PLATELET RICH PLASMA (PRP) INJECTION

The "modern" version of dextrose prolotherapy: Injections of autologous centrifuged blood with platelets concentrated is used as the injectate.

What is PRP?

- Type of injection therapy used for various chronic sports injuries to promote healing.
- PRP = abbreviation for Platelet-Rich Plasma.
- Over 6,000 PRP journal articles have been published between 2013–15 (between 2012–13 was about 400).

History of PRP

- First human application was described in mandibular reconstruction in oromaxillary surgery in 1998 (Robert Marx, Prof. of Surgery and Chief of Oromaxillary Surgery Division at Univ. of Miami).
- Since then, PRP has experienced a surge in clinical uses and research.
- Endorsement from athletes:
  - Tiger Woods
  - Alex Rodriguez (NY Yankees)
  - Masahiro Tanaka (NY Yankees)
  - Kobe Bryant (LA Lakers)
  - Troy Polamalu (Pitts Steelers)
  - Hines Ward (Pitts Steelers, 2009)
How Is PRP Prepared?
Various systems but basics are:

![PRP Preparation Diagram]

Think of:
- PRP as “Fertilizer”
- Stem Cells as “Seeds”

Cell Sources

**ADIPOSE TISSUE**
(Zuk et al. 2001)

and

**BONE MARROW**
(Caplan et al. 1999)

Mesenchymal Stem Cells

- First identified in **bone marrow** by Caplan in 1991 and, subsequently, in **adipose tissues** by Zuk et al at UCLA in 2001, Mesenchymal Adult Stem Cells can differentiate into:
  - Ligament
  - Tendon
  - Cartilage
  - Muscle
  - Bone
  - Adipose tissue

How Does MSCs Help Arthritis?

- Not entirely understood.
- 1) Regeneration of cartilage has been demonstrated in vitro and in animal models.

[Cartilage Regeneration Diagram]

How Does MSCs Help Arthritis?

- 2) Paracrine mechanism (cell-to-cell talk) via cytokines and growth factors.

[Paracrine Mechanism Diagram]
Many Ways to Prepare MSCs...

So what we do instead:

Obtaining BMAC:

Why Musculoskeletal Ultrasound?

Applications of MSK U/S?

- Dynamic Real time patient interaction
- Soft tissue
- Better spatial resolution
- No radiation
- No contraindications
- Low cost

- Therapeutic Interventions
  - aspiration cyst / bursal / hematoma / soft calcification
  - Difficult joint injections
  - Small joints, hip injections
  - Tendon sheath injections
  - Biceps, paratenon of achilles, deQuervain’s
  - Regenerative tendon injections
  - Prolotherapy
  - PRP injections
  - Stem cell injections
  - Nerve entrapments associated with soft tissue injury
  - hydrodissection
  - Releases / Tenotomy with Tenex FAST procedure
  - Lateral elbow
  - Plantar fascia
  - Trigger digit

Issue with “Expanded” MSCs

- In US, however, FDA does not allow culturing of the stem cells in clinics.
  (FDA does not allow these cells to be “more than minimally manipulated” or be outside of the patient for over 24 hrs.)
- Clinicians have used centrifuge to concentrate MSCs from bone marrow (Bone Marrow Aspirate Concentrate) or adipose tissues (Adipose Derived Stromal Vascular Fraction)

17

18
Therapeutics/Ultrasound guided injections

- Small or large peripheral joints
- Insures precision
- No “fishing around”
- Ability to document procedures

Sibbitt et al. J Rheumatol ’09
“Does sonographic needle guidance affect the clinical outcome of intraarticular injections?”

Results
- 43% reduction of procedural pain
- 58.5% reduction in absolute pain scores \( (p < 0.001) \)
- 75% reduction in significant pain \( (\text{VAS} \ p < 0.001) \)

US also increased detection of effusion by 200%
volume of aspirated fluid by 337%

CMC Osteoarthritis

CMC Osteoarthritis thumb

41 patients with painful shoulder

**Group 1**blind subacromial injection of 20 mg triamcinolone (n = 20)

**Group 2** US guided injection of 20 mg triamcinolone (n = 21)

assessed within 5 days before injection & 6 weeks after injection

Six weeks after injection, the VAS and the SFA score showed a significantly greater improvement in Group 2 compared with Group 1 (mean VAS score change 34.9 for Group 2 vs 7.1 for Group 1, p < 0.001). 

Joint space is often collapsed and indistinguishable

Arthroscopy: The Journal of Arthroscopic & Related Surgery, El Attrache '05

41 live awake patients injected anteriorly

Only 26.8% (11 of 41) of injections placed anteriorly were actually intra-articular

40 cadaver shoulders injected, 20 anteriorly and 20 posteriorly, to assess the accuracy of injections placed in the glenohumeral joint

1 mL gadolinium injected into the joint to determine accuracy of position

The anterior approach had an 80% accuracy rate and .75 positive predictive value

The posterior approach had a 50% accuracy rate and a .67 positive predictive value.

Anterior injections produced higher rate of accuracy than posterior injections.
Glenohumeral joint injection using lateral to medial approach LAX

Smith et al, ’08
Accuracy of Sonographically Guided Intra-articular Injections in the Native Adult Hip

Twenty-eight consecutive patients

Overall, 97% of US guided needles were accurate.
1 inaccurate placement from inadvertent needle withdrawal during connection of the extension tubing for contrast agent injection

Conclusions: US guidance can be used to inject the native adult hip joint with acceptable accuracy

Twenty-eight consecutive patients

28 patients with hip OA and synovitis detected by US
40 IA steroid injection under US guidance compared to age matched controls
Walking pain VAS reduced vs baseline P<.001 at 1 & 3 months
Synovial hypertrophy reduced in 75% at 1 & 3 months vs baseline
Conclusion: efficacious, safe therapeutic approach for pain control and reducing synovial hypertrophy avoiding use of X-ray guidance

Finnoff et al PM&R ’10
Accuracy of ultrasound-guided versus unguided pes anserinus bursa injections

12 US-guided and 12 unguided pes anserinus bursa injections
92% (11 of 12 specimens) in the US-guided
17% (2 of 12 specimens) in the unguided
US-guided injection technique was significantly more accurate than the unguided technique (Williams-corrected chi(2) = 12.528, P < .01).
Accuracy of ultrasound-guided versus palpation-guided acromioclavicular joint injections: a cadaveric study

All 10 US guided (100%) injected into ACJ
10 US guided and 10 palpation-guided ACJ injections
4 of 10 (40%) palpation-guided injections within the ACJ
(P = .0054)

Conclusions

- U/S is a useful tool in guiding minimally invasive orthobiologic procedures
- New and exciting modality that will assist in better diagnosing and treating sports medicine conditions in the training room, sideline, or in your clinic
- The field is still emerging and expertise takes time and practice
- Formal certification now available for Physicians and ultrasonographers—not just radiologists

References