EFFICACY OF POLARIZED LIGHT THERAPY FOR MUSCULOSKELETAL PAIN

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We evaluated the efficacy of polarized light therapy for pain attenuation in outpatients with various types of musculoskeletal pain. The patients consisted of 100 with herniated intervertebral disc, 48 cases of myofascial pain syndrome, 36 with sprain and strain, 26 with frozen shoulder, 23 with arthritis, 15 with Raynaud's syndrome, and 15 cases of tendinitis or epicondylitis. Degree of pain was assessed by a visual analogue scale: VAS (0 to 10) before and after polarized light therapy. The polarized light therapy system used had 1800 mW power output and a wavelength range of 600 to 1600 nm. Along with irradiation of trigger and tender points, irradiation was carried out near the stellate ganglion for 5 to 10 min for the upper limbs and near the lumbar sympathetic ganglion for 10 min. The mean VAS before treatment was 8.3 ± 1.7 , whereas that after treatment was 3.1 ± 1.9 . The difference was significant ($P < 0.01$). Excellent results (full recovery of movement and strength with more than 75% of the VAS improvement rate) were seen in 135 patients (51.3%), and good results (significant improvement of movement and strength with an improvement in the VAS score between 50% and 75%) were obtained in 69 patients (26.2%). Thermographic evaluation revealed increases of regional temperature when the temperature was relatively hypothermic, and decreases when it was relatively hyperthermic. Although some first and second degree burns at the probe site were observed, they were transient and no specific treatment was needed. Our results indicate that polarized light therapy is effective in the attenuation of musculoskeletal pain of various origins, as is low reactive-level laser therapy (LLLT).

KEY WORDS Musculoskeletal pain Polarized light therapy Pain clinic Rehabilitation

Introduction

Musculoskeletal pain can be caused by inflammation, degeneration, or trauma to the skeletal or myofascial tissues.¹ Myofascial pain is the most common cause of chronic low back or cervical pain. Other conditions that produce soft tissue pain are bursitis, synovitis and tendinitis. Skeletal pain may be due to osteoarthritis, degenerative arthritis, ankylosing spondylitis, inflammation of the facet joint and spondylolisthesis amongst other conditions. Treatment protocols for musculoskeletal pain include nerve blocks, oral medication, transcutaneous electrical nerve stimulation (TENS), acupuncture and others. The use of low level laser therapy (LLLT) and polarized light therapy in pain management are relatively new modalities of therapy and have been used with increasing frequency in the field of pain clinic and rehabilitation medicine.²⁻⁴ In this study, we evaluated the efficacy of polarized light therapy for musculoskeletal pain of various origins including herniated intervertebral disc, myofascial pain syn-

drome, frozen shoulder, sprain and strain, tendinitis, and epicondylitis.

Methods

We evaluated 263 outpatients who visited our clinic for the 10 months from May 1992 through February 1993. Included were various types of musculoskeletal pain, such as herniated intervertebral disc, myofascial pain syndrome, sprain and strain and frozen shoulder. The polarized light therapy system when used as a continuous mode has a maximum power output of 1800 mW at 600–1600 nm mostly in the near infrared spectrum (Super lizer, Tokyo Iken, Japan). The power output can be regulated every 10% from 10% to 100% in terms of volume. The system has continuous and cycle (pulse) modes of irradiation, and time cycles can be controlled every second from 1 to 10 s. The probe used in this study is 10 mm in diameter.

The polarized light was irradiated at trigger and tender points and near the stellate ganglion for the upper limb, and trigger and tender points and near the lumbar sympathetic ganglion for the lower limb. For trigger and tender point irradiation we used 80% of power volume with cycles of 7 s on and 1 s off for the average seven to 10 points that were

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repeated three to four times. For irradiation near the stellate ganglion we used 70% of volume with cycles of 1 s on and 3 s off for 5 to 10 min. For irradiation near the lumbar sympathetic ganglion we used cycles of 1 s on and 3 s off for 10 min with 80% of volume for the anterior approach, and 100% of volume for the posterior approach. Irradiation was conducted three to six times a week, and the total number of treatments varied from three to 36 times depending on the size of the affected areas and type of pain.

Physical examination, thermographic evaluation and assessment of the degree of pain by a visual analogue scale (VAS) were performed before and after each treatment. A score of 10 indicates maximum pain, whereas 0 represents no pain in VAS. The VAS improvement rate (%) was calculated by the pre-treatment VAS minus the post-treatment VAS divided by pre-treatment VAS times 100. The assessment was made at the end of polarized light therapy. It was classified as excellent when VAS improvement rate was more than 75% with full recovery of movement and functional strength; good when the rate was between 50% to 75% with significant improvement of movement and strength; fair when the rate was from 25% to 50% with moderate improvement of movement and strength; and poor when the rate was below 25% or no improvement of movement and strength.

Results

The age and sex distribution of 263 patients are shown in Table 1. There were more female patients than male patients (151 versus 112). Seventy patients were in their thirties, 64 in their fifties and 55 in their forties.

Diseases causing musculoskeletal pain are summarized in Table 2. Herniated intervertebral disc (HIVD) was seen in 100 patients, myofascial pain syndrome (MPS) in 48, sprain and strain in 36, frozen shoulder in 26, and arthritis in 23.

The time in months from onset of pain to the initial polarized light therapy is shown in Table 3.

Table 1. Age and sex distribution of patients

Age (years)	Male	Female	Total
>20	2	3	5 (1.9%)
20-29	3	26	29 (11.0%)
30-39	33	38	71 (27.1%)
40-49	31	24	55 (20.9%)
50-59	29	35	64 (24.3%)
60<	14	25	39 (14.8%)
Total	112 (42.6%)	151 (57.4%)	263 (100%)

Table 2. Disease distribution of patients

Disease	Number of patients
1. Herniated intervertebral disc (HIVD)	100 (38%)
Lumbar	76 (28.9%)
Cervical	24 (9.1%)
Combined radiculopathy	44
Lumbar	33
Cervical	11
Post operation	6
Lumbar	6
Cervical	0
2. Myofascial pain syndrome (MPS)	48 (18.3%)
3. Sprain and strain (knee, angle, wrist . . .)	36 (13.7%)
4. Frozen shoulder	26 (9.9%)
5. Arthritis	23 (8.7%)
Osteoarthritis	17
Rheumatoid arthritis	6
6. Raynaud's syndrome	15 (5.9%)
7. Tendinitis or epicondylitis	15 (5.7%)
Total	100 (100%)

Table 3. Duration of symptoms

Duration (months)	Number of patients (%)
0-1	27 (10.2%)
1-6	61 (23.2%)
7-12	88 (33.5%)
13-36	64 (24.3%)
37-60	15 (5.7%)
61>	8 (3.1%)

One-third of the patients visited our clinic between 7 and 12 months after the onset of pain.

VAS was significantly improved by the therapy as shown in Table 4. Mean pre-treatment VAS was

Table 4. VAS before and after treatment

Disease	Before treatment	After treatment
1. HIVD		
Lumbar lesion (76)	8.7 ± 1.2	3.5 ± 2.1*
Cervical lesion (24)	8.9 ± 1.1	3.0 ± 1.8*
2. MPS	7.8 ± 1.8	2.7 ± 1.7*
3. Sprain and strain (36)	7.9 ± 1.7	2.5 ± 1.6*
4. Frozen shoulder (26)	8.3 ± 1.8	3.0 ± 1.9*
5. Arthritis (23)	8.1 ± 1.9	3.2 ± 2.0*
6. Raynaud's syndrome (15)	8.7 ± 1.3	3.7 ± 2.2*
7. Tendinitis (15)	7.7 ± 1.9	2.9 ± 1.7*
Total (263)	8.3 ± 1.7	3.1 ± 1.9*

HIVD = herniated intervertebral disc; MPS = myofascial pain syndrome; VAS = visual analogue scale.

*Significant versus VAS before treatment.

8.3 ± 1.7 (mean + SD), whereas post-treatment VAS was 3.5 ± 1.9 .

Excellent results were obtained in 135 patients including 31 of myofascial pain syndrome, and 24 of sprain and strain. Good results were seen in 69 patients (Table 5). The VAS improvement rate above 50% was observed in 204 patients (76.5%). However, fair or poor results were seen in 59 patients (22.4%).

Thermographic evaluation was performed in 162 patients. The typical thermographic changes obtained in a patient with Raynaud's syndrome are shown in Figure 1. Polarized light irradiation near the right stellate ganglion clearly increased the regional temperature as shown in the figure. Temperature changes by the therapy are summarized in Table 6. Temperature decreased if the regional temperature was relatively high before the therapy, whereas it increased when the regional temperature was relatively low before the therapy. However, patients with localized hyperthermia and radicular hypothermia showed biphasic changes.

Some first degree burns at the probe site were noted in 11 patients, local skin rash in four, and conjunctival congestion in two, second degree of burn in one. The total side-effects were thus noted in 18 out of 263 patients (6.8%). However, these side-effects were transient and no specific treatment was needed.

Discussion

Our results indicate that polarized light therapy is effective for pain attenuation in patients with musculoskeletal pain of various causes. This therapeutic modality has some similarity to LLLT.⁴⁻⁶ Improvement of blood flow, promotion of healing of damaged tissues, inhibition of pain-related substances, and normalization of nerve cell function may be also expected by polarized light irradiation as by LLLT.^{3,6-8} Further, as the system used has

higher energy than LLLT system (1800 mW versus 60 to 100 mW), it produces more efficient penetration into the affected tissues than LLLT. Its wavelength is 600 to 1600 nm and produces a thermal effect felt as a warm or hot sensation and a tingling stimulation in the irradiated areas.⁹ In rehabilitation, LLLT has been shown to decrease the time required to turn a non-weightbearing injury into a weightbearing one, getting the patient back into useful social and business life much earlier, and at less cost, compared to conventional physical therapy methods.^{2,3} This is because LLLT reduces muscle spasm along with pain attenuation. We also noted significant improvement of movement and strength of the upper or lower limbs following polarized light therapy in this study. Therefore, polarized light therapy may also be as beneficial for the reduction of muscle spasm as LLLT.

Polarized light irradiation near the stellate ganglion or lumbar sympathetic ganglion seems to attenuate pain by increasing regional blood flow that is obtained by stellate ganglion block.⁷⁻⁹ It was reported that irradiation near the stellate ganglion by polarized light was more effective than LLLT in a patient with Raynaud's sign.⁸ It is not clear how irradiation near the stellate ganglion by either LLLT or polarized light works. However, it was proved that regional temperature increased and pain was relieved by LLLT or polarized light irradiation.⁸ Thermograms show increases of regional temperatures in patients with a hypothermic pattern like Raynaud's sign, whereas temperatures decreased in patients with a hyperthermic pattern like acute tendinitis. This phenomenon is called normalization or modulation by the photoactivating action of LLLT. Accordingly normalization or modulation can be seen in polarized light therapy as well. This may be also true for the lumbar sympathetic ganglion irradiation. We need more power output to obtain sufficient effects in irradiation in the lumbar sympathetic ganglion than in the stellate ganglion, because anatomically the lumbar sympathetic gang-

Table 5. Result of treatment

Disease	Excellent	Good	Fair	Poor	Total
1. HIVD					
Lumbar lesion	31 (40.8%)	24 (31.5%)	13 (17.1%)	8 (10.5%)	76
Cervical lesion	11 (45.8%)	8 (33.3%)	3 (12.5%)	2 (8.4%)	24
2. MPS	31 (64.5%)	9 (18.7%)	4 (8.3%)	1 (2.7%)	48
3. Sprain and strain	24 (66.7%)	7 (19.4%)	4 (11.1%)	1 (7.6%)	36
4. Frozen shoulder	14 (53.8%)	6 (23.4%)	4 (13.3%)	2 (7.6%)	26
5. Arthritis	11 (47.8%)	6 (26.2%)	3 (13.9%)	3 (13.3%)	23
6. Raynaud's syndrome	5 (33.3%)	5 (33.3%)	3 (20.0%)	2 (12.3%)	15
7. Tendinitis	8 (53.3%)	4 (26.7%)	2 (13.3%)	1 (6.6%)	15
Total (263)	135 (51.3%)	69 (26.2%)	36 (13.7%)	23 (8.7%)	263

HIVD = herniated intervertebral disc; MPS = myofascial pain syndrome.
() indicates % of total.

Figure 1. Thermograms obtained in a 36-year-old female patient with Raynaud's syndrome before polarized light therapy (upper) and after irradiation near the right stellate ganglion for 6 min (lower). Regional temperature at points of a and c was increased by the therapy

lion lies deeper than the stellate ganglion. Irradiation near the stellate ganglion or the lumbar sympathetic ganglion along with irradiation of trigger and tender points may be more effective in pain attenuation than irradiation of trigger and tender points alone.

Although the number is small (one second degree and 11 of first degree), we experienced burns of the irradiated areas. To avoid the burn it should

be advised to reduce the power volume from 80% to 70% or 60% depending on patients' body size.

LLLT is non-invasive and more acceptable by patients than nerve blocks, its immediate effect, however, is inferior to nerve blocks. In contrast to LLLT, polarized light irradiation produces a warm sensation and tingling stimulation, and then patients are usually satisfied by the therapy. This can be stated as the advantage of this therapy.

Table 6. Temperature changes by treatment

Lesion	Number	Temperature before treatment (°C)	Temperature after treatment (°C)
1. Localized or diffuse hyperthermia pattern	91	34.2 ± 1.4	32.4 ± 1.6
2. Localized hyperthermia with radicular hypothermia pattern	56	33.8 ± 1.3 29.4 ± 1.7	32.1 ± 1.7 31.5 ± 1.4
3. Diffuse hypothermia pattern	15	30.2 ± 1.3	31.8 ± 1.6

In conclusion, polarized light therapy is effective for both pain attenuation and improvement in movement and strength in patients with various kinds of musculoskeletal pain. Polarized light therapy has photoactivation and thermal effect, better tissue penetration, and similar beneficial effects as compared with LLLT.

References

1. Raj, P.P. (1986). Pain of musculoskeletal origins. *Practical Management of Pain* (ed. Raj, P.P.) p. 443. Year Book Medical Publications, Chicago.
2. Ohshiro, T. (1991). *LLLT: Practical Application*. John Wiley & Sons, Chichester.
3. Kemmotsu, O. (1992). *Illustrated Explanation of Semiconductor Laser and Pain Treatment*. Medical View, Tokyo.
4. Kemmotsu, O. (1993). Clinical application of low reactive-level laser therapy (LLLT) and polarized light therapy (Super Lizer) for chronic pain syndrome. *The Journal of the Korean Pain Society* 6, in press.
5. Kemmotsu, O., Kaseno, S., Sato, K. and Otsuka, H. (1991). LLLT for pain attenuation—The current experience in the pain clinic. In *Progress in Laser Therapy* (eds Ohshiro, T. and Calderhead, R.G.) pp. 197–200. John Wiley & Sons, Chichester.
6. Kemmotsu, O., Sato, K., Furumido, H. and Harada, K. (1991). Efficacy of low reactive-level laser therapy for pain attenuation of postherpetic neuralgia. *Laser Therapy* 3, 71–75.
7. Otsuka, H., Kemmotsu, O., Dozaki, S. and Imai, M. (1992). Low reactive-level laser therapy near the stellate ganglion for postherpetic facial neuralgia. *Japanese Journal of Anesthesiology* 41, 1809–1813.
8. Otsuka, H., Kemmotsu, O., Imai, M. and Kaseno, S. (1992). The combination of low reactive-level laser therapy (LLLT) and stellate ganglion block for the treatment of allergic rhinitis. *Laser Therapy* 4, 117–120.
9. Otsuka, H., Okubo, K., Imai, M., Kaseno, S. and Kemmotsu, O. (1992). Polarized light irradiation near the stellate ganglion in a patient with Raynaud's sign. *Japanese Journal of Anesthesiology* 41, 1814–1817.