Regenerative Medicine in Orthopedics

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August 6, 2026

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Disclosure:

I have nothing to disclose……

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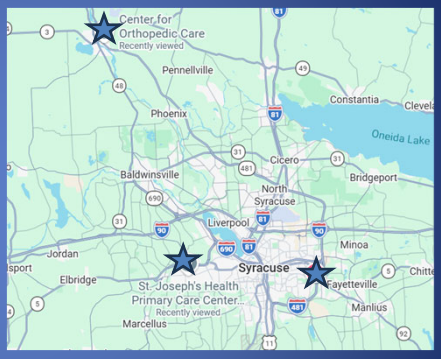
We are St. Joseph's Orthopedics and Spine

- Fayetteville
- Fulton
- Camillus
- **315-703-2222**
- Walk-in Fayetteville 8 am- 4 pm



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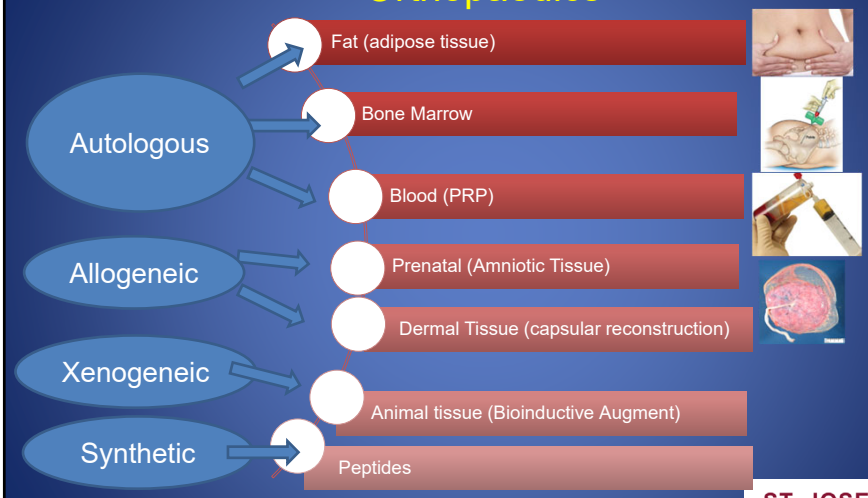
A Glance at the Regenerative Space in Orthopaedics



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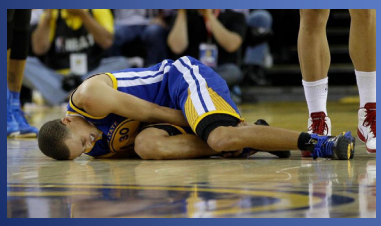
Platelet Rich Plasma
What are we talking about?



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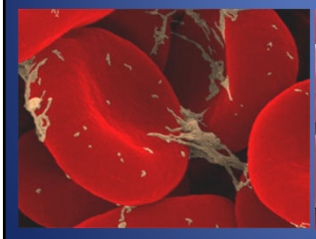
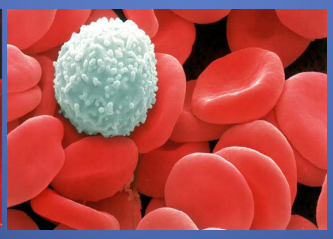
Where does it come from?

Components of blood:

Plasma

Red Blood Cells White Blood Cells Platelets





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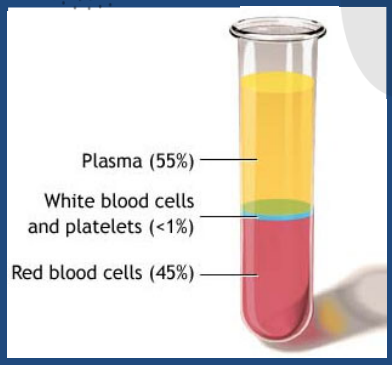
Plasma

- Liquid component of blood that consists mainly of water.
- Contains dissolved salts (electrolytes).
- Plasma acts as a reservoir that can either replenish insufficient water or absorb excess water from tissues



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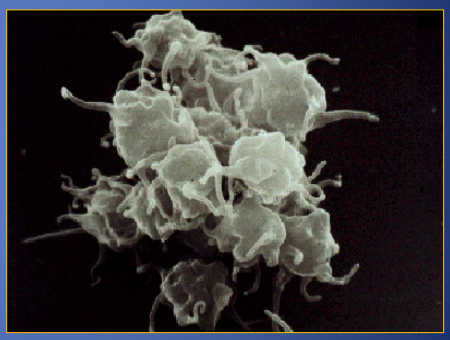
Platelets



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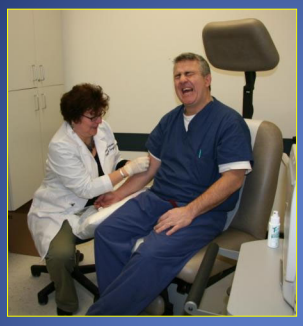
Methods of Concentrating Platelets



- Arthrex Double-Syringe® Autologous Conditioned Plasma (ACP) 10 cc blood/yield = 3cc product
- Biomet GPS® III Platelet Concentrate System 27cc blood/yield = 3cc product

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Biomet GPS III®

Blood is drawn using provided 60mL Tube and transferred into centrifugation tube.

Blood is transferred to concentrator

Blood is centrifuged for 15min at 3200rpm

Platelet-Poor Plasma is removed from Yellow Port

Platelet-Rich Plasma is collected from the Red Port

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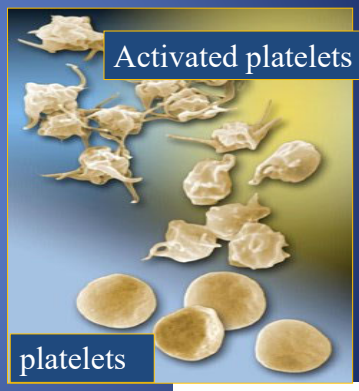
PRP thought to use the bodies own ability to heal itself

- Pathologies which have poor healing potential
- Platelet rich therapies allow for an opportunity to utilize the body's own growth factors (GF) to improve the quality & speed of recovery from an injury.



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What's the problem here

- Many Pathologies involve anatomic areas with minimal **BLOOD FLOW & LOW CELL TURNOVER RATE**
  - ✓ **Joint spaces, ligaments & cartilage have a naturally limited blood supply**
  - ✓ **Muscle & tendons commonly experience decreased local blood flow following injury (e.g. rotator cuff, lateral epicondyle, Achilles, patella)**
- This imbalance of Growth Factor **supply & demand** hinders the regenerative process

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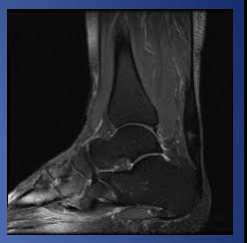
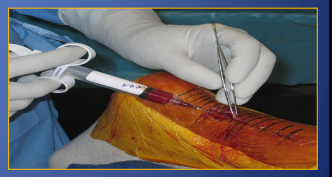
When do we use PRP?

- Treatment of various tendinopathies.
  - Achilles, peroneal, lateral epicondyle
  - Partial tendon tears
  - Plantar fasciitis
- Ligament tears (acute injury)
  - MCL
  - Ankle sprain
  - UCL
- Muscle Injuries
  - hamstring
- Augment surgical repairs
- **Osteoarthritis**





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Growth Factors

"Alphabet Soup"

These names you will hear are going to be playing a bigger factor in the years to come.

Industry is going to use these to enhance products

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Review of Growth Factors Involved in Tendon Healing

wth Factor (bFGF)-

ssels and cells to migrate to the

Fa

Produced in cells that
tendon healing during

Vascular Endothelial G

Stimulates blood vessel ingrowth during healing.
Plays a role in overuse injuries

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So many choices….

- WBC "rich" (Biomet, Magellan) vs. WBC "poor" (ACP, Cascade)
- How many platelets?
  - Volume (platelet, blood)
  - Cycles throughout day
- How many injections? When to inject?
- Therefor ⟶ Mixed results

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Obstacles

- Regulatory (FDA)
  - Minimal manipulation
- Research
  - Used in multiple indications, little data
  - Minimal level one comparative data ($$$)
- Financial
  - Considered experimental
  - Coding is inconsistent
  - Patient expense

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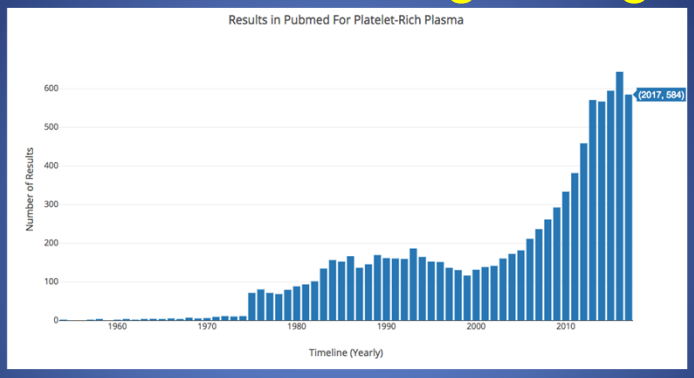
Yet… Interest is growing



April 2026:

PRP: 48293
PRP + Rotator cuff repair: 1915
PRP + OA: 6671

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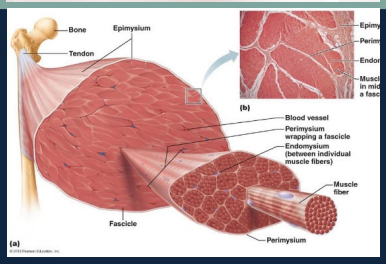
Does it work in clinical setting??

- Due to it's success in laboratory studies, it was the subject of thousands of clinical studies
  - Mostly Case studies, or low powered randomized studies



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REVIEW ARTICLE | VOLUME 29, ISSUE 5, P1059-1070, MAY 01, 2020

The effect of perioperative platelet-rich plasma injections on postoperative failure rates following rotator cuff repair: a systematic review with meta-analysis

Parker A. Cavendish, BS • Joshua S. Everhart, MD, MPH • Alex C. DiBartola, MD, MPH • Alexander D. Eikenberry, BS • Gregory L. Cvetanovich, MD • David C. Flanigan, MD

JOURNAL OF SHOULDER AND ELBOW SURGERY

- 16 Randomized controlled studies reporting rates of failures
- PRP augmentation at time of surgery
- Across studies:
  - 25% reduction in risk of failure
  - Small to medium tears AND
  - Large to massive tears
- Conclusion: PRP reduces risk of failure following repair
  - ***However, because of variability in preparation, specific recommendation can't be made

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However, the alternative???

- Weber et al, Arthroscopy 3/2019
  - Cortisone injection prior to RCR surgery
    - Single injection = increased risk of failure
    - 2 or more injections = over 2 fold increased odds ratio of failure
    - Increased risk closer to surgery
- Shams et al, EJOST 12/2016
  - Cortisone vs. PRP Partial RCT
    - Both showed improved clinical outcomes
    - PRP better results at 12 weeks
    - No difference at 6 months

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Future directions?

Comparison Between Hyaluronic Acid and Platelet-Rich Plasma, Intra-articular Infiltration in the Treatment of Gonarthrosis

Fabio Cerza,*† MD, Stefano Carnì,‡ MD, Alessandro Carcangiu,*§ MD, Igino Di Vavo,* MD, Valerio Schiavilla,* MD, Andrea Pecora,* MD, Giuseppe De Biasi,‖ and Michele Ciuffreda‖

Investigation performed at the Paolo Colombo Hospital of Velletri, Rome, Italy

AJSM Dec 2012

***PRP showed a significantly better clinical outcome than HA

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Biology of PRP and its Clinical application in Cartilage repair: Review
Xie X, Zhang C, & Taun R Arthritis Res & Therapy 16:204 2014

- PRP may act as scaffold for cartilage defect in OA
- Anabolic effect on chondrocytes, MSC
- Inhibit inflammation and alleviate OA symptoms
- ?? Anti-microbial, anti-inflammatory, anabolic

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Is it Kosher????

- Legal in
  - NCAA
  - NBA
  - NFL
  - WNBA
  - NHL
  - MLB

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World Anti-Doping Agency September 2009

Local injection at the site of injury will require a declaration of use that is in compliance with the International Standard for Therapeutic Use Exemptions (TUE) from a medical professional.

*** Need a Doctor's note

Doses of IGF-1 in PRP are subtherapeutic for anabolic effects

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Conclusions

- PRP is a higher concentration of platelets
- Small studies showing earlier RTP in acute injuries
- Still need for rigorous research to define differences in
  - Concentration
  - Number of injections
  - WBC?
- While mixed results in level of benefit, no adverse effects have been reported (except cost)
- Studies are mostly short term, this is a short term treatment

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What about "Stem Cells"

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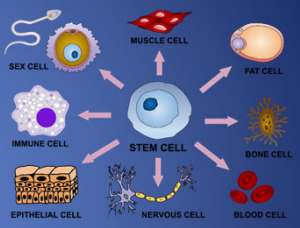
According to Dr. Rodeo……

- Resting, not proliferating
- "Asymmetric cell division", self renewal and progenitor (preserves the number of stem cells)
- Bone Marrow and Adipose
- Progenitor cells = "connective tissue progenitors" (bone, cartilage, fat, muscle, ligament, tendon)
- Real goal: target the CTP to turn into what you need



"Stem Cell 101"
Rodeo, AJSM 2021
Caplan, JOR 1991

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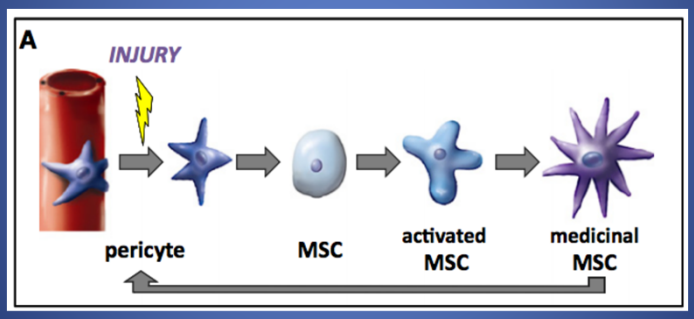
Mesenchymal Stem Cells “MSC”



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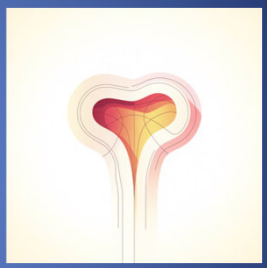
Bone Marrow – What It Is

- Soft, spongy tissue inside bone that supports blood production and immune function.
- Two major forms: red marrow (hematopoietic) and yellow marrow (fat-rich storage).
- Produces more than 200 billion new blood cells daily.
- Without marrow, the body cannot transport oxygen, fight infection, or clot effectively.



Cross-section of marrow within long bone

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Instrumentation

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Why Bone Marrow (BMAC)?

Factor	Bone Marrow (BMAC)	Adipose Tissue (SVF or MFAT)
Stem Cell Potency	Higher concentration of "true" MSCs	Higher total nucleated cell count, but fewer MSCs
Differentiation Potential	More osteogenic (bone-forming) potential	More adipogenic (fat-forming) potential
Clinical Evidence	More robust evidence in orthopedic literature	Emerging, less standardized evidence
Regulation (U.S.)	Can be used at point of care (minimal manipulation)	Enzymatic processing is more regulated
Immune Modulation	Strong anti-inflammatory & immunomodulatory properties	Also immunomodulatory, possibly more pro-angiogenic

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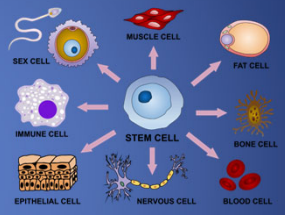
BMAC Lasts Longer

- Boffa et al compared BMAC vs HA in bilateral OA knees.
- Result: overall outcomes were similar, but BMAC showed more durable pain benefit in mild OA knees at 12 and 24 months.



Cell-rich aspirate is heterogeneous across studies

Anz AW, Hubbard R, Rendos NK, et al. Orthop J Sports Med. 2020;8(2):2325967119900958. Anz AW, Hubbard R, Rendos NK, et al. Orthop J Sports Med. 2022;10(3):23259671221076362. Boffa A, Di Martino A, Andriolo L, et al. Knee Surg Sports Traumatol Arthrosc. 2022;30(12):3958-3967.

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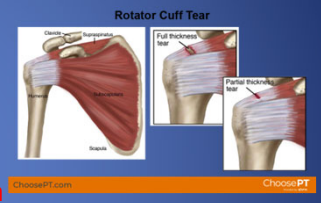
BMAC for Partial Rotator Cuff Tears – Key Study

- Kim et al studied 24 patients with partial cuff tears: BMAC-PRP injection vs exercise alone.
- Mechanism targeted = local biologic augmentation at the tear site under ultrasound guidance.
- Result: VAS and ASES improved more in the injection group at 3 months.
- Tear size decreased after injection, but the difference versus control was not significant.



Partial-thickness rotator cuff tear illustration

Kim SJ, Kim EK, Kim SJ, Song DH. J Orthop Surg Res. 2018;13(1):1.

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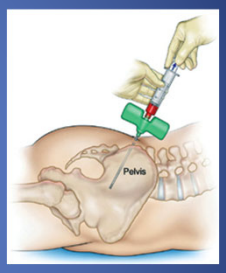
BMAC Summary

- Mechanism: iliac crest aspirate concentrated into a cell-rich product containing MSC progenitors, cytokines, and growth factors.



Bone marrow harvest from the iliac crest

Keeling LE, Belk JW, Kraeutler MJ, et al. Am J Sports Med. 2022;50(8):2315-2323. Lee JS, et al. Arthroscopy. 2024.

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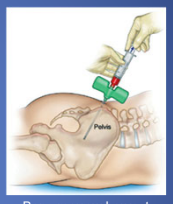
Bone Marrow Aspirate (BMAC) – Evidence Summary

- Evidence strongest in knee osteoarthritis → pain & function improvement
- Data in tendon/muscle injuries remains limited
- Significant variability in harvest technique and cell concentration
- Bottom line: symptoms often improve, BMAC is best viewed as a biologic augment – not a guarantee of cartilage or tendon regrowth.



Bone marrow harvest

Multipotent cell concept

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Conclusion

- Still need more data
- Early studies are promising
- Regulatory obstacles
- Expense, Expense, Expense
- Clear definition and standardization of products
- FDA Approval

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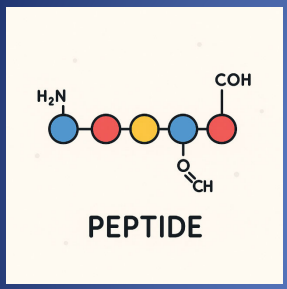
What about Peptides????



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Key Biological Differences

Feature	Peptides	Growth Factors
Size	Small (2–50 amino acids)	Large & Complex
Function	Specific, targeted "keys" for single tasks (e.g., "make collagen")	"Project managers" overseeing complex repair and cell growth
Stability	Generally stable and easy to formulate	Fragile and notoriously unstable
Penetration	Smaller size allows better skin penetration	Bulkier molecules; often need delivery aids like microneedling

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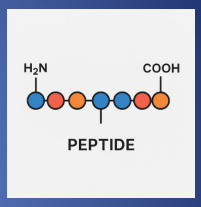
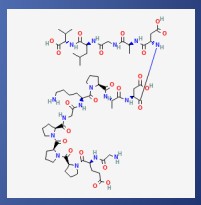
Peptides in Regenerative Medicine

- Peptides are short chains of amino acids (2-50) that regulate biological processes.
- They play a role in cell signaling, inflammation, and tissue repair.
- Compared to proteins, peptides are smaller and can be easily absorbed.
- Emerging as a promising tool in regenerative medicine alongside PRP and stem cells.





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Lin *et al.*
Journal of Orthopaedic Surgery and Research (2023) 18:694
https://doi.org/10.1186/s13018-023-04182-w

Journal of Orthopaedic Surgery and Research

RESEARCH ARTICLE Open Access

Analgesic efficacy of collagen peptide in knee osteoarthritis: a meta-analysis of randomized controlled trials

Chun-Ru Lin[1], Sung Huang Laurent Tsai[2], Ko-Yen Huang[3], Po-An Tsai[1], Hsuan Chou[4] and Shu-Hao Chang[5,6*]

- • Meta-analysis of 4 randomized controlled trials (507 patients with knee OA). (Oral)
- • Collagen peptides significantly reduced pain vs placebo:
- - p = 0.004.
- • No significant increase in adverse events:
- - p = 0.05.
- • Common side effects: GI discomfort, headaches.
- • Conclusion: Collagen peptides are safe and moderately effective for pain relief in knee OA.

Lin CR, Tsai SHL, Huang KY, et al. Analgesic efficacy of collagen peptide in knee osteoarthritis: a meta-analysis of randomized controlled trials. Journal of Orthopaedic Surgery and Research. 2023;18:694

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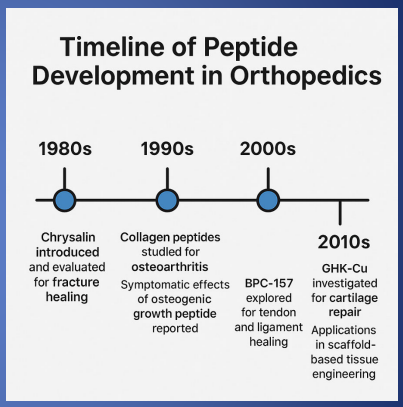
Clinical Applications of Peptides

- Orthopedic Injuries: Tendon, ligament, and cartilage repair.
- Wound Healing: Skin regeneration, burns, scars.
- Neurological Recovery: Potential for nerve damage repair.
- Anti-Aging & Aesthetics: Collagen production, skin rejuvenation.



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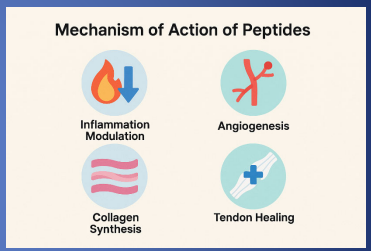
Mechanism of Action of Peptides

- 🛡️ Modulate inflammation – Reduce pro-inflammatory cytokines (e.g., TNF-α, IL-6)
- 💉 Stimulate angiogenesis – Promote capillary growth (BPC-157, TB-500)
- 🧵 Enhance collagen synthesis – Strengthen tendons, ligaments (GHK-Cu)
- 🔬 Influence stem cell behavior – Guide differentiation and repair (TB-500)
- ⚙️ Support cell migration and tissue remodeling
- 💊 Possibility of oral and injectable delivery



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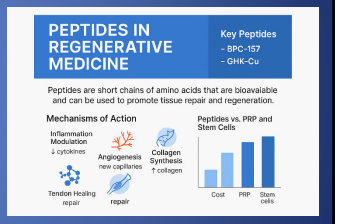
Key Peptides in Regenerative Medicine

- BPC-157: (Body Protection Compound) Enhances healing of tendons, ligaments, and muscles.
- Thymosin Beta-500: Promotes wound healing and reduces inflammation.
- GHK-Cu: Copper peptide that stimulates tissue repair and collagen production.
- LL-37: Antimicrobial peptide with regenerative properties.



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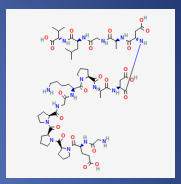
Body Protection Compound-157

- Derived from a larger protein isolated from human gastric juice.
- Initially described in 1990s
- Original indication- inflammatory bowel disease
- Stability in acidic gastric environment… oral delivery?
- Effects: cell protection, anti-inflammatory, repair



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> Altern Ther Health Med. 2021 Jul;27(4):8-13.

Intra-Articular Injection of BPC 157 for Multiple Types of Knee Pain

Edwin Lee, Blake Padgett

- Retrospective study
- n =16
- 6-12 month follow up
- Intra articular knee injection
  - 12 received BPC 157
    - 11/12 (91.6%) had significant improvement
  - 4 received BPC 157 + TB 4
    - 3/4 (75%) had significant improvement

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Thymosin B4 (TB4/TB500)

- Identified in calf thymus
- TB-4: full naturally occurring 43-amino-acid protein found in the human body
- **TB-500 is a synthetic fragment** 7-amino-acid active segment
- responsible for cell migration and tissue repair
- Studies show tissue protective and regenerative effects in cardiac, corneal, and dermal
- NO ORTHOPEDIC STUDIES

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Side effects

- Local skin reaction
- Decreased insulin sensitivity
- Water retention

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Peptides in Orthopedics – Level of Evidence

- Preclinical (animal model) evidence is strong for BPC-157 and TB-500.
- Small-scale human studies show promising results in ligament and tendon healing.
- GHK-Cu widely used in dermatology; early orthopedic application emerging.
- Most data are animal models, case reports, open-label studies, and observational cohorts.
- No large-scale RCTs yet; off-label use is common in sports and regenerative clinics.

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Clinical Use of Peptides – Real-World Evidence

- BPC-157 used off-label in sports medicine for tendon and ligament healing.
- Case series report accelerated healing in rotator cuff and MCL sprains.
- Injectable GHK-Cu used for collagen repair in degenerative joint disease.
- Thymosin Beta-4 applied in PRP formulations to enhance healing in post-op rehab. (Wolverine)
- Recent commentary in Arthroscopy (2025) highlights growing clinical interest.

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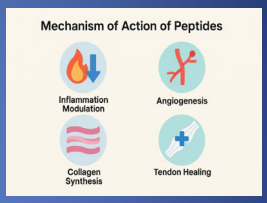
Peptides – Overall Evidence Summary

- BPC-157: strongest orthopaedic signal; primarily animal tendon/ligament data.
- TB-500/Thymosin β4: migration/angiogenesis mechanisms; minimal clinical data.
- GHK-Cu: strongest in skin biology; limited orthopaedic trials.
- Overall:
  - Common mechanisms: ↓ cytokines, ↑ angiogenesis, ↑ fibroblast migration, ↑ collagen organization.
  - animal data > human evidence
  - use remains experimental.



Peptides: mechanism strong, clinical data limited

Refs: DeFoor MT, Dekker TJ. Arthroscopy. 2025;41(2):150–152. Vasireddi N, et al. 2025 review. Lin CR, et al. 2023 meta-analysis.
DeFoor MT, Dekker TJ. Arthroscopy. 2025;41(2):150-152. Vasireddi N, et al. 2025. Lin CR, et al. 2023.

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Is it Kosher????

- **Illegal** in (as of 2026)
  - NCAA
  - NBA
  - NFL
  - WNBA
  - NHL
  - MLB

  **** BPC-157 banned by World Anti-Doping Agency

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Disclaimer…..

- BPC-157 is not approved for human clinical use by any global regulatory authority. The FDA has stated that there is ***no legal basis*** for selling BPC-157 as a drug, food, or dietary supplement, and it is not approved for compounding in pharmacies.

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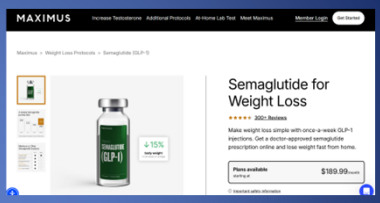
Yet…..

- Can be found on Amazon (oral)
- Many out of (NY) state virtual clinics “prescribe”
- Google can find many websites to purchase oral, powder, injections
- GLP-1 is a peptide…..



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But…

HEALTH NEWSLETTER

RFK Jr. backs easier peptide access for wellness as doctors raise red flags

And more of this week's top health stories, right to your inbox

By Fox News Staff · Fox News

Published April 17, 2026 5:31pm EDT

HEALTH AND SCIENCE

RFK Jr.'s peptide policy could boost Hims & Hers as its GLP-1 business evolves

PUBLISHED THU, APR 16 2026-1:44 PM EDT | UPDATED THU, APR 16 2026-4:19 PM EDT

Brandon Gomez
@IN/BRANDON-GOMEZ/
@BGOMEZREPORTS

SHARE

CBS News

FDA will consider easing restrictions on peptides as RFK Jr. calls himself a "big fan"

The FDA meeting announcement follows repeated pledges by Health Secretary Robert F. Kennedy Jr. to loosen regulations on peptides,...

3 days ago

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Therefore….

- FDA Pharmacy Compounding Advisory Committee (PCAC) met July 2026 re: adding BPC-157 and TB-500 to compounding list…..

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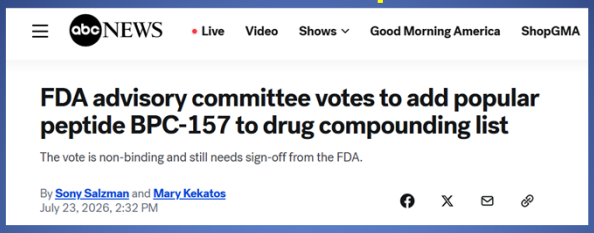
Hot off the press


ABC NEWS • Live Video Shows Good Morning America ShopGMA

FDA advisory committee votes to add popular peptide BPC-157 to drug compounding list

The vote is non-binding and still needs sign-off from the FDA.

By Sony Salzman and Mary Kekatos
July 23, 2026, 2:32 PM

- Pharmacy Compounding Advisory Committee (PCAC) voted 8-6 to add BPC-157 and TB 500 to approved compounding list
- FDA subcommittee
- Still requires FDA approval

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Peptides – Clinical Reality in Sports Medicine

- Used off-label in sports clinics for tendon and ligament injuries
- No standardized dosing, timing, or delivery protocols
- BPC-157 banned by WADA → major issue for athletes
- Risk of contamination from non-regulated sources
- Should be framed as experimental when discussing with patients

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PRP vs BMAC vs Peptides – Practical Comparison

- PRP: (Fertilizer, $$) moderate evidence OA, some tendinopathies
- BMAC: (seed, $$$) growing evidence especially OA
- Peptides: (sunlight, $) strong theory, weak clinical evidence
- All are adjuncts — NOT replacements for rehab

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In a Nutshell….

- Peptides: **promising**, easy to administer, (longer shelf life, oral) can be used alone or in combination with PRP/stem cells.
- PRP: Provides growth factors, but results can vary, most studied.
- Stem Cells: Can differentiate into various tissues but are expensive.

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What I Tell My Athletes

- "Regenerative" does NOT mean regrowing new tissue reliably
- Most treatments improve pain and function, not structure
- Rehab, load management, and biomechanics are still #1
- PRP and BMAC may help the right patient — results vary
- Peptides: experimental, unregulated, banned in most sports
- If it sounds too good to be true → it probably is

Athlete expectations matter

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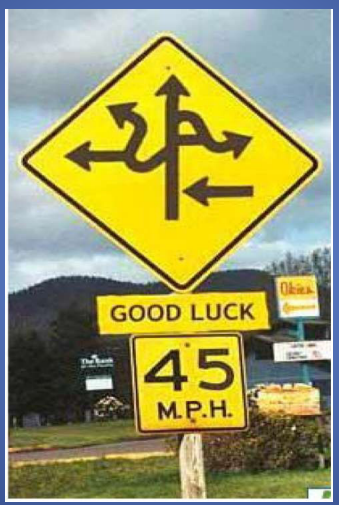
Questions?



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Thank You

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