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Laser Therapy for Fibromyositic Rheumatisms

LEONARDO LONGO, M.D., Ph.D., ZLATKO SIMUNOVIC, M.D., MARCO POSTIGLIONE, M.D., and MARIANO POSTIGLIONE, M.D.

ABSTRACT

Background and objectives: **The objectives of this study is to treat the cases of fibromyositic rheumatisms untreatable with other therapies. The authors chose defocalized laser beams because some experimental studies had showed their analgesic and anti-phlogistic effects on experimental phlogosis. Since 1980 non-surgical laser effects were often noncomparable because of the lack of common treatment protocols. This summarizes fifteen years of clinical observations as to the purpose of identifying some indications on laser treatment of defined pathologies included in fibromyositic rheumatism.** ***Study design/materials and methods:*** **846 patients with different types of fibromyositic rheumatisms were submitted to defocalized laser therapy from 1980 to 1995. Criteria for selection included age, sex, and pathological pictures. Control groups were used to compare results with those of traditional methods. Diodes and CO_2 lasers were employed, to exploit the photothermic and photochemical effects of the laser radiations to the fullest extent.** ***Results:*** **On the whole, results were positive in comparison with other methods both as regards recovery time and persistence of results. Results were evaluated on the basis of subjective (such as local pain) and objective (hypomotility, phlogosis) criteria.** ***Conclusions:*** **Results obtained (approximately 2/3 of the patients benefited from the treatment) indicate that there are greater advantages in use of laser over other presently available methods. Standardalization of treatment protocols deserves further studies.**

INTRODUCTION

Biological effects of light on human tissue were described for the first time by Hippocrates,[1] and biological nonsurgical laser effects were reported for the first time at the end of the 1960s.[2,3]

Today, there are many bibliographical reviews on the subject.[4–14] From these reviews it appears that the results obtained are often nonreproducable and noncomparable because of the lack of common protocols for treatment and evaluation.[6,12]

Therefore, such results can only be accepted as clinical observations. Furthermore, doubt exists about the laser mechanism of action which is not yet completely understood. Nevertheless it is appropriate to first study the observed facts adn then their causes.[15] With this in mind, we have tried to summarize approximately 15 years of clinical observations on selected patients, in an effort to identify some clear indications about laser-treated pathologies and the results obtained.

The present paper is a schematic summary. Further studies are underway and will be forthcoming.

PATIENTS AND METHODS

Eight-hundred forty-six patients of both sexes and of middle-advanced age, suffering from different types of fibromyositic rheumatism, underwent defocalized laser therapy, from December 1980 to December 1995. Of these patients (Table 1), 512 were selected according to the following criteria: late–middle age, both sexes, presence of phlogosis findings and functional limitation for 2 months, no positive results after two other physical therapies, exclusion of surgical cases, and exclusion of cases with sign of pain only.

The method of "simple blind" for all the pathologies treated was used for patient and evaluators, except for lumbago and periarthritis of the shoulder, where a "double blind" method was used.

During the laser treatment, patients ceased participation in sports, drugs, and physical therapy, but continued their jobs, because immobilization was not necessary. Twenty-seven patients with periarthritis also presented radiologically identified metaplasic calcifications.

Sixteen periarthritic patients, with a similar clinical and radiological picture, were given infrared light exposure for control purposes.[16] The same dosage was given as that of laser radiation employed in similar clinical conditions without statistically significant results.[16] A control homogeneous group of randomized patients with similar clinical symptoms was treated with traditional physical and pharmacological means.

Laser treatment was also given to groups of patients with hip periarthritis, fibromyositis, and insertional tendinitis, selected according to the above criteria. Cases of borsitis, neuritis and tenosynovitis were treated when associated to more complex clinical conditions such as periarthritis, otherwise they were not included in this review

Institute for Laser Medicine, Florence, Italy (L.L., M. and M.P.), Laser Center of Locarno Switzerland (Z.S.)

TABLE 1. TREATED PATIENTS AND RESULTS

Pathologies		*Groups (and %) of results (number of cases)* 1st	2nd	3rd	4th
Periarthyritis					
Scapulo-humeral (90)	nr	12	12	16	50
	%	13.3	13.3	17.8	55.6
Ankle (20)	nr	4	2	4	10
	%	20	10	20	50
Fibromyositis					
Cervical (64)	nr	2	1	10	51
	%	3.1	1.6	15.6	79.7
Thoracic (6)	nr	0	0	3	3
	%	0	0	50	50
Lumbar (81)	nr	5	2	11	63
	%	6.2	2.5	13.6	77.8
Sacro-coccygeal (5)	nr	0	0	3	3
	%	0	0	50	50
S. of Dupuytren (7)	nr	1	0	3	3
	%	14.3	0	42.9	42.9
S. of La Peyronie (87)	nr	11	21	22	33
	%	12.6	24.1	25.3	37.9
Insertional tendinitis					
Epicondylitis (19)	nr	2	2	4	11
	%	10.5	10.5	21.1	57.9
Tendinitis of knee (88)	nr	3	5	17	63
	%	3.4	5.7	19.3	71.6
Tenoperiostitis of the pubis (16)	nr	0	0	5	11
	%	0	0	31.3	68.8
Tendinitis of Achille's tendon (29)	nr	1	1	6	21
	%	3.4	3.4	20.7	72.4

because they did not satisfy the criteria. Diode and CO_2 lasers were employed, the characteristics of which are given in Table 2.[17]

Diode lasers were used alone in cases of acute phlogosis with local hyperthermia in which heat was definitely to be avoided on trigger points and on small painful points.[6,12,18–21] CO_2 laser was used singly with a scanner on painful and contracted zones because of the great quantity of available energy in a uniform manner on a large target area (about 10 square m).[6,12,22–24] In any case, both laser types were used almost always in association (Table 3). In fact, CO_2 lasers were employed to irradiate the whole site of anatomic and functional lesions. Diode lasers were used to cover trigger points and points corresponding to well-defined anatomic structures, approximately 1 cm in diameter and relatively deep, like radicular nerves, ligament and tendon insertions as well as synovial sacs.[4–14,18,20,21]

RESULTS

In the evaluation of results, due account was taken of clinical subjective and objective parameters as well as of measurements as indicated next. Spontaneous and caused pain was measured according to Ritchie's scale. Spontaneous and caused motility was measured with common arthrogoniometers. The other signs of phlogosis, if present, were evaluated clinically. The results obtained, divided the patients into four groups for each pathology:

TABLE 2. TYPE OF LASERS USED

Characteristics	*Diode*	*CO_2*
Wavelength (nm)	904	10600
Emission	SPW	SPW
Duration of spiked pulse (ns)	200	100
Peak power (watts)	54	150
Duty cycle (%)	0.1	30
Repetition pulse frequency (Hz)	10–3000	10–1000
Spot (square cm)	1	5–10
Beam divergency and expansion	12°V × 7°H	1.5 mRad
Distance source/tissue	Contact	20 cm

Group 4: Disappearance of all parameters.
Group 3: Improvement of two parameters.
Group 2: Improvement of motility or phlogosis.
Group 1: No change.

No worsening of the pre-existing pathology was ever noticed. For each pathology, statistical analysis was used in the evaluation.[25,26] Ecography and Rx were performed before, and 1 year after, the treatment. Instrumental data, however, were often dissociated from the clinical symptomatological picture,[27] including the disappearance of the metaplasic calcifications, that was noted by echography and x-rays, in 13 out of 27 cases of periarthritis and in 5 out of 16 cases of La Peyronie's syndrome.[16,28] The results of the laser treatment of chronic complete periarthritis are summarized in Table 1.

The patients included 90 cases of scapulo–humeral periarthrytis, 20 cases of periarthritis of the ankle, 64 cervical cases and 6 cases of thoracic fibromyositis, 81 cases of lumbar and 5 cases of sacro-coccygeal fibromyositis, 87 cases La Peyronie's syndrome, 7 cases of Dupuytren's syndrome, 19 cases of epicondylitis, 88 cases of insertional tendinitis of the knee, 16 cases tenoperiostitis of the pubis, and 29 cases of Achille's tendon.

Results were always evaluated 1 month after the end of the laser therapy cycle (Table 1). During the course of treatment, patients were requested not to take any medicament or to undergo other physical therapy apart from rehabilitation exercises. A follow-up was always made after 6 months, and the result was considered positive if it persisted for at least this period of time (Table 4). For practical and financial reasons, relapses were treated only if they appeared at least 6 months after the first treatment.

DISCUSSION

Several authors have investigated both *in vivo* and *in vitro* analgesic, antiphylogistic, and de-contracturing mechanisms of action.[4–14] Particularly, "the laser induced active hyperemia on the local microcirculation,[29] the inhibition of further collagen production by fibroblasts,[30] the hyperpolarization of nerve fibers,[3,31] and inhibitions of macrocellular productive phlogosis[32,33] are all ef-

TABLE 3. DOSES OF LASER IRRADIATION FOR EACH PATHOLOGY

Pathology	*Min/spot*	*SPOT (cms)*	*Number of spots (for sessions)*	*Number of sessions (1/day)*	*Energy density (Joule) for spot*
Sc. Hum. periarthritis	1–3	10 (1)	4 (1–7)	12	12-36 (0.6–1.8)
Ankle	1–5	5 (1)	5	15	12-48 (0.6–2.5)
Cervical	1–3	10 (1)	2–4 (2–14)	15	12-36 (0.6–1.8)
Toracic	1–3	10 (1)	2–4 (2–14)	10	idem
Lumbar	3–7	10 (1)	2–4 (2–8)	15–20	12-80 (0.6–4.2)
Sacro-coccygeal	3–7	10 (1)	2–4 (2–8)	15	idem
La peyronie	1 (10)	5 (1)	4	15	12-48 (0.6–2.5)
Dupuytren	1 (10)	5 (1)	4	15	12-48 (0.6–2.5)
Epicondylitis	1–3	5 (1)	4	10–15	12-24 (0.6–1.2)
Knee	1–3	10 (1)	5–7	10–15	12-36 (0.6–1.8)
Pubis	3–5	5 (1)	2–4	10–12	12-48 (0.6–2.5)
Achille's tendon	1–3	5 (1)	2–4	15	12-36 (0.5–1.8)

CO_2 laser is used at 100 W of peak power, 1000 (half time of irradiation) and 10 Hertz in SPW. Diode laser is used always at 54 W of peak power, and 3000 Hertz, in SPW. Where there are parentheses, the figures in parentheses refer to diode lasers; figures without parentheses refer CO_2 laser. Where there are not parentheses, figures refer both laser, diode and CO_2.

fects of the laser tissue interaction that could explain the analgesic, antiphlogistic, and de-contracturing effects."[16,34]

Laser biochemical effects could be due to either thermic and photochemical mechanisms.[4–14] However, the lack of standardization of research protocols in this field makes it impossible to draw definite conclusions.

Nevertheless clinical evidence demonstrated beyond a doubt that certain types of lasers do possess the aforementioned properties and that in certain cases, each type of laser beam can produce different and even opposite effects, depending strictly on the dose employed.[6,12,30,32,34] In fact, whenever authors report opposite results on the same pathology, it is always evident that different energy doses have been used even when the same lasers have been employed for the same pathology.[12] The same situation arises in the case of different results reported in experimental data. The expression *defocalized laser therapy* (DLT) is preferred to *low-level laser therapy* (LLLT) and to *soft* and *mid-power laser*, because the focalization is at least as important as power density to obtain laser biological effects.[35]

Furthermore, the energetic density reached in many cases of fibromyositic rheumatism is of a "high" order, whereas in microsurgery "low" or "mid" doses are used. Consequently, an unnecessarily confusing terminology can be avoided by the use of DLT. Regarding laser different penetration power, it is probable that in the treatment of fibromyositic rheumatism, CO_2 laser triggers a series of photochemical and photothermic effects indirectly, through cutaneous free nervous terminations. In fact, CO_2 laser radiation, released in the deep infrared is absorbed within certain limits in direct relation with the tissue water content.[6] On the other hand, diode laser penetration is independent of tissue water and is only partly influenced by the tissue pigment content.[6] Consequently, diode lasers direct penetration is much greater than CO_2, other tissue conditions being equal. However, it is not known yet which wavelength for the various diode lasers is the best for the treatment of fibromyositic rheumatism. The most commonly used is the 904 nm, whereas there is a tendency to use more frequently the 830 nm, perhaps because the latter has a deeper penetration power.[21,36] We prefer to use both radiations in association in the attempt to potentiate their effects through a synergetic action. In fact, CO_2 laser induces a tissue distension that allows a greater absorption of diodic radiation, thus reducing the duration of each irradiation as well as the total number of applications necessary to obtain positive clinical results.[6,12,16] This clinical observation deserves further confirmation. Another doubt regards the need for irradiation coherence to obtain a therapeutic effect. It appears that there is no such need *in vitro*.[37] However, such tests have been performed mostly by biologists and physicists who in the recent past have consistently denied any nonsurgical effects of laser light on biological tissue.[37] *In vivo*, there are insufficient data so far to draw definite conclusions. In our experience, we have noted a statistically significant difference between cases treated with infrared diodic laser rays and cases treated with infrared light of the same wavelength, dosage, and clinical conditions being equal.[16] However, undoubtedly the enormous advantage of laser coherent light is that it can be exactly dosed in any moment and can be distributed evenly on a given surface. This is unattainable with any other presently available instrument.

TABLE 4. FOLLOW UP

Months	*1*	*6*	*12*
Periarthrytis			
Scapulo-humeral	12	2	6
Ankle	4	0	2
Fibromyositis			
Cervical	2	0	13
Lumbar	5	3	18
S. of Dupuytren	1	2	2
S. of La Peyronie	21	5	15
Insertional tendinitis			
Epicondylitis	2	0	3
Tendinitis of knee	3	3	17
Tenoperiostitis of the pubis	0	0	0
Tendinitis of Achille's tendon	1	0	2

CONCLUSION

Much study is still required on the lasers effect on fibromyositic rheumatisms. However, after reviewing our results and comparing them with those available in scientific literature, it is possible to draw some preliminary conclusions.

This type of treatment is valid and noninvasive and is frequently capable of providing a satisfactory solution to cases otherwise untreatable and resistant to at least two other types of physical therapies. Negative cases are due not only to the individual complexity of the clinical picture but particularly to our ignorance on the dosage to use in each pathology. Note that none of the cases treated has shown any worsening of the initial clinical picture. The exact mechanisms of laser action are not yet known, just as is the case for several pharmaceutical products presently in use, including aspirin and vitamins. However, there are valid hypotheses supported by many clinical and experimental data, that recognize analgesic, antiphlogistic, and decontracturing laser light effects that are strictly dose-dependant. Coherence allows the exact identification of the dose-effect correlation at clinical levels as well as at the level of medico-biological research. It is our conviction that research in the near future will identify the best methodology to use in the laser treatment of every single pathology as well as clarify the exact mechanisms of laser action.

REFERENCES

1. Koelbing, U.M. (1993). Medical therapy history. Ciba Medicine History Collection. Genève, CH.
2. Mester, E., Ludany, G., Selyei, M., Szende, B., and Tota, G.J. (1968). The stimulating effects of lower power laser rays on biological systems. Laser Rev. 1:3–9.
3. Fork, R.L. (1971). Laser stimulation of nerve cells in aplasia. Science 171:907–908.
4. Trelles, M.A. (1992). Soft laser-Therapia Ilustre Coleglo Oficial de Medicos de Madrid.
5. Oshiro, T., Calderhead, R.G. (1988). Low level laser therapy—A practical introduction. Wiley, Chichester.
6. Longo, L. (1986). Terapia laser. USES ed. Florence.
7. Karu, T.I. (1989). Photobiology of low power laser therapy. Harwood Acad. Publ., London.
8. Kert, J. (1989). Clinical laser therapy—Low level laser therapy. Scandinavian Medical Laser Technology, Copenhagen.
9. Oshiro, T. (1991). Low reactive level laser therapy: practical application. Wiley, Chichester.
10. D'Ovidio, M. (1990). LASER—Elementi, clinica ed aggiornamenti. EUR ed, Rome.
11. Pontinen, P. (1992). Low level laser therapy as a med. treatment modality. Art URPO, Finland.
12. Baxter, G.D. (1994). Therapeutic lasers—Theory and practice. Churchill Livingstone, Edinburgh.
13. Danhof, G. (1993). Laser therapie in der sportmedizin und Orthopadie. WBV Schorndorf.
14. Banta, D., Schou, I. (1992). Laser applications in medicine and surgery—Effectiveness, cost-effectiveness and policy implications. Acad. Press.
15. Virchow, R. (1972). In Florey L General pathology. Italian ed. Piccin ed. Padua, 426–431.
16. Longo, L., Clementi, F. (1992). CO_2 laser treatment of calcific metaplasias. In Spinelli P, Dal fante M., and Marchesini, R. Photodynamic therapy and biomedical lasers. Elsevier, 186–190.
17. Longo, L. (1984). Laser terapia in algologia: Fattori fisici e clinico-biologici Algos. II(1):36–38.
18. Walker, J. (1983). Relief from chronic pain by low power laser irradiation. Neurosci. Lett. 43:339–344.
19. Martino, G., Galberti, G., Milani, M., Stefanini, S., Sichiorllo, G.E., and Fava, G. (1988). Preliminary results on the role of monochromatic light in rehabilitation. Laser I(2):8–15.
20. Haimovici, N.B., Languasco, G.B. (1988). Clinical use of anti-inflammatory action of the laser in activated osteoarthritis of small peripheral joints. Laser I(2):4–12.
21. Simunovic, Z. (1996). Low energy laser therapy with trigger points technique. Proc. Laser Med 95, Munich. In Waidelich, W. Laser In medicine. Springer-Verlag (in press).
22. Longo, L., Tamburini, A., Monti, A., Cattaneo, L., Sesti, A.G. (1988). Treatment with 904 nm and 10600 nm laser of acute lumbago: double blind control. Laser I:(3):16–20.
23. Morselli, M., Soragni, O., Anselmi, C. et al. (1985a). Very low energy density treatment by CO_2 laser in sports medicine. Laser Surg. Med. 5:150.
24. Morselli, M., Soragni, O., Lupia, B.P. et al. (1985b). Effect of very low energy density treatment of joint pain by CO_2 laser. Lasers Surg. Med. 5:149.
25. Snedecor, G.W., Cochran, W.G. (1967). Statistical analysis. Ames, IA: State University Press. 331–337.
26. Borsini, F. (1986). Randomization program for Apple IIc computer. Brain Res. Bull. 15:279.
27. Melzack, R., Wall, P.D. (1989). Textbook of pain, 2nd ed. Churchill Livingstone, Edinburgh.
28. Longo, L., Peruzzi, G.P., Durval, A. (1990). Laser therapy on La Peyronie's syndrome. In Waidelich W. Laser/optoelectronics in Medicine. Proc. od Laser 89 Optoelektronik, Munchen, Springer Verlag, 116–121.
29. Lievens, P. (1988). The influence of laser treatment on the lymphatic system and on wound healing. Laser, I(2):6–12.
30. Abergel, R.P., Meeker, C.A., Lam, T.S., Dwyer, R.M., Lesavoy, M.A., and Vitto, J. (1984). Control of connective tissue metabolism by lasers. Recent developments and future prospects. J. Am. Acad. Dermatol. 11:1142–50.
31. Bieglio, C. De Bisschop, G. (1986). Physical treatment for radicular pain with low power laser stimulation Lasers Surg. Med. 6:173.
32. Longo, L., Corcos, L. (1991). Defocused CO_2 laser therapy in pathologic wounds healing. Proc Laser Med 91, Munchen, in Waidelich, W. Hofstetter, A., Laser/optoelectronics in medicine. Springer Verlag, Heidelberg, 408–412.
33. Trelles, M.A., Mayayo, E., Miro, L. et al. (1989). The action of LLLT on mast cells: a possible pain relief mechanism examined. Laser Therapy 1:27–30.
34. Mester, A.F., Mester, A. (1988). Scientific background of laser biostimulation. Laser I(1):23–26.
35. Calderhead, R.G. (1990). On the importance of the correct reporting of parameters and the adoption of a standard terminology in clinical papers on low reactive level laser therapy. Laser 90 Abs, Manchester, UK.
36. Rochkind, S., Nissan, M., and Lubart, R. (1990). The effect of a simple transcutaneous irradiation of peripheral nerve: Comparative study with five different wavelengths. Laser Med. Sci. 4:259–63.
37. Jori, G. Sul meccanismo di fotostimolazione di sistemi biologici con radiazione visibile a bassa potenza. Abs XII Congresso della Soc. Ital. di Laser Chirurgia e Medicina, 21/23 Settembre 1995, Bologna, 48.

Address reprint requests to:
Professor Leonardo Longo
Institute for Laser Medicine
Borgo Pinti, 57
50121 Firenze, Italy
e-mail: longo@dada.it