

Research article

# Research on the possibilities of a therapeutic approach through physical interventions with Laser MLS (Multiwave Locked System) in post-combustion pathology (burns and severe burns)

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## Abstract:

**Introduction.** Depending on their severity, most of the burns are "particularly disabling injuries", which is why a constant improvement of current therapeutic interventions is necessary [1]. The patient describes the severe burn as the "ultimate agony" placing an important responsibility on the medical staff to achieve a satisfactory level of recovery and reintegration into society [2]. "Burns negatively influence the main aspects of life", but also the quality of life [3]. Laser therapy has stood out in recent years in stimulating the healing process of burn patients [4]. The role of this study is to highlight the therapeutic effects of the MLS LASER in the case of burns and severe burns.

**Methods.** We previously carried out a systematic review of the related literature through the method of filtering and selecting profile documentary material, widely used and accepted at the international level: Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). Thus, we searched, using contextually, combinations/syntaxes of search keywords in the following international databases: Elsevier, PubMed, PMC, PEDro, articles published in English in ISI indexed journals Web of Knowledge/Science, during 01.01.2021-31.12.2021.

**Results and discussion.** Seven of the selected articles have been included in our systematic literature review. The evolution of burn injuries materialized through improvements, will hopefully be achievable, both through direct observation and through the favorable dynamic progress of the scores of the quantification scales used: (VSS – Vancouver Scar Scale, VAS – Visual Analogue Scale, 5-D ITCH Scale, according to the model of the American Spinal Injury Association Impairment Scale – AIS - for sensitivity disorders, 3-step scale, ROM – Range of motion, MMT – Manual Muscle Test Scale, The Barthel Index, FIM – Functional Independence Measure scale, ADL, Timed up and go test, Walk Speed, Berg Balance Scale, Six-Minutes Walk Test). If it will be possible, sufficiently sustained medium/long-term follow-up of the cases included in our doctoral research will also be measured by the frequency of readmissions.

**Conclusions.** Through this research, which is part of the doctoral study, we hope to be able to deepen aspects related to both the still existing limits and the identifiable possibilities for optimizing the conceptual and practical approach to patients with such pathologies.

**Keywords:** Burns, MLS LASER, Burn wound, Burn Rehabilitation, Multiwave Locked System.

## 1. Introduction

Burns are considered a "major public health problem, they are medical-surgical emergencies", and they involve an exceptional multidisciplinary collaboration [2]. Globally, "over 265,000 deaths annually" are reported due to burns, and "over 11 million" refer to health services [2]. Unfortunately, in our country too, we are facing an increase in the number of patients suffering burns in hospital units [10]. Special attention is needed on the "psychological trauma" resulting from burns, problems such as "communication disorders, decreased self-confidence, personality changes, sleep disorders and family conflicts" are recorded [3].

SKIN is the largest organ in the human body, having the role of ensuring "constant functioning and structural homeostasis" [4]. Defined as our body's "first defensive barrier" that protects us from environmental aggressors, [4] it becomes more "prone to infection" once it is burned [11].

BURN is defined as a "traumatic injury to the body that can be produced by various agents" [12]: "thermal (burns by flame, hot liquids, "contact" burns), chemical (caused by acids, bases, salts, phosphorus, magnesium)" [13], electrical ("burns by contact at the point of entry and exit of the electric current, burns by electric arc, thermal burns "clothes on fire") [14].

In order to establish the prognosis and the therapeutic conduct, it is necessary to evaluate: [15]

- BURNED SURFACE is expressed in percentage units, in relation to the body surface, considered 100%. It is calculated according to the "RULE OF 9" [16]

- DEPTH OF THE BURN

**First degree burns** involve only the superficial layer of the skin. As a pathophysiological mechanism we have the following sequence: injury -> dilation of dermal capillaries resulting in "hyperemic areas, with moderate pain." [2] The blood perfusion at the level of the dermis is not affected, so that with digital pressure the hyperemic areas turn white. The presence of blistering is not characteristic. Also, it does not leave scars. [2]

**Second degree burns** are burns with extension in the dermis, they are subdivided into: "IIA - Superficial partial burns" [2] - are characterized by erythematous skin and the presence of blistering. "The underlying dermis is moist, turns white on direct pressure and is usually very painful." [2] "IIB - Deep partial depth burns" [2] - presents "often a dry and thickened texture" [2], absence of erythema, poor healing.

**Third degree burns** are those that completely destroy the "epidermis, dermis, skin appendages or even subdermal structures" [14]. "Serosanguineous" or "white or greyish-white eschar" are characteristic, they leave scars [14]. These are burns with a surgical indication.

- PARTICULAR LOCATIONS

- "Face - massive edema can obstruct the airway" [15]. In addition, it is disabling from the functional aspect of mastication, speech and possibly swallowing, as well as through its disfiguring potential.

- "Perineum and external genital organs" [15] - with long-term risks of maintaining the trailing evolution through contact with urine (including/possibly infection).

- "Circular burns of the limbs" - risk of peripheral ischemia [15].

- "Hand burn" [15] - to maintain the integrity of the function, emergency surgery is usually chosen. Impairment of dexterity or posture/gait.

- "III degree circumferential burn of the chest wall - leads to loss of elasticity" [15].

- Respiratory labor aggravating the evolution of life risk.

Table 1. Intervention strategy for preventive or corrective posture, including, if necessary, by orthosis and/or mobilization [16] [23]

BODY PART BURNED		
<i>FACE</i>	Maintaining facial contours to prevent contractions / retractions around the mouth, eyes and other areas of mobility. At the mouth: microstomy It may be necessary to use nasal splints to maintain the caliber of the nostrils	Mobilizations and postures every day Molded face masks Mouth splint orthoses, e.g., horizontal, vertical lip retractors Nasal splints orthoses / Appropriate dilator inserted into nostril
<i>NECK</i>	Area with high potential for contracts / retractions - commonly: on flexion ! Avoid flexion ! Maintain the contour of the neck and chin	Position of slight extension or orthosis Patient lying on his back, without a pillow, with a small roller behind his neck Chin extension collar Orthoses type molded extension splint
<i>SHOULDER</i>	Common type of contracture / retraction: in adduction	Arm postured in abduction at least 90 ° and 10-15 ° anteflexion Anterior shoulder region: avoid shoulder protraction during positioning as well as elongation of the ipsilateral brachial plexus Mobilizations and postures every day Orthoses type abduction splint (molded from thermo-plastic material) under the arms Orthosis type bandage / collar and cuff Positioning / corrective stabilization structures made of foam / spongy material
<i>ELBOW</i>	Common type of contracture / retraction: in flexion or extension ! lesions on the anterior face predispose to flexion contracture / retraction (more common)	3-point splint orthosis made of molded thermo-plastic material Mobilizations and postures every day Positioning in extension and supination and / or flexion, respectively
<i>WRIST</i>	Common type of contracture / retraction: in flexion or dorsal extension	Mobilizations and postures every day For flexion contracture / retraction: possibly dynamic orthosis (using molded splints - possibly serialized - made of thermo-plastic material) of extension at 20 ° Circumferential burns of the wrist and hand require positioning by orthosis with splints in combined flexion and extension
<i>MP METACARPAL PHALANGEAL JOINT</i>	Common type of contracture / retraction: in extension - produced by burns of the back of the hand ! Palmar burns, affecting the flexor tendons of the fist / hand, predispose to flexion contracture / retraction	Burns at the palmar level, affecting the tendons of the flexor muscles of the fist / hand, which predispose to contracture / retraction in flexion are positioned by splint extension  Preventive / corrective positions for extension contracts / retractions are positioned by orthosis in flexion at 50-70 ° and those in flexion, in reverse - with the maintenance of the opposability of the thumb and complete extension of interphalangeal
<i>IP INTERPHALANGEAL JOINT (PROXIMAL AND DISTAL)</i>	Common type of contracture / retraction: in flexion	
<i>HIP</i>	Common type of contracture / retraction: in flexion and adduction	Mobilizations and postures every day fully extended and abducted, in ventral decubitus (if possible) with positioning by molded thermo-plastic foam fasteners
<i>KNEE</i>	Common type of contracture / retraction: in flexion (generated by burns on the posterior surface)	3-point splint orthosis made of molded thermo-plastic material in full extension Mobilizations and postures every day in flexion / extension

<b>ANKLE</b>	Common type of contracture / retraction: in plantar flexion ! Burns to the back of the foot, including the toes, predispose to dorsiflexion contracture / retraction	Mobilizations and postures every day, in a neutral position (with dorsiflexion at 90 °) - including burns to the posterior or circumferential surface Orthosis with molded or prefabricated thermo-plastic splints (suitable in size and profile)
<b>METATARSAL-PHALANGEAL JOINT</b>	Common type of contracture / retraction: in dorsiflexion	Mobilizations and postures every day Orthosis with positioning to counteract the tendency to contracture / retraction

## - RESUSCITATION PHASES

I. PERIOD OF POST-COMBUSTION SHOCK (0-72 hours) This period is highlighted by large hydro-electrolytic and metabolic imbalances, it can be accompanied by edema, hypoxia and respiratory failure [17]. Edema appears in the first 6-12 hours leading to "obstruction of local lymphatics" [15]. Due to inhalation of fire and smoke, it accounts for over 50% of deaths [15]. Hydration is essential, calculating the required amount of liquids/ 24h is done according to the Parkland formula: 4ml/kg x burnt surface (%), of which 50% in the first 8h [18]. "The vital prognosis of the patient depends on this period" [14]

II. METAGRESSIONAL – DYSMETABOLIC PERIOD (days 4-21) This stage is characterized by the possibility of severe complications. Therefore, it is the most difficult period for both the patient and the medical staff [19]. "Septicemia or toxic and septic shock" may occur [14]. The most common are pulmonary complications [17].

III. CONVALESCENCE PERIOD (starts after day 22 and lasts until healed) The main role is occupied by the recovery team. The rehabilitation program can stretch from months to years, until the "complete maturation of the scars" is done [19]. We are also talking about the reconstructive period in which aesthetic and functional surgical interventions are carried out for "pathological scars, retractile bands, muscle-tendinous retraction" [18]. The main objective of burn management is the early identification of severe burns, the management of airway injuries with the possibility of oxygen administration and, very importantly, fluid resuscitation [20]. "Wound care is the first step in the local treatment of both acute and chronic wounds." [21] This consists of "debris removal in a moist occlusive environment with a minimum of psychological stress and pain to the patient." [21] "Wound tissue temperature must be maintained above 33°C" and tissue nutrition and oxygenation is extremely important. [21] Depending on: "cause, size, depth, location, level of contamination and costs" [21], the optimal wound environment that can improve healing should be achieved through the use of topical treatment and dressings (creams/ointments/disinfectant products) and/or intervention surgical [17]. The Rehabilitation program is initiated as early as possible [2]. An important part of the recovery program is the prevention / correction of contracts. They appear due to myofibroblasts that accumulate immediately after the injury and "continue to proliferate inside the scar" resulting in possible "major functional and aesthetic sequelae" [2]. The process requires a lot of patience and perseverance so that the vast majority of burn patients can return to normality (or quasi-normality N.B.) with appropriate treatment (and rehabilitation – N.B.) [2]. The functional recovery program for patients with burn injuries will include: the use of passive and active exercises to improve muscle atrophy, regain muscle strength and coordinate movements, [22] "prevention and improvement of ankylosis, deformities and/or contractures of soft parts induced by hypertrophic or retractile scars, damage to tendons, joint capsules and muscles, resulting from prolonged immobilization", [19] cardio-respiratory physical therapy, [22] the use of adjunctive therapies for: "pain, itching, paresthesia, altered sleep quality, swallowing and/or phonation disorders"; [19] use of splints/ortheses; [22] physical treatments: "Hydrotherapy, Compression therapy, deep vibration therapy,

LASER therapy"; [22] improvement of psycho-emotional state and quality of life and re-integration into society as soon as possible. Where possible, positioning the patient at rest is done so that the swollen areas are "over the heart to facilitate lymphatic drainage and limit edema". [16] [17]

We created a table adapted to the existing literature [16] [23] regarding the intervention strategy for preventive or corrective posture, including, if necessary, by orthosis and/or mobilization:

MLS Laser therapy appeared thanks to the scientific research of the "ASA (American Society of Anesthesiologists)" [24]. The MLS (Multiwave Locked System) Laser involves the synchronized combination of emission laser in "continuous system (808 nm), having anti-inflammatory and anti-edema effect and "pulsed system (905 nm", with analgesic effect) empowering each other and achieving results immediate and long-term [25]. The MLS Laser is a "multidiode optical group" which performs a "robotic multi-target movement" [26]. It feeds "6 continuous and pulsed sources", thanks to this method of treatment an entire area is treated instantly, allowing an immediate tissue response. "Target area ( $\varnothing=5$  cm)" is automatically moved over the entire portion to be treated [26]. MLS (Multiwave Locked System) Laser therapy is a new technique, "tested and officially validated by the FDA - U.S. Food and Drug Administration (Scientifically and Clinically)" starting in 2003 in the US and later in Europe [26].

HOW IT WORKS: local circulation is activated, resulting in an increase in the level of oxygen and nutrients in the lesion. Through bio stimulation, it increases the production of ATP (cellular energy) helping to "restore tissues, the formation of scar tissue, accelerates the healing process, decreases inflammation." It returns the cells to their resting potential. Another quality is the possibility of cell replication, synthesis of RNA and proteins (for example, collagen), favoring repair processes [27]. As benefits we can list that "it is non-invasive and painless"[28] there is no age criterion, [26] reduced symptomatology from the first applications, [26] reduced treatment time, [26] "anti-inflammatory, anti-edema, analgesic" effect, [26] "improving blood circulation", [28] fast healing of "fractures, dislocations, muscle strains and contractures", [28] rapid recovery of "structural integrity of injured muscles", [26] reduction of edema, [28] immediate and long-lasting results on inflammatory and painful processes. [26]

## 2. METHOD

In order to identify the current state of knowledge of this topic, we previously carried out a systematic review of the related literature through the method of filtering and selecting profile documentary material, widely used and accepted at the international level: Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) [5]. Thus, we searched, using contextually, combinations/syntaxes of the keywords in the following international databases: Elsevier [6], PubMed [7], PMC [8], PEDro [9], articles published in English in ISI indexed journals Web of Knowledge/Science, during 01.01.2021-31.12.2021. Nine sets of words, keyword combinations/syntaxes for database search have been used: "burn wound" + "laser" + "MLS"; "burn eschar" + "laser" + "MLS"; "burn wound" + "laser" + "Multiwave Locked System"; "burn eschar" + "laser" + "Multiwave Locked System"; "burn wound" + "MLS"; "burn eschar" + "MLS"; "burn wound" + "Multiwave Locked System"; "burn eschar" + "Multiwave Locked System"; "burn" + "Multiwave Locked System" (Table 2). In the end, we used the method of Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) [5]. Starting from a number of 18 articles found, after the duplicates were removed, a number of 15 articles resulted, 7 of which we included in the current study (Figure 1).

Table 2. Keyword/ “syntaxes” selected for our article and the results found in each data-base.

Keyword/ “syntaxes” sets	Elsevier	PubMed	PMC	PEDro	TOTAL
"burn wound" + "laser" + "MLS"	0	0	3	0	3
"burn eschar" + "laser" + "MLS"	0	0	0	0	0
"burn wound" + "laser" + "Multiwave Locked System"	0	0	0	0	0
"burn eschar" + "laser" + "Multiwave Locked System"	0	0	0	0	0
"burn wound" + "MLS"	0	0	15	0	15
"burn eschar" + "MLS"	0	0	0	0	0
"burn wound" + "Multiwave Locked System"	0	0	0	0	0
"burn eschar" + "Multiwave Locked System"	0	0	0	0	0
"burn" + "Multiwave Locked System"	0	0	0	0	0
<b>TOTAL</b>	0	0	18	0	<b>18</b>

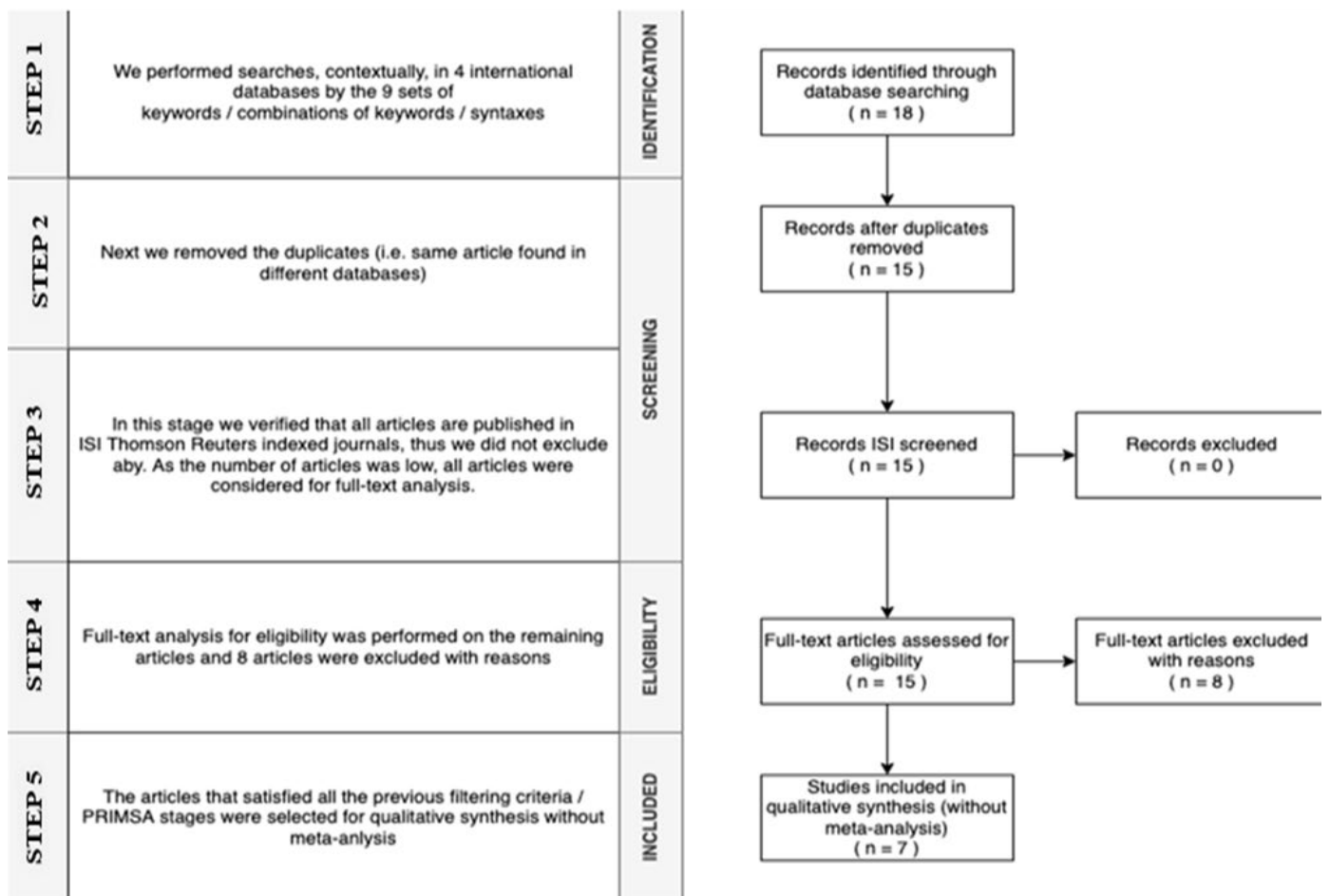


Figure 1. Preferred Reporting Items for Systematic Reviews and Meta-Analyses flow diagram relating to our systematic review of literature

We aim to evaluate retrospectively, prospectively and comparatively two groups of patients: a control group retrospectively constituted of about 50 patients who did not benefit from MLS Laser therapy in the treatment of burns and a prospective study group consisting of about 50 patients who will benefit from therapy including MLS Laser in the treatment of burns (in addition to the classic treatment that patients of both groups benefit from - quasi-similar according to the existing good practice protocols applied in our hospital). Inclusion of patients will be done only after obtaining informed consent from the patient. The study will be carried out in the Clinical Department of Neuromuscular Rehabilitation (RNM) with the support of the Clinical Department of Plastic Surgery - Reconstructive Microsurgery of the "Bagdasar Arseni" Emergency Clinical Hospital, Bucharest (SCUBA). This doctoral research will be carried out with the approval of the Bioethics Commission of SCUBA. Patients will be monitored by means of (Semi)quantitative assessment tools of severity and at the same time of clinical-functional evolution such as: VSS (Vancouver Scar Scale), VAS (Visual Analogue Scale), 5-D ITCH Scale, According to the model of the American Spinal Injury Association Impairment Scale (AIS) - for sensitivity disorders - 3-step scale, ROM (Range of motion), MMT (Manual Muscle Test Scale), The Barthel Index, FIM (Functional Independence Measure scale, ADL, Timed up and go test, Walk Speed, Berg Balance Scale, Six-Minutes Walk Test. Inclusion criteria: men and women aged >18 years, diagnosed with burns of various degrees. Exclusion criteria: refusal to participate in the study, impossibility of obtaining the patient's informed consent, age < 18 years.

Statistical analysis will be performed using SPSS v.24 software (Statistical Package for Social Sciences, version 24) and Microsoft Excel 2007 and will include demographic data, descriptive statistics, comparison tests, parametric difference data/tests or, depending on the (non-)normality of the data, non-parametric, possibly also correlation tests, graphical representations through diagrams and/or histograms. The obtained values will be considered statistically significant if:  $p < 0.05$ . The 95% confidence level with confidence intervals related to specific calculations will be taken into account.

### 3. EXPECTED RESULTS

We aspire that our overall related endeavor will contribute in the improvement of obtained outcomes of burn patients.

### 4. PRELIMINARY CONCLUSIONS

The literature regarding our subject matter is scarce, thus motivating our choice for initiating the doctoral research in this field.

#### Author contributions.

All the authors have equal contribution.

#### Conflict of interests:

The authors declare no conflicts of interests.

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