What's New in Sports Medicine?

Brett Martindale, MD

OGDEN CLINIC
We specialize in you.

Disclosure

- This presentation has no ineligible company content, promotes no ineligible company, and is not supported by any ineligible company. I receive no financial remuneration from any ineligible company related to this presentation.

OGDEN CLINIC
We specialize in you.

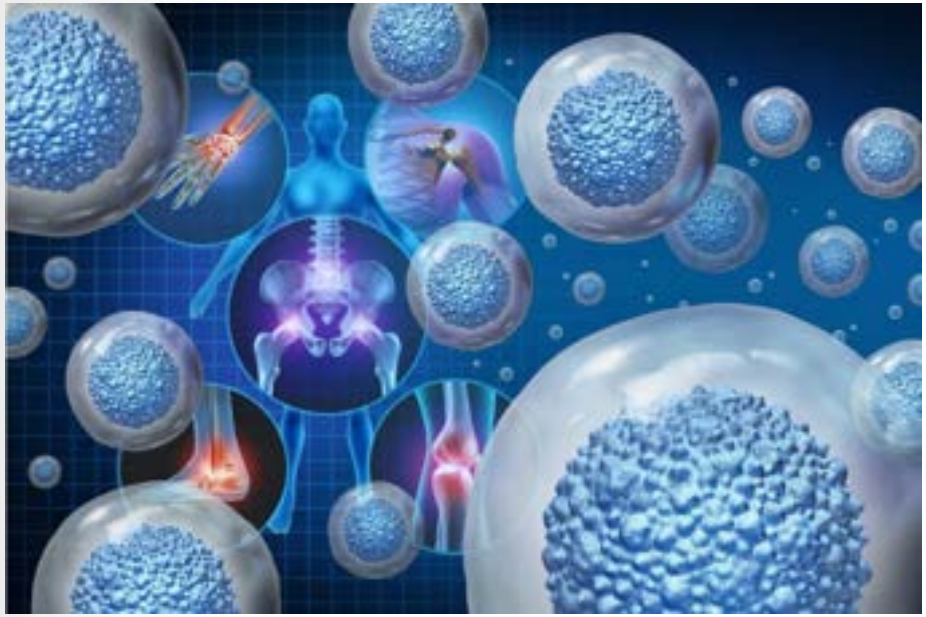
A lot of things…

- Concussion management
- R.I.C.E vs. M.E.A.T.
- Ultrasound diagnostics and intervention
- Trigger point/myofascial theory
- Rehabilitation protocols
- Early sports specialization
- Elbow epidemic in throwers (especially baseball pitchers)

OGDEN CLINIC
We specialize in you.

Regenerative Medicine

Enabling and enhancing the body's natural repair mechanisms to restore the function of otherwise poorly healing or irreparable tissues in situ.[1]



OGDEN CLINIC
We specialize in you.

1. Li Z, et al. Tissue Engineering for Musculoskeletal Regeneration and Disease Modeling. Handb Exp Pharmacol. 2021;265:235-268. PMID: 33471201; PMCID: PMC8049527.

Regenerative Medicine

- Coined in 1992
- FDA and Congress sanctioned this term in the 2016 21st Century Cares Act
- Controversy surrounds the term because of many unfounded claims incorrectly applied to it, with indiscriminate use and aggressive marketing (which hinders progress in this field)
- Encompasses many modalities (Orthobiologics, prolotherapy, exosomes, shock-wave therapy, etc.)

OGDEN CLINIC
We specialize in you.

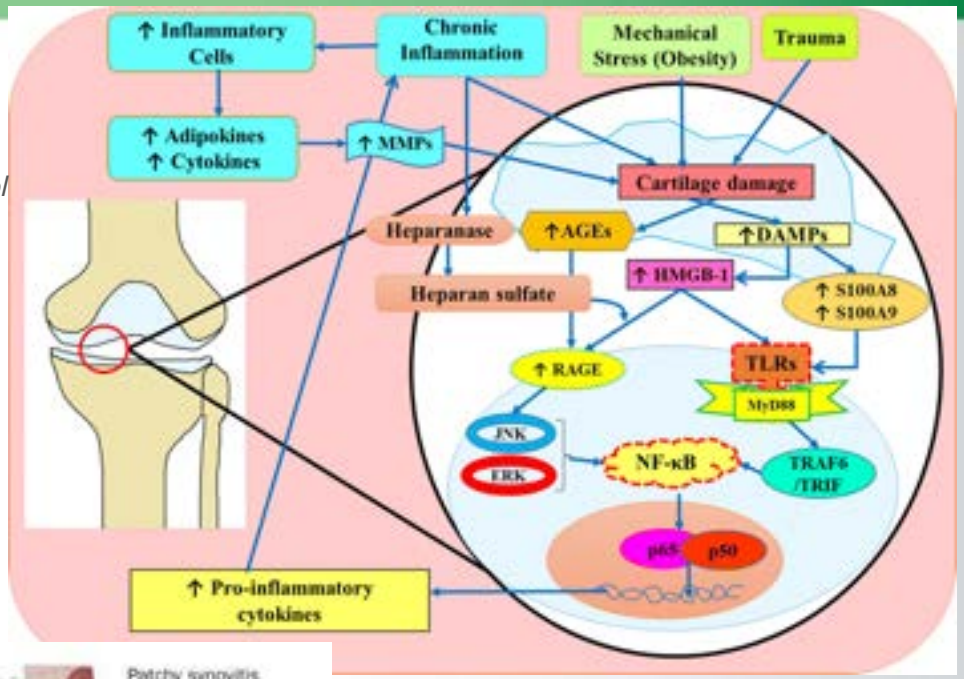
The Problem - Physiology

- Tendinopathy and Osteoarthritis
- Protracted (tendon) or no known (OA) healing capacity

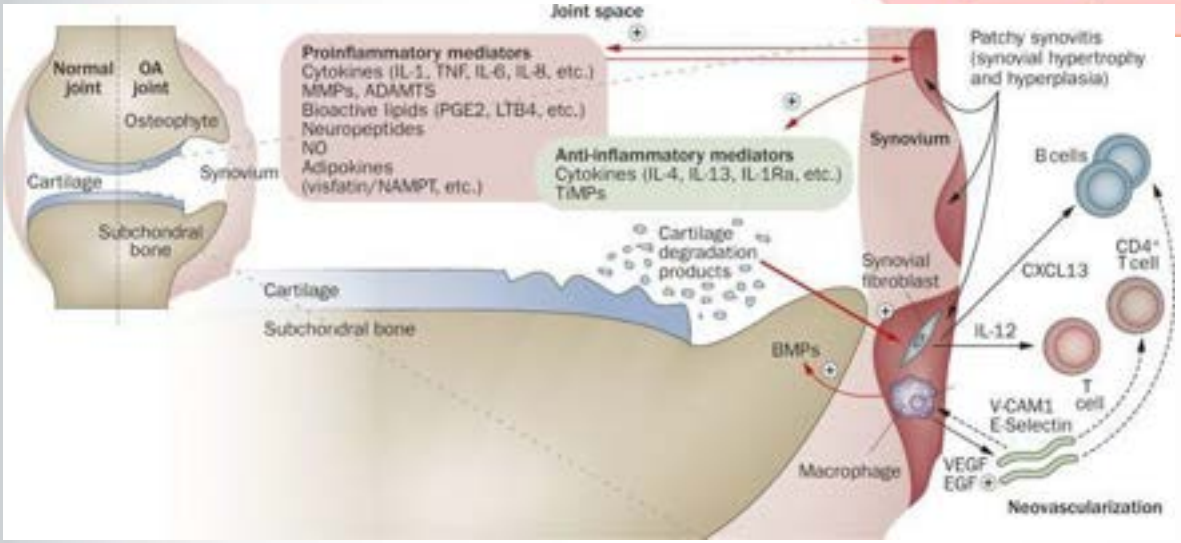
OGDEN CLINIC
We specialize in you.

Osteoarthritis pathophysiology

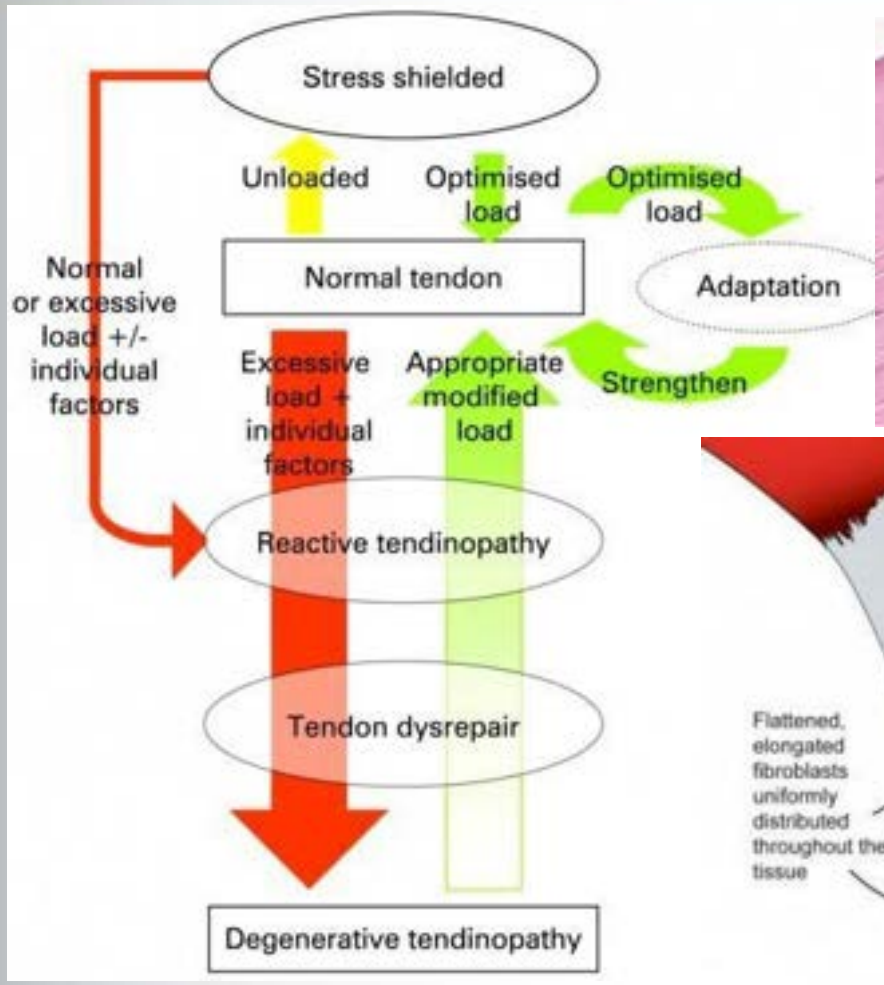
Rosenberg, J.H., Rai, V., Dilisio, M.F. *et al.* Damage-associated molecular patterns in the pathogenesis of osteoarthritis: potentially novel therapeutic targets. *Mol Cell Biochem* **434**, 171–179 (2017). https://doi.org/10.1007/s11010-017-3047-4

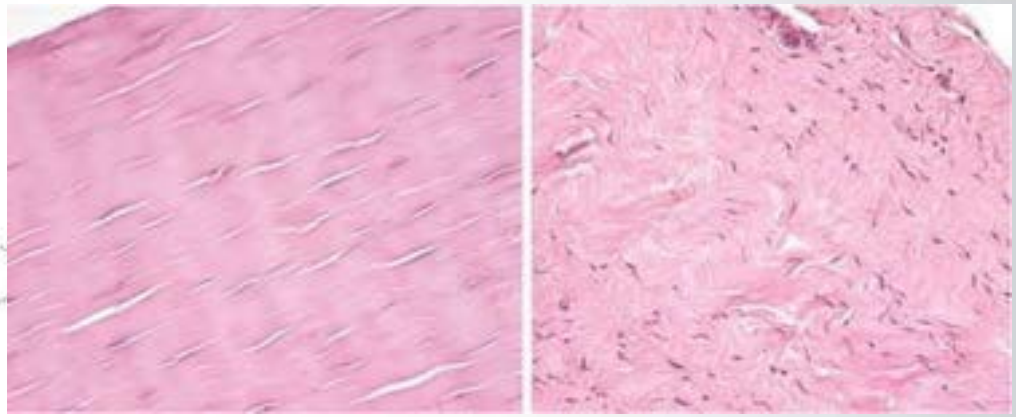


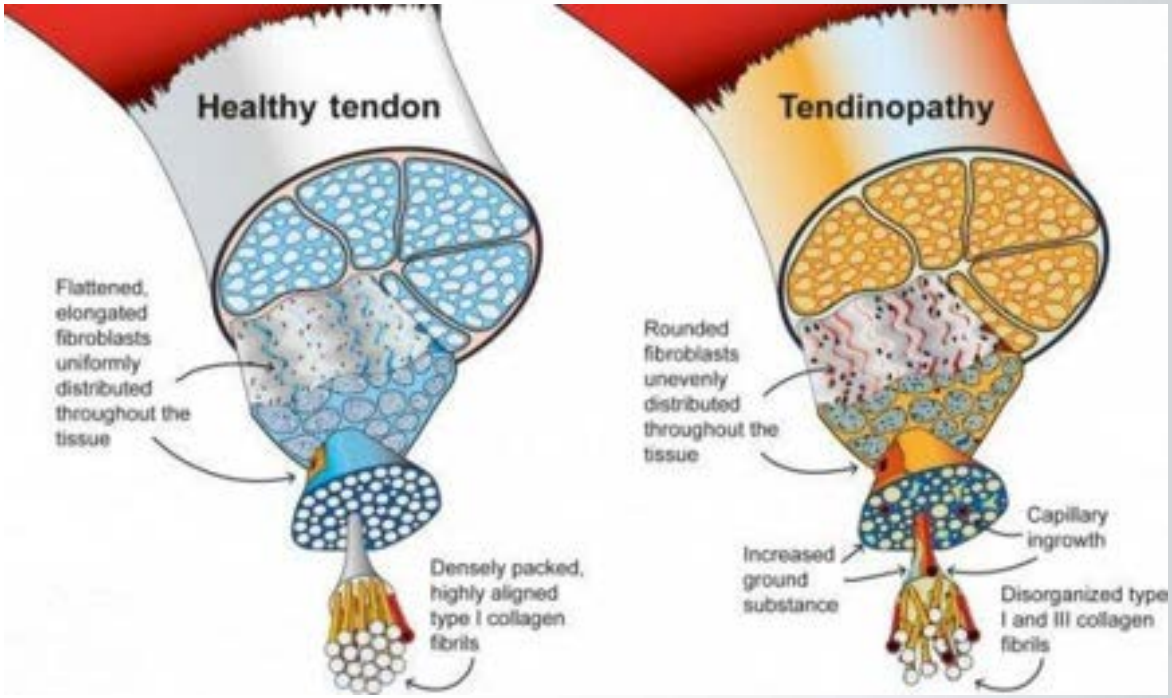
Sellam, J., Berenbaum, F. The role of synovitis in pathophysiology and clinical symptoms of osteoarthritis. *Nat Rev Rheumatol* **6**, 625–635 (2010). https://doi.org/10.1038/nrrheum.2010.159



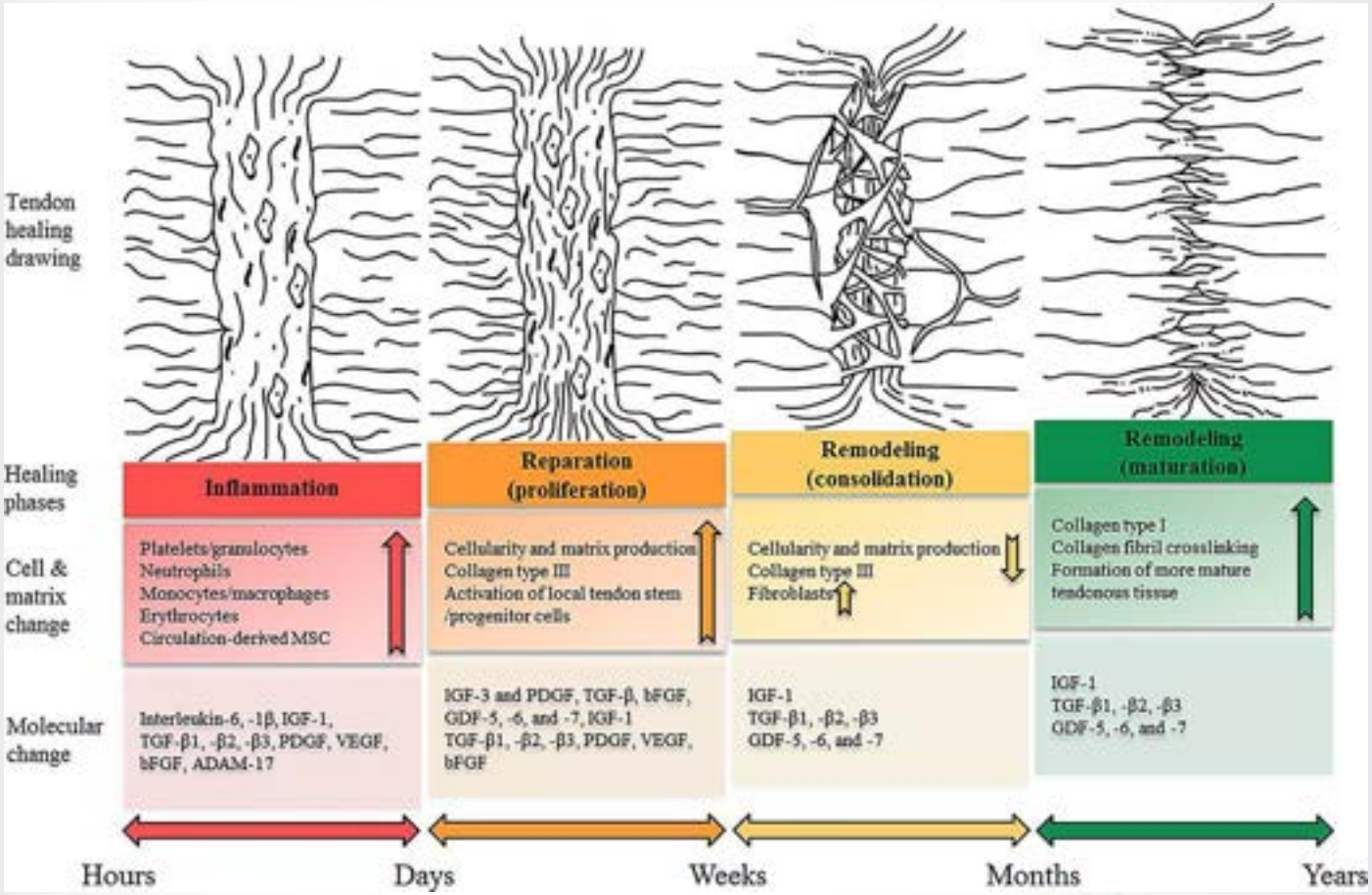
Tendonopathy pathophysiology







Tendon (soft tissue) Healing



Schneider M, et al. Rescue plan for Achilles: Therapeutics steering the fate and functions of stem cells in tendon wound healing, Advanced Drug Delivery Reviews, Volume 129, 2018, Pages 352-375, ISSN 0169-409X, https://doi.org/10.1016/j.addr.2017.12.016. (https://www.sciencedirect.com/science/article/pii/S0169409X17303198)

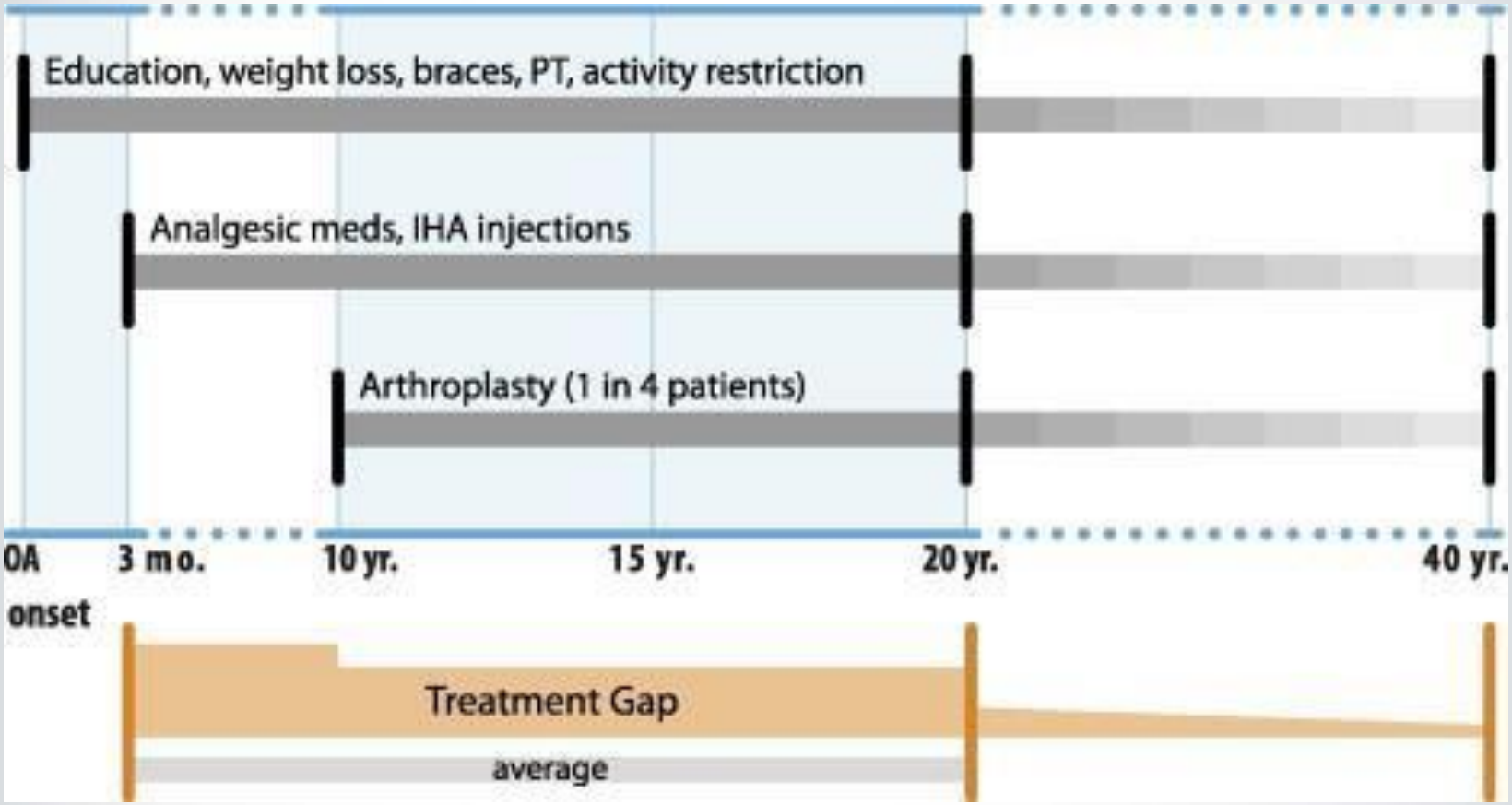
OGDEN CLINIC
We specialize in you.

The Problem - Treatment

- Patients have a history of failed treatments
- Near-term and long-term goals of the patient
- What does the patient feel comfortable with?
  - Most don’t want surgery
  - Most don’t want to keep doing PT if they don’t see effect

OGDEN CLINIC
We specialize in you.

Treatment Gap



Nicholas J. et al. Clinical and economic consequences of the treatment gap in knee osteoarthritis management, Medical Hypotheses, Volume 76, Issue 6, 2011, Pages 887-892, ISSN 0306-9877, https://doi.org/10.1016/j.mehy.2011.02.044.

OGDEN CLINIC
We specialize in you.

Regenerative Medicine

- Can play a role in filling that physiology and treatment gap
- Extracorporeal Shock Wave Therapy (ESWT)
- Orthobiologics, especially platelet rich plasma (PRP)

OGDEN CLINIC
We specialize in you.

Extracorporeal Shock Wave

OGDEN CLINIC
We specialize in you.

ESWT

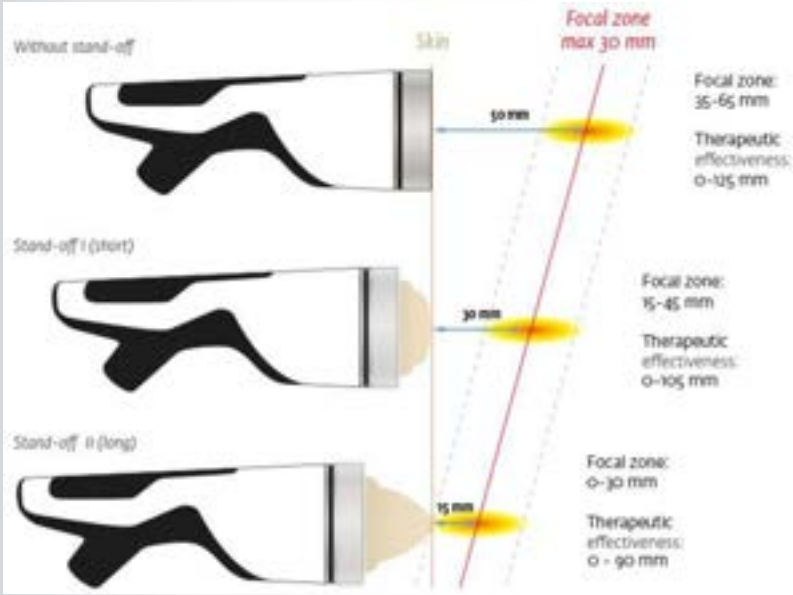
- Research led to pulverizing kidney stones in 1980
  - Bone density noticeably increased in these patients
  - MSK studies started in early ‘90s
- Acoustic pressure waves which propagate faster than sound
  - Causes abrupt tensile and shear stress on tissues, eliciting a healing response

OGDEN CLINIC
We specialize in you.

ESWT Types

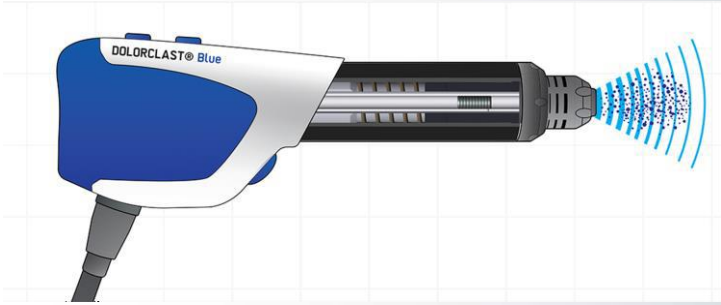
Focused

- True shock wave
- Focuses to a single point at a greater depth



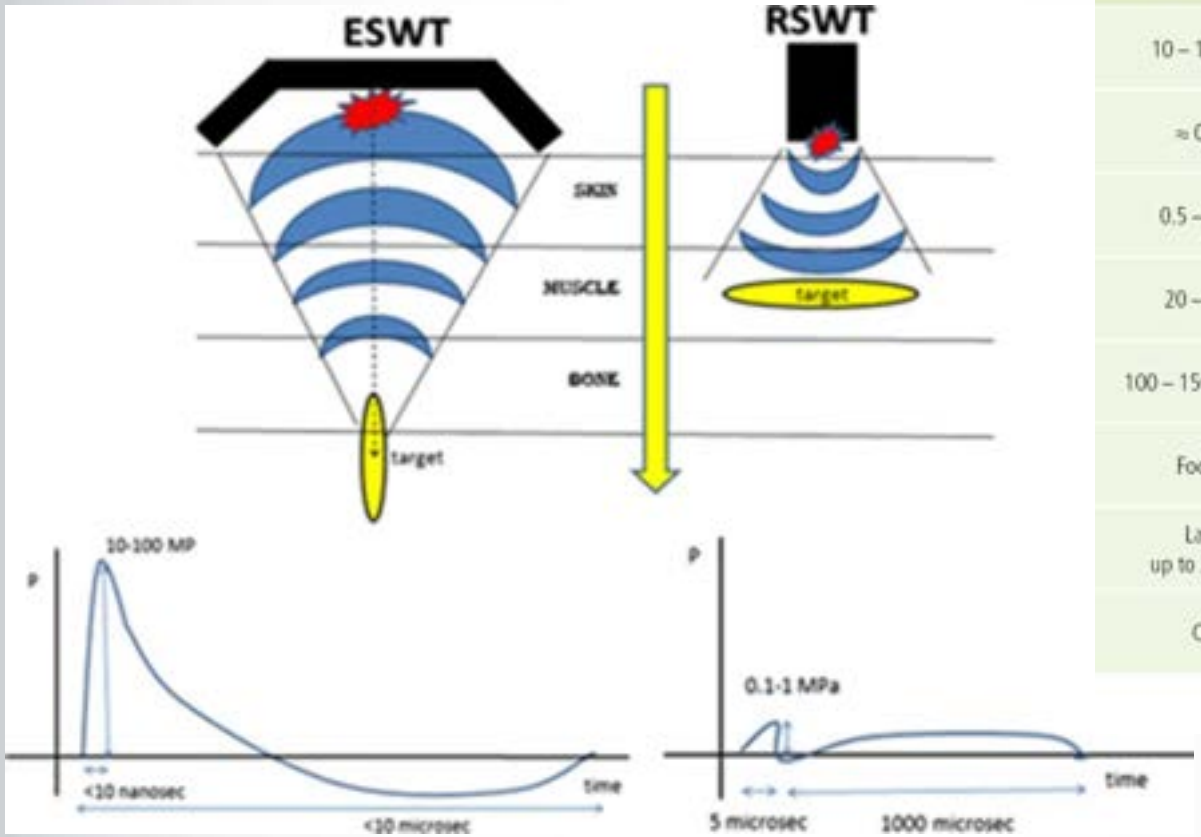
Radial

- Oscillating pressure wave
- Energy spread from a single point, but does not penetrate as deeply



OGDEN CLINIC
We specialize in you.

ESWT

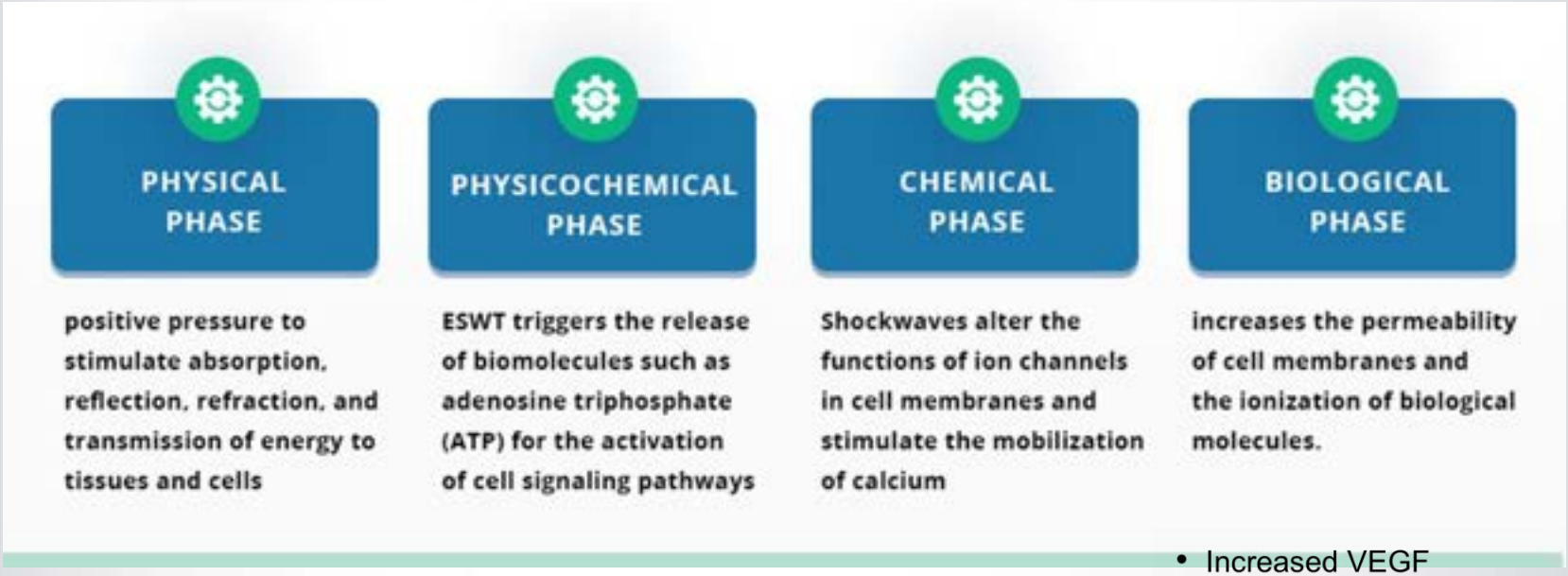


Shock waves		Pressure waves
10 – 100 MPa	**Pressure**	0.1 – 1 MPa
≈ 0.2 µs	**Pulse duration**	≈ 0.2 – 5 ms
0.5 – 2 mNs	**Momentum**	100 – 200 mNs
20 – 35 mJ	**Energy**	150 – 200 mJ
100 – 150 MPa/mm	**Pressure gradient**	0.1 – 0.5 kPa/mm
Focused	**Pressure field**	Radial, divergent
Large, up to 200 mm	**Penetration depth**	Small, superficial, up to 50 mm
Cells	**Effects**	Tissue

Fig. 18: Main differences between shock waves and pressure waves

OGDEN CLINIC
We specialize in you.

ESWT: Mechanism of Action



- Increased cell permeability
- Induces autocrine and paracrine effects

- Intracellular signalling pathways upregulated

- Increase in NO production

- Increased VEGF production
- Induces angiogenesis, osteogenesis, analgesia, immunomodulation
- Reduces inflammation, substance P

OGDEN CLINIC
We specialize in you.

ESWT: Applicability

- Tendinopathy
  - Plantar fasciitis
  - Achilles tendinitis
  - Patellar tendinitis
  - Trochanteric "bursitis"
  - Rotator cuff
  - Tennis/golfer elbow
  - Wrist tendinitis
- Stress fracture/nonunion
- Bone marrow lesions (arthritis)
- Muscle strain
- Muscle/myofascial pain
- Neuropathy (e.g. carpal tunnel syndrome)

OGDEN CLINIC
We specialize in you.

ESWT: Studies

- Achilles tendinopathy
  - Furia 2006, Rompe 2007, Rasmussen 2008, Rompe 2009, Abdelkader 2021, Rompe 2008, Pinitkwamdee 2020
- Plantar fasciopathy
  - Rompe 1996, Rompe 2003, Ogden 2004, Theodore 2004, Kudo 2006, Gollwizter 2007, Gollwitzer 2015, Gerdesmeyer 2008, Marks 2008, Hawamdeh 2016, Ibrahim 2017
- Lateral epicondylitis
  - Pettrone 2005, Rompe 2004, Spacca 2005, Yan 2017
- Stress Fracture/Nonunion
  - Moretti 2009, Albisetti 2010, Sansone 2022

OGDEN CLINIC
We specialize in you.

ESWT: Studies

Systematic review

Use of extracorporeal shockwave therapies for athletes and physically active individuals: a systematic review

Hye Chang Rhim [1,2] Jaehyung Shin [2] Jane Kang,[3] Paige Dyrek,[1] Zack Crockett,[1] Pearl Galido,[4] Carrie Wade,[5] Karsten Hollander [6] Joanne Borg-Stein,[1] Steven Sampson,[7] Adam S Tenforde [1]

Br J Sports Med: first published as 1

Extracorporeal Shockwave Therapy in the Management of Sports Medicine Injuries

Schroeder, Allison N. MD[1]; Tenforde, Adam S. MD[2]; Jelsing, Elena J. MD[3]

Author Information

Current Sports Medicine Reports 20(6):p 298-305, June 2021. | DOI: 10.1249/JSR.0000000000000851

The effect of extracorporeal shock-wave therapy on pain in patients with various tendinopathies: a systematic review and meta-analysis of randomized control trials

Lobat Majidi, Sorour Khateri, Nikta Nikbakht, Yousef Moradi & Mohammad Reza Nikoo

BMC Sports Science, Medicine and Rehabilitation 16, Article number: 93 (2024) | Cite this article

Received: 29 October 2021 | Revised: 9 February 2022 | Accepted: 11 February 2022

DOI: 10.1002/pmrj.12790

PRACTICE MANAGEMENT

PM&R

Best practices for extracorporeal shockwave therapy in musculoskeletal medicine: Clinical application and training consideration

Adam S. Tenforde MD[1] | Haylee E. Borgstrom MD, MS[1] | Stephanie DeLuca MD[1] | Molly McCormack BA[1] | Mani Singh MD[2] | Jennifer Soo Hoo MD[3] | Phillip H. Yun MD[4]

OGDEN CLINIC

We specialize in you.

ESWT: General Protocol

- 3-6 weekly sessions (each lasting 10-15 minutes)
- Radial to surrounding tissues, focused directly on pathologic area
- Clinical focusing, titrating energy to tolerance

OGDEN CLINIC
We specialize in you.

ESWT: Practicalities

- Pain relief often immediate, but temporary (hyperstimulation analgesia)
- May improve through the course of treatment, but greatest effects are 4-6 weeks following treatment
- Patients may continue normal activity ("in-season" treatment)
- Easily combined with other treatments (especially PT, but also dry needling, massage, PRP, surgery)

OGDEN CLINIC
We specialize in you.

ESWT

Contraindications

- Active cancer in area of treatment
- Pregnancy (gravidity in the treatment area)
- Infection or DVT in treatment area)
- Open physes???
- Overlying lungs???

Adverse Effects

- No known serious side effects
- Sensory nerve hyperstimulation can lead to temporary paresthesia
- Pain during application
- Petechiae/ecchymosis or edema at treatment site

OGDEN CLINIC
We specialize in you.

ESWT: Personal Experience

- 53 y/o female with 18 mos. left shoulder pain
- Tried CSI, barbotage, PT, no effect
- 3 sessions of ESWT

OGDEN CLINIC
We specialize in you.

ESWT: Personal Experience

OGDEN CLINIC
We specialize in you.

ESWT: Personal Experience

- 49 y/o male former collegiate runner (now recreational) with >1yr of insertional Achilles tendon pain
- 3 sessions of ESWT
- Had his first pain free run in over a year

OGDEN CLINIC
We specialize in you.

Extracorporeal Shock Wave

ESWT is a non-invasive, minimally interruptive treatment for a wide variety of musculoskeletal disorders, particularly in adjunct, without any known serious side effects.

OGDEN CLINIC
We specialize in you.

Orthobiologics

OGDEN CLINIC
We specialize in you.

Orthobiologics

- Prolotherapy? Needle Tenotomy?
- Platelet Rich Plasma
- Autologous conditioned plasma, autologous conditioned serum, Autologous protein solution, Alpha-2 macroglobulin
- Bone Marrow
- Adipose Tissue
- Perinatal Tissues

OGDEN CLINIC
We specialize in you.

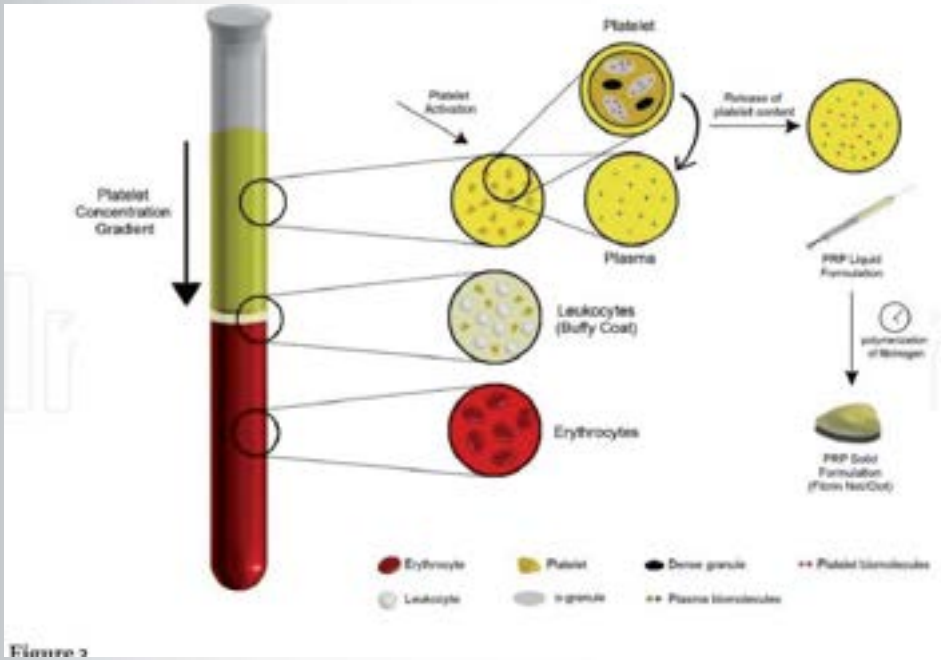
Platelet Rich Plasma (PRP)

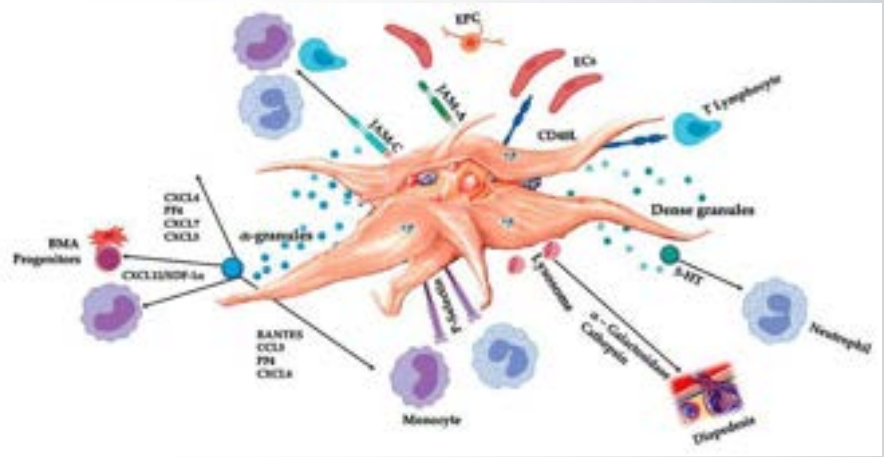
- Autologous plasma which has a platelet concentration above baseline
  - Leukocyte rich (leukocyte concentration above baseline)
  - Leukocyte poor (leukocyte concentration below baseline)
  - Which leukocytes present (granulocytes and/or agranulocytes)
  - RBC content

OGDEN CLINIC
We specialize in you.

Platelet Rich Plasma (PRP)

- PRP is inflammatorily complex
  - May be contextual
- Plasma itself has signaling molecules





OGDEN CLINIC
We specialize in you.

PRP: Physiology

"Basic" Basic Science: Growth factors, cytokines

Growth factor or cytokine	Role(s) in wound healing, musculoskeletal repair, and regeneration
Ang-2	Angiogenesis; chondrogenic and osteogenic differentiation
EGF	Endothelial chemotaxis and angiogenesis; MSC and epithelial cell mitogenesis; collagen synthesis; osteogenic and chondrogenic differentiation of MSCs
bFGF	MSC, chondrocyte, osteoblast, and capillary endothelial cells mitogenesis; chondrocyte, myoblast, and osteoblast differentiation
HGF	Angiogenesis, endothelial cell mitogenesis; anti-inflammatory effects
IGF-1	Myoblast proliferation and differentiation; fibroblast chemotaxis and protein synthesis; osteoblast proliferation and differentiation; MSC proliferation and survival
IL-1	Pro-inflammatory and catabolic effects
PDGF-AB PDGF-BB	Chemotaxis of inflammatory cells; angiogenesis; fibroblast chemotaxis and proliferation; ECM synthesis; MSC and osteoblast mitogenesis
MMPs	ECM remodeling and tissue degradation
TGF-β1	Fibroblast activation and proliferation; ECM synthesis; endothelial chemotaxis and angiogenesis; MSC proliferation; chondrogenic and osteogenic differentiation
TGF-β2	MSC proliferation; chondrogenic and osteogenic differentiation
VEGF	Angiogenesis and vasculogenesis; macrophage and granulocyte chemotaxis

Yuan, X.(., Gellhorn, A.C. (2020). Platelet-Rich Plasma. In: Cooper, G., Herrera, J., Kirkbride, J., Perlman, Z. (eds) Regenerative Medicine for Spine and Joint Pain. Springer, Cham. https://doi.org/10.1007/978-3-030-42771-9_5

OGDEN CLINIC
We specialize in you.

PRP: Applicability

- Tendinopathy
  - Plantar fasciitis
  - Achilles tendinitis
  - Patellar tendinitis
  - Trochanteric "bursitis"
  - Rotator cuff
  - Tennis/golfer elbow
  - Wrist tendinitis
- Osteoarthritis
- Ligamentous injury (e.g. UCL or ATFL tear)
- Meniscus tears?
- Carpal tunnel syndrome?
- Adhesive capsulitis?

OGDEN CLINIC
We specialize in you.

PRP: Studies

- Lateral epicondylitis
  - Hastie 2018, Shim 2022, Niemiec 2022, Li 2022, Kamble 2023

Review > J Shoulder Elbow Surg. 2023 Sep;32(9):1770-1783. doi: 10.1016/j.jse.2023.04.018. Epub 2023 May 27.

Corticosteroid injections for the treatment of lateral epicondylitis are superior to platelet-rich plasma at 1 month but platelet-rich plasma is more effective at 6 months: an updated systematic review and meta-analysis of level 1 and 2 studies

Erik Hohmann [1], Kevin Tetsworth [2], Vaida Glatt [3]

Affiliations + expand

PMID: 37247780 DOI: 10.1016/j.jse.2023.04.018

OGDEN CLINIC
We specialize in you.

PRP: Studies

- Plantar fasciitis

Review > Foot Ankle Surg. 2024 Feb 15:S1268-7731(24)00031-6. doi: 10.1016/j.fas.2024.02.004. Online ahead of print.

Platelet rich plasma therapy versus other modalities for treatment of plantar fasciitis: A systematic review and meta-analysis

Agustin Herber [1], Oscar Covarrubias [2], Mohammad Daher [2], Wei Shao Tung [3], Arianna L Gianakos [3]

Affiliations + expand

PMID: 38395675 DOI: 10.1016/j.fas.2024.02.004

Randomized Controlled Trial > BMC Musculoskelet Disord. 2023 Mar 7;24(1):172. doi: 10.1186/s12891-023-06277-1.

Effect of platelet-rich plasma versus steroid injection in plantar fasciitis: a randomized clinical trial

Rachit Sharma [#1], Narendra Kumar Chaudhary [#2], Mandeep Karki [1], Dev Ram Sunuwar [3], Devendra Raj Singh [4], Pranil Man Singh Pradhan [5], Prakash Gyawali [1], Sailendra Kumar Duwal Shrestha [6], Kailash Kumar Bhandari [1]

Affiliations + expand

PMID: 36882804 PMCID: PMC9989576 DOI: 10.1186/s12891-023-06277-1

OGDEN CLINIC

We specialize in you.

PRP: Studies

- Achilles tendinitis (Huang 2023, Desouza 2023)
- Patellar tendinitis (Bosco 2023)
- Gluteal tendinitis (Fitzbpatrick 2018)
- Rotator cuff (Dakkak 2024, Shen 2024, Desouza 2024)
- UCL tear (Fucaloro 2024)
- Generally more heterogeneity in the results for above issues.

OGDEN CLINIC
We specialize in you.

PRP: Studies

- Osteoarthritis

Orthop J Sports Med. 2024 Feb; 12(2): 23259671241227883. PMCID: PMC10896053
Published online 2024 Feb 26. doi: 10.1177/23259671241227883 PMID: 38410168

Comparison of Conventional Dose Versus Superdose Platelet-Rich Plasma for Knee Osteoarthritis: A Prospective, Triple-Blind, Randomized Clinical Trial

Sandeep Patel, MS,*† Shivam Gahlaut, MS,† Tarkik Thami, MS,† Devendra Kumar Chouhan, MS,† Ashish Jain, MD,‡ and Mandeep Singh Dhillon, MS†

Review > Arthroscopy. 2024 Mar 19:S0749-8063(24)00206-8. doi: 10.1016/j.arthro.2024.03.018. Online ahead of print.

A Greater Platelet Dose May Yield Better Clinical Outcomes for Platelet-Rich Plasma in the Treatment of Knee Osteoarthritis: A Systematic Review

William A Berrigan [1], Zach Ballowitz [2], Anna Park [3], Aakash Reddy [4], Ryan Liu [4], Drew La

Affiliations + expand

PMID: 38513880 DOI: 10.1016/j.arthro.2024.03.018

Meta-Analysis > Am J Sports Med. 2023 Jul;51(9):2487-2497. doi: 10.1177/03635465221095563. Epub 2022 Jun 7.

The Use of Intra-articular Platelet-Rich Plasma as a Therapeutic Intervention for Hip Osteoarthritis: A Systematic Review and Meta-analysis

Anthony Lim [1], John B Zhu [1], Vikas Khanduja [2]

Affiliations + expand

PMID: 35971803 PMCID: PMC10353029 DOI: 10.1177/03635465221095563

OGDEN CLINIC
We specialize in you.

PRP: Knowledge Gaps

- Leukocyte rich vs. poor
- Granulocytes vs. agranulocytes
- Platelet concentration, platelet:leukocyte ratio
- Post-procedure protocols
  - Rehabilitation intensity/timing
  - Immobilization vs early movement
  - NSAIDs OK?
- Number of injections to perform

OGDEN CLINIC
We specialize in you.

PRP: Practicalities

- Often significant discomfort in the days following administration (more mild generally with joints)
- Usually calming to baseline within 10-14 days
- Maximal effect is often 2-6 months after administration
- Because of the downtime, considered an “off-season” treatment
- Should ideally be combined with rehabilitation protocols

OGDEN CLINIC
We specialize in you.

PRP

Contraindications

- Active infection
- Cancer?
- NSAIDs?
- Anti-coagulants?
- Hematologic disease?

Adverse Effects

- Same as other injections therapies (infection, though this is typically much less common)
- Discomfort following injection
- Hyperacute response

OGDEN CLINIC
We specialize in you.

PRP: Personal Experience

- 50 y/o female with right lateral epicondylitis
  - Took 12+ weeks to start noticing improvement
  - Desired contralateral side treatment about 1 year later
- 48 y/o male with left trochanteric tendinitis
  - Pain-free in 4 weeks
- 67 y/o female with left knee OA
  - Relief with 1 injection for about 1 year, repeated twice

OGDEN CLINIC
We specialize in you.

Orthobiologics: Horizons

- Exosomes
- Allogeneic cells
- Stimulation of instrinsic stem cells
- True stem cells (e.g. human skeletal stem cell)
- Immune cell sub-type roles, selective activation
- Gene editing (CRISPR)
- Isolate individual or selective growth factors/cytokines

OGDEN CLINIC
We specialize in you.

Regenerative Medicine

- Can stimulate innate healing responses
- Fills a treatment gap for tendinopathy and osteoarthritis
  - "Another tool in the toolbox"
- Significant knowledge gaps for ideal utilization
  - Exploited to make false claims
- Tremendous potential
  - Right patient, right drug, right dose, right route, and right time

OGDEN CLINIC
We specialize in you.

Thank you

Brett Martindale, MD

Brett.Martindale@ogdenclinic.com

OGDEN CLINIC
We specialize in you.