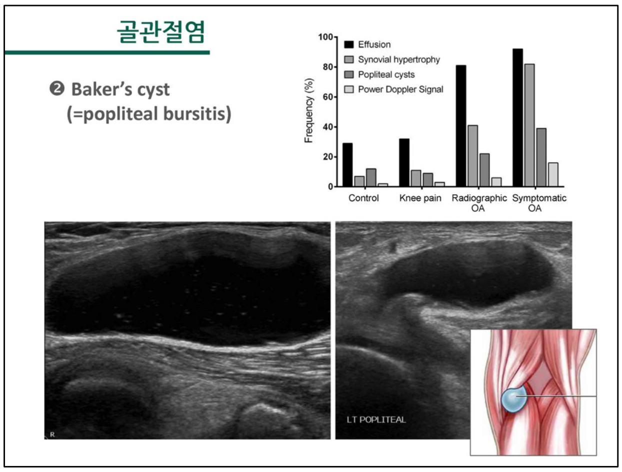
Distention and thickening of capsule

Episodically inflamed synovium
Reduced viscosity of synovial fluid
Fibrillated/destroyed cartilage
Bony outgrowths (osteophytes)
Bone sclerosis
Frayed, cracked meniscus
Thickened capsule



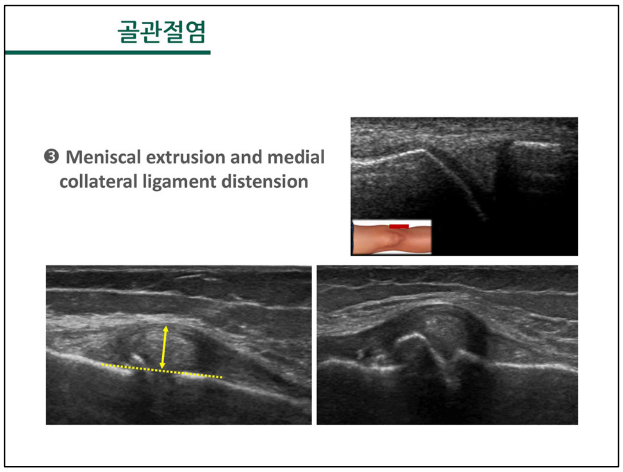
골관절염

❶ **Synovitis** : synovial hypertrophy/proliferation, effusion



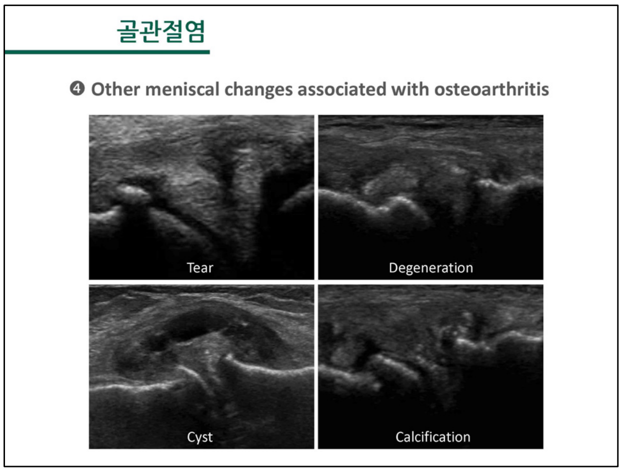
골관절염

❷ **Baker's cyst (=popliteal bursitis)**



골관절염

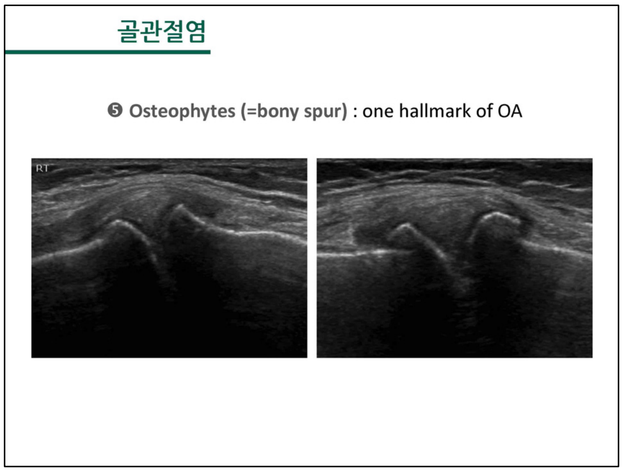
❸ **Meniscal extrusion and medial collateral ligament distension**



골관절염

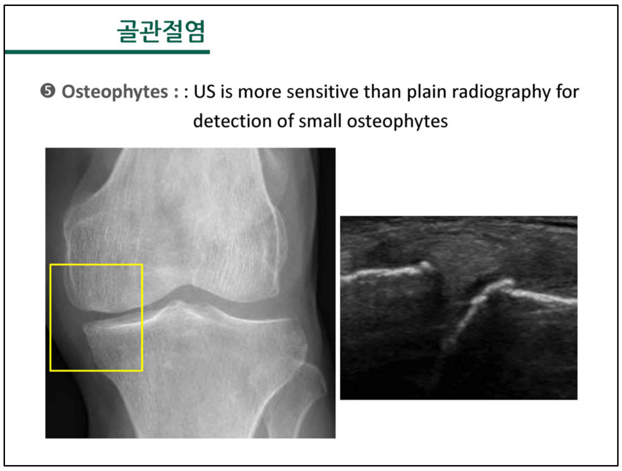
❹ Other meniscal changes associated with osteoarthritis

Tear
Degeneration
Cyst
Calcification



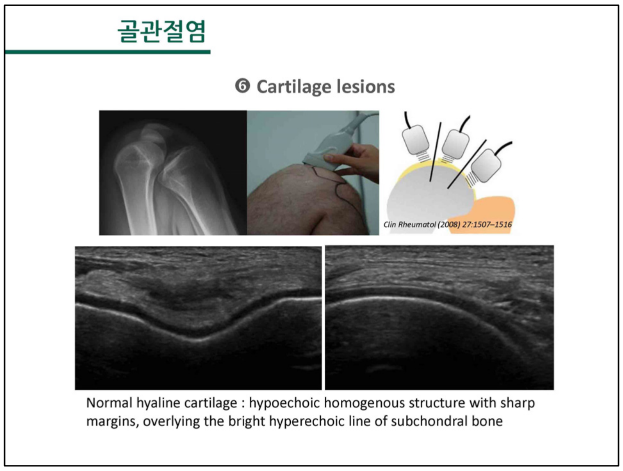
골관절염

❺ Osteophytes (=bony spur) : one hallmark of OA



골관절염

❺ Osteophytes : : US is more sensitive than plain radiography for detection of small osteophytes

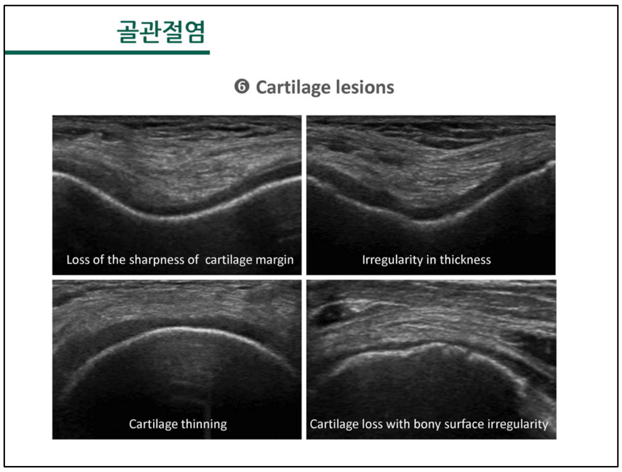


골관절염

❻ Cartilage lesions

Clin Rheumatol (2008) 27:1507–1516

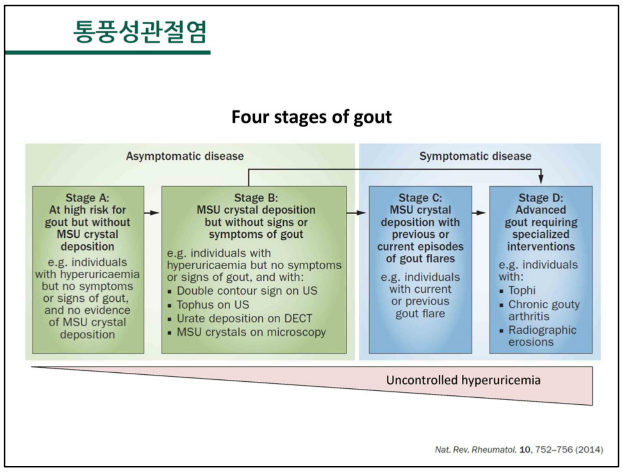
Normal hyaline cartilage : hypoechoic homogenous structure with sharp margins, overlying the bright hyperechoic line of subchondral bone



골관절염

❻ Cartilage lesions

Loss of the sharpness of cartilage margin
Irregularity in thickness
Cartilage thinning
Cartilage loss with bony surface irregularity



통풍성관절염

Four stages of gout

Asymptomatic disease

Symptomatic disease

Stage A: At high risk for gout but without MSU crystal deposition
e.g. individuals with hyperuricaemia but no symptoms or signs of gout, and no evidence of MSU crystal deposition

Stage B: MSU crystal deposition but without signs or symptoms of gout
e.g. individuals with hyperuricaemia but no symptoms or signs of gout, and with:
- Double contour sign on US
- Tophus on US
- Urate deposition on DECT
- MSU crystals on microscopy

Stage C: MSU crystal deposition with previous or current episodes of gout flares
e.g. individuals with current or previous gout flare

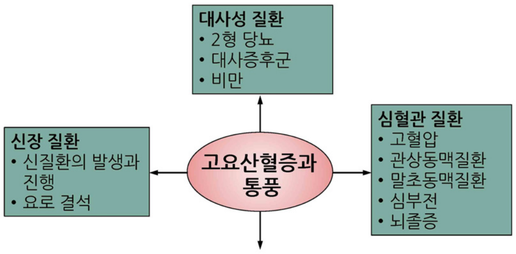
Stage D: Advanced gout requiring specialized interventions
e.g. individuals with:
- Tophi
- Chronic gouty arthritis
- Radiographic erosions

Uncontrolled hyperuricemia

Nat. Rev. Rheumatol. **10**, 752–756 (2014)

통풍성관절염

통풍과 동반 질환



대사성 질환
- 2형 당뇨
- 대사증후군
- 비만

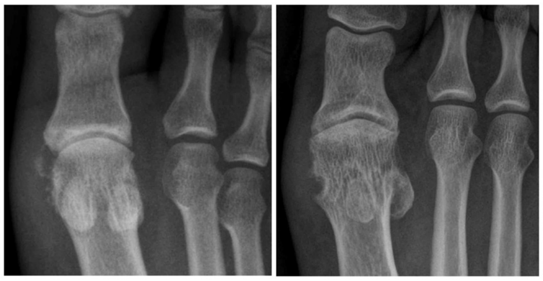
신장 질환
- 신질환의 발생과 진행
- 요로 결석

고요산혈증과 통풍

심혈관 질환
- 고혈압
- 관상동맥질환
- 말초동맥질환
- 심부전
- 뇌졸증

동반 질환에 의한 사망률 증가의 독립적 위험인자로 작용

통풍성관절염



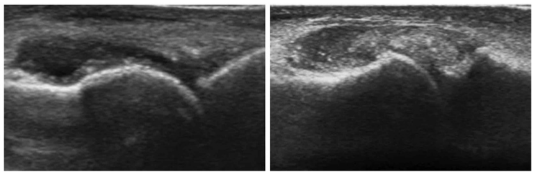
- Soft tissue swelling
- Tophaceous deposition

- Overhanging bone erosion
- Bone overgrowth

통풍성관절염

(1) Effusion, synovial hypertrophy, bone erosion

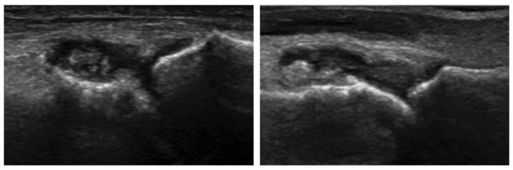
- Non-specific findings for gouty arthritis
- Hyperechoic spots (<1mm) floating in joint effusion, making “snow-storm appearance”, and they can be seen in proliferated synovium.
- Hyperechoic cloudy area or cottony images (<1cm)



통풍성관절염

(2) Aggregates

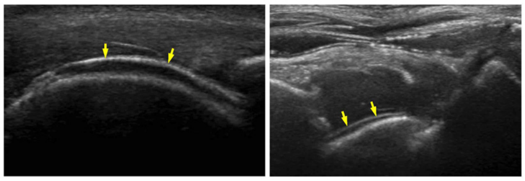
Heterogeneous hyperechoic foci that maintain their high degree of reflectivity even when the gain setting is minimized or the insonation angle is changed and which occasionally may generate posterior acoustic shadow



통풍성관절염

(3) Double contour (DC) sign

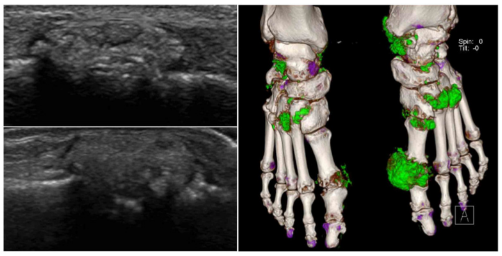
Abnormal hyperechoic band over the superficial margin of the articular hyaline cartilage, independent of the angle of insonation and which may be either irregular or regular, continuous or intermittent and can be distinguished from the cartilage interface sign

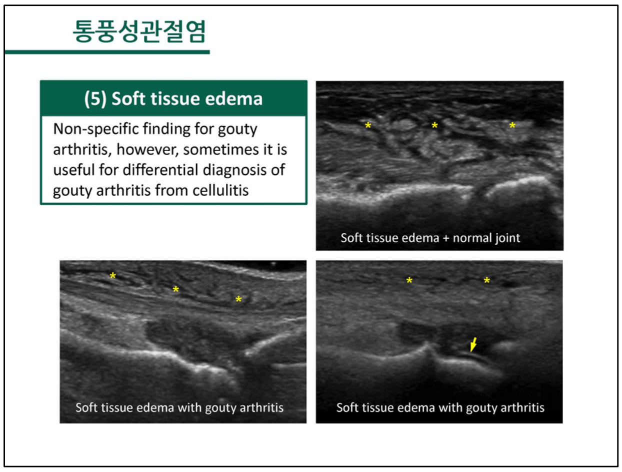


통풍성관절염

(4) Tophus

A circumscribed, inhomogeneous, hyperechoic and/or hypoechoic aggregation (which may or may not generate posterior acoustic shadow) which may be surrounded by a small anechoic rim



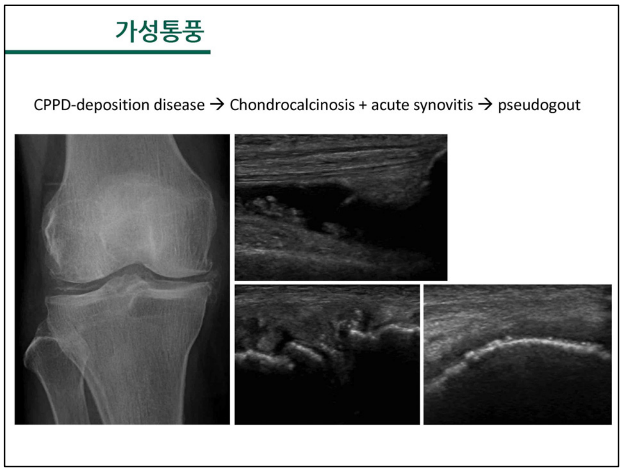


통풍성관절염

(5) Soft tissue edema

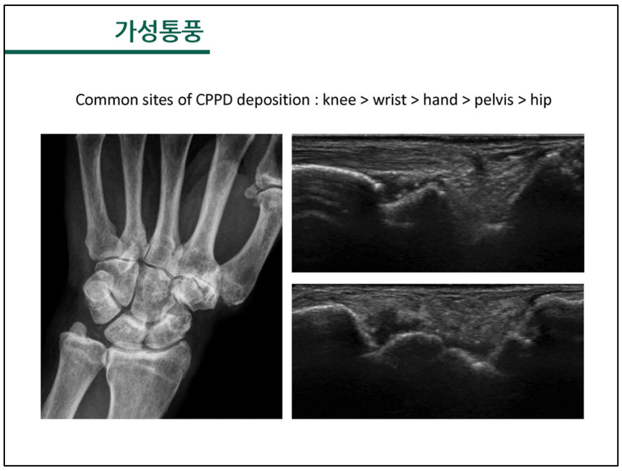
Non-specific finding for gouty arthritis, however, sometimes it is useful for differential diagnosis of gouty arthritis from cellulitis

Soft tissue edema + normal joint
Soft tissue edema with gouty arthritis
Soft tissue edema with gouty arthritis



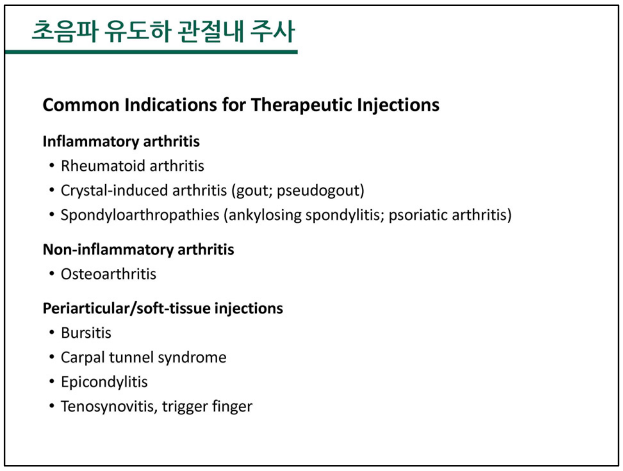
가성통풍

CPPD-deposition disease → Chondrocalcinosis + acute synovitis → pseudogout



가성통풍

Common sites of CPPD deposition : knee > wrist > hand > pelvis > hip



초음파 유도하 관절내 주사

Common Indications for Therapeutic Injections

Inflammatory arthritis

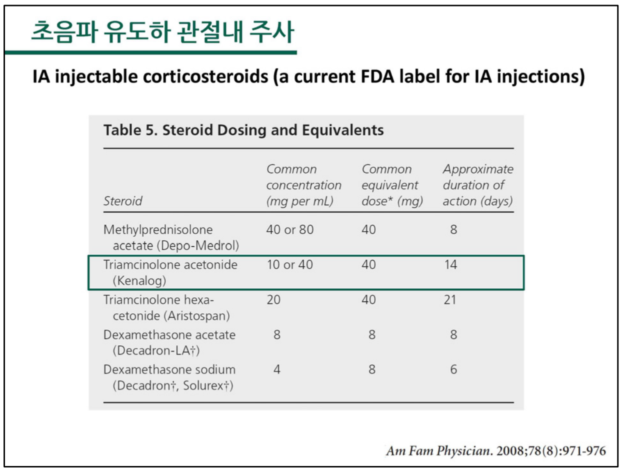
- Rheumatoid arthritis
- Crystal-induced arthritis (gout; pseudogout)
- Spondyloarthropathies (ankylosing spondylitis; psoriatic arthritis)

Non-inflammatory arthritis

- Osteoarthritis

Periarticular/soft-tissue injections

- Bursitis
- Carpal tunnel syndrome
- Epicondylitis
- Tenosynovitis, trigger finger



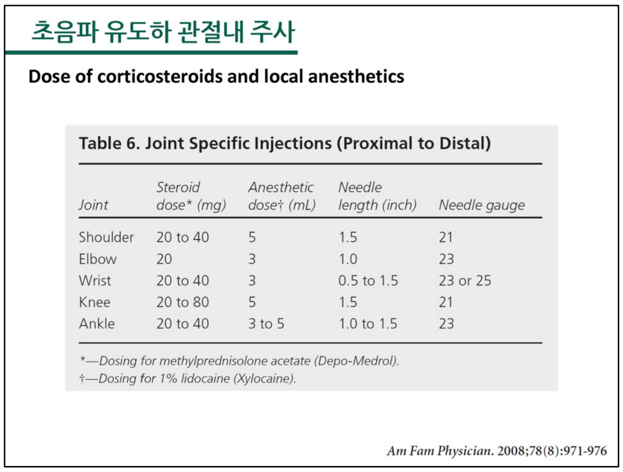
초음파 유도하 관절내 주사

IA injectable corticosteroids (a current FDA label for IA injections)

Table 5. Steroid Dosing and Equivalents

Steroid	*Common concentration (mg per mL)*	*Common equivalent dose* (mg)*	*Approximate duration of action (days)*
Methylprednisolone acetate (Depo-Medrol)	40 or 80	40	8
Triamcinolone acetonide (Kenalog)	10 or 40	40	14
Triamcinolone hexa-cetonide (Aristospan)	20	40	21
Dexamethasone acetate (Decadron-LA†)	8	8	8
Dexamethasone sodium (Decadron†, Solurex†)	4	8	6

Am Fam Physician. 2008;78(8):971-976



초음파 유도하 관절내 주사

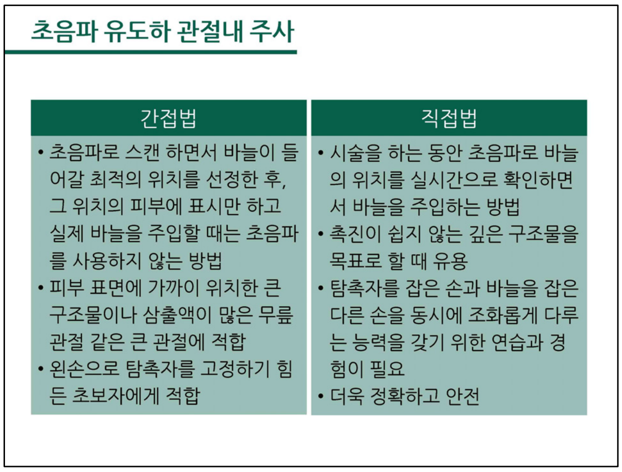
Dose of corticosteroids and local anesthetics

Table 6. Joint Specific Injections (Proximal to Distal)

Joint	*Steroid dose* (mg)*	*Anesthetic dose† (mL)*	*Needle length (inch)*	*Needle gauge*
Shoulder	20 to 40	5	1.5	21
Elbow	20	3	1.0	23
Wrist	20 to 40	3	0.5 to 1.5	23 or 25
Knee	20 to 80	5	1.5	21
Ankle	20 to 40	3 to 5	1.0 to 1.5	23

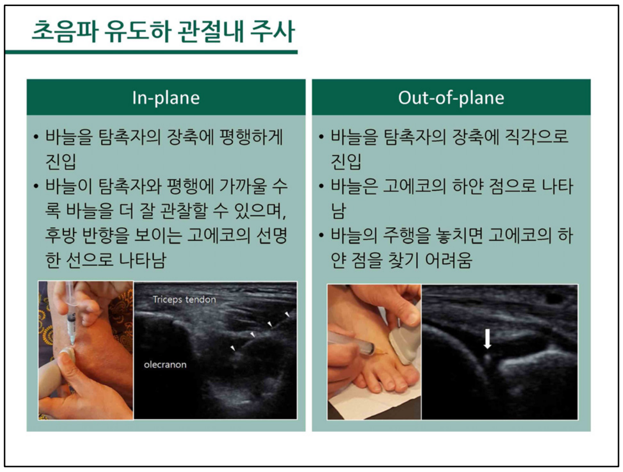
**—Dosing for methylprednisolone acetate (Depo-Medrol).*
†—Dosing for 1% lidocaine (Xylocaine).

Am Fam Physician. 2008;78(8):971-976



초음파 유도하 관절내 주사

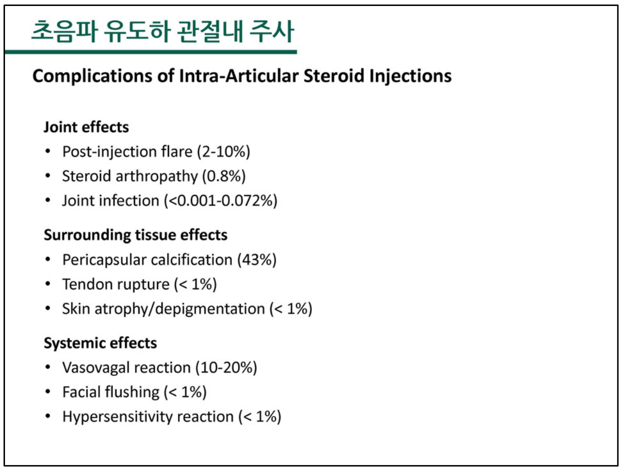
간접법	직접법
• 초음파로 스캔 하면서 바늘이 들어갈 최적의 위치를 선정한 후, 그 위치의 피부에 표시만 하고 실제 바늘을 주입할 때는 초음파를 사용하지 않는 방법 • 피부 표면에 가까이 위치한 큰 구조물이나 삼출액이 많은 무릎관절 같은 큰 관절에 적합 • 왼손으로 탐촉자를 고정하기 힘든 초보자에게 적합	• 시술을 하는 동안 초음파로 바늘의 위치를 실시간으로 확인하면서 바늘을 주입하는 방법 • 촉진이 쉽지 않는 깊은 구조물을 목표로 할 때 유용 • 탐촉자를 잡은 손과 바늘을 잡은 다른 손을 동시에 조화롭게 다루는 능력을 갖기 위한 연습과 경험이 필요 • 더욱 정확하고 안전



초음파 유도하 관절내 주사

In-plane	Out-of-plane
• 바늘을 탐촉자의 장축에 평행하게 진입 • 바늘이 탐촉자와 평행에 가까울 수록 바늘을 더 잘 관찰할 수 있으며, 후방 반향을 보이는 고에코의 선명한 선으로 나타남	• 바늘을 탐촉자의 장축에 직각으로 진입 • 바늘은 고에코의 하얀 점으로 나타남 • 바늘의 주행을 놓치면 고에코의 하얀 점을 찾기 어려움

Triceps tendon
olecranon



초음파 유도하 관절내 주사

Complications of Intra-Articular Steroid Injections

Joint effects

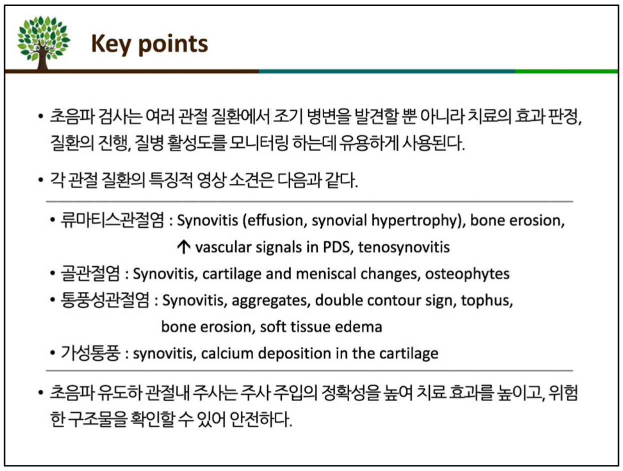
- Post-injection flare (2-10%)
- Steroid arthropathy (0.8%)
- Joint infection (<0.001-0.072%)

Surrounding tissue effects

- Pericapsular calcification (43%)
- Tendon rupture (< 1%)
- Skin atrophy/depigmentation (< 1%)

Systemic effects

- Vasovagal reaction (10-20%)
- Facial flushing (< 1%)
- Hypersensitivity reaction (< 1%)



Key points

- 초음파 검사는 여러 관절 질환에서 조기 병변을 발견할 뿐 아니라 치료의 효과 판정, 질환의 진행, 질병 활성도를 모니터링 하는데 유용하게 사용된다.
- 각 관절 질환의 특징적 영상 소견은 다음과 같다.
  - 류마티스관절염 : Synovitis (effusion, synovial hypertrophy), bone erosion, ↑ vascular signals in PDS, tenosynovitis
  - 골관절염 : Synovitis, cartilage and meniscal changes, osteophytes
  - 통풍성관절염 : Synovitis, aggregates, double contour sign, tophus, bone erosion, soft tissue edema
  - 가성통풍 : synovitis, calcium deposition in the cartilage
- 초음파 유도하 관절내 주사는 주사 주입의 정확성을 높여 치료 효과를 높이고, 위험한 구조물을 확인할 수 있어 안전하다.

감사합니다