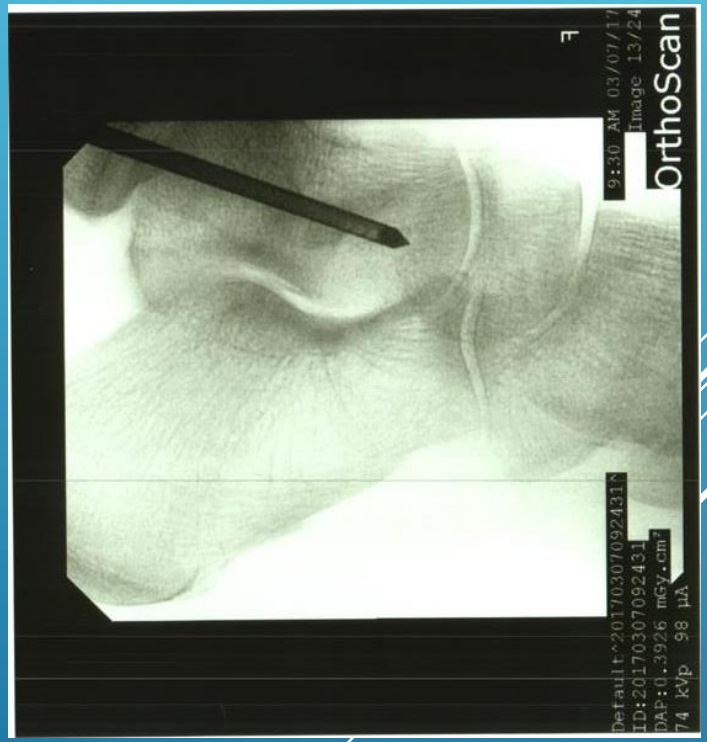
# SUBCHONDROPLASTY REPAIR OF BONE MARROW LESIONS AND CURRENT LITERATURE





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# SPECIAL THANKS TO FRED KING & JORY BARONE

- Medstar Washington Hospital Center Medical Library & Staff

Database(s):

- Epub Ahead of Print In-Process & Other Non-Indexed Citations
- Ovid MEDLINE(R) Daily and Ovid MEDLINE(R) 1946 to Present
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# SEARCH DATE(S): JANRUARY 7-FEBRURARY 1ST 2017

# SEARCH STRATEGIES

- (subchondral or subchondroplasty).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword, floating subheading] (7344)
  2 bone marrow lesion$.mp. (1026)
  3 1 and 2 (233)
  4 limit 3 to (conference abstract or conference paper or conference proceeding) (124)
  5 limit 3 to yr="2010 -Current" (200)
  6 limit 5 to english language (199)
  7 limit 6 to (conference abstract or conference paper or conference proceeding or "conference review") (114)
- # Searches Results 1 subchondroplasty.mp. 21 2 limit 1 to yr="2010 -Current" 21 3 remove duplicates from 2 10 4 (bone? adj2 marrow).mp. 602131 5 lesion?.mp. 1631982 6 4 and 5 30452 7 (bone? adj2 marrow adj4 lesion?).mp. 3465 8 (bone? adj1 marrow adj3 lesion?).mp. 2991 9 (bone? adj1 marrow adj3 lesion? adj3 repair$).mp. 4 10 remove duplicates from 9 3

# SUBCHONDROPLASTY (SCP)

- SCP procedure is a repair (ORIF) of a MRI identified subchondral fractures (Bone Marrow Lesion) associated with osteoarthritis
- Calcium phosphate bone substitutes (CPBS) are commonly used to augment and repair bone voids and defects after fracture
- "Subchondroplasty" is a marketing tradename, and is not recognized as standard diagnosis or generic procedure terminology

# WHY TREAT BONE MARROW LESIONS?

Your patient presents for ankle pain….

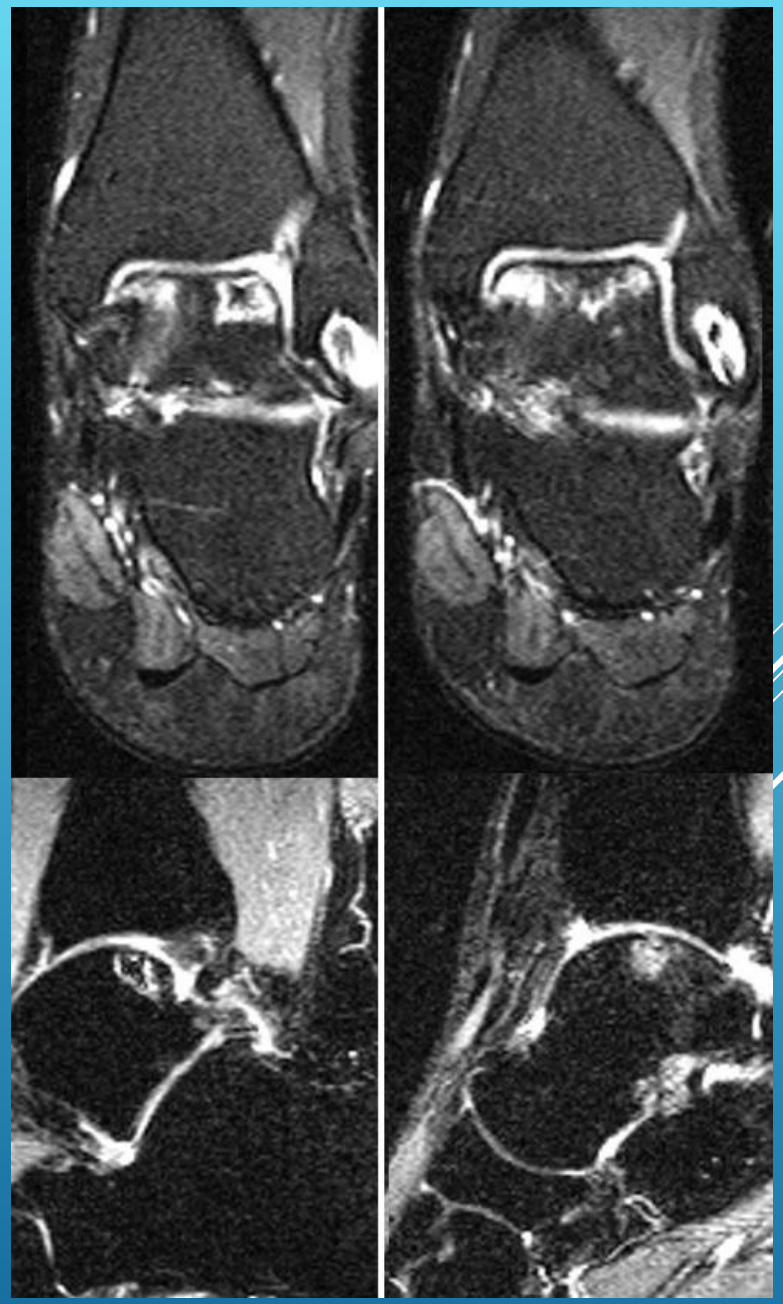
- Articular Cartilage has no associated pain fibers
- Ligaments have proprioceptive fibers
- Synovium has some associated pain fibers
- **BONE HAS PAIN FIBERS**

# SUBCHONDROPLASTY: REPAIR OF BONE MARROW LESIONS

- Bone Marrow Lesions essentially act as chronic insufficiency stress fractures
  - Repair of a fracture requires Open Reduction Internal Fixation
    - 'SCP' Procedure
    - Decompressional Osteotomy w/ backfill

# SCP PROCEDURE

- MRI T2 fat suppressed image to plan
- Flouroscopy in OR to correlate w/ MRI
  - (I put up the MRI on big screen TV's in the OR)
- Drill to the lesion
  - Various companies make simple one pass kits/drills
- Fill the defect w/ a very porous calcium phosphate
  - (I mix Calc Phos w/ patients Bone Marrow Aspirate)



# BONE MARROW LESIONS

## Histopathologically:

- fibrosis, necrosis, trabecular abnormalities, vascular ingrowth

Histology of bone marrow lesions in osteoarthritis: A systematic literature review.
Van Beest S., Kroon F.P.B., Damman W., Schoones J.W., Ioan-Facsinay A., Kloppenburg M.
Arthritis and Rheumatology. Conference: American College of Rheumatology/Association of Rheumatology Health Professionals Annual Scientific Meeting, ACR/ARHP 2016. United States. Conference Start: 20161111. Conference End: 20161116. 68 (pp 3069-3070), 2016. Date of Publication: October 2016.
AN: 613887345

# BONE MARROW LESIONS

- Vascular breaching of the osteochondral junction is associated with subchondral marrow replacement by fibrovascular tissues.
  - Characteristic of some BML's observed by MRI.

- Angiogenesis (edema) is thought to be a marker for other pathological processes associated with pain.

Links between angiogenesis, inflammation and pain in OA. Walsh D.A. Annals of the Rheumatic Diseases. Conference: Annual European Congress of Rheumatology of the European League Against Rheumatism, EULAR 2016. United Kingdom. Conference Start: 20160608. Conference pp.18, 2016. Date of Publication: June 2016.

# SCP LITERATURE = KNEE LITERATURE

- Only a handful of papers available…

# FLATTENING OF ARTICULAR SURFACE AND BML'S

- The MOST study – 1025 knees
- Flattening or depression of the osseous articular surface is defined as 'subchondral bone attrition'
  - Cause unknown, but reflected on MRI as Bone Marrow Lesions
- One explanation for the presence and development of SBA is subchondral remodeling due to increased stress, which is reflected as BMLs on MRI.

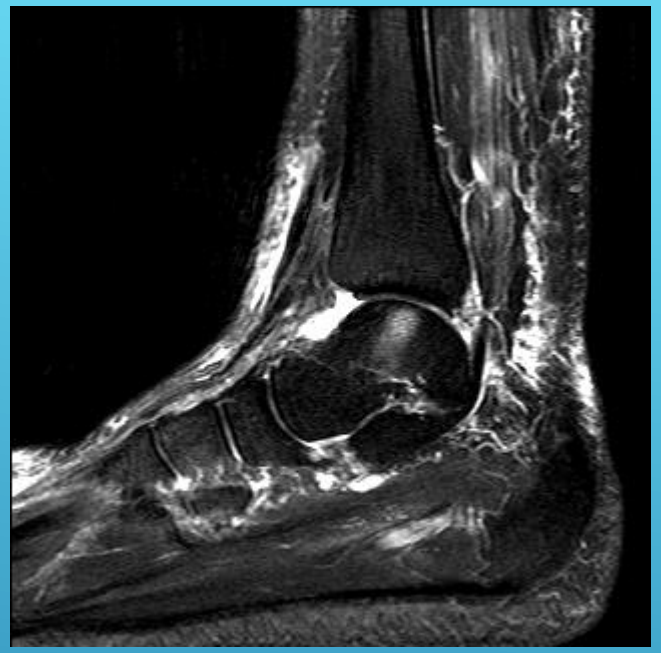
**Subchondral bone marrow lesions are highly associated with, and predict subchondral bone attrition longitudinally: the MOST study**
**Frank W. Roemer, M.D., Tuhing Neoai, M.D., Ph.D., Michael C. Nevitt, Ph.D., David Felson, M.D., M.P.H., Yanyan Zhu, Ph.D., Yuging Zhang, M.Sc., John A. Lynch, Ph.D., M. Kassim Javaid, M.D., Michael D. Cremg, M.D., James Torner, Ph.D., Cora E. Lewis, M.D., and Ali Guermazi, M.D.**

# THINGS TO KNOW:

- Ultimately Subchondral remodeling fails in joints
  - Due to increased focalization of stress.

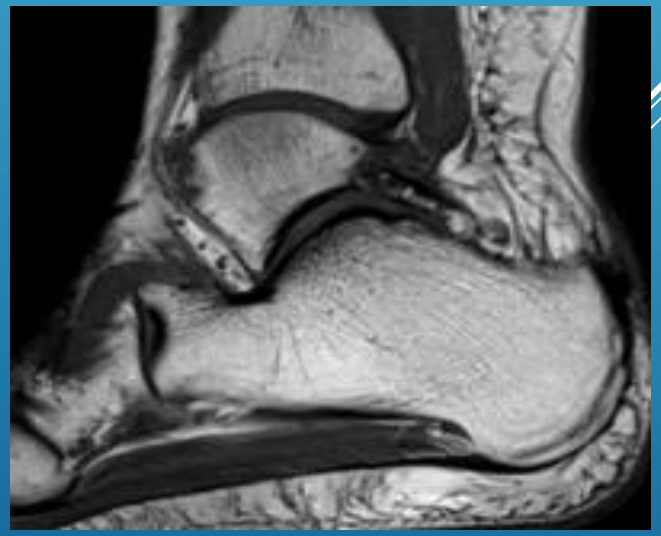
- Subchondral bone has reduced healing capacity
  - Increased vascularization
  - Increased inflammation
  - Subchondral bone attrition (flattening/compression)
    - FURTHER CARTILAGE LOSS

# BONE MARROW LESIONS MRI



T2/STRI:

Hyperintensity on fat-suppressed, T2 weighted, and STIR sequences



T1:

Intermediate or low intensity on T1 weighted sequences in comparison with normal subchondral bone

# SHORT TERM OUTCOME OF SCP IN KNEE:

- SCP is an effective treatment modality in the management of patients with knee OA and BME lesions.
- The goal of the procedure is to provide enduring pain relief caused by BME
  - 50 patients demonstrated an average 4.7 point improvement in pain on a 10 point visual analog scale
    - (pre-SCP 8.3, post-SCP 3.6)
    - (average f/u 14.6 months, average age 55)
  - 4/50 pts went on to TKA
  - Need for long term f/u

**Short-Term Outcomes of the Subchondroplasty Procedure for the Treatment of Bone Marrow Edema Lesions in Patients with Knee Osteoarthritis**
Orthop J Sports Med. 2015 Jul; 3(7 suppl2): 2325967115S00125. Published online 2015 Jul 17. doi: Adrian Thomas Davis, MD,[1] Jennifer Marie Byrd, MD,[1] Justin Angelo Zenner, DO,[1] Darren A. Frank, MD,[2] Patrick J. DeMeo, MD,[3] and Sam Akhavan, MD[4]

# KNEE: 2 YEAR F/U POST

- Inclusion: Moderate to severe joint disease confined to the same compartment as the BML for greater than 2 months and pain min 4/10.
- Mean improvement 4.2-4.5 on VAS scale
  - 27.2 months average
- 2 year survivorship 42/60 (70%)
  - 18 went on to TKA
    - Mean age 58 yo for TKA
    - Mean age 55 yo for survivorship
- Rejected null hypothesis that function not improved after SCP
  - Meaning patients experienced durable functional/symptomatic improvement for 2 years

Subchondroplasty for Treating Bone Marrow Lesions Steven Brad Cohen, MD1 Peter F. Sharkey, MD1 1Department of Orthopedic Surgery, Rothman Institute, Thomas Jefferson University, Philadelphia, Pennsylvania J Knee Surg 2016;29:555–563.

# KNEE ARTHROPLASTY AFTER SCP

Does application of CBPS for repair of MRI identified subchondral fratures associated w/ arthritis adversely affect performance of subsequent TKA?

-Good question for those who perform TAR's

22 pt's w/ periarituclar fx combine w/ use of SCP later had TKA.

-F/U 23.5 months.

No difference in surgical complexity or complication from prior SCP.

J Arthroplasty. 2016 Oct;31(10):2188-92. doi: 10.1016/j.arth.2015.12.051. Epub 2016 May 10.
**Knee Arthroplasty After Subchondroplasty: Early Results, Complications, and Technical Challenges.**
Yoo JY[1], O'Malley MJ[1], Matsen Ko LJ[1], Cohen SB[1], Sharkey PF[1].

# SCP INEFFECTIVE FOR BML'S IN ADULTS W/ ADVANCED OSTEOARTHRITIS

- Does percutaneous calcium phosphate injection improve validated patient-reported outcome measures?
- 33 patients with Grade III or IV cartilage loss in knee with BML on MRI
- 22 patients had poor clinical outcomes as assessed by the Tegner Lysholm Knee Scoring.
  - 3 had fair results
  - 5 had good results
  - 7 had excellent results
- No relation between age, sex, or bmi

Subchondral Calcium Phosphate is Ineffective for Bone Marrow Edema Lesions in Adults With Advanced Osteoarthritis
Dipal Chatterjee, MD, Alan McGee, MD, Eric Strauss, MD, Thomas Youm, MD, and Laith Jazrawi, MD. Clin Orthop Relat Res. 2015 Jul; 473(7): 2334–2342

# SCP INEFFECTIVE?: LETTER TO THE EDITOR

- Small Sample Size: 20 of 22 failures did show improvement
- KOOS scores improperly represented
- Tegner-Lysholm Score is used to grade ACL recon success, not BML's
- Grade IV patients: Weak R2 value (poorly represented)

Conflict of Interest?:

-Author of letter to editor or family member received payment from med device co. (<10k)

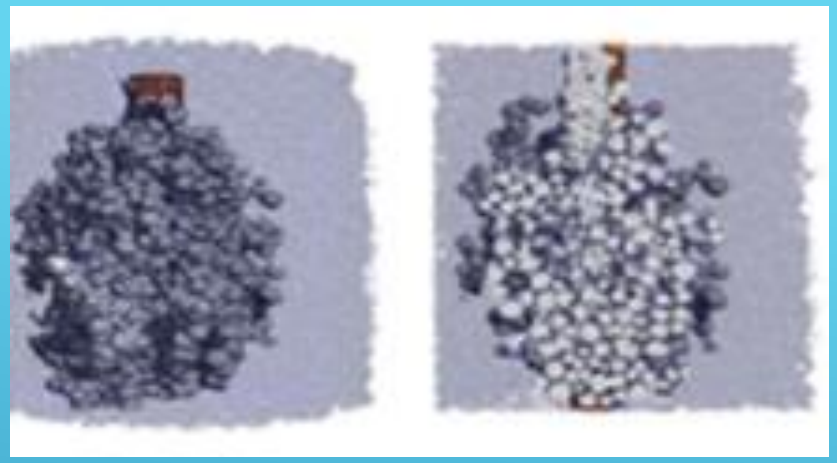
# WHICH CALCIUM PHOSPHATE PRODUCT IS THE 'BEST'?

- We want something w/ similar strength and size/porosity as cancellous bone.

- To keep branding out of this, I will let you look this up.
  - Happy to answer your questions aside

Colon D A, Yoon B J V, Russell TA, Cammisa F P, Abjornson C: Assessment of the injection behavior of commercially available bone BSMs for subchondroplasty procedure, The Knee 22:597–603, 2015

# CALCIUM PHOSPHATE VS BONE



- Porosity 75-85% cancellous vs 5-10% cortical
  - Want a high porosity material to extravate into cancellous bone
- Cancellous Bone compressive strength 2-6 MPa
  - Want to inject a slightly stronger material
    - but not too strong (cortical bone 110-150 Mpa)
- Poor size 300-600 µm
  - Want to inject slightly smaller poor size to extravate extensively
    - (in thought anyways)

Potential Bone Replacement Materials Prepared by Two Methods Steve Lee1 , Michael Porter1 , Scott Wasko2 , Grace Lau3 , Po-Yu Chen4 , Ekaterina E. Novitskaya1 , Antoni P. Tomsia3 , Adah Almutairi2 , Marc A. Meyers1,5 and Joanna McKittrick1,5 1 University of California, San Diego, Materials Science and Engineering Program, 9500 Gilman Dr., La Jolla, CA 92093 USA 2 University of California, San Diego, Skaggs School of Pharmacy, 9500 Gilman Dr., La Jolla, CA 92093 USA 3 Lawrence Berkeley National Laboratory, 1 Cyclotron Rd., Berkeley, CA 94720 USA 4 National Tsing Hua University, Department of Materials Science and Engineering, Hsinchu 30013, Taiwan, R.O.C. 5University of California, San Diego, Dept. of Mechanical and Aerospace Engineering, 9500 Gilman Dr., La Jolla, CA 92093 USA

# THANK YOU

- There are small case reports in the foot & ankle, but no substantive literature.
- We could use foot/ankle literature out of the larger institutions…
  - I’ve had good results, but who am I???