RMTI Meeting (Jupiter, FL)

IPG Medical / ACC BIO

Laser Treatment of Musculoskeletal Tissue for Pain Reduction with Regenalase™

June 7, 2025

For more information visit AcCELLerated Biologics: www.accelleratedbiologics.com

MKT-00009 Rev A

Regenalase Product Summary

- Efficacious and affordable laser system to treat soft tissue (including cartilage) defects (e.g., degenerative disk disease in spinal disks and osteoarthritis of articulate joints)
- Device comprises two lasers:
  - 1550 nm 10 W Er fiber laser for minimally invasive nano-fractional surgery of cartilage
  - 980 nm 30 W diode laser for adjunct non-invasive photobiomodulation therapy
- Full system also includes:
  - Single-Dot disposable fiber cables for minimally invasive surgery
  - Photobiomodulation kit with delivery cable and set of attachments for photobiomodulation therapy
- Can be used both in office and OR settings

Regenalase System Specifications

	Laser A	Laser B
Wavelength, µm	0.98	1.55
Operating modes	Pulsed/CW	Pulsed/CW
Max power, W	30	10
Delivery system	Optical fiber cable + attachments	Surgical fibers 400 and 600 µm
Principal application	Non-invasive deep tissue heating and photobiomodulation	Minimally invasive cartilage regeneration in spinal disks and articulate joints
Dimensions HxWxD, mm	270 x 270 x 270	
Weight, kg	7	

FDA cleared indications of Regenalase (K233344)

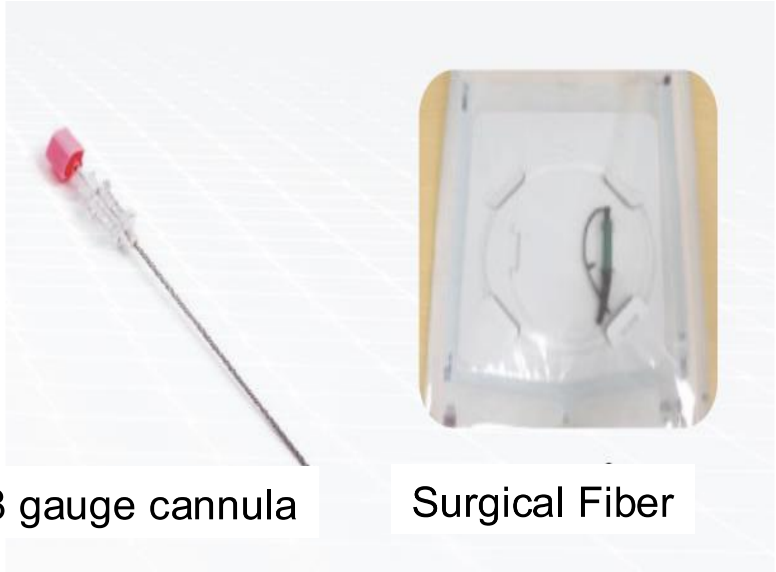
- 1550nm laser: Indicated for use in surgical applications requiring the vaporization, incision, excision, ablation, cutting and hemostasis, or coagulation of soft tissue, including meniscus cartilage, in conjunction with an imaging modality for medical specialties including: General Surgery, Orthopedics, Podiatry, Arthroscopy and Spinal Surgery.

- 980nm laser: Indicated for use to provide heating for the purpose of elevating tissue temperature for selected medical conditions such as temporary relief of pain, muscle spasms, and increase in local circulation.

Treat Joint Collagen using Fractional Technology

- A fractional treatment creates microscopic zones of thermal coagulation of articulated cartilage surrounded by healthy tissue.

- Laser energy is delivered via a 400 um surgical fiber that is inside an 18 gauge cannula.

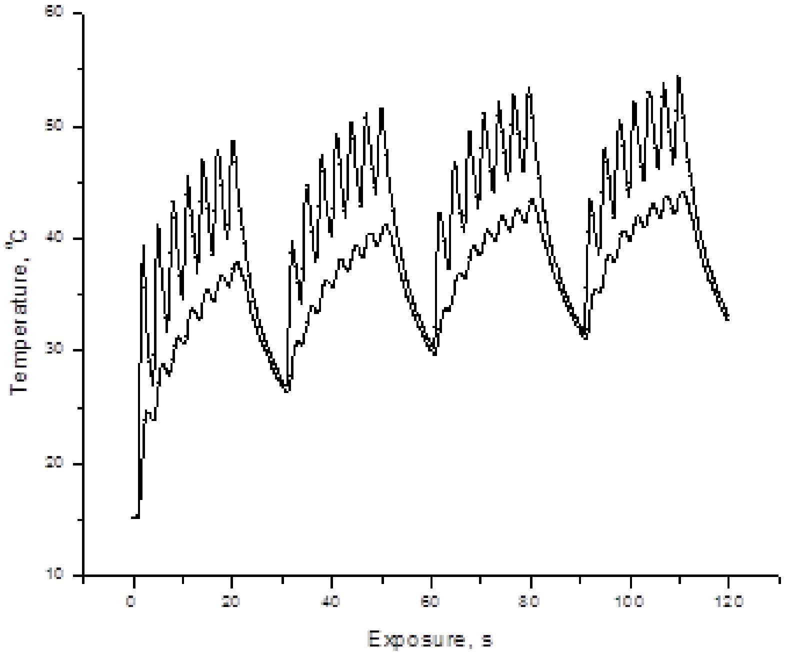


18 gauge cannula

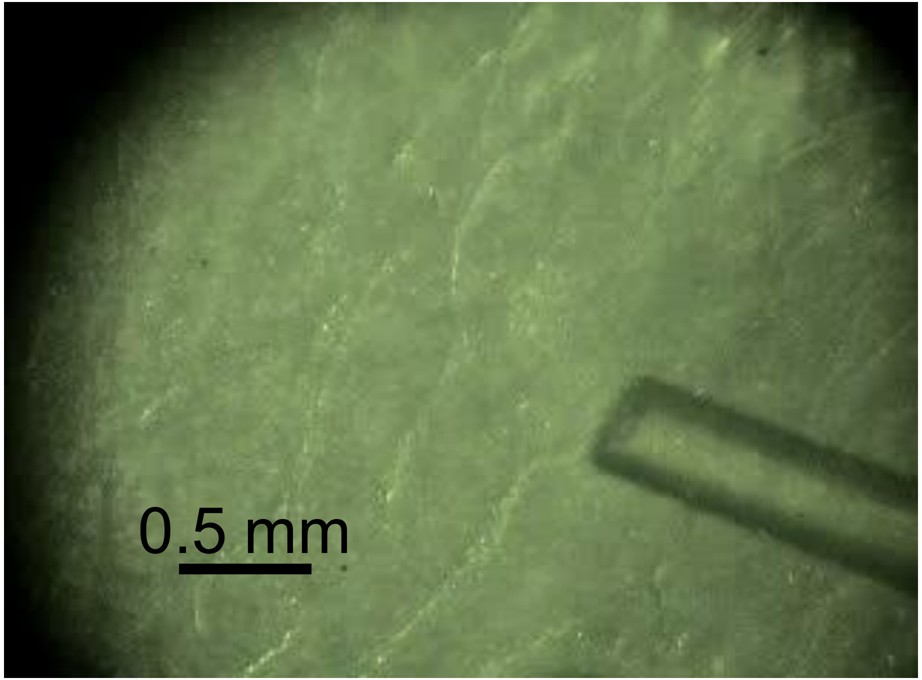
Surgical Fiber

Ex Vivo Laser Treatment Action on Cartilage

Laser radiation 1550 nm, peak power 0.7 W, pulse repetition rate 1 Hz



Laser-induced thermo-mechanical oscillations in vertebral disc cartilage

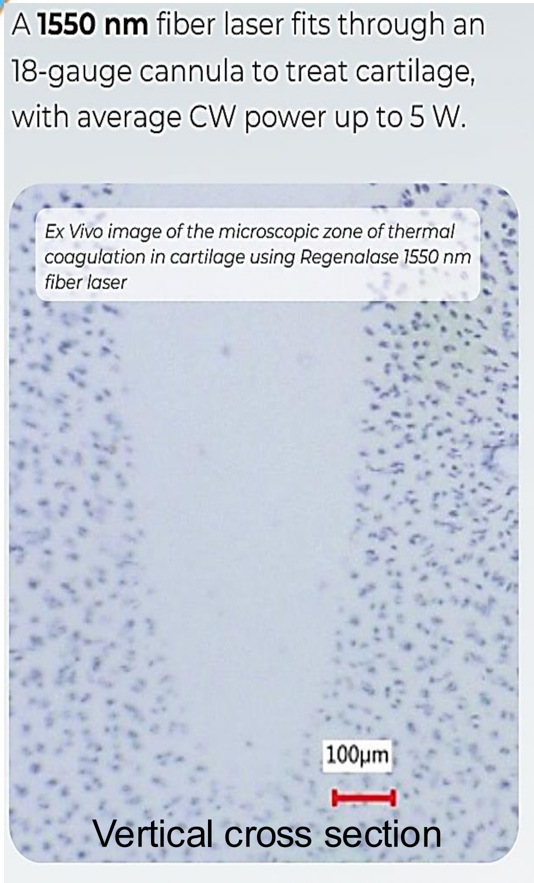


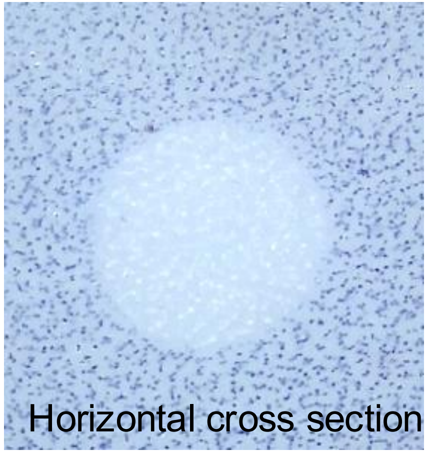
Upper curve - central region of laser spot

Lower curve - point ~ 1 mm from the center

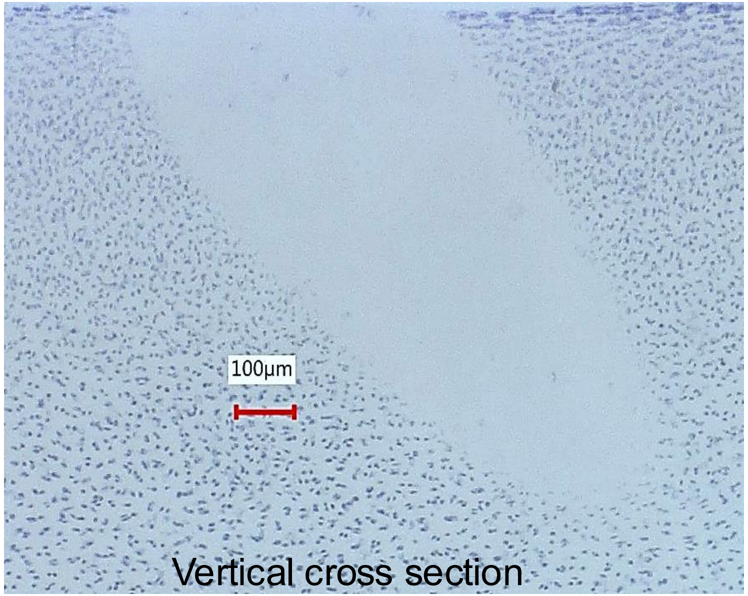
Single Fiber: Single Microscopic Coagulative Zone in cartilage (histology with NBTC stain)

Precise, focused laser beams to create tiny, microscopic columns of coagulated cartilage





Vertical delivery (at 90 deg angle to tissue surface)



Tilted delivery (at 45 deg angle to tissue surface)

Animal study data (Atomic-Force Microscopy)

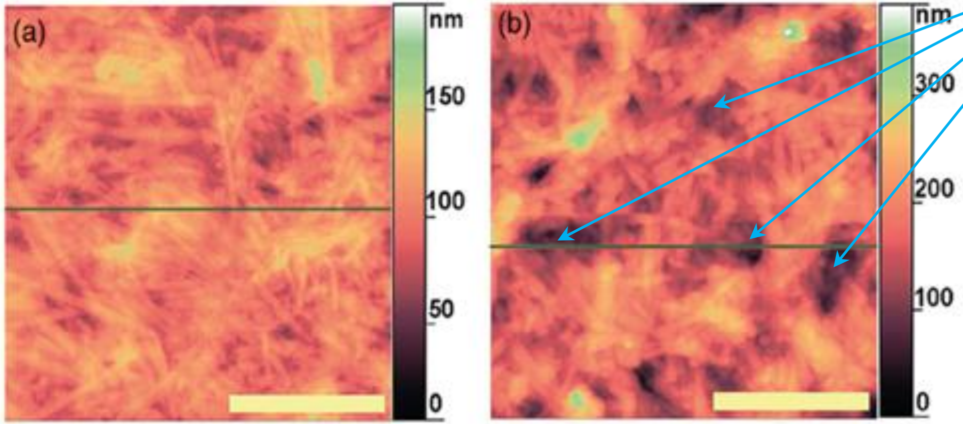
Formation of nano-pores in the cartilage matrix

Untreated articular cartilage

Laser-treated articular cartilage

Atomic Force microscopy

Nano-pores

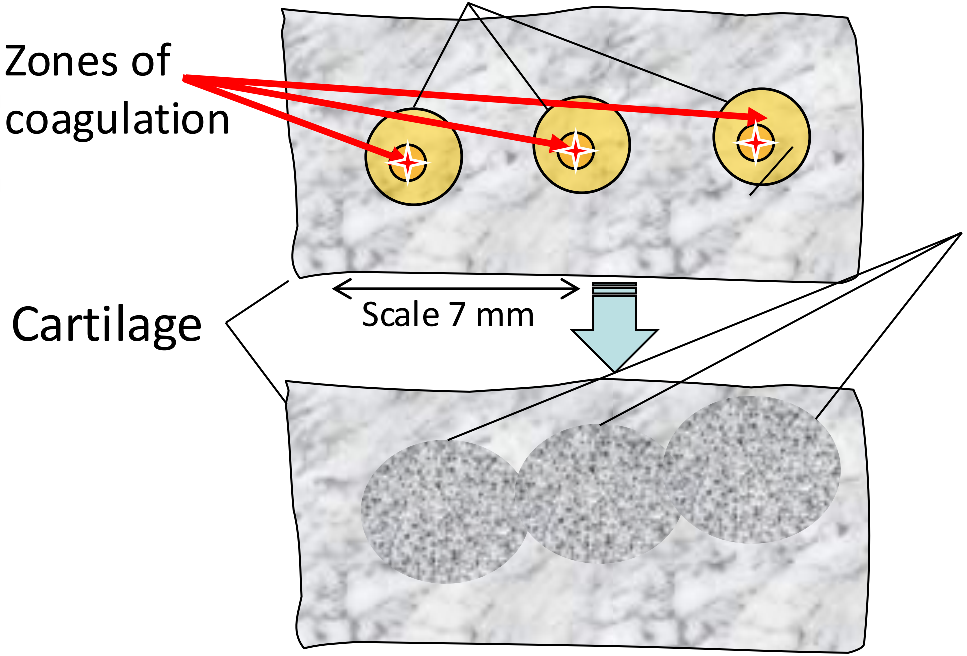


E Sobol, et al, "Laser in orthopaedic surgery" in the book "Lasers for medical applications: Diagnostics, therapy and surgery", 2013.

E Sobol, et al, Laser-induced micropore formation and modification of cartilage structure in osteoarthritis healing, Journal of Biomedical Optics, 2017

Mechanisms of Nano-Fractional Laser Treatment

Laser action creates local and remote, short-term and long-term mechanical stresses



Laser-induced coagulation and thermo-mechanical stresses initiate cartilage regeneration processes via three-fold effect:

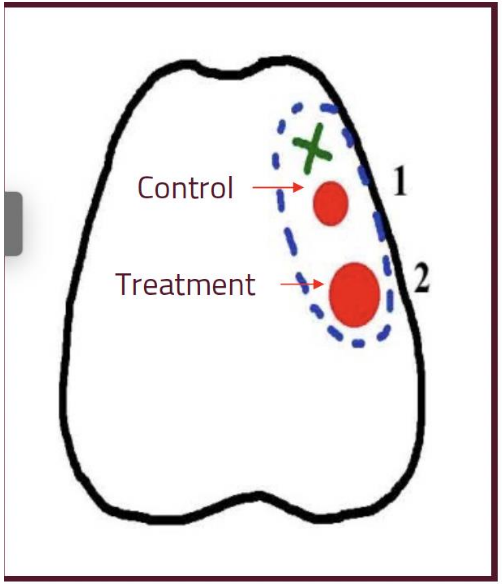
1) Induce healing response on coagulated cartilage
2) Induce nano sized pores in ECM to facilitate convective/diffusion-driven exchange of nutrients & metabolic waste products between chondrocytes and synovial fluid
3) Induce mechano-transduction signaling in chondrocytes

Animal Study 1: Regeneration of Hyaline Cartilage

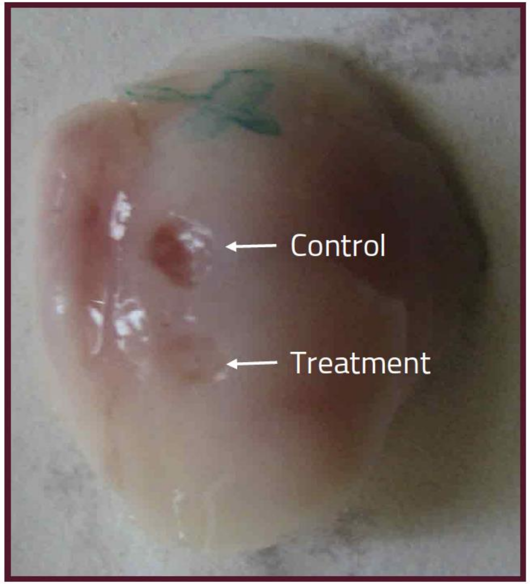
Cartilage Laser / Cell Therapy

Mini Pig Trial

Day 1 :Method & Surgery:
Two Cartilage defects created on the same joint



Day 60: Evaluation & Surgery :
One Defect Treated
One Defect as control



Day 120: Sacrifice & Evaluation
Histologic Analysis:
Histology and Pictures

Treatment side:
Filling of defect ; formation of Lamina Splendens
(marked with the arrow)

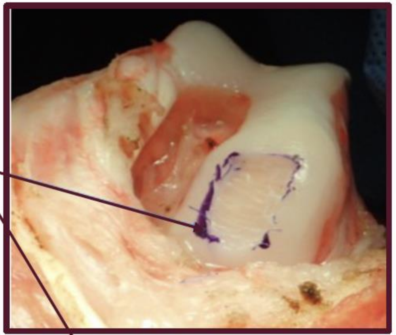
Animal Study 2: Regeneration of Hyaline Cartilage

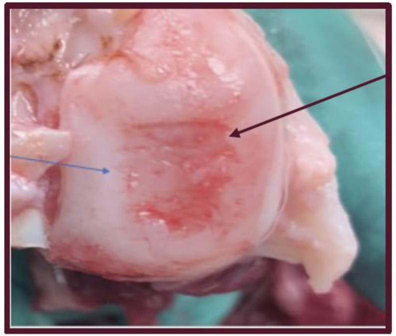
Cartilage Laser / Cell Therapy

Goat Trial

Method:

Day 1 Defect Surgery: Two Cartilage Defects Created on Different Joints.



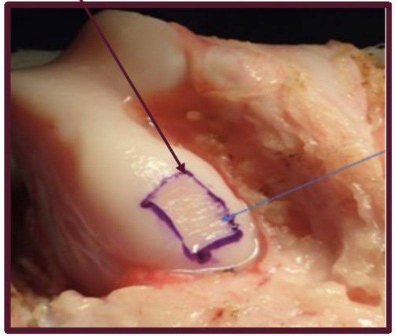


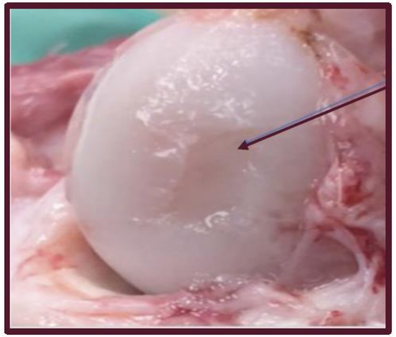
__Histology Control Defect__

"The defect site appears to have reddened, rough areas consistent with loss of hyaline cartilage ."

Defect Size:

11mm X 6mm X .75 mm





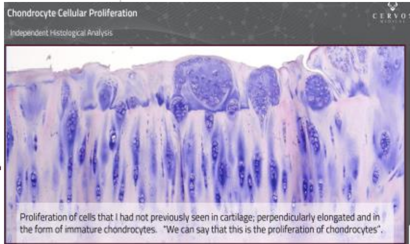
__Histology Treatment Defect__

"There is complete cartilage coverage of defect."

Day 60 Surgery:

- One Joint Treated
  Laser and Marrow
- One Joint as Control

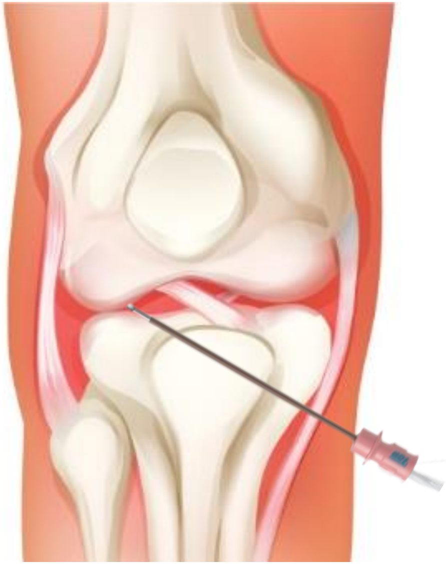
Day 120 surgery:
Histology and Pictures



Treatment of Knee Cartilage with 1550 nm Laser

IPG MEDICAL

- A cannula with surgical fiber is inserted into the knee joint, contacting target cartilage for fractional treatment
- Visual guidance is provided by nanoscope or ultrasound imaging



Clinical History 2006 – today

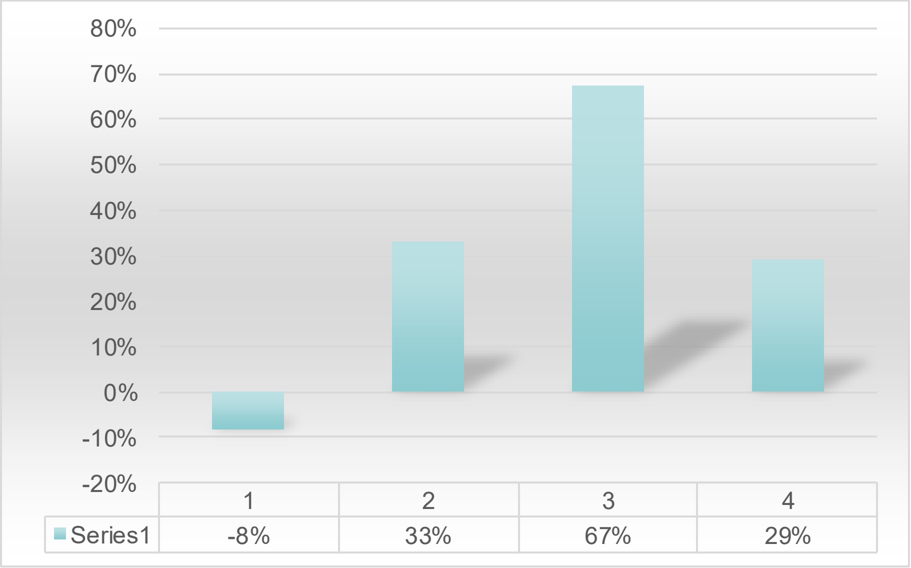
Title	Study ID	Year started	PI(s)	# of subjects	Status
Laser reconstruction of cartilage for treatment of DDD with disc instability	Spinal Discs 1	2006	A. Baskov (RU)	475	Completed [Ref 1]
Laser reconstruction of cartilage in knee joint	Knee 1	2014	A. Baskov (RU)	12	Completed
Combined Effect of IPG Medical Laser and Bone Marrow Grafting on Cartilage Defects of the Knee	Knee 3	2019	M. Scarpone K. Kyriakides (US)	52	On-going
Combined Effect of Laser and Bone Marrow Grafting in treatment of osteoarthritis	Knee 2	2020	A. Baskov (RU)	24	On-going

Preliminary summary of knee studies

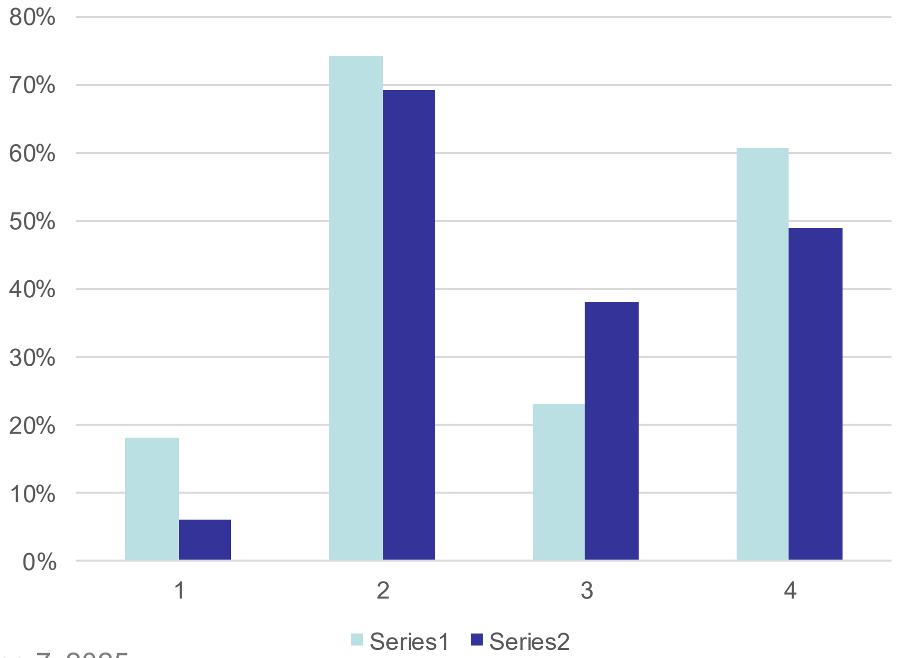
- The overall pain score decreased by several grades on the VAS. Maximum pain and average pain scores decrease is statistically significant at the 12 months FU.
- Categories of quality of life assessment SF-36 related to physical health demonstrate positive dynamics. Pain, emotional well being, and general health scores increased statistically significant at the 12 months FU.
- The total score on the KOOS scale also increased, indicating a decrease in pain and an improvement in the condition of the knee. Nevertheless, the increase is not statistically significant at the 12 months FU.
- 90% of patients in treatment group showed improved in pain and function at 6 and 12 months follow-up .
- No side effects have been reported.

Study 3: Preliminary results, 6 month FU, 90% responded

Wall Squats 6 Months

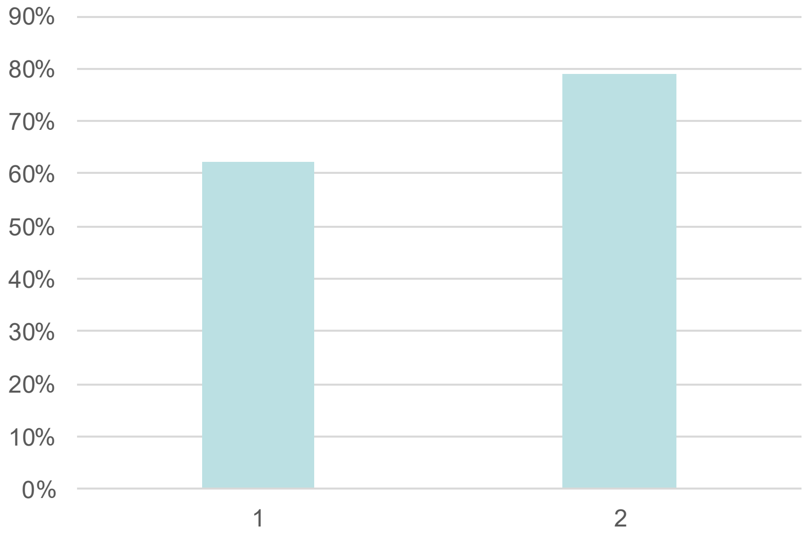


Pain Score 6 months

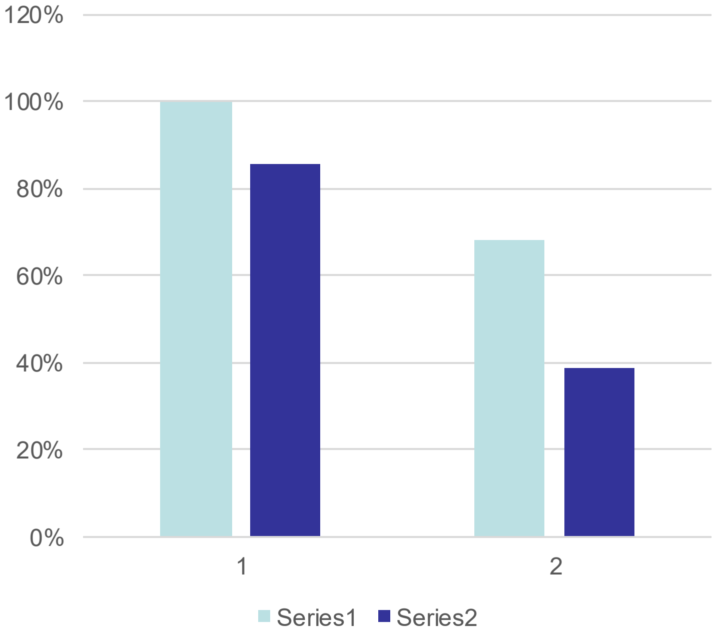


Study 3: Preliminary results, 12 month FU, 90% responded

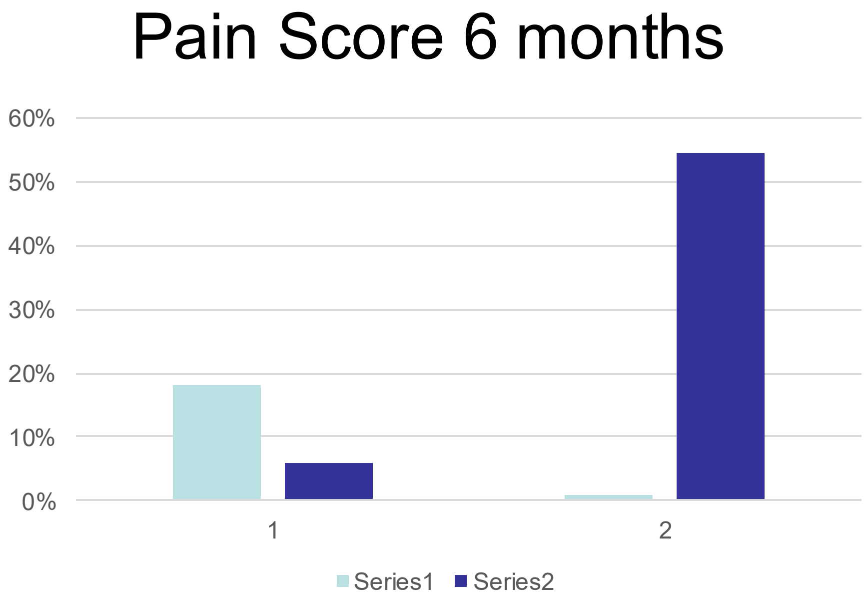
Wall Squats 12 Months



Pain Score 12 months



Study 2 Contralateral knee



The contralateral knee showed a 100% improvement in best pain and an 86% improvement in worst pain at 12 months. N=3

Individual Cases (courtesy of Dr M Scarpone)

- **Patient: EL • AGE: 62**

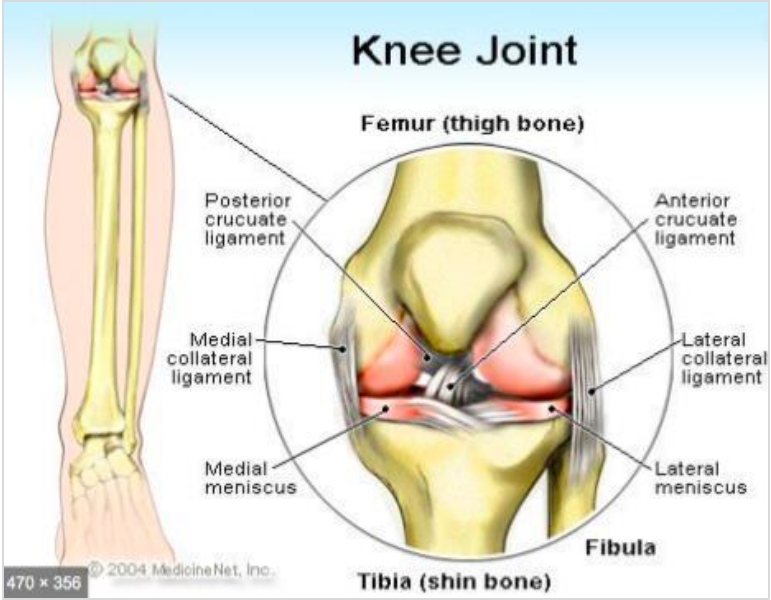
- **BMI:** 34

LEVEL: Stage 3, 4

MEDS: NSAID's daily,
HA & cortisone injections

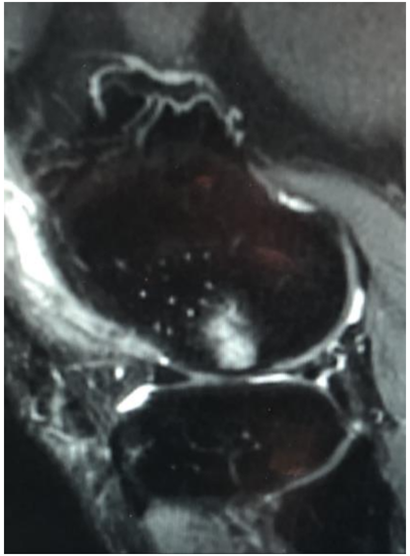
HISTORY. Non-repaired full thickness tear ACL. Suggested by HSS physician he needed a knee replacement

CONDITION: Unrepaired ACL leading to Bone Edema & Cartilage Loss. MEDIAL Femoral Condyle

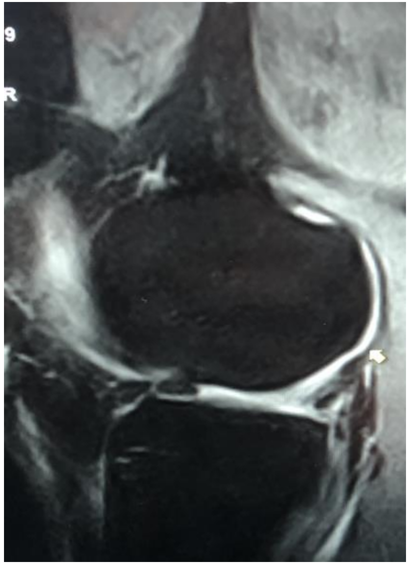


Individual Cases (courtesy of Dr M Scarpone)

- Patient: EL • AGE: 62
- Therapy: BMA injection IA, IO and fractional laser therapy.
- Outcome: Resolution of marrow edema and improved cartilage thickness medial compartment
- No longer takes pain meds. Daily activity and sleeping without pain



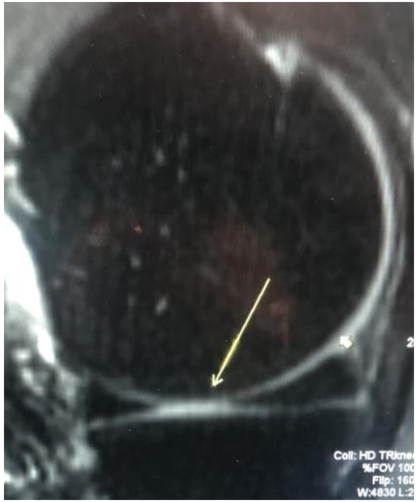
Before: Joint space narrowing



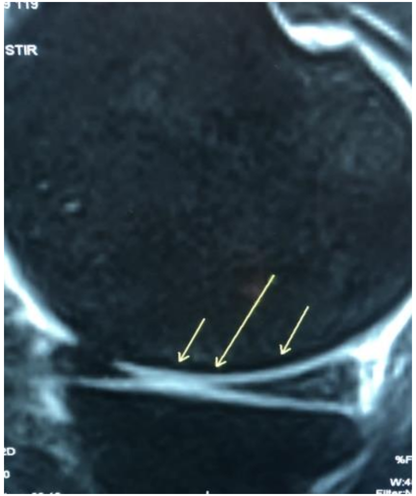
6 months post: Increase in joint space

Individual Cases (courtesy of Dr M Scarpone)

- Patient: EL • AGE: 62
- Therapy: BMA injection IA, IO and fractional laser therapy.
- Outcome: Resolution of marrow edema and improved cartilage thickness medial compartment
- NOTE: Compartment of knee that had stage 1 OA but was untreated had no change. Treated compartment that had stage 3,4 had significant improvement.



Before:



6 months post:

Individual Cases (courtesy of Dr M Scarpone)

- **Patient: MB • AGE: 52**

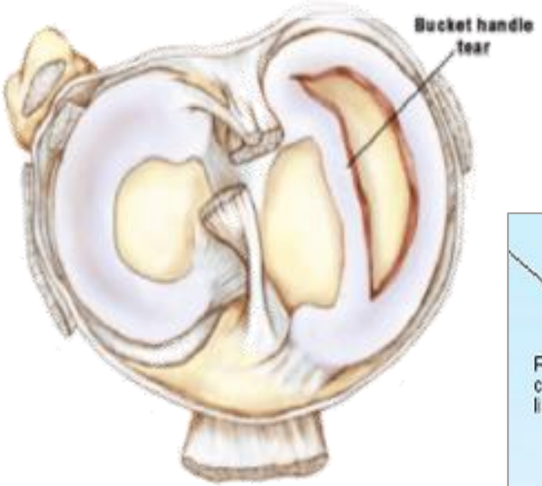
- BMI: 24

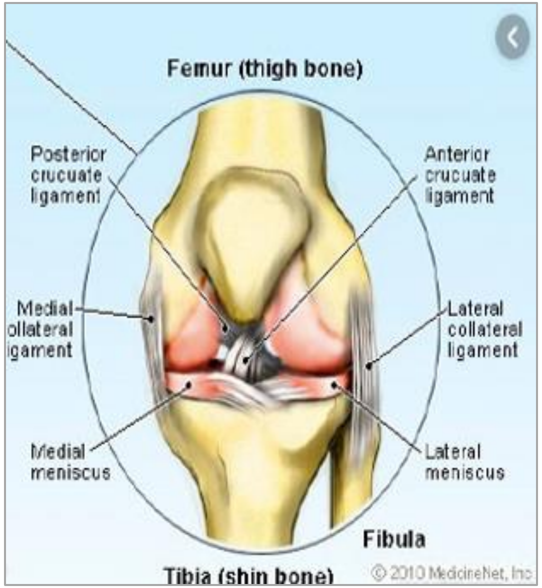
  LEVEL: Stage 3,4 OA

  MEDS: NSAID's almost daily.

  HISTORY:
- Right knee replacement.
- Left knee ACL re-construction
- Meniscal surgery (tissue excised).

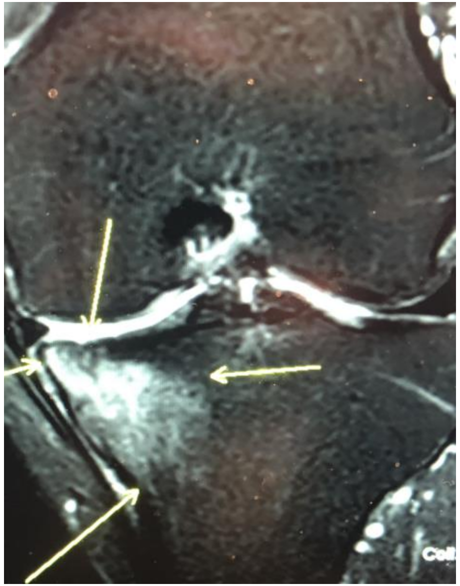
CONDITION: Swelling of subchondral bone. Cartilage loss. Suggested by Lahey Clinic that he needed a knee replacement



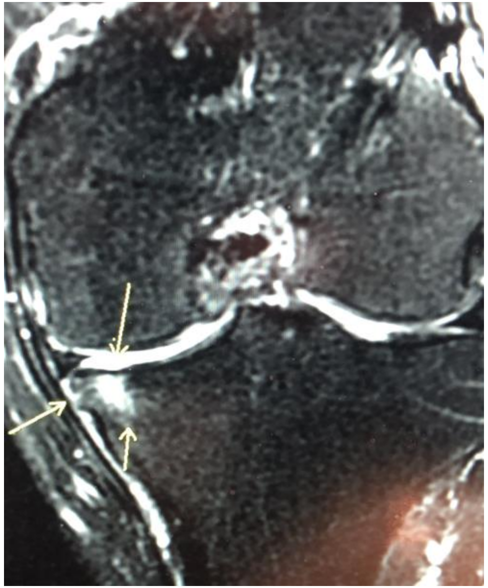


Individual Cases (courtesy of Dr M Scarpone)

- Patient: MB • AGE: 52
- Therapy: BMA injection IA, IO and fractional laser therapy.
- Outcome: Resolution of marrow edema and improved cartilage thickness tibia plateau
- No longer takes pain meds or wears brace. Daily activity and sleeping without pain



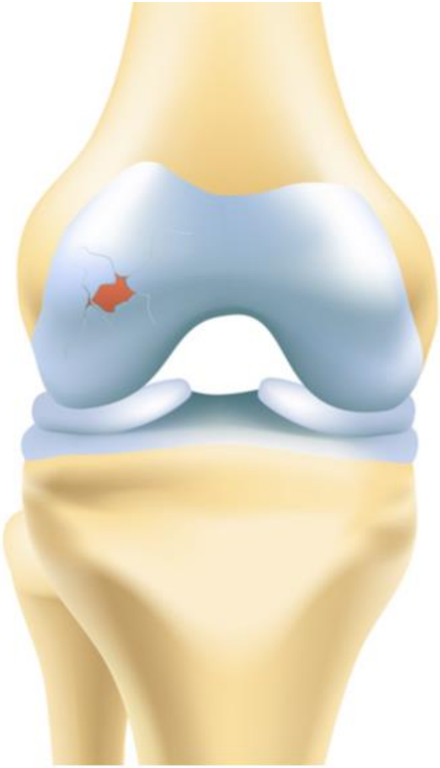
Before:



6 months post:

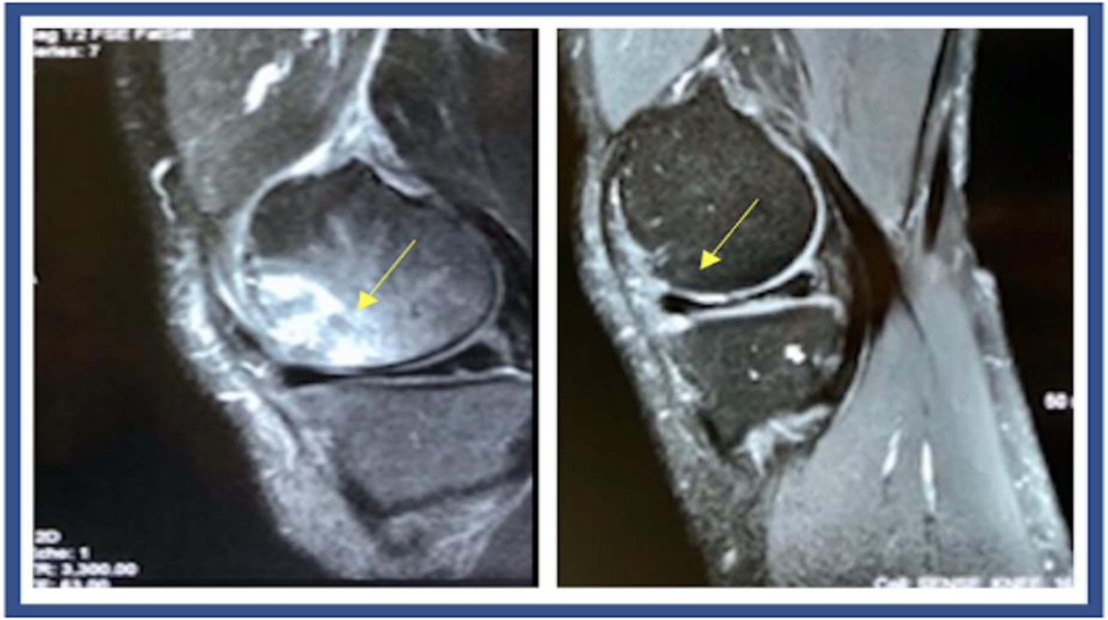
Individual Cases (courtesy of Dr M Scarpone)

BMI:	29
LEVEL:	Stage 3; femoral condyle.
MEDS:	Intermittent over the counter PRP, marrow & cortisone injections
HISTORY.	Increasing pain during daily activity
CONDITION	Bone Edema & Cartilage Loss



Individual Cases (courtesy of Dr M Scarpone)

- Patient: BM • AGE: 57
- Therapy: BMA injection IA, IO and fractional laser therapy.
- Outcome: Resolution of marrow edema and improved cartilage thickness
- Reduced pain meds. Daily activity and sleeping with less pain



Before: **6 months post:**

Clinical Guidelines

- **Clinical Guidelines for using IPG Medical Regenalase System for Treatment of Cartilage Defects in Knee Joints in an Office or Outpatient Setting have been developed and are available upon request**

Clinical Guidelines – Table of Contents

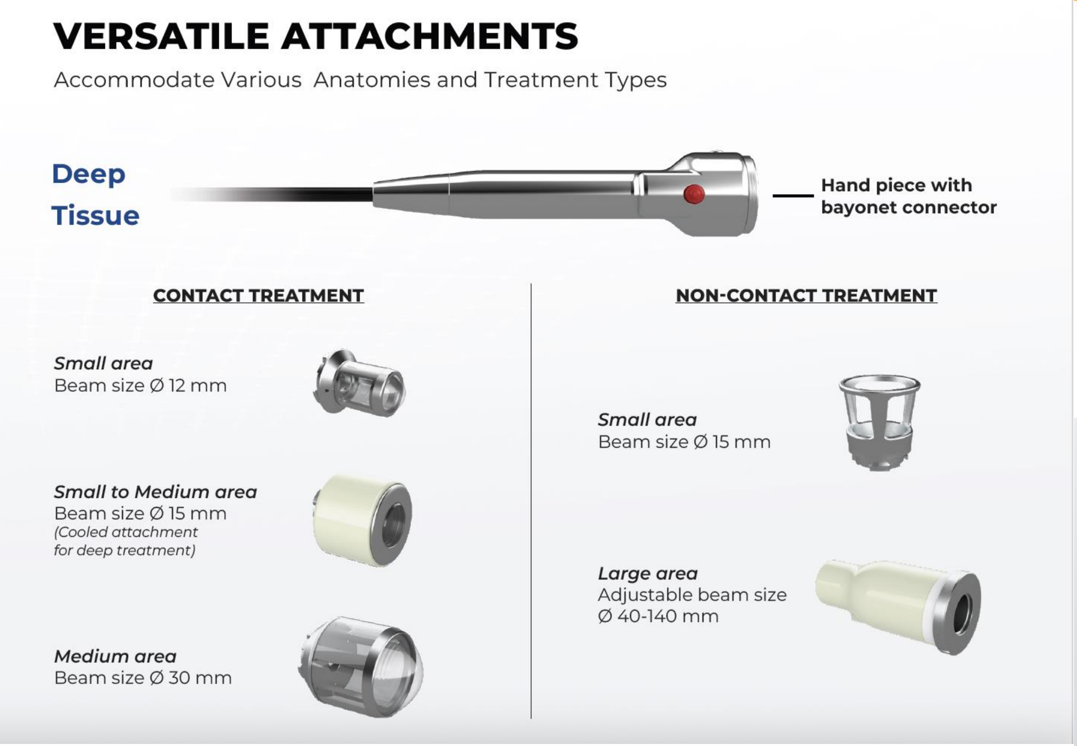
Main Publications on Fractional Laser Regeneration of Cartilage

IPG MEDICAL

1. A V. Baskov , I A. Borshchenko, A B. Shekhter , V A. Baskov , A E. Guller and E N. Sobol, Long Term Clinical Results in Laser Reconstruction of Spine Discs, J Spine 4 , 2015: 210.doi:10.4172/21657939.1000210
2. V.A. Baskov, I.A. Drakin, O.N. Dreval, A.V. Baskov, A.B. Shekhter, E.N. Sobol, A.I. Drakin, Nonablative laser irradiation of the intervertebral discs as a method of reduction of recurrent disc herniations, Pacific Medical Journal, 2015, No. 4, p. 29–31.
3. E. Sobol, A. Shekhter, A. Baskov, Chapter 21 "Laser in orthopaedic surgery" in the book "Lasers for medical applications: Diagnostics, therapy and surgery", Edited by Helena Jelinkova, Woodhead Publishing, Cambridge, UK, 2013
4. E. Sobol, A. Shekhter, A. Guller, O. Baum, A. Baskov, Laser-induced regeneration of cartilage, Journal of Biomedical Optics 16(8), 080902, 2011
5. E. Sobol, A. Sviridov, A. Omeltchenko, O. Baum, A. Baskov, I. Borchshenko, V. Golubev, V. Baskov, Optical methods for diagnostics and feedback control in laser-induced regeneration of spine disc and joint cartilages, Proc. SPIE 7897, 78971G, 2011.
6. E. Sobol, O. Zakharkina, A. Baskov, A. Shekhter, I. Borschenko, A. Guller, V. Baskov, A. Omelchenko, A. Sviridov. Laser engineering of spine discs. Laser Physics 2009; 19 (4):825-835.
7. E. Sobol, A. Baskov, V. Bagratashvili, O. Zakharkina, I. Bortschenko, N. Vorobieva, A. Shekhter, V. Baskov. Laser Reconstruction of the Intervertebral Discs. Proc. Interdisciplinary Congress "World Spine III", Rio de Janeiro, Brazil, 2005; p. 2.
8. E.Sobol , A.Baskov, A.Shechter , N.Vorobieva, A.Omelchenko O.Zakharkina, V.Baskov, M.Mertig , W.Pompe, Laser-induced growth of cartilage and bony tissues on the rabbit intervertebral discs. Proc. of the 12th World Congress of Neurosurgery, Sydney, Australia, 2001, pp 140-143.
9. E.Sobol, A.Baskov, A method and a system for creating controllable non-uniformities of structure and mechanical stress in cartilaginous tissues as well as a method for administering medicaments and other useful substances for controllable activation of regeneration processes, patent RU 2412114, 2006.
10. E Sobol, O Baum, A Shekhter, S Wachsmann-Hogiu, A Shnirelman, Yu Alexandrovskaya, I Sadovskyy, V Vinokur, Laser-induced micropore formation and modification of cartilage structure in osteoarthritis healing, 2017, Journal of Biomedical Optics 22 (9), 091515
11. V.Bagratashvili, A.Baskov, I.Bortschenko, N.Ignatieva, A.Omelchenko, Y.Ovchinnikov, A.Shekhter, E.Sobol, V.Svistushkin, A.Sviridov "Laser Engineering of Cartilage" Eds. V.Bagratashvili, E.Sobol, A.Shekhter, FISMATLIT, Moscow, 2006.
12. E. Sobol, A. Baskov, A. Shekhter, I. Borschenko, O. Zakharkina. Laser regeneration of spine discs cartilage: mechanism, in-vivo study and clinical applications. Proceedings of Light-Activated Tissue Regeneration and Therapy Conference; R. Waynant and D. R. Tata eds.; Springer 2008; pp. 259-266.
13. A.Baskov, A.Shechter, E.Sobol, N.Vorobieva, A.Gavril'chak, A.Omel'chenko, V.Baskov, O.Zakharkina, F.Feldchtein V.Kamensky, R.Kuranov. Effects IR laser irradiation on regeneration processes in spine disc cartilage. Laser Medicine 2002, V.6, 2, 18-23.
14. A.B.Shekhter, V.A.Baskov, O.L.Zakharkina, A.E.Guller, I.A.Borschenko, I.Yu.Kolyshev, G.J. Kapanadze, A.V. Baskov, E.N. Sobol, Simulation of the intervertebral discs degenerative changes (spine osteochondrosis) in rabbits: macroscopic and histological study , Biomedicina, 2009, 2, pp. 70-80.
15. A.Tokareva, A.Baskov, A.Shekter, E.Sobol, Proc. 13th World Congress ICRS, Sorrento-Naples, Italy, 2016
16. Yu.Alexandrovskaya, O.Baum, A.Shekhter, E.Petersen, O.Tiflova, A.Dmitriev, V.Ulyanov, V.Svistushkin, L.Selezneva, E.Sobol, Mechanisms of laser activation of chondrocytes in osteoarthritis healing, Laser Physics Letters, 2018, V.15 (8), P. 085601.
17. E. Sobol, A. Baskov, I. Borshchenko, A. Shekhter, Low-invasive reconstruction of spine discs under thermo-mechanical effect of fiber laser, Proc. SPIE, Clinical and Translational Neurophotonics 2018 10480, 1048005

PhotoBiomodualtion Module

MEDICAL



Deep Tissue Laser Therapy:

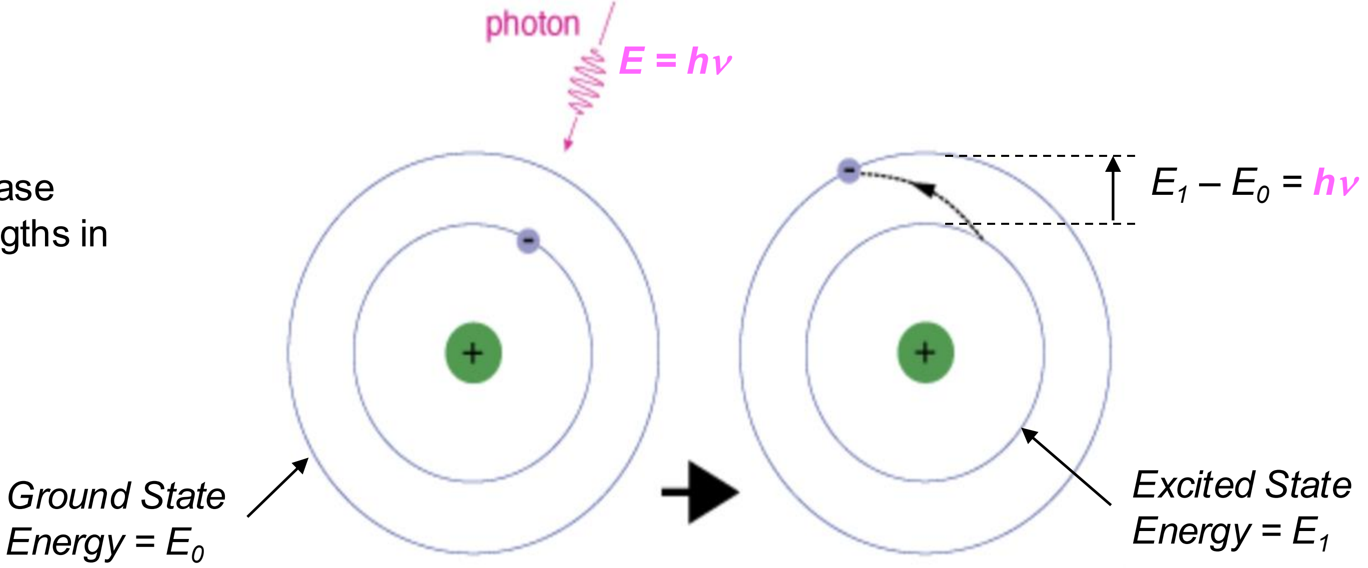
Benefits	Pain relief, non-surgical, an alternative to NSAIDs.
Clinical Applications	Acute or chronic tendinopathies, sprains and strains, neck and back pain.
Evidence	Over 400 clinical and over 4,000 laboratory studies have been published using deep tissue laser therapy.

Biological Molecules: Chromophores

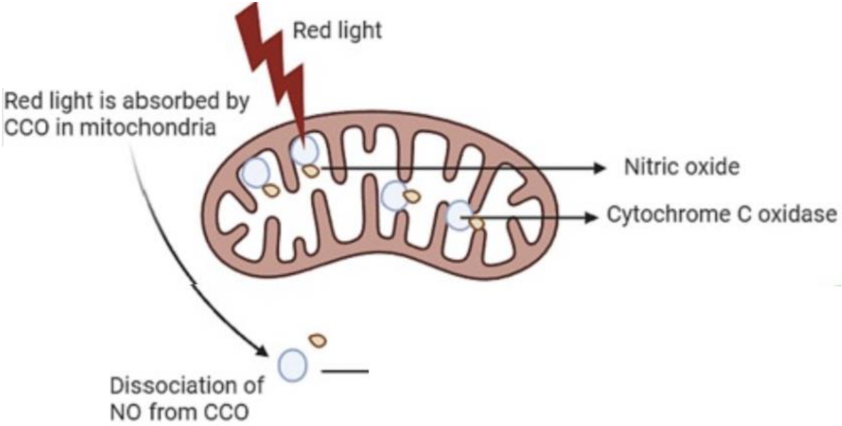
- A biological molecule can absorb only the photon energy, E, of the right frequency, ν, that provides the exact energy to raise a molecule's outer (ground state) electron to the next higher energy level (= excited state).

- The molecule's added energy can facilitate conformational change or interactions with its environment as the excited electron transitions

Eg., Cytochrome C Oxidase Absorbs photon wavelengths in range: 810 – 980 nm



Cytochrome c oxidase chromophore



NIR Light. ⟹ cell membrane receptors ⟹ cytochrome c oxidase ⟹ Release Nitric Oxide ⟹ oxygen uptake ⟹

Aerobic ATP ⟹ opening of calcium channels ⟹ increased intracellular calcium concentration.

Nitric Oxide (NO)

NO acts as a signaling molecule to regulate oxygen consumption based on cellular needs, ensuring that ATP production is matched to the available oxygen supply.

NO occupies the same site on cytochrome c oxidase (Complex IV) used by oxygen to create ATP so it acts as a downward regulator of ATP production.

When cytochrome c oxidase is exposed to red light, the bound nitric oxide is released, making the site available for oxygen binding. This leads to increased ATP production.

In addition, the resulting elevated level of extra-cellular NO improves vasodilation.

Red light may also directly influence mitochondrial function within red blood cells, optimizing their ability to bind and release oxygen as well as release bound NO

Photobiomodulation clinical guidelines

PBM: Important to optimize the wavelength and pulse of the light to reach the depth of the target tissue and the energy of the photon to correspond to the target chromophore.

Periodic Visits: This therapy requires periodic follow up. This is NOT a one and done therapy.

Protocol: Use both CW and super pulse protocol each at 5 minutes.

Pre-set: The pre-set menu will address 95% of your needs

In office treatment protocol Laser+PRP

PRP Characterization- Use a two-spin protocol and start with at least 60 mL, preferably 120 mL to create the dose needed per the recent literature.

Order of Procedure: Administer the laser therapy first and then the PRP.

Delivery: Use the same 18-gauge cannula used as the working channel to deliver the fiber to also inject the PRP

Guidance: Use Ultrasound to help visualize the knee joint and surrounding tissues, allowing for precise placement of the PRP injection into the affected area.

Bilateral knee OA: Patients with bilateral knee OA, do not dilute the PRP across both knees. Treat both knees with laser and one knee with PRP. Follow up visit treat the other knee with PRP as needed.

Deep Tissue Laser: Regularly scheduled Periodic follow up using the Deep Tissue laser as needed. Once per week minimum, twice per week recommended

Follow up

Welcome to observe live treatment by
Drs. Tortland & Scarpone
at 5PM (after lab session)

Thank You!