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Thank you to Vincent Disabella, DO FAOASM, for having me present with him today.
- Discuss where orthobiologics came from and what are the players in the landscape.
- Discuss the contents of PRP and Stem Cells, as well as key differences in each.
- Discuss the distinct difference in the field of Interventional Orthopedics vs. conventional injections/orthopedics.
PROLÖTHERAPY – 1937
FLUOROSCOPY (live Xray) – 1990’s
ULTRASOUND GUIDANCE 2000’s
PLATELET RICH PLASMA (autologous)
STEM CELLS INJECTIONS

Related: surgery augmentation with biologics (fundamentally a different field)
Future Orthobiologic Injectates:

- Bone marrow concentrate (BMAC)
- Platelet rich plasma (PRP)
- Cytokine rich serums (A2M, etc.)
- Fat grafts
- Culture expanded allo and auto MSCs
- Stromal vascular fraction (FDA Crack down)
- Other stem/progenitor cells
- Recombinant growth factors
Homologous
Someone else’s cells

- Can cause immunological response.
  - Need anti-rejection medications
- Can inherit the donor’s bad cells.
- Embryonic Stem cells
  - Can carry bad genes
  - Can form tumors

Autologous
Patient’s own stem cells

- No immunological response
- Can be harvested and used in the same treatment session.
What is PRP?
Introduced in a dental paper in 1998/ Horse racing 2003

Human publication in 2006 (elbow)

Media attention 2009 (Hines Ward Pittsburgh Steelers)
• Derived by the isolation of **Platelets from autologous blood.**
  - Blood is drawn and spun down to isolate concentrated growth factors and cytokines that have been shown to initiate and promote healing
  - The PRP is injected into the injury site.
  - PRP starts a cascade of biological processes
    - Release numerous growth factors, including PDGF, TGF-β, VEGF, SDF-1α, TNF, TNFαR, IL-1, IL-1R, TIMP, PDGF, IGF, FGF-2.
  - These growth factors have been shown to orchestrate the key biological processes of angiogenesis, inflammation resolution, cell migration, cell proliferation, angiogenesis, matrix synthesis, and tissue regeneration.
**Prolotherapy predates steroid injections.**

This was the injection of high concentrations of dextrose to cause irritation and stimulate inflammation.

Was first done in 1937 by Gedney and Hackett.

Laid the ground work for PRP and Stem Cell therapy.

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**PRP is used in many fields of medicine besides orthopedics.**

Was first used in dentistry in the late 1990's.

Used in plastics and cosmetics extensively.

Used in veterinary medicine.
What is Stem Cell Therapy?
We will discuss how it is used in orthopedics and sports medicine.
We will be discussing autologous stem cell therapy.

We will discuss it in the context of Orthobiologics.

Two sources of Stem Cells are utilized.
- Bone Marrow or BMAC
- Adipose or AMC

Concentration of Mesenchymal Stem Cells in each.
- Bone Marrow is about 0.005% MSC’s
- Adipose is about 5% MSC’s

The amount of live cells are identical in the same sample of each.
- Capable of differentiating into osteoblasts, chondrocytes and adipocytes
- Can differentiate into bone, tendon/ligament, cartilage and muscle.
- Can be isolated from bone marrow and adipose tissue.
- Stabilize the environment and release other cells that are crucial in the healing process
Done by approximately 95% of US Physicians

- Knee
- Shoulder
- Hip
• Orthobiologic injectates facilitate healing of bone, tendon, ligament, muscle, or cartilage
• Precise placement of those injectates into damaged structures using imaging guidance
• Utilization of guidance ensures that the right area is injected.

• A cadaveric investigation suggests that sonographic guidance can be used to inject the ACJ with a high degree of accuracy, and should be considered superior to palpation guidance.
Studies show that US guided injections are superior to palpation guided injections. One-third of CE-guided injections were inaccurate. US-guided injections performed by a trainee rheumatologist were more accurate than the CE-guided injections performed by more senior rheumatologists (83% versus 66%; \( P < 0.01 \)).
Shoulder Injections

Done by approximately 1% of US Physicians

- Tendons (RTC, Biceps)
- Ligaments (SGHL, IGHL, MGHL)
- Labrum
- Bone (augmentation for AVN)
- Nerves (Suprascapular n.)
Done by approximately 1% of US Physicians

- Tendons of muscles (Quadriceps, Patella, etc.)
- Bone (augmentation for edema/AVN)
- Ligaments (ACL, MCL, LCL, PCL, ALL, Coronary)
- Meniscus (medial and lateral)
Hip Injections

Done by approximately 1% of US Physicians

- Labrum
- Joint
- Tendons (Hamstring, adductor)
- Ligament (ligamentum teres)
- Muscles
- Bone (augmentation for AVN)
Done by approximately 1% of US Physicians

- Joints (Facets and SI)
- Ligaments (ILL, Interspinous, Intertransverse, Ligamentum Flavum)
- Muscles (Multifidi)
- Nerve roots (Transforminal Injection)
- Epidurals (Cervical, Lumbar, Caudal)
- Discs (intervertebral discs)
Elbow
UCL Injuries

Wrist
Carpal Tunnel/Median Nerve Hydrodissection
TFCC Injuries

Hand
Trigger finger injections
FPL Tears
• Ankle
  ATFL Tears
  Posterior Tibial Tendon Tears

• Foot
  Plantar Fasciitis
  Flexor Hallicus Longus tendonitis
• Knee
• Shoulder
• Hip
• Spine
• Ankle
• Foot

(Above): Knee Replacement
(Left): Arthroscopic Shoulder Surgery
- This is in a sense a separate field but will be discussed.
- Using the biologics in conjunction with a surgical procedure.
  - Can be done pre or post operatively.
  - Can be done in conjunction with the surgical procedure.
- Like Orthobiologics this a new and expanding practice in which there is not a great deal of large controlled studies at this time—actually much less research than straight PRP and Stem Cell procedures.
Multiple studies showing that using PRP and Stem Cells during a surgical procedure enhances healing and shortens healing times.

Studies also show that using these biologics in the post-operative period is beneficial.
- Ersen et al showed better biomechanical properties at the tendon-bone interface in rotator cuff repair with PRP in the rat model.
- Other studies have showed no better integrity of the rotator cuff repair but less pain and faster recovery. Much more research is needed.
Many small studies currently going on with augmenting surgery.

- Using PRP and Stem Cells with RC repair.
- Using PRP and Stem Cells with ACL repair.
- Using PRP with Hip Arthroscopy for impingement and labral repair.

MUCH MORE RESEARCH IS NEEDED.
- Using stem cell in a surgical procedure.
  - Cases are documented of putting BMC into joints along with the surgical procedures.
  - Using bone marrow along with bone grafts in spinal surgery is a common practice.
  - Using BMC and PRP during tendon repairs.
  - Using AMC or adipose preparations as soft tissue fillers when closing large incisions to help with healing.
We have started doing a unique procedure in our practice where we are surgically “implanting” the stem cells.
- Using BMC and AMC to help regenerate articular cartilage.
- Harvest BMC and AMC from the patient in the operating room.
- Isolate the stem cell fraction simultaneously with the surgical procedure.
- Implant the stem cells in the articular defect.
Case Presentation

- Patient was a 57 year old former marine who tore his PHMM when jumping off a wall in an obstacle race.
- Had standard arthroscopic meniscectomy and had a small femoral condyle articular defect which was treated with microfracture.
- Patient continued to have pain post operatively.
- Was treated with corticosteroid injections and visco supplementation.
- Continued to have pain and was unable to run.
• Approximately 10 months post original procedure the patient had a second procedure. The implantation of stem cells.
  • BMC and AMC were harvested in the operating room and prepared.
  • The patient had a standard microfracture procedure done on the 2cm femoral condyle articular cartilage defect.
  • The BMC was then injected into the burrows of the microfracture.
  • The AMC was then injected through a needle under visualization in a coating manner to seal the burrows and cover the articular defect.
  • Patient followed a standard microfracture rehabilitation protocol.
7 months post operatively the patient was walking normally and completed a Sprint Obstacle race.
  • Had minor pain 3/10 in the knee which resolved in 2 days without medication.

6 weeks later the patient competed in a Super Obstacle race with some minor pain which resolved in a few days.
  • Not much different from his pre-injury races two years prior.

Currently 9 months post operation is running 3-5 miles 4 times weekly without pain and completing sub 8 minute miles.
• Orthobiologics provide a promising alternative to acute and chronic tendon, bone, muscle, and ligament issues.

• Additional studies need to be done to delineate the full benefits.

• Interventional Orthopedics represents a new and exciting field that bridges the gap between simple articular injections and orthopedic surgery.

• Orthobiologic Orthopedic assisted procedures can assist in the field of orthopedics to yield better results.