



# Laser



Soheil Sohani PhD PT

Assistant professor of IUMS

**TABLE 6–3. Ineffective Applications of Low Level Laser**

Condition	Outcome Variables	Reference/Type of Study
Fibromyalgia/ myofascial pain syndrome	Pain, functional measure, AROM	Dundar et al, 2007 <sup>29</sup> (RCT)
Spine (lumbar)	Pain, ROM, modified	Ay et al, 2010 <sup>33</sup> (RCT)
TMJ	Pain, mandibular ROM	Melis et al, 2012 <sup>34</sup> (SR) Petrucchi et al, 2011 <sup>35</sup> (SR) Tengrungsun et al, 2012 <sup>36</sup> (SR)
Shoulder pain/ dysfunction	Pain, AROM	Bal et al, 2009 <sup>44</sup> (RCT) Dogan et al, 2010 <sup>45</sup> (RCT) Vecchio et al, 1993 <sup>46</sup> (RCT) Yeldan et al, 2009 <sup>47</sup> (RCT)
Carpal tunnel syndrome	Pain, strength, functional measure NCV, nerve cross sectional area	Tascioglu et al, 2012 <sup>52</sup> (RCT)
Achilles tendonitis	Pain, functional measure	Tumulty et al, 2012 <sup>54</sup> (RCT)
Degenerative joint disease (knee)	Pain, functional measures, ROM	Toscioglu et al, 2004 <sup>58</sup> (RCT) Bjorndal et al, 2003 <sup>59</sup> (SR)
Degenerative joint disease (hand)	Pain, functional measure, ROM	Meireles et al, 2010 <sup>60</sup> (RCT)
Wounds	Wound size, pain	Lucas et al, 2000 <sup>64</sup> (SR) Leclere et al, 2010 <sup>67</sup> (RCT)

RCT= randomized controlled trial; SR = systematic review.



**TABLE 6–2. Effective Applications of High-Intensity Laser**

Condition	Outcome Variables	Reference/Type of Study
Temporomandibular dysfunction	Pain, mandibular AROM/PROM	Marini et al, 2010 <sup>68</sup> (RCT)
Spine (low back)	Pain, functional measure	Fiore et al, 2011 <sup>70</sup> (RCT)
Shoulder pain/ dysfunction	Pain, ROM, functional measure	Santamato et al, 2009 <sup>8</sup> (RCT)

AROM = active range of motion; PROM = passive range of motion; RCT = randomized controlled trial.

**TABLE 6–5. Contraindications for Laser and LED/SLED**

Contraindication	Explanation
Direct eye exposure	Retinal damage due to concentrated laser light energy
Pregnancy	Avoid treatment of the low back and pelvic/abdominal region during pregnancy because the effects of any light therapy during pregnancy are unknown.
Active malignancy	Avoid treatment over areas of active malignancy because known molecular, cellular, metabolic, and circulatory effects of laser and LED/SLED application may exacerbate malignancies.
Active hemorrhage	Avoid treatment over areas of abnormal bleeding because increased circulatory response and vasodilation with laser and LED/SLED application may increase hemorrhage.
Open growth plates	Avoid use of laser and LED/SLED over open growth plates because exposure may interfere with active growth plates in children due to the general effect of increased metabolic and circulatory activity.
Endocrine system	Avoid exposure of endocrine glands, notably the thyroid gland in the anterior region of the neck, because changes in circulating levels of related hormones may occur.



**TABLE 6–4. Precautions for Laser and LED/SLED**

Precaution	Explanation
Impaired sensation	High-intensity lasers and SLED arrays may generate cutaneous or subcutaneous heat and require intact sensation sufficient for the patient to be aware of excessive heating.
Indirect eye exposure	Due to risk of retinal damage with laser, appropriate protective eyeglasses for the therapist and patient are required.

**TABLE 6–8. Selected Dosage Guidelines (World Association for Laser Therapy)\***

Condition	Number of Points or Areas (cm <sup>2</sup> ) of Irradiation	Total Joules Per Session	Notes
<b>Tendinopathies</b>			
Carpal tunnel syndrome	2–3	8	min 4 J/point
Lateral epicondylitis	1–2	4	max 100 mW/cm <sup>2</sup>
Supraspinatus	2–3	8	min 4 J/point
Achilles tendon	2–3	8	max 100 mW/cm <sup>2</sup>
<b>Arthritis</b>			
Temporomandibular joint	1–2	4	min 4 J/point
Cervical spine	4–12	16	min 4 J/point
Lumbar spine	4–8	16	min 4 J/point
Knee (medial)	3–6	12	min 4J/point

\*Laser class 3b, 780–860 nm, GaAlAs lasers, continuous or pulsed, mean output: 5–500 mW; World Association for Laser Therapy (WALT), [www.walt.nu](http://www.walt.nu).

**TABLE 6–9. Treatment Guidelines for LLLT**

Condition	Dosage	Frequency
Cervical tender/trigger points associated with fibromyalgia/myofascial pain syndrome	2 J/cm <sup>2</sup> ; 11–18 points	5 times/week; 2 weeks
Carpal tunnel syndrome	6–13 J/point; 2–5 points	5 times/week; 2 weeks
Lateral epicondylitis	1 J/point; 4–6 points	5 times/week; 3 weeks



## Box 6 ■ 1 Preparation of Patient and Device for Laser Treatment

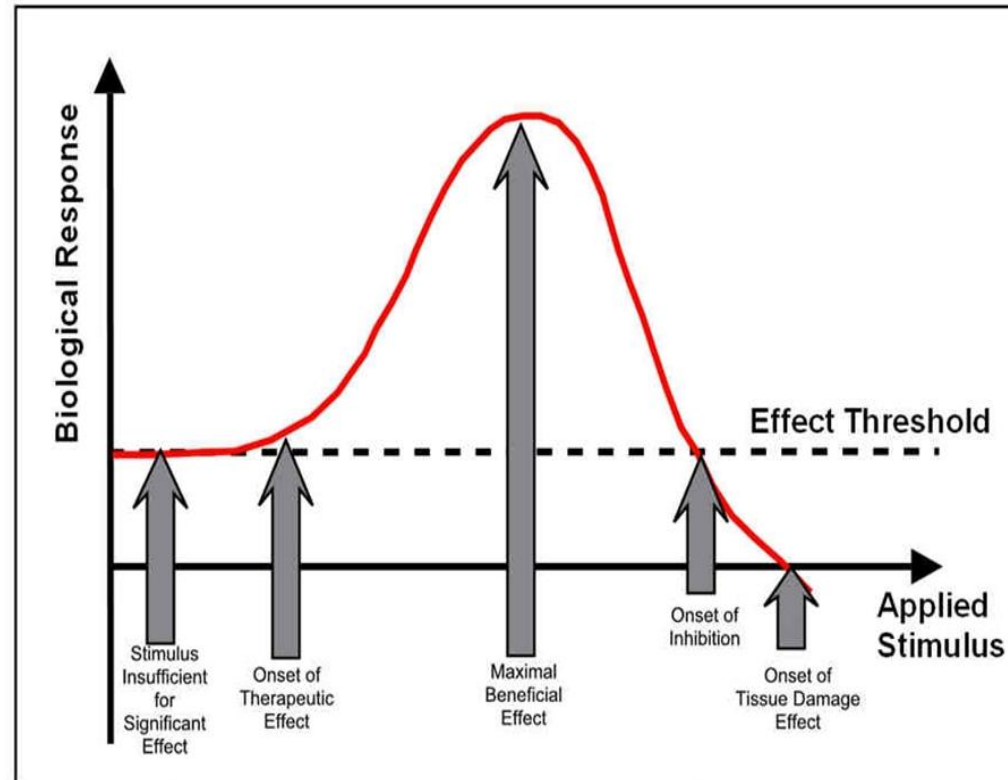
1. Select the appropriate infrared low-level laser device.
2. Describe the desired benefits to the patient, including how lasers work, any possible adverse effects, and what the patient can expect to experience during the treatment.
3. Position the patient appropriately, shielding the treatment area from others in the clinic.
4. Expose the skin of the area to be treated.
5. Provide protective eyewear to the patient.
6. Inspect the skin over the treatment area for open wounds, other lesions, and sensation.
7. Select the parameters on the laser device to provide the desired dosage to the intended points of application.
8. Don protective eyewear.
9. Position the laser applicator so it is in contact with the skin.
10. Activate the device.
11. Instruct the patient to inform the clinician if the treatment cannot be tolerated for any reason.



## Box 6 ■ 2 Clinical Outcome Measures for Laser Effectiveness

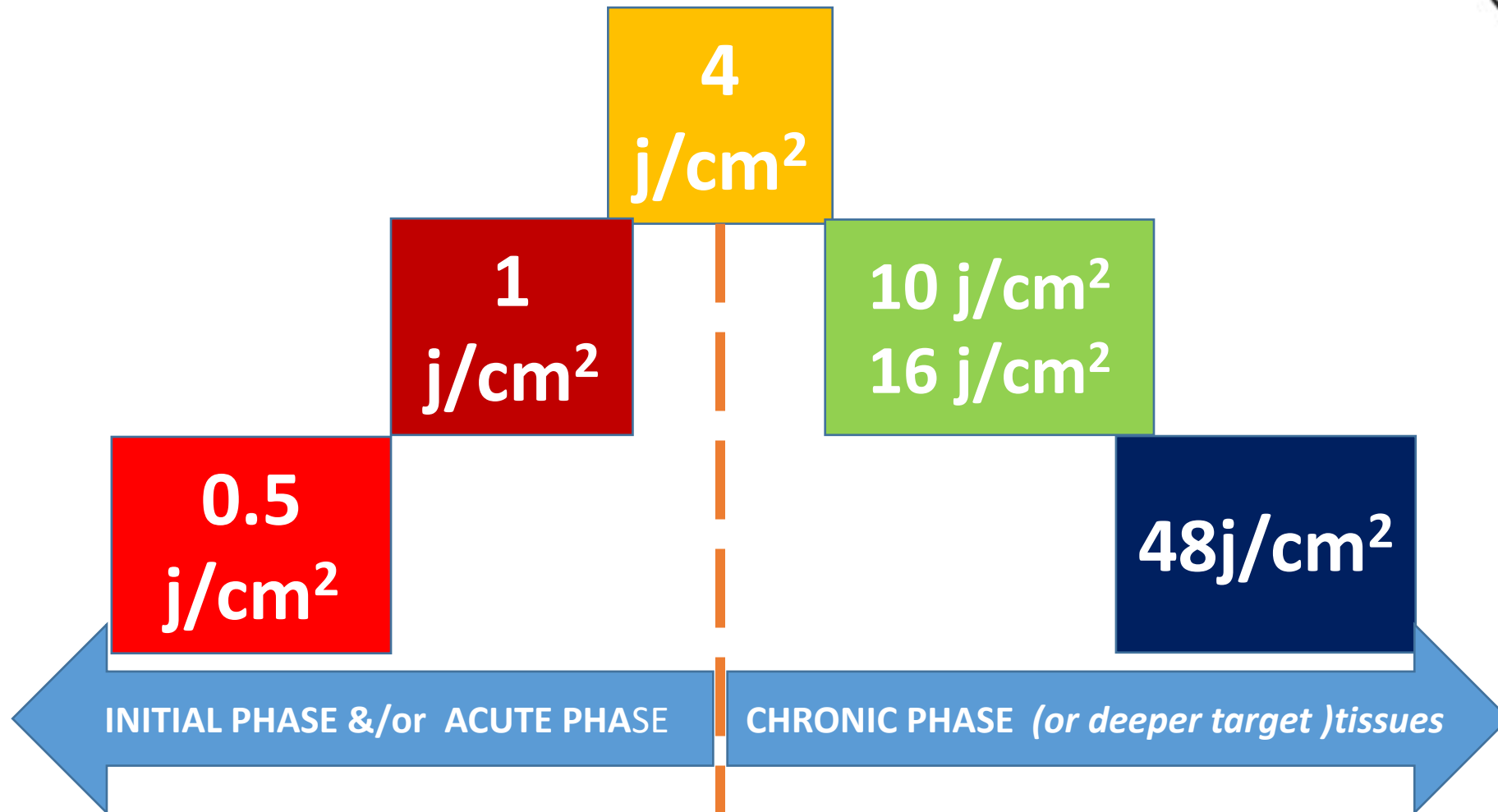
1. Active and passive range of motion
2. Manual muscle testing
3. Grip dynamometry
4. Pain (e.g., VAS, pain questionnaires)
5. Pressure algometry
6. Sensory testing
7. Nerve conduction and evoked response studies
8. Functional measures (e.g., Oswestry, Waddell disability indices, FIM, SF-36, DASH)

## Why there is a need to have a correct dosage?

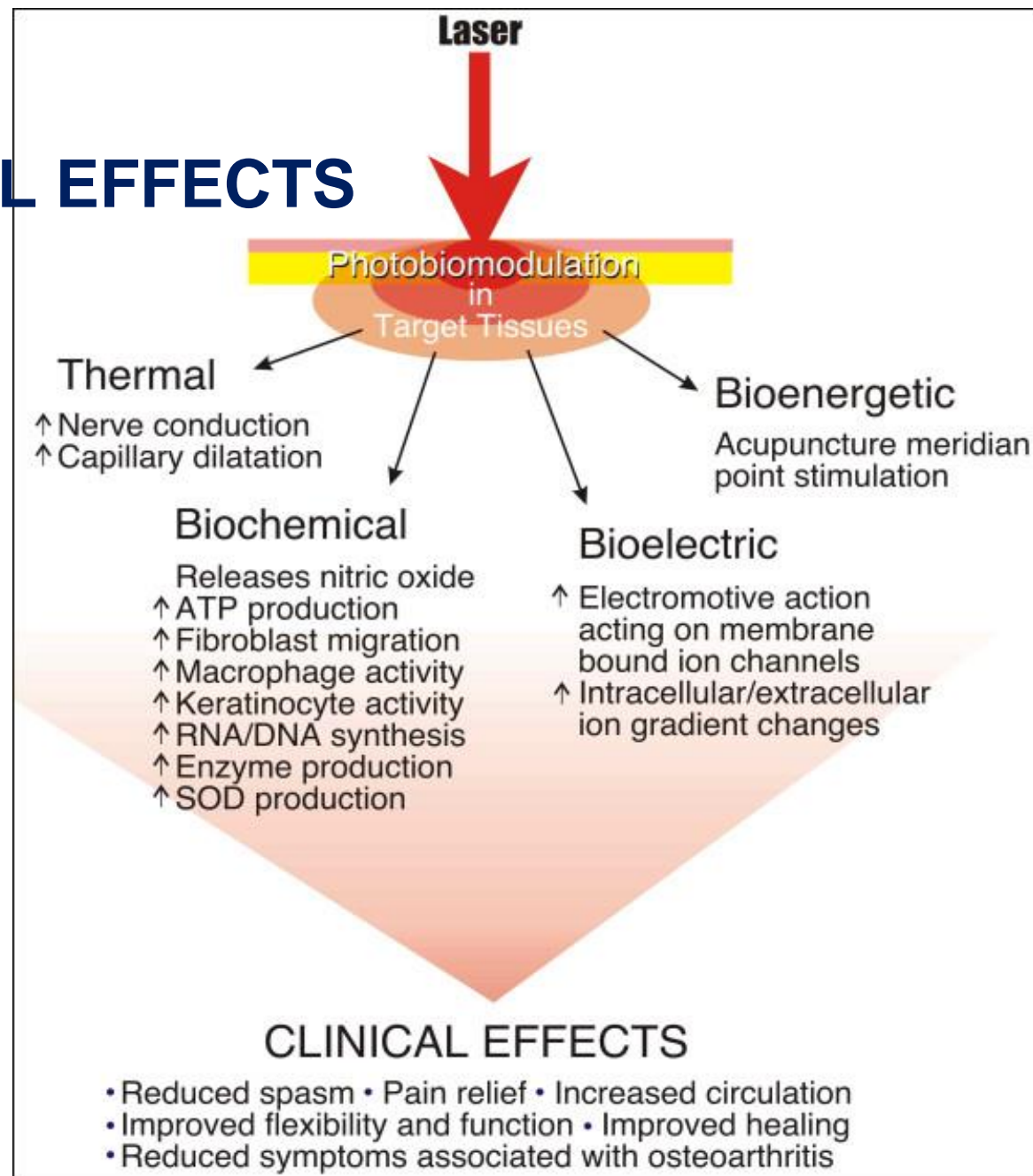


# Suitable Energy Density:

*Electrotherapy explained 2006*

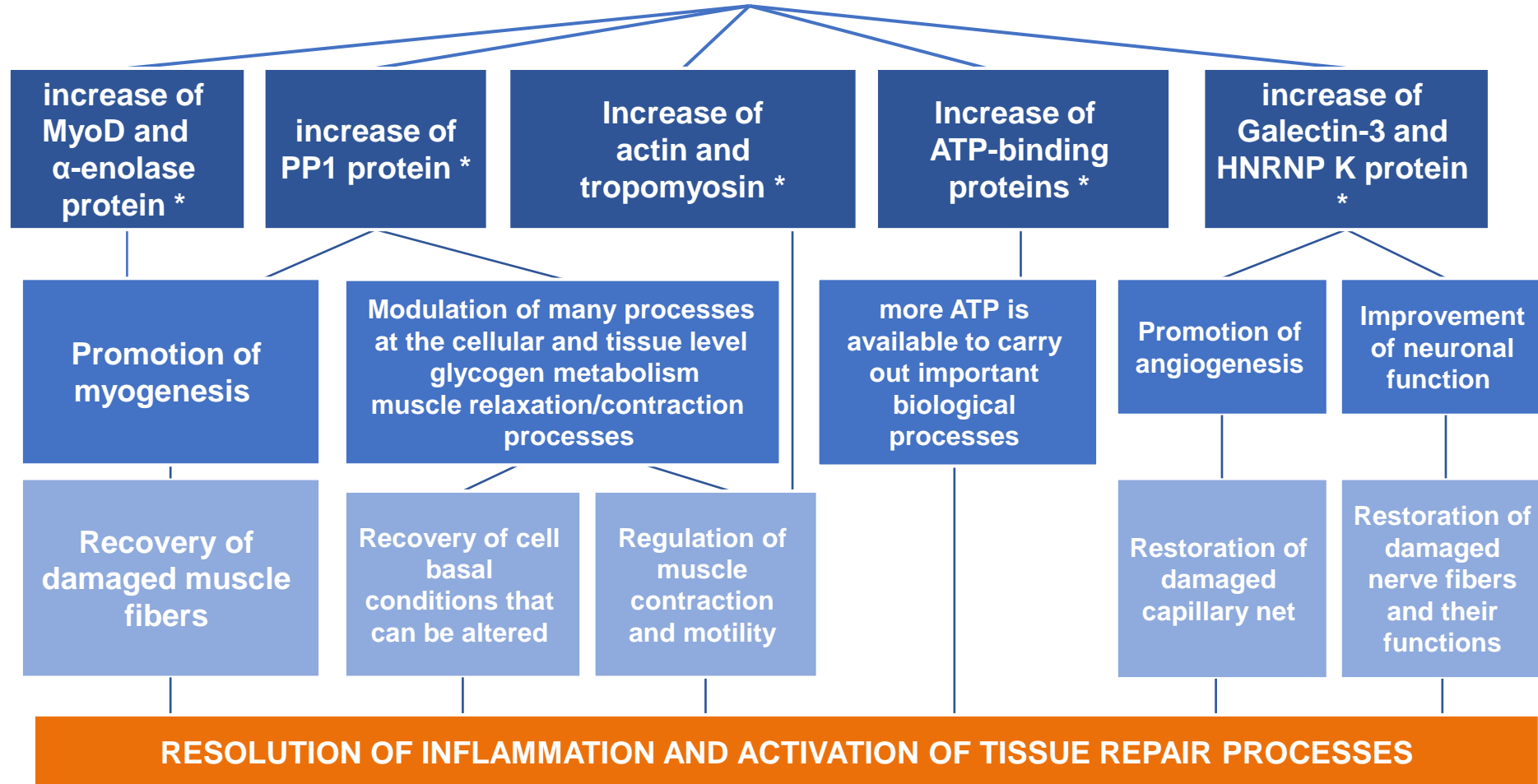


## CLINICAL EFFECTS





# Metabolic-functional and reparative effects



\* MONICI M, CIALDAI F, ROMANO G, CORSETTO PA, RIZZO AM, CASELLI A, RANALDI F. (2012) Effect of IR Laser on Myoblasts: Prospects of Application for Counteracting Microgravity-Induced Muscle Atrophy. Microgravity Science and Technology; 25(1):35-42 ; \*MONICI M, CIALDAI F, RANALDI F, PAOLI P, BOSCARO F, MONETI G. CASELLI A. (2013) Effect of IR laser on myoblasts: a proteomic study, Molecular Biosystems. DOI: 10.1039/c2mb25398d

# Therapeutic Indications

- *JOINT and MUSCLE PAINS*
- *ARTHRITIS*
- *TENDONITIS*
- *BURSITIS*
- *MUSCULAR CONTRACTIONS*
- *NEURALGIA*
- *CONTUSIONS*
- *DISLOCATIONS*
- *TEARS, STRAINS*
- *EDEMAS and HEMATOMAS*
- *ULCERS, SORES, WOUNDS*



# Contraindications



- ***Eye and periocular area***
- ***areas of suspicious, potentially or known cancerous tissue***
- *gestational Uterus*
- *areas of active hemorrhage*
- *sympathetic ganglia and vague nerve*
- *thyroid or carotid sinus region*
- *bone growth centers until bone growth is complete*
- *thoracic area if the patient is using a pacemaker*
- *skin infections*
- *areas injected with steroids in the past 2-3 weeks*
- *tattoos, even those removed*
- *pay attention in people with diabetes and high phototype*

# Limit of Traditional Laser Therapy

## LLLT (Class 3B laser)



LLLT applies very **low power**. The biological processes generated by the laser-tissue interaction are prevalently photochemical and limited to a **surface biostimulation**.

The application of LLLT involve:

- **Long treatment time**
- **High number of sessions**
- Therapeutic **results only at the end** of the treatment period
- In any case can be effective **only for pathologies** located at a **limited depth**

# Limit of Traditional Laser Therapy

## High Power (Class IV laser)



High Power Laser **if not controlled** with a proper emission, can potentially induce **thermal damage**.

For this reason **most** of the very high power laser in the market **can't** actually **work to the maximal power declared** by the constructor.



# Limit of Traditional Laser Therapy

## Emissions

primary action on pain  
and secondary delayed  
action on inflammation and  
oedema.

primary action on  
inflammation and oedema  
and secondary delayed  
action on pain.

**PULSED**

**CONTINUOUS**

### **COMBINATION OF PULSED/CONTINUOUS**

more effective on treatment of oedema, inflammation and  
pain, but with long treatment times and results only after  
8-10 treatment sessions.

## How does the high-power laser therapy work?



In the human body the light is absorbed by chromophores. The stimulation of chromophores on mitochondrial membranes stimulates the production of ATP which leads to a cascade of events:

1. Response of more growth factors inside the cells and tissues as a result of increased ATP and protein synthesis.
2. Accelerated growth with cell division that leads to a more rapid repair of damaged tissues (inflammation, tissue damage).
3. greater metabolic activity through an increase of the synthesis of enzymes, availability of oxygen and nutrients.

# Benefits



## *Vasodilatation:*

is an increase in blood supply, increase in the local heat of the requests cellular metabolic and neuro-vegetative stimulation.

## *Increased lymphatic drainage:*

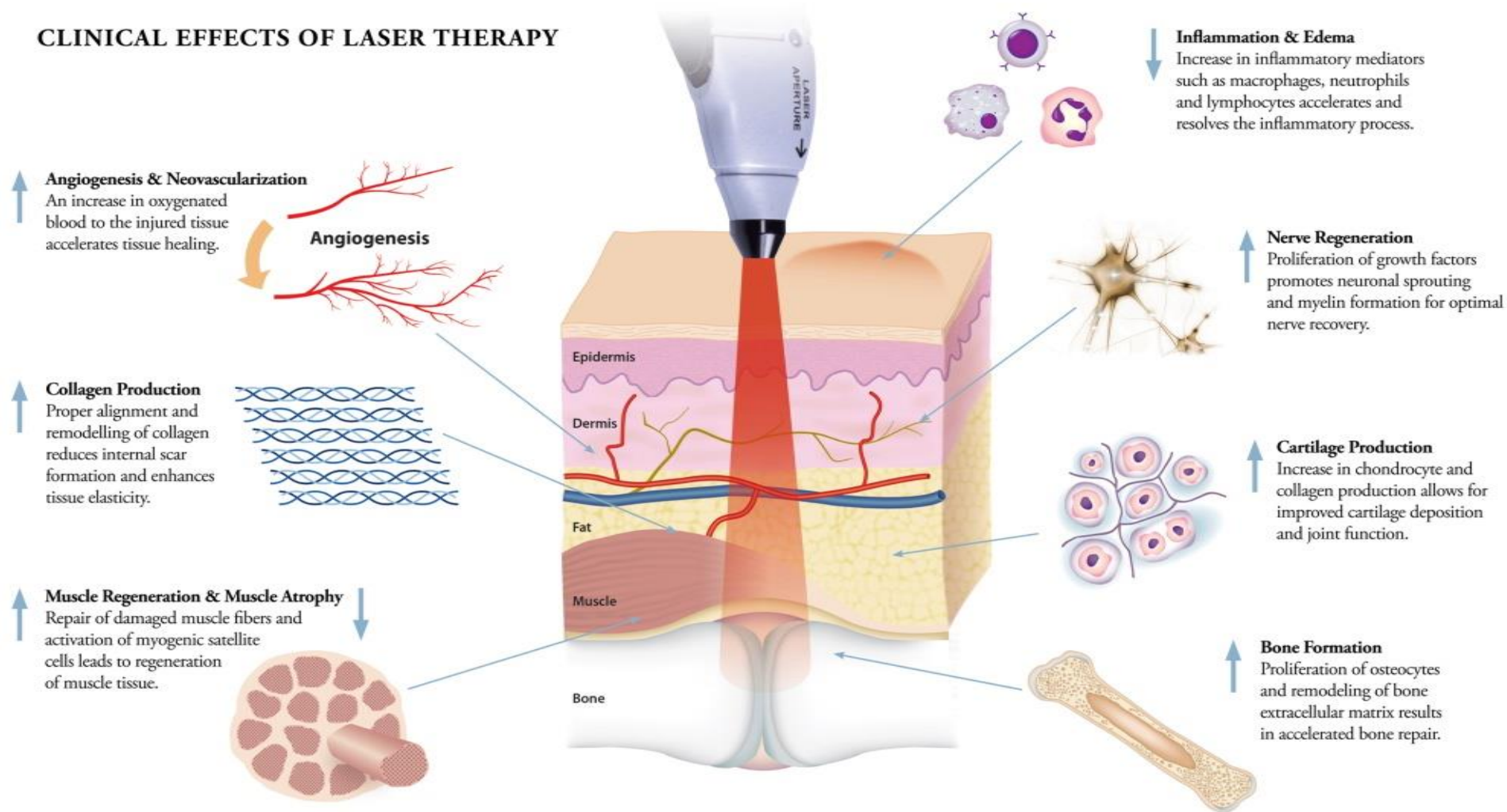
Greater absorption of excess interstitial fluids with edema reduction.

## *Metabolic stimulation:*

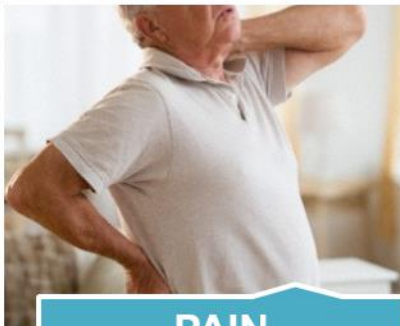
- Acceleration of the process of transformation of ADP to ATP and electronic parts between the intra-and extra-cellular environments:

  1. An increase in the concentration of nucleic acids and amino acids.
  2. Increase the threshold of pain and endorphins.
  3. Stimulation of polymorphonuclear leukocytes and macrophages.
  4. Reduced secretion of prostaglandins.
  5. Prostacyclin increase.
  6. Increased production of collagen and thus acceleration of the repair of wounds .
  7. Reduced formation of fibrous tissue and scar adherences.

## CLINICAL EFFECTS OF LASER THERAPY



# Therapeutic Protocols



**PAIN  
MANAGEMENT**



**EDEMA-  
HEMATOMA**



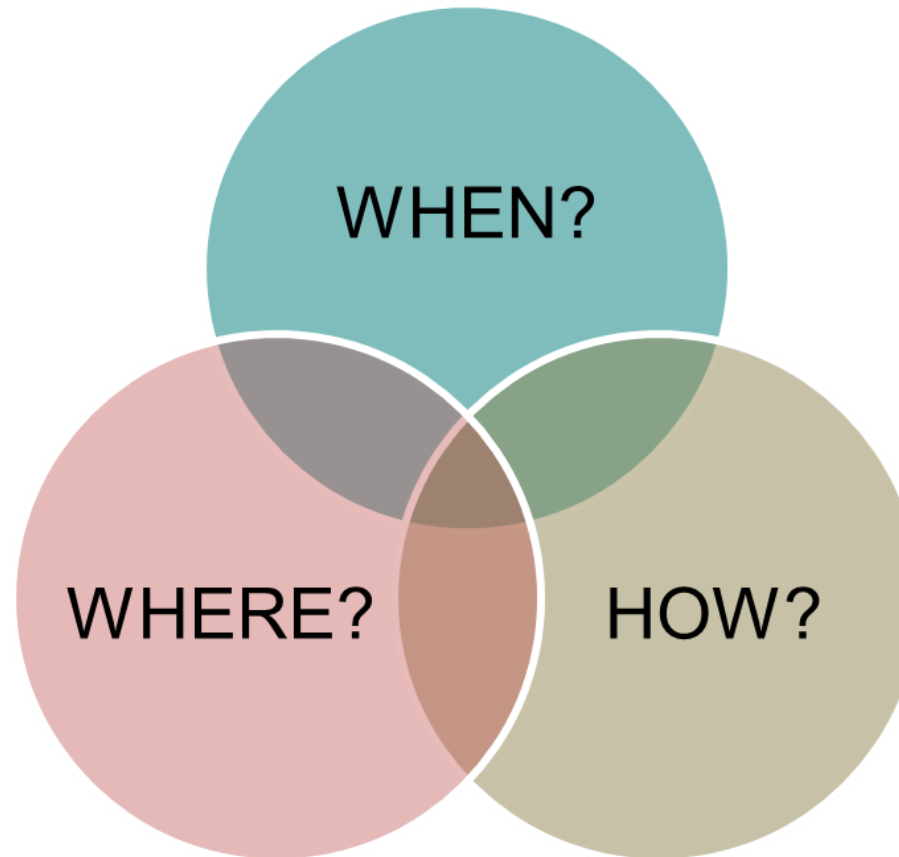
**ARTHRITIS**



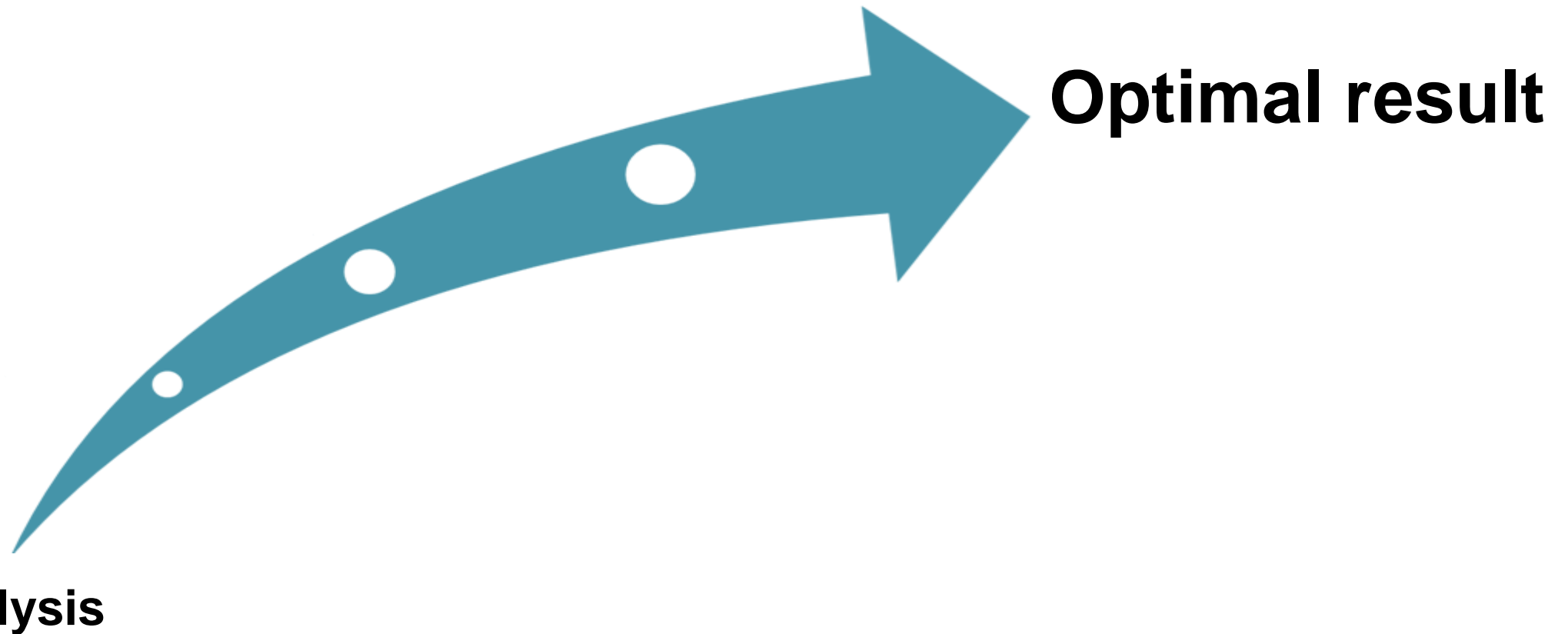
**WOUND  
HEALING**



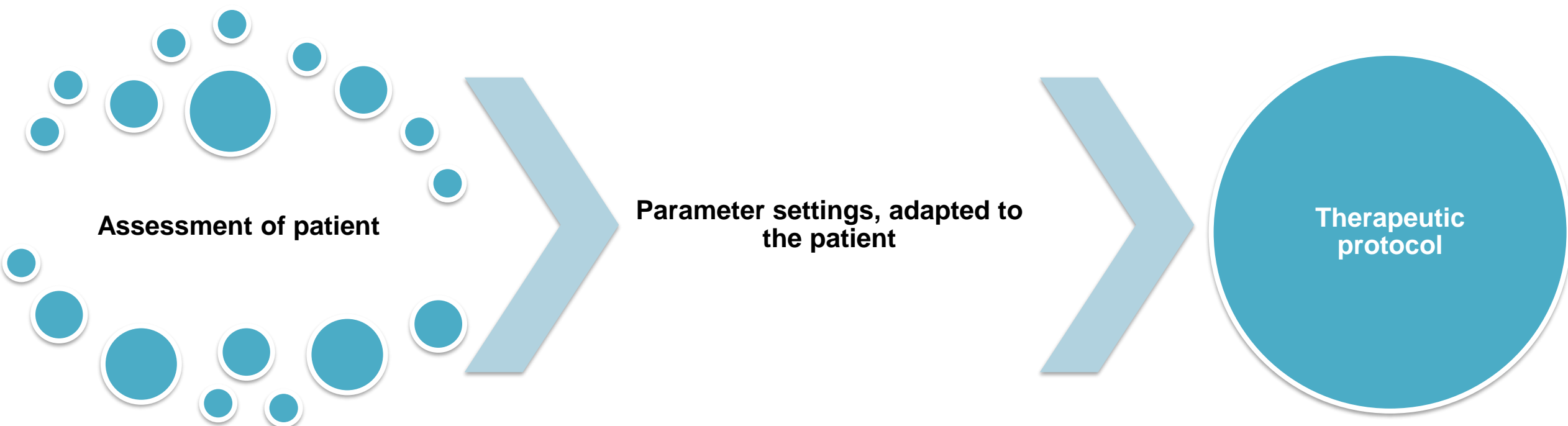
- Pain Management | Global approach



How to treat in order to get a good result from the first session and to maintain the result ov

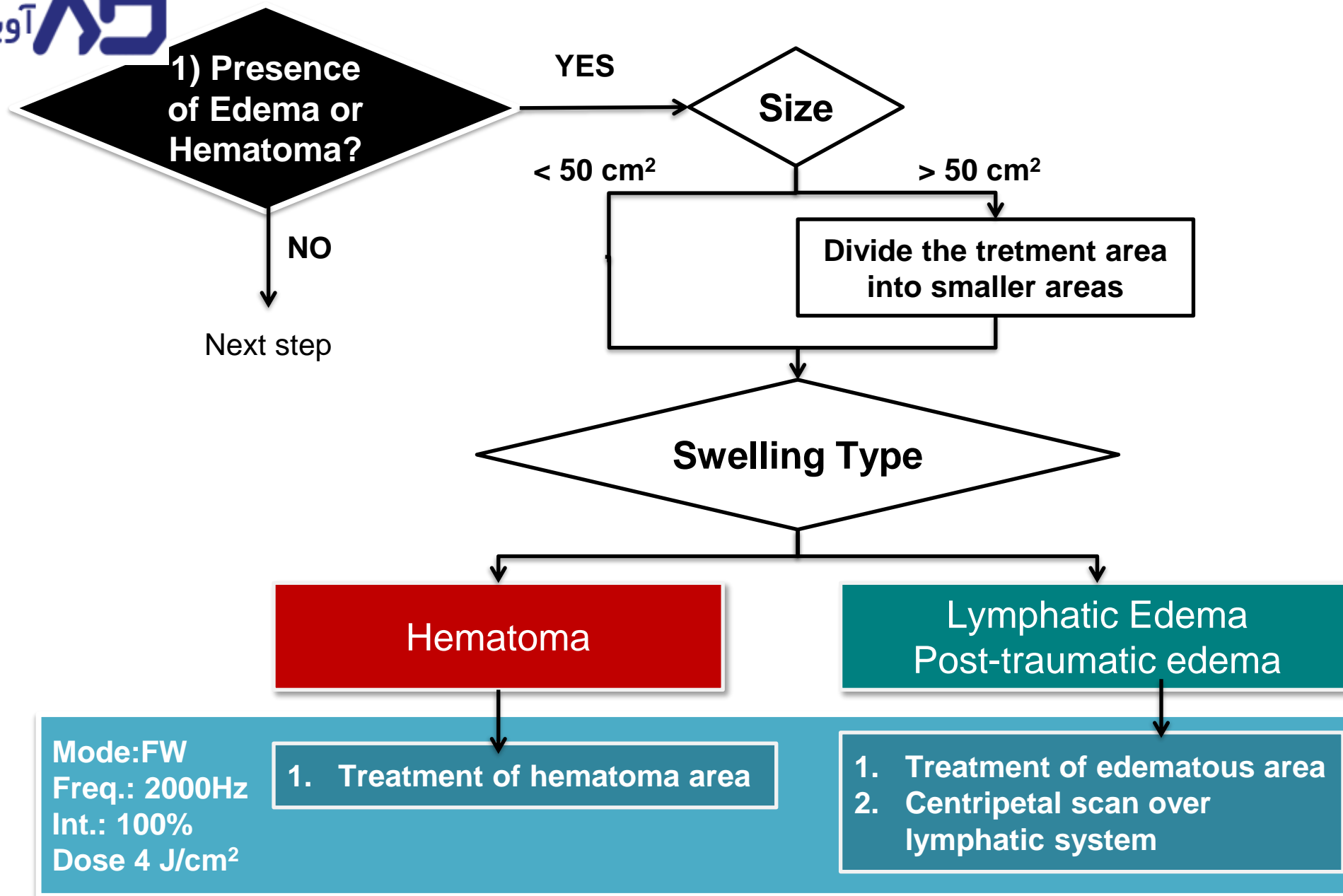


# • Therapeutic protocol procedure

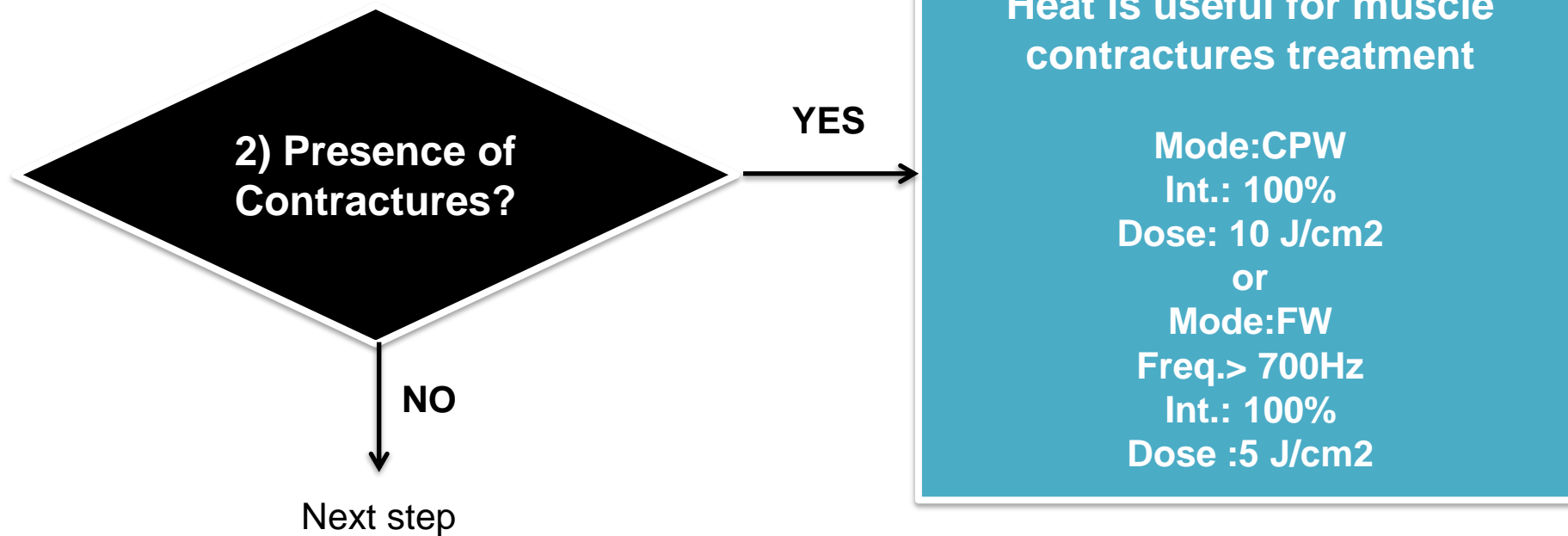


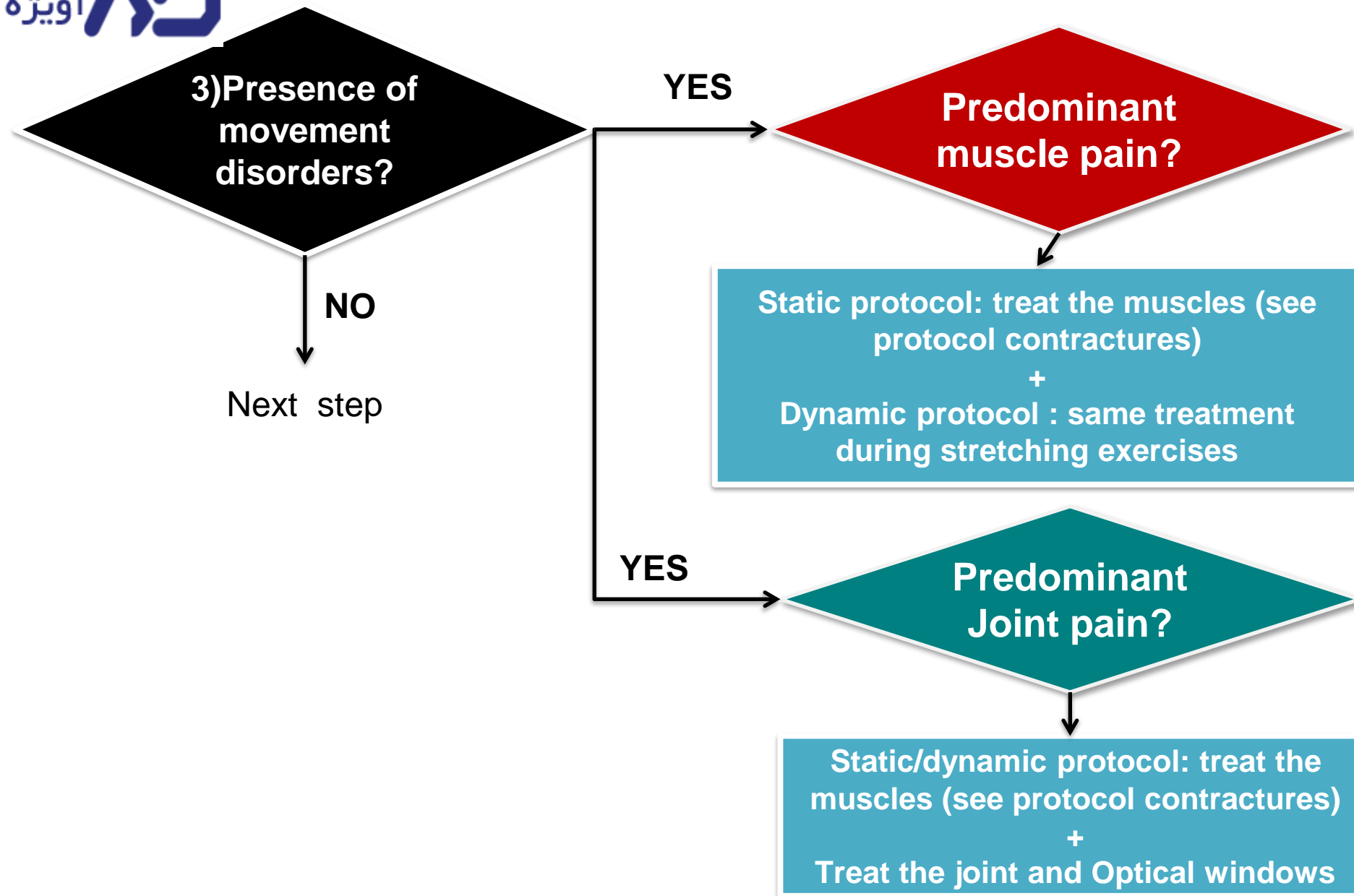
1. Presence of hematoma or edema?
2. Presence of contracture?
3. Movement disorders?
4. Presence of trigger points?
5. Dermatome pain?
6. Peripheral neuropathy?

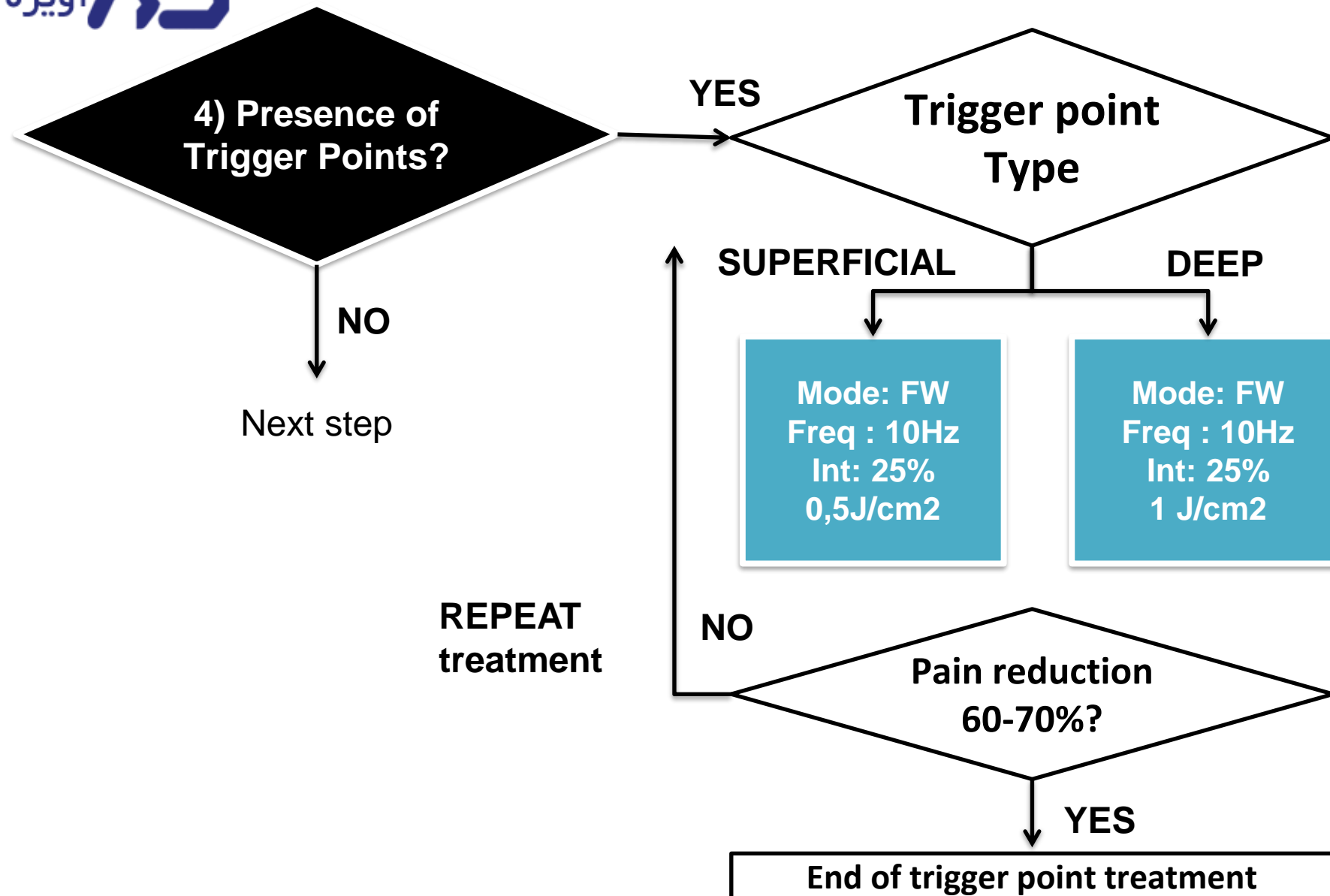


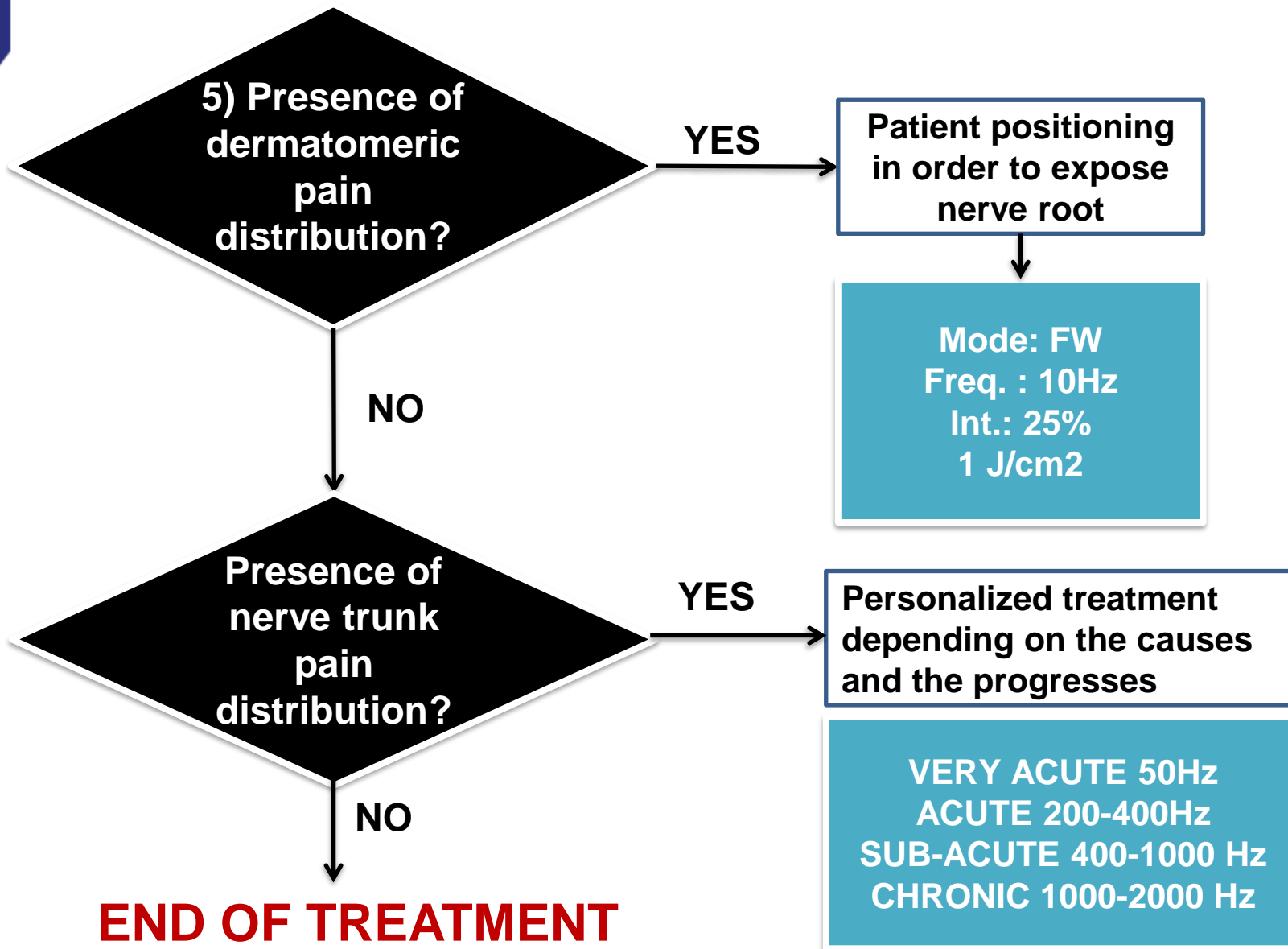












# LUMIX<sup>®</sup> C.P.S.<sup>®</sup>

## FIELDS OF APPLICATION

- Acute and chronic pain therapy
- Rehabilitation therapy
- Post-surgical therapy
- Physiotherapy
- Traumatology
- Orthopedics
- Sports Medicine





## UP TO 5 WAVELENGTHS:

650nm

810nm

910nm

980nm

1064nm



Laser class: 4

Medical device class: IIb

## **CW VISIBLE SOURCE**

**Wavelength: 650nm**

**Emission modality: CW and  
frequenced/interrupted 0.2Hz**

**Peak Power: 130 mW**

## **PW SOURCE**

**Wavelength: 910nm**

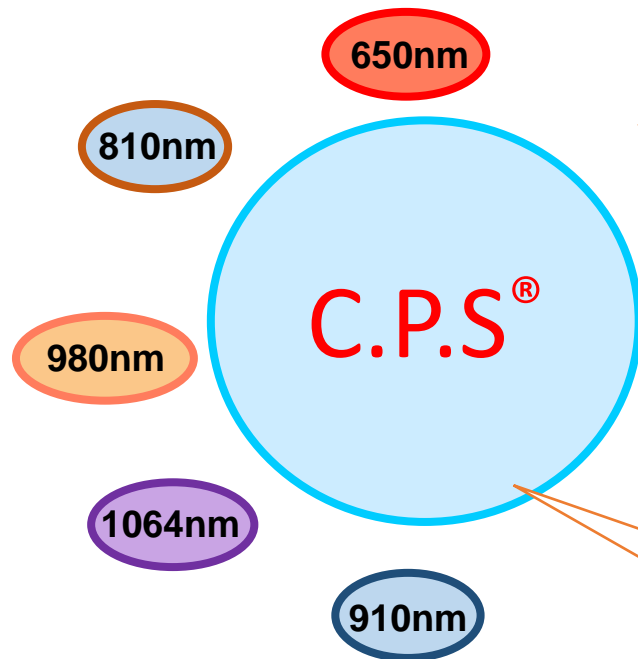
**Emission modality: pulsed and  
superpulsed up to 100.000Hz**

**Peak power: 45 W**

**Average power: 500 mW**

## **CW SOURCE**

**Wavelengths: 810nm, 980nm and 1064nm**



### **MULTI-WAVELENGTH LASER SYSTEM**

Wavelengths designed purposely to guarantee the uniformity of the energy distribution from the superficial to the deeper tissue layers.

### **COMBINATION AND SYNCHRONIZATION**

The synchronization and the combination of several types of continuous, pulsed and superpulsed laser sources allows to address directly both the symptomatology and the causes.

### **SUPERIMPOSITION: SINGLE SPOT**

Diodes optically superimposed and mixed with optical fibers to carry out the homogeneous irradiation to one point.

# LUMIX® C.P.S.

## 11 VERSIONS

CODE	MODEL	AVERAGE POWER OPTION	PEAK POWER	PW INFRARED	CW INFRARED			CW VISIBLE
				910nm	810nm	980nm	1064nm	650nm
LCPS5	LUMIX® C.P.S.	5W	45W	1W	2W		2W	130 mW
LCPS6	LUMIX® C.P.S.	6W	45W	1W	3W		2W	130 mW
LCPS701	LUMIX® C.P.S.	7W	45W	1W	3W	3W		130 mW
LCPS702	LUMIX® C.P.S.	7W	45W	1W	6W			130 mW
LCPS901	LUMIX® C.P.S.	9W	45W	1W		8W		130 mW
LCPS902	LUMIX® C.P.S.	9W	45W	1W			8W	130 mW
LCPS12	LUMIX® C.P.S.	12W	45W	1W			11W	130 mW
LCPS1501	LUMIX® C.P.S.	15W	45W	1W	6W	8W		130 mW
LCPS1502	LUMIX® C.P.S.	15W	45W	1W	6W		8W	130 mW
LCPS17	LUMIX® C.P.S.	17W	45W	1W			16W	130 mW
LCPS31	LUMIX® C.P.S.	31W	45W	1W			30W	130 mW

# WAVELENGTH



## 650nm

Water absorption: <1%

Hemoglobin absorption: ~90%

The emitted energy is almost totally absorbed by hemoglobin, so it is particularly recommended as coagulant and antiedemigen.

**ANTALGIC EFFECT:** ☹️

**ANTIEDEMIEN EFFECT:** 😊 😊 😊 😊

**ANTI-INFLAMMATORY EFFECT:** ☹️

**COAGULANT EFFECT:** 😊 😊 😊 😊

At this wavelength the skin melanin optically absorbs the radiation.

A high dose of energy is transferred to the surface region encouraging also antiedemigen effects.

It is a great wavelength for tissue regeneration, wounds healing and fast cicatrization.

The 650nm wavelength corresponds to red color and appears to be great for hemoglobin photocoagulation.

# WAVELENGTH



## 810nm

Water absorption: ~3%

Hemoglobin absorption: <1%

It is the wavelength with the lowest level of water and hemoglobin absorption, therefore it allows to reach great penetrations but, since it is the nearest to the point of maximum melanin absorption, it is particularly sensitive to color and skin tone.

**ANTALGIC EFFECT:** 😊

**ANTIEDEMICEN EFFECT:** 😊 😊 😊 😊

**ANTI-INFLAMMATORY EFFECT:** 😊 😊 😊 😊

**COAGULANT EFFECT:** ☹️

The 810nm wavelength allows a greater absorption of enzymes, promoting the stimulation of ATP cellular production.

The 810 nm wavelength allows a fast activation of the hemoglobin oxidation process: it promotes the regeneration by transferring the correct quantity of energy to muscles and tendons.



# WAVELENGTH



## 910nm

Water absorption: ~8%

Hemoglobin absorption: ~8%

Together with 810nm, it is the wavelength with the highest level of penetration; furthermore the available great peak power (pulsed and superpulsed sources) allows to treat directly the symptomatology.

**ANTALGIC EFFECT:** 😊 😊 😊

**ANTIEDEMICEN EFFECT:** 😊 😊 😊 😊

**ANTI-INFLAMMATORY EFFECT:** 😊 😊 😊 😊 😊

**COAGULANT EFFECT:** 😞

The tissue absorption of this radiation allows the interested cells to have more fuel oxygen. As for 810nm wavelength, the ATP cellular production is stimulated and, therefore, the regenerative processes of the interested tissues are promoted, encouraging the natural healing processes.

# WAVELENGTH



## 910nm

**pulsed** and **superpulsed** sources, with high peak power and short impulses (hundreds of nanoseconds), it is the wavelength with the best efficiency in depth and with a reduced thermal effect. This allows also a great effect in the antalgic treatments. The possibility to have high peak powers allows to transfer the average power generated from the laser sources in depth into the human tissues.

Based on the type of pathology being treated, on the modalities and doses, laser radiation at this wavelength acts by increasing the pain threshold higher through direct action on algogenic nerve endings and by stimulating indirectly the liberation of endorphins. Moreover, *the induced hyperemia and the macrophage activation, reducing ischemia and the local stasis of endogeneous algogenic matters, exlude the onset of other possible sources of pain and inflammation.*

Finally, *the recovery of the cellular membrane potential contributes to interrupt the vicious circle of contracture-vasoconstriction-pain and to resolve the inflammation.*

Experimental evidence has proven the regenerative biological stimulus with trophic-stimulating effects, determined by laser radiation at 910nm.

# WAVELENGTH



## 980nm

Water absorption: ~40%

Hemoglobin absorption: ~10%

It is the wavelength with the highest level of water absorption so, at the same power, it is the wavelength characterised by a superior thermal effect.

**ANTALGIC EFFECT:** 😊 😊 😊

**ANTIEDEMICEN EFFECT:** 😊 😊 😊 😊

**ANTI-INFLAMMATORY EFFECT:** 😊 😊 😊

**COAGULANT EFFECT:** ☹️

The water of tissues is mostly absorbed by the wavelength of 980 nm, so a large part of energy is consequently converted to heat. The temperature change at cellular level generated by this radiation, stimulates the local microcirculation by carrying oxygen fuel to cells.

The application of laser radiation at the wavelength of 980nm interacts with the peripheral nervous system: it activates the Gate-Control mechanism with a fast antalgic effect.

# WAVELENGTH



## 1064nm

Water absorption: ~30%

Hemoglobin absorption: ~10%

Together with 980nm, it is the wavelength which has a high water absorption so, at the same power, it is the wavelength characterised by a superior thermal effect. However, it is the farthest to the point of maximum melanin absorption, so it is less sensitive to color and skin tone.

**ANTALGIC EFFECT:** 😊 😊 😊

**ANTIEDEMICEN EFFECT:** 😊 😊 😊 😊

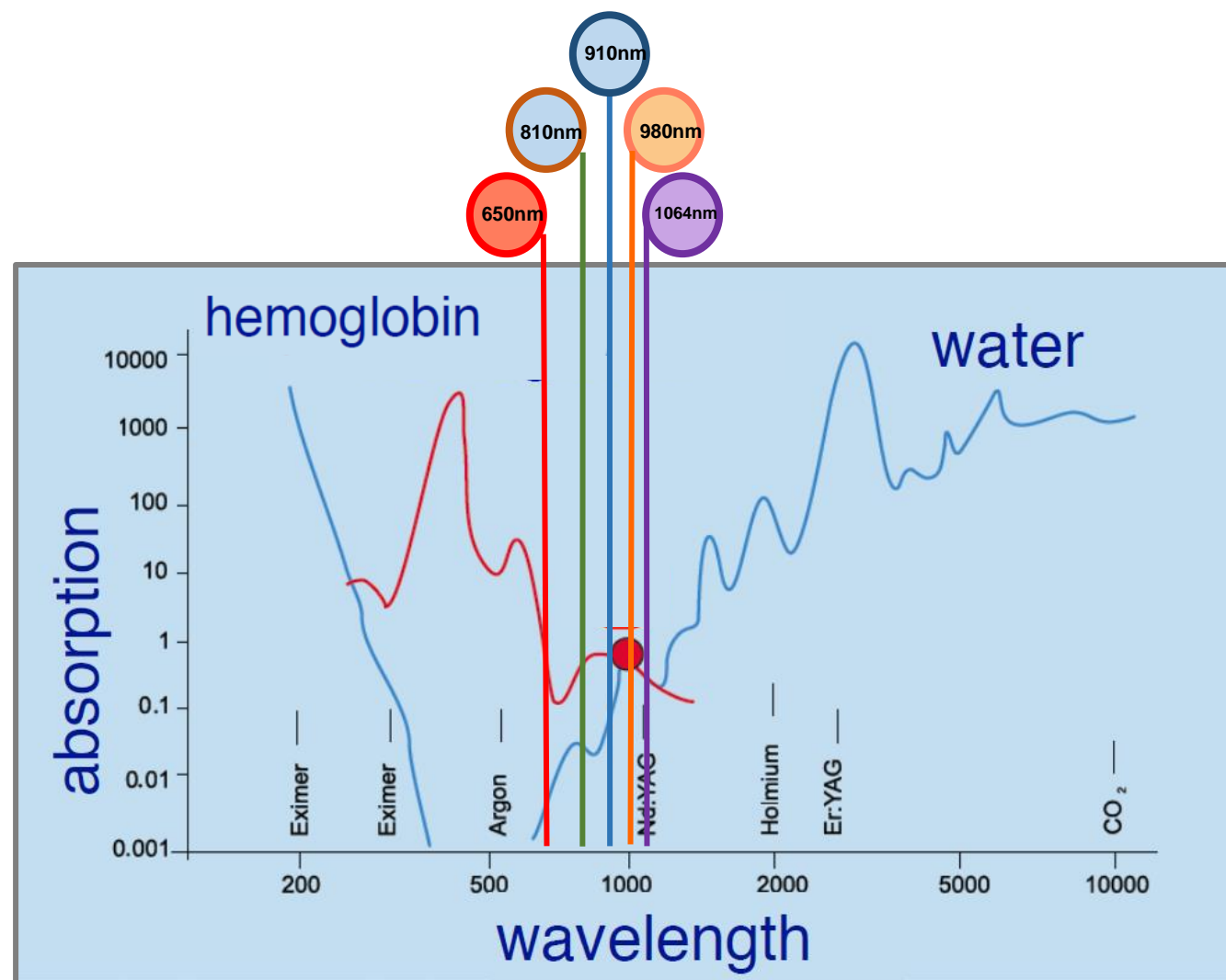
**ANTI-INFLAMMATORY EFFECT:** 😊 😊 😊

**COAGULANT EFFECT:** 😞

The water of tissues is highly absorbed by this wavelength, so a good quantity of energy is consequently converted to heat.

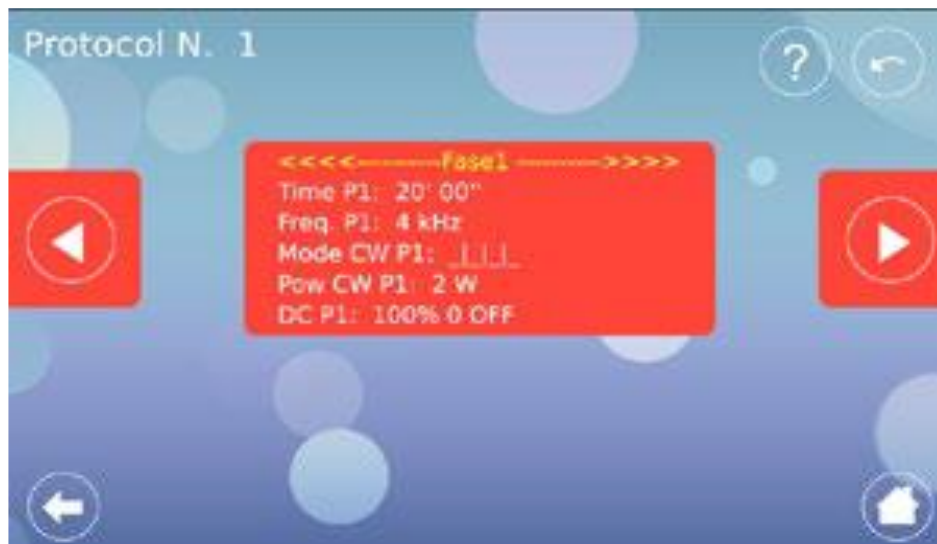
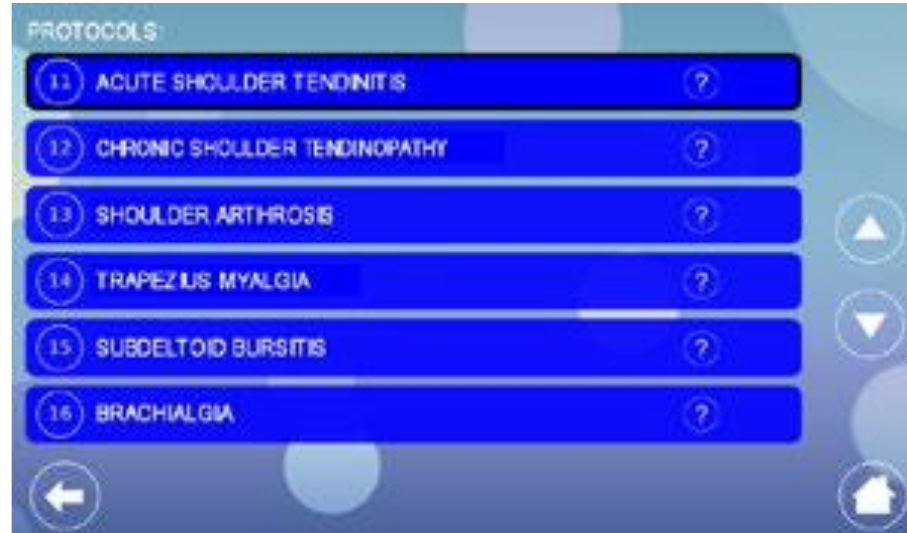
The high directionality of this wavelength allows to reach the interested area with the correct quantity of energy.

In this way, it is possible to obtain a fast analgic effect with a control of the inflammatory processes and with the deep activation of the metabolic processes of the cellular activities.



EFFECT	650nm	810nm	910nm	980nm	1064nm
ANTALGIC	•	•	• • •	• • •	• • •
ANTI-EDEMA	• • • •	• • • •	• • • •	• • • •	• • • •
ANTI-INFLAMMATORY	•	• • • •	• • • • •	• • •	• • •
COAGULANT	• • • •	•	•	•	•
PHOTOMECHANICAL AND PHOTOBIOSTIMULANT			• • • • •		





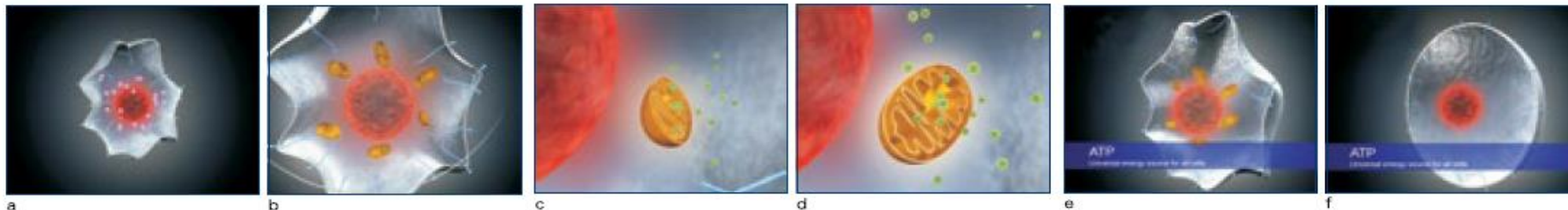
## PHOTOMECHANICAL EFFECT OF LUMIX® Plus and LUMIX® Ultra ON ATP

The LUMIX® Plus and LUMIX® Ultra increases ATP production, significantly increasing the cellular regenerative ability (Fig. a-b-c-d-e-f).

Further biostimulation effect benefits are:

- **increase in protein synthesis:** new proteins replace damaged ones
  - **increased immune system defence:** activation of macrophages and neutrophils, cells responsible for the body's defences
  - **increase of keratinocytes and blood vessel cells:** extension of tissue healing
  - **increase factors that regulate growth and cell proliferation:** this takes place in fibroblasts, cells that are the foundation of most tissues of the body
  - **increase bone formation capacity:** upregulates osteoblastic activity and downregulates osteoclastic activity.
- In particular, it has been observed that it facilitates osseointegration of implants and speeds up tissue healing.

The photomechanical effect and Superpulsation activate after 30,000 Hz of frequency.



ATP (adenosine triphosphate) is the main carrier molecule of cellular energy. It is produced in the mitochondrial membrane.



## BIOSTIMULATION

Bone regeneration, tissue regeneration, bedsores, ulcers (vascular ulcers of the malleolus, diabetic ulcers, etc.), sores, lesions, perilesional points, edema, post-distorting edema, bruising, chondropathies, biointegration of implanted materials.





## PAIN THERAPY antalgic effect

Neck, shoulder, and back pain, back injury, sciatica, and general radicular syndromes of inflammatory and biomechanical origin. Articular and periarticular pain (direct and indirect antalgic effect for anti-inflammatory action).

Inflammatory and degenerative neuritis and neuropathies. Muscle contractures and myofascial trigger areas.



## POST-TRAUMATIC SPORTS MEDICINE

Post-traumatic edema, traumatic origin capsular and ligamentous inflammation, sprains and muscle strain, distortions, contusions.



## ANTI-INFLAMMATORY

Acute tendinitis and relapse phases of chronic tendinopathy.  
Degenerative origin capsular and ligamentous inflammation.  
Acute inflammatory arthritis characterised by alternating phases of spontaneous exacerbation and remission (excellent anti-edema effect), pain and phlogosis in degenerative chronic arthropathy (arthrosis, rheumatic, etc.), bursitis, plantar fasciitis.





## LOCALIZED ANTI-EDEMA

Reduction of localized edema in the paravertebral area or in the area surrounding herniated discs.



## REHABILITATION THERAPY

Post-surgery therapy, motor joint rehabilitation after removal of plaster casts or orthopedic surgery.



## PHOTOBIOSTIMULATION IN AESTHETIC MEDICINE

**LUMIX® C.P.S.®** Acts on fibroblasts to generate production of collagen and hyaluronic acid and improves skin tone. In specific facial treatments, it stimulates microcirculation and oxygenating processes in skin, facilitating and enhancing the activity of **anti-aging** formulations. In a non-thermal, non-ablative manner, **LUMIX® C.P.S.®** triggers a sequence of different biochemical effects that promote the synthesis of neo-collagen and elastin by the fibroblasts in the dermis. This process generates a **bio-stimulating and regenerative effect on aging and tissues** damaged by UV exposure, lack of collagen or post-acne scars. The antibacterial and anti-inflammatory action of **LUMIX® C.P.S.®** is applied to treat **active acne**.



**Colour touch-screen display with simple, intuitive interface**



**Preset therapeutic protocols**





**Automatic treatment with spacers  
according to the area to treat**





**Spacers according to the area  
to treat (diameter 30 and 60mm)**

**Articulated arm  
Ergonomic handle and trolley**





**Audio-video  
application  
tutorials**



**WiFi Bluetooth  
Pedal (Optional)**



**USB port for  
software update**



**Laser safety  
goggles**

# Our scientific studies



## **The low level laser therapy in the management of neurological burning mouth syndrome. A pilot study.**

Umberto Romeo, DDS I, Alessandro Del Vecchio, DDS, Mauro Capocci, DDS I, Claudia Maggiore, MD, DDS2, Maurizio Ripari, MD, DDS I  
Sapienza" University of Rome, Rome, Italy

## **Studio preliminare, il laser nel trattamento di lesioni in pazienti affetti da epidermolisi bollosa, efficacia antalgica e biostimolante**

Ezio Sindici, Paola Mlekuz, Massimo Riso, Tiziana Ruggiero, Renato Pol  
CIR Lingotto Dental School, Dipartimento di Scienze Chirurgiche, Reparto di Chirurgia Stomatologica-HCP. Responsabile: Prof. Stefano Carossa

## **High-Frequency low level diode laser irradiation promotes proliferation and migration of primary cultured human gingival epithelial cells**

Kenichiro Ejiri, Akira Aoki, Yoko Yamaguchi, Mitsuhiro Ohshima, Yuichi Izumi

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# Thank You!



Soheil Sohani, Assistant Professor of Physiotherapy

School of Rehabilitation Sciences, Iran University of Medical Sciences, Tehran, Iran

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