

Effects of Skin-Contact Monochromatic Infrared Irradiation on Tendonitis, Capsulitis, and Myofascial Pain*

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Abstract. Skin-Contact monochromatic infrared irradiation has recently become available via adaptation of superluminescent diode technology. Craniofacial and cervical myalgias, insertion tendonitis, and dysfunctions of the temporomandibular joints are addressed. This article attempts to establish protocol guidelines and report patient responses to this very effective, noninvasive, physiotherapeutic treatment modality. Both surgical and nonsurgical cases are reported, and clinical application as well as home unit use is evaluated. Details on technique are given, and contraindications are outlined. Particular advantages are rapid patient response, operator-friendly technique, diversity of application parameters, and the opportunity to manage both acute and chronic conditions in the absence of oral or injectable pharmacology.

Key Words: Infrared-Skin-Contact-Infrared-Monochromatic-Irradiation-Tendonitis-Capsulitis-Myofascial Pain-Muscle-Spasm

Introduction

Conservative management of acute, Chronic, and/or postoperative pain and inflammation requires several essential parameters: it should be health-friendly to the patient, quickly effective at reaching pain-reduction goals, easy to administer, cost-effective for both patient and professional, and able to address a broad spectrum of conditions. Management of these patient needs has usually been via oral or injectable medications, or by one or several physiotherapeutic modalities. It is obviously desirable to avoid oral or injectable pharmacology if simple, effective, nonpharmacologic alternatives are available. Physical therapy modalities are mainly pain-modulation devices, and while often effective, may be technique sensitive (electrical modalities, iontophoresis), cumbersome (infrared heat lamps, diathermy, hot or cold packs), potentially harmful (ultrasound), and generally not easily transportable or available in a home or bed-ridden setting, (i.e., easy patient self-management).

In any clinical or home setting where painful conditions are treated, tendonitis, capsulitis, and myofascial pain are frequent etiologic components of those painful conditions. While addressing these painful situations, as well as intra-articular dysfunctions, we should look to reduced pain and edema, decreased inflammation, increased range of motion, and removing work and lifestyle restrictions of the patient as desirable goals in treating nearly all diagnoses. Associate conditions most frequently encountered by this author while assessing and treating over 2500 temporomandibular joint (TMJ) dysfunction and craniofacial pain patients are TMJ capsulitis, trapezius tendonitis/tendonosis (TS), splenius capitis tendonitis/tendonosis (SCS), and myofascial pain and muscle spasm in the masseter, trapezius, and paracervical musculature.

TMJ capsulitis and edema are nearly always a component of sprained capsular ligaments, displaced fibrocartilage (with or without reduction upon opening), and post-operative sequelae. Clinical signs include intrameatal or preauricular tenderness to palpation. The edema portion of the capsulitis generally prevents a patient from biting the teeth, together in a normal day-to-day occlusion on the affected side, and the edema may be externally visible depending upon the degree of severity. TS and SCS are often a result of acceleration/deceleration injuries, and manifest with occipital area tendonitis and referred pain retro-orbitally and periorbitally, frequently with photophobia and/or nausea, as well as having the occipital pain component. TS and SCS differ in their origin site and the mediolateral manifestation of the referred pain periorbitally. For the purpose of this study, TS and SCS will be considered jointly, as the treatment modality used could hardly treat one condition separate from the other. Paracervical musculature, masseter, and trapezius myofascial pain and muscle spasm have a variety of etiologies, but generally manifest with sitespecific pain, tightness, decreased range of motion, and pain referral areas of high concentrations of lactic acid and other waste products ("trigger points" with the trapezius and paracervical musculature condition, often leading to TS and/or SCS.

This study reports my experience and results treating these various conditions with Skin-contact monochromatic infrared irradiation.

Materials and Methods

From October 1993 to June 1995, patients were selected for treatment based solely upon diagnosis. Only those patients that were pregnant or presented with active malignancy were excluded from treatment with the modality. Neither age, sex, race, build, or skin pigmentation were considered as parameters. Males comprised 9.8% of patients treated; females comprised 90.2%. It should be noted, however, that this clinic has a patient base that consists predominantly of females of childbearing age. For this reason, the majority of patients treated would normally fall into those two categories. Both new patients presenting for initial evaluation and treatment (73.5%), and existing patients of this clinic with exacerbations of conditions previously treated with other methods (26.5%) were prescribed the modality. Of all patients, 91.9% had previous management for their condition(s) consisting of hot/cold packs, ultrasound, electrical stimulation, massage therapy and/or pharmacology.

Equipment chosen for the clinical portion of the treatment was the Anodyne 4000 Professional Therapy System (Anodyne Therapeutics, LLC). The unit has four flexible pads, each containing an array of 60 superluminescent infrared diodes emitting pulsed near-infrared irradiation. Infrared irradiation power density (irradiance) output can be varied up to a maximum of 10 milliwatts per square centimeter (mw/cm^2), and is delivered in a uniform and homogenous manner over a $22.5/\text{cm}^2$ area per pad. There is some associated warmth felt by the patient proportional to the irradiance. All patients in this portion of the study were treated at a 7-bar reading on the control box scale, corresponding to an irradiance of $9.0 \text{ mw}/\text{cm}^2$. Pad placement was in light contact with the patient's skin and the pads were flexed to obtain perpendicular delivery even in curved areas. The pads were held in place over the TMJ and masseter areas by nylon-backed neoprene straps with velcro fasteners; over the paracervical musculature, TS and SCS areas by patient pressure while reclining against a soft cervical pillow; and over the superior portion of the trapezius muscles by gravity via placement under patient clothing. One to six pads were used per patient application depending upon number of pain-producing areas diagnosed. In the home treatment setting, the Anodyne 2000 Home Therapy System (Anodyne Therapeutics, LLC), was utilized. This unit has two pads; irradiance is not adjustable, and is preset for output at $7.5 \text{ mw}/\text{cm}^2$ by the manufacturer. Areas and methods of pad placement were the same as in the clinical setting.

Application treatment times in the clinical setting were generally 45 min, occasionally shorter, with output consistently set as above. This corresponds to an energy density (radiant exposure) of 64.8 joules per square centimeter (J/cm^2). Initially, each clinical patient was prescribed three treatments, with 1-2 days in between each treatment, depending upon patient and clinic availability. Additional treatment sessions were prescribed for patients with residual signs and/or symptoms. Some clinical setting patients received only one or two treatments depending upon the resolution of each patient's condition. Treatment times with the home unit were prescribed at 30 min daily for 1 week for most home patients, corresponding to a radiant exposure of 36.0 J per treatment. Applications were made twice daily for postsurgical patients.

Clinical patients were asked to rate the percent relief of pain and/or spasm treated. Rating parameters were: total relief (100%), excellent relief ($>75\%$), fair relief (50-75%), poor relief ($<50\%$), and no relief (0%). Ratings were taken at each treatment appointment, and treatment discontinued if no additional improvement occurred on three successive visits, or if total relief was reported with no recurrence of symptomatology or signs. For reporting purposes, lengths of treatment were divided into three categories: 1-3 treatments, 4-6 treatments, and 7-12 treatments.

Prior to March 1994, informed consent forms were given to the patients to sign. No consent forms were utilized after Food and Drug Administration 510K Clearance was granted March 30, 1994.

Results

Tendonitis

One hundred two patients were treated for TS/SCS, representing 200 total cases treated. Of the 102 patients, 94 (92.0%) had some type of previous treatment for these conditions. Figure 1 shows TS/SCS patient responses to treatment with skin-contact monochromatic infrared irradiation: 176 (88.0%) of the cases treated had total to

excellent relief from the treatment in 1-12 applications. Twenty-two total cases (11.0%) had fair to poor relief, and 2 cases (1.0%) had no relief. Results using the home therapy system were not statistically nor clinically significantly different than results obtained in the clinical setting.

Capsulitis

One hundred nonsurgical patients were treated for TMJ capsulitis, representing 195 total cases treated. Figure 2 shows nonsurgical TMJ capsulitis patient responses to treatment using skin-contact monochromatic infrared irradiation. Total to excellent relief in 1-12 treatments in 173 cases (88.7%) was demonstrated. Nineteen cases (9.7%) had fair to poor relief, and 3 cases (1.6%) had no relief. Of the 28 postoperative cases treated for capsulitis, 23 cases (82.1%) reported total to excellent relief in 1-12 treatments. Four cases (14.3%) reported fair to poor relief, and 1 case (3.6%) reported no relief. Results with the home therapy system were not statistically nor clinically significantly different than with clinical applications.

Myofascial Pain/Muscle Spasm

Figure 4 reveals results of 361 case responses to treatment of myofascial pain/muscle spasm using skin-contact monochromatic infrared irradiation. The graph shows 324 (89.8%) of all patients treated had total to excellent relief in 12 treatments or less. Thirty-three cases (9.1%) had fair to poor relief overall, and 4 cases (1.1%) had no relief. Results using the home therapy system were not statistically nor clinically significantly different than with clinical applications.

Discussion

Wavelength-dependent photobiostimulation responses are a part of our everyday life. Increased melanin production, color recognition, and synthesis of vitamin D are a few examples. In this study, the excellent results of the infrared portion of the electromagnetic spectrum on pain relief seem to be related to several factors. One of these factors is the opportunity to place the infrared irradiation in direct contact with the patient's skin for extended periods of time (30-45 min) without harm to the patient. Another factor is the delivery of the irradiance perpendicular to all target areas via flexible pads containing the superluminous diodes. Consistent, homogeneous dosage delivery from patient to patient and condition to condition allows ease of establishing application protocols, and uniform comparison of treatment results between practitioners. The consistent results from diagnosis to diagnosis indicate a commonality of effect on inflammatory processes, regardless of site or etiology.

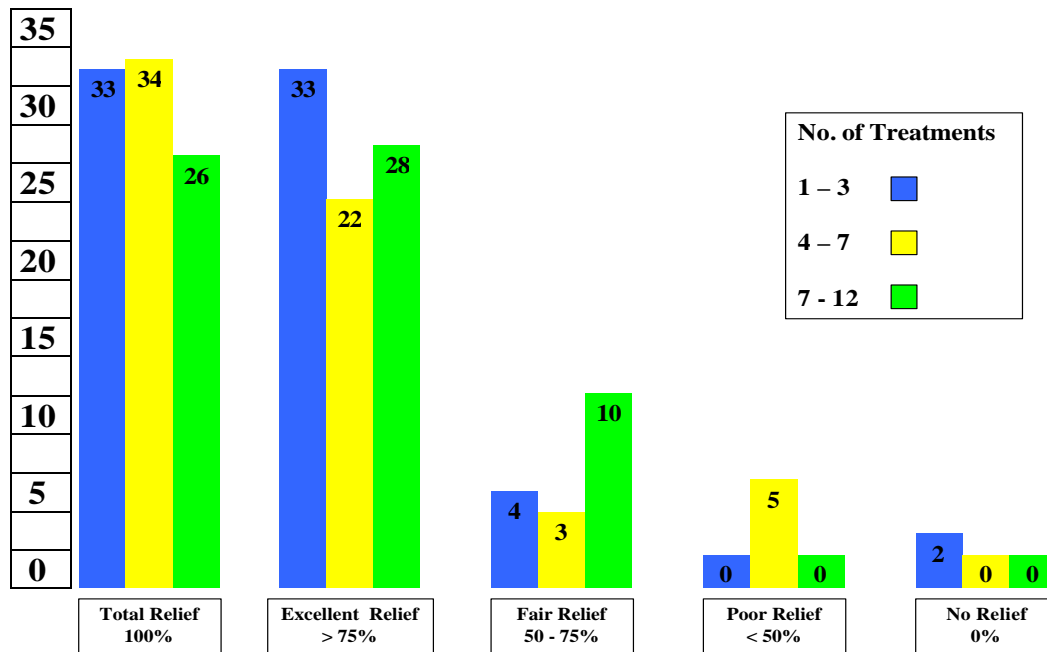
Since nearly all patients treated (91.9%) had a history of some type of previous therapeutic intervention, the results indicate a high rate of successful conservative treatment whether or not the diagnoses were new or subjected to previously applied standard treatment parameters. This is a great benefit, as skin contact monochromatic infrared irradiation can be considered as a first line of physiotherapeutic treatment for soft-tissue disorders encountered in pain management. The absence of technique-sensitive application and lack of harmful patient side effects enables this modality to be easily delegated to auxiliary personnel or to home use, and the rapid patient response is certainly an aid in pain-patient management.

The vast majority of supportive research regarding photobioactivation has been limited to evaluation of effects of low level laser therapy. This is primarily due to the fact that, until recently, lasers were the only convenient means of delivering effective monochromatic irradiation. However, with recent developments in superluminous diode technology, we can now deliver effective, safe, technique-friendly skin-contact monochromatic infrared irradiance with energy densities previously limited to laser irradiation. This eliminates or reduces the restrictions of immobility, hand-held delivery, or high cost some laser systems impose. Basford, Smith, Karu, and Baxter have indicated that the effects are not necessarily due to the unique qualities of laser irradiation, but are primarily wavelength and energy-dependent [1-4]. It has been previously reported that these excellent responses to treatment may be partially due to increased fibroblastic activity [5,6], respiratory chain photobioactivation [2,31], bioactivation of serotonin [2], improved lymphatic evacuation [7], or increased circulation [7]. Whatever may be the mechanism(s) involved, this easy, safe, and effective modality is an extremely valuable tool for eliminating or reducing pain, inflammation, edema, and loss of range of motion.

No. of Cases

Results of TS/SCS treatment of 200 cases

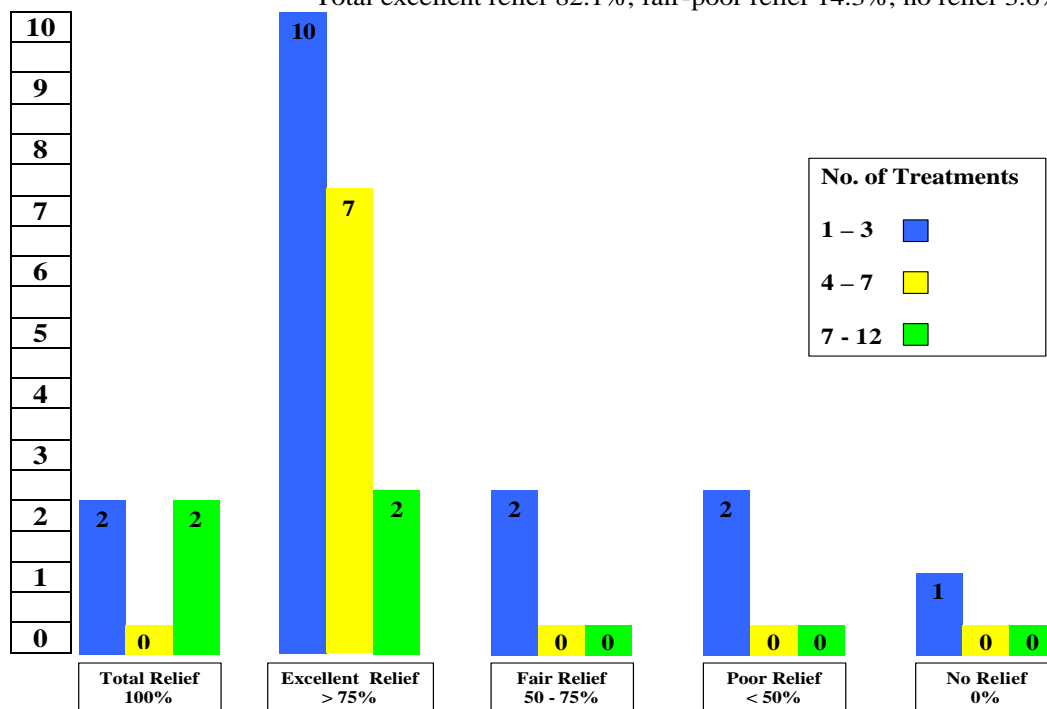
Total excellent relief 88.0%, fair-poor relief 11.0%, no relief 1.0%



No. of Cases

Results of postoperative capsulitis – 28 cases

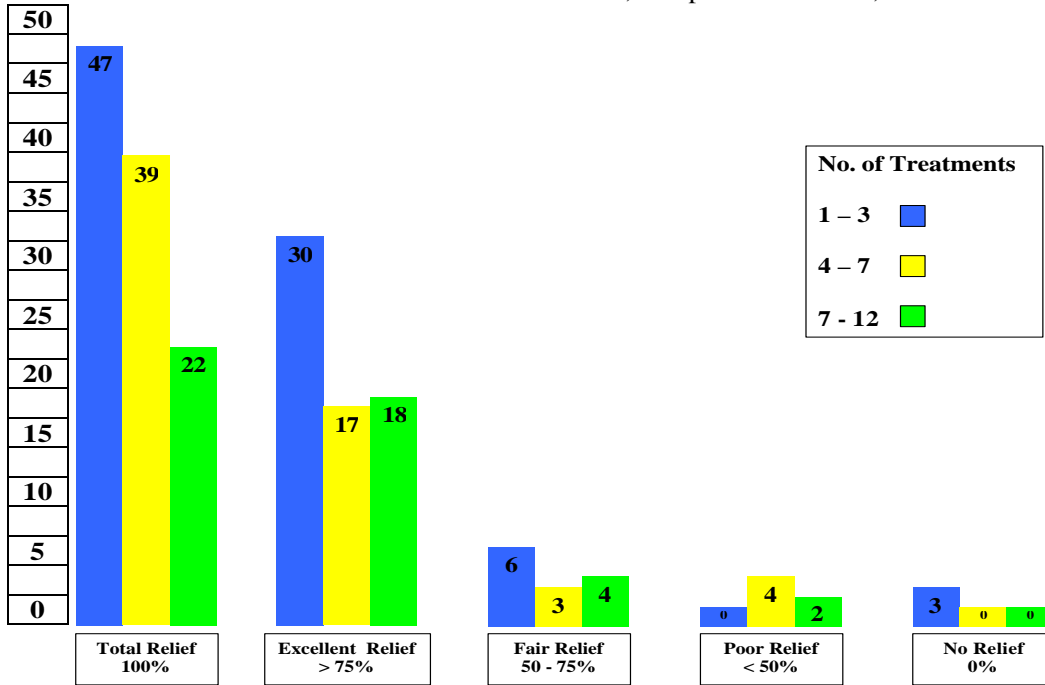
Total excellent relief 82.1%, fair-poor relief 14.3%, no relief 3.6%



No. of Cases

Results of non-surgical capsulitis – 195 cases

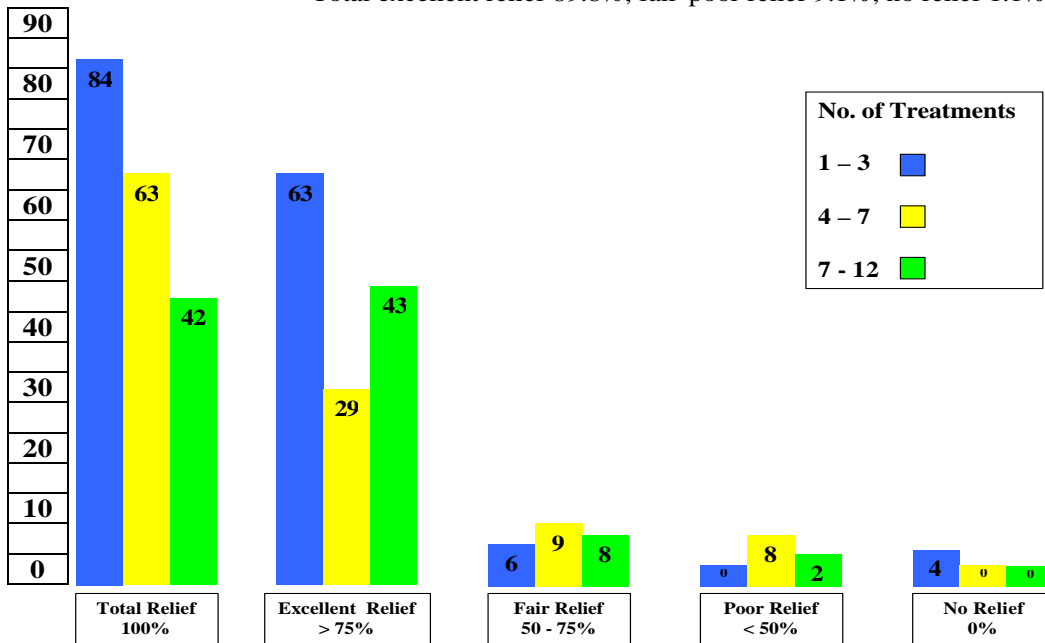
Total excellent relief 88.6%, fair-poor relief 9.8%, no relief 1.6%



No. of Cases

Results of myofascial pain/muscle spasm – 361 cases

Total excellent relief 89.8%, fair-poor relief 9.1%, no relief 1.1%



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