

10 Must Have Devices for Your Practice

A review of the most popular electromagnetic devices, from ease of use to patient satisfaction.

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Physical medicine and rehabilitation is an exciting and very dynamic field for those of us directly involved in patient care. Part of what makes this branch of medicine particularly attractive for prospective students/practitioners is the emerging technology, which infuses this subspecialty with some interesting treatment options. I have chosen 10 of the most popular devices used in clinical practice to review.

Selection Criteria

This report will focus on those technologies I have experience with via clinical testing and/or daily patient use. The items selected have been reviewed based on the following criteria: strength of treatment (average treatment effect), ease of treatment (patient/provider hassle factor), patient adherence (acceptance), existing research base, and cost effectiveness. Each of these criteria has been assigned a score between 1 and 10 (Table 1, page 30). I hope this type of informal descriptive exercise is of benefit to readers who might be exploring the idea of incorporating the various forms of electromagnetic therapies into their practices. This is a completely unscientific review, meaning, we did not perform a comparative effectiveness study of each technology. This article provides evaluations of each of these devices based on both formal and informal assessments. The primary aim was to identify the top 10 technologies of the new millennium.

1. Extracorporeal Shockwave Therapy

Extracorporeal shockwave therapy (ESWT)—also known as acoustic compression, myotripsy, and/or shockwave therapy—has rapidly become the gold standard for the treatment of chronic, calcified, mineralized, and fibrotic tissue stemming from longstanding trauma. The etiology of the traumatic injury



can vary from repetitive strain to acute, forceful injury. The more consolidated the tissue, the greater the therapeutic target for shockwave treatments. Therefore, it is not surprising that clinicians are experiencing above average results for enthesopathic conditions or where fibrotic scarring is confirmed.

Strength of Treatment

Personal experience has taught me that care must be applied by the provider in the delivery of the focused sound waves emitted from the probe. There is no mistaking when this device is “on,” and subtlety is not usually an adjective used to describe this technology. One merely has to pass over “abnormal” and/or disrupted tissue for it to be felt by the patient. For example, ESWT along active trigger points or a calcified tendon, such as in calcific supraspinatus tendonitis, where the increased stiffness of the lesion causes the mechanical waves to collide with the target lesion, leads to a painful pressure sensations felt by the patient. One particular device, the PiezoWave by Richard Wolf Co., actually has a sono-isolation function that allows the practitioner to routinely scan over normal or healthy soft tissue with no sensations felt until an area of dysfunction (disorganization) is encountered, at which point the patient describes experiencing nociception, felt as a deep achy sensation.

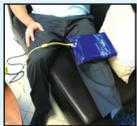
Ease of Treatment

The ESWT units we have tested and used clinically have been relatively simple to use, with only frequency, intensity, and selection of stand off pads being the decision points.

Patient Adherence

There is a “duality” or balance between possible clinical benefits and the risk of “aggravating” the target condition. All practitioners should use a shared decision-making paradigm, in which the patient ultimately decides whether to proceed or not. Generally, patients referred for ESWT have chronic conditions. They tend to be tired of their pain and usually are willing to do what they have to do for some pain relief. This treatment has a higher probability than most other treatments to lead to post-treatment discomfort. In fact, it is an expected and desired part of the treatment,

Table 1. Review of 10 Office-Based Electromagnetic Devices for Pain Management

Device	Treatment Effect	Ease of Treatment	Patient Adherence	Cost	Research Support
ESWT 	8	8	6	5	7.5
PEMF 	7	9	8	7	4
Class IV laser 	8	6	7.5	6.5	6.5
H-Wave electrotherapy 	7.5	8.5	8	6	7.5
IFC 	6.5	5.5	7.5	8.5	4
Laser-acupuncture 	5	8	8	9	5
Shortwave diathermy 	7	7.5	8	7.5	6
MENS 	3	8.5	8	9	5
Infrared phototherapy 	7	8	8.5	6.5	7.5
TENS 	6.5	8.5	8	7.5	8

ESWT, extracorporeal shockwave therapy; **IFC**, interferential current; **MENS**, microcurrent electrical neuromuscular stimulation; **PEMF**, pulsed electromagnetic field; **TENS**, transcutaneous electrical neuromuscular stimulation
 All measurements are based on a scale of 1 to 10.

signaling initiation of the acute phase of healing. Despite intensive pre-treatment patient education, expect a higher rate of patient complaints of soreness after using ESWT. Soreness can be worse than usual because the use of ice or non-steroidal anti-inflammatory drugs immediately after ESWT treatment is contraindicated.

Cost-Effectiveness

Manufacturers need to find a way to get this technology into the market at a lower price point than exists today. The true shockwave devices can cost \$20,000 to \$30,000 or more, making them a serious capital investment and too costly for many practices. The health care system is undergoing significant reform, and more than ever, cost containment is a high priority. There is no reason why this technology cannot be made available at lower cost, without which, my sense is that true market penetration will not be achieved. One of the largest prospective markets for ESWT is physical therapy (PT). ESWT would be a serious capital investment for many practices and given that there is no specific and payable Current Procedural Terminology (CPT) code for ESWT, it is a difficult argument to make that providers should purchase this technology in the absence of a reimbursement option.

Research Base

Probably due to the multidisciplinary appeal of ESWT, combined with early adoption of the first-generation ESWT technology by the podiatry sector, there is a relatively robust and varied research base. Research support is considered a strength of ESWT because numerous clinical trials are on record (>250) and have been published since this technology emerged in the early 2000s.

2. Pulsed Electromagnetic Fields

Almost the extreme opposite of ESWT from a patient-sensation standpoint, pulsed electromagnetic field (PEMF) generally are not “felt” during a treatment session, but the treatment effects typically will not disappoint. Our 2 favorite applications are for migraine head pain and non-healing bone fracture(s). Others have used PEMF for soft-tissue pathologies with varying severity, chronicity, and complexity. This is a very user-friendly modality for patients and does not usually involve direct provider-patient (attended) time other than to set up.



Strength of Treatment

The clinical expectation when using PEMF is that the patient will get some sort of reaction post-treatment. The worst treatment response is no response at all. Patients who are recalcitrant to the various forms of physical therapeutics tend not to be responsive to many other medical options as well.

Ease of Treatment

The application and set up for PEMF that use the C-arm (ring) method are very user friendly, with an uncomplicated set of options that control intensity/frequency etc. The learning curve for the novice (new to the product) is not steep because the treatment mechanics are relatively uncomplicated.

Patient Adherence

Patient adherence and compliance with rehabilitation devices usually is tied into several factors, including perceived value/benefit, costs, side effects, and time/duration of treatment. PEMF scores high in this category because treatments are delivered efficiently in a streamlined manner and normally do not have significant adverse effects that might potentially scare off a patient.

Cost Effectiveness

The clinical units tested are not inexpensive. It is my belief that the much more affordable home options, including magnets and home EMF units, do not offer the same therapeutic benefits as the clinical units. The clinical units offer dynamic field generation and propagation, with better range of field strength and intensity controls.

Research Base

Given that rating various products and technologies is highly subjective, when it comes to assessing the research support, we are looking for both quality and quantity. There is a paucity of publications on this technology. There is considerably more literature from European journals (translated), so assessing methodologic quality is challenging. In my opinion, if there is any technology that could benefit all stakeholders with expanded investigation it is directly applied electromagnetic field application. It is only a matter of time before we begin to gain a better understanding of this natural life force.

3. Class IV Laser

A number of commonly available class IV cold laser treatment units are taking the marketplace by storm. Patients will no longer need convincing that there “really is something going on,” as was often the case when using the 632-nm

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light wavelength or less-powerful class IIIb devices (usually <1 W total power emission capability). The class IV units, on the other hand, can be “felt” because they generate significant heat in the irradiated region.

With more energy emission comes shorter treatment times and a different dynamic in photo-biological approaches. The higher energy

capabilities measured in total energy per area per session (*power density x time*) and power densities (*power x time/area*) will demand a new set of data. Those who like to make assumptions via extrapolation—beware. There are no dose response curves available in photobiology as there are for toxic exposures and for pharmaceuticals. The speed with which a treatment is delivered and the total energy exposures will change from class III to class IV devices, hence, the need for good in vivo and in vitro studies followed by clinical trials.

Strength of Treatment

Unlike some of the more passive treatments, the class IV laser produces heat that can be felt, eliminating any patient doubts whether the device is “turned on” or not. Although not a necessary requirement for a photo-biological effect, the secondary heating aspect of these devices will add another element to be considered, and, ultimately, the intensity of the beam may be the rate-limiting factor for patient tolerance. As expected, with additional power levels (2 to 3 times the order of magnitude of prior generation units), it behooves the practitioner to have sufficient understanding of laser biophysiology plus some hands on training prior to treating patients.

Ease of Treatment

The class IV laser systems all have a very useful feature, especially appreciated by the novice user—pre-programmed dosages already built into the selection circuitry. The clinician simply selects the condition (Achilles tendonitis-acute) and the system calculates the time and settings. Where we used to have to calculate power densities and total energy applied, the device can now recommend those parameters. Manufacturers got it right when they began performing and

inputting the calculated values in the machines, requiring the provider to only select a condition.

Patient Adherence

Patient adherence to class IV laser treatment tends to be very strong as long as the sessions are uncomplicated (no adverse events) and out of pocket fees are not a barrier. In centers that charge an extra fee for the treatment, patients experiencing a marginal benefit usually will drop out after just a few sessions. The perceived value of the session, as well as with total patient experience, are determining factors.

Cost-effectiveness

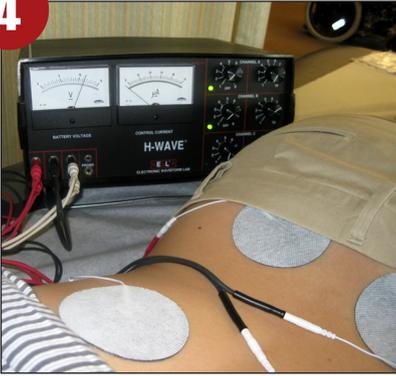
Class IV lasers are not inexpensive (\$4,000-\$20,000). This creates a situation whereby a device with seemingly promising properties and some good healing potential is put in front of physical medicine and rehabilitation practitioners at a high price point. The challenge with the class IV predecessors has been that providers have unknowingly been advised by market representatives to bill insurance companies using the CPT infra-red code (78552). If one reads the descriptor for proper use of this code, however, it defines infrared irradiation as not only consisting of an infrared wavelength but also producing heat (heat lamp). Cold lasers do not generate heat since they are non-thermal. Insurance audit assessments have routinely requested pay back of all cold laser treatments that were billed based on erroneous use of this code. The new generation of class IV devices should more appropriately fit the CPT definition espoused in the CPT manual.

I have alluded to the potential effectiveness of this modality, especially now that the higher power ranges are available. Not that extra power always equates to better treatment outcome. The Arndt-Schulz law is a reminder that sometimes less is better. In this case, it is our subjective opinion that more power was needed to irradiate larger areas and that adequate energy saturation at greater intensities required increased wattage. The cost for professional grade clinical class IV laser systems continues to be prohibitive for too many practitioners. Greater market penetration would be expected with significant cost reductions—not unlike for many of the products making this top 10 list.

Research Base

I have alluded to the great number of available reports and publications in the field of laser therapy. However, the reason laser therapy continues to have many detractors and skeptics is simply because of the quality of the available research. More and better (more convincing) research is needed to take class IV laser therapy to the next level.

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4. H-Wave Electrotherapy

In our opinion, the H-Wave machine by Electronic Waveform Lab, Inc., is one of the iconic electrotherapy devices on the market today. It has become a staple in our core service provisions and is

one of the few devices that all our clinics are encouraged to have on site. I do not sell, assist in selling, advertise, or in any way endorse this or any product for financial or other gains. I have always distanced myself from the products tested to avoid any conflict of interest.

This technology is popular because of its simplicity, ease of use, and patient response. The mechanism of action is rather unique in that H wave stimulation targets the lymphatic system, and flow dynamics in particular. Research supports one of the positive effects to be an enhanced lymphatic flow allowing for improved cellular waste clearance and increased tissue oxygenation. The H wave pathophysiological model represents somewhat of a paradigm shift in the field of electrotherapy.

Strength of Treatment

Most patients who undergo H wave treatment will have an opinion on whether it helps with their problem or not. It is rare to have a non-committal treatment response—the bane of treatment responses. Our practices have had good success at treating a wide range of conditions, including tendinopathies, arthropathy, and myofascial pain, with virtually no adverse effects being reported by patients. Some patients insist on having a home unit, which can sometimes be arranged, depending on the insurance carrier.

Ease of Treatment

The device is very user friendly and does not require an extensive training in-service for providers. The user simply chooses from 2 frequency settings and then adjusts for intensity based on patient comfort. This treatment is unassisted and does not require the provider to administer the treatment, other than simply setting a patient up and turning the machine on.

Patient Adherence

Patient acceptance typically is above average, especially as treatment success builds over time. The H-Wave is a powerful adjunctive treatment, and although I cannot attest to the precision of the postulated mechanism of action (for any device),

our empirical observations confirm the positive effects patients experience with lymphedema, acute swelling, and pain.

Cost-Effectiveness

Good technology doesn't come cheap. That seems to be the recurring theme among the best of the best electromagnetic technologies. At a price point of just under \$4,000 for a clinical unit, the pricing on the H-Wave is more consistent with historical clinical outpatient facility expenditures for electrotherapy devices. The home units, however, are only a few hundred dollars less expensive than the professional grade clinical units. The most common complaint comes not from providers or patients, rather from the payers who have to pay for relatively high-priced home units. Having said this, some will remark that whatever the price, it should be paid if it helps reduce or eliminate pain. The sad reality is that our health care system has limits (finite resources), and health care reform appears to be largely about value. So, pricing does matter at both the individual and institutional level.

Research Base

This proprietary form of electrostimulation has some interesting publications through various academic sources, including independent groups not associated with the product or company. The number of methodologically sound studies exceeds that of many older and more mature devices still in the marketplace today. At the end of the day, however, it will be each clinician's personal trial with this technology that will determine perceived effectiveness and utility.

5. Interferential Current Therapy

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Interferential current (IFC) therapy is not a new technology; rather, it has been available for many years and predates all but the transcutaneous electrical nerve stimulation (TENS) unit from a longevity standpoint. When it comes to reducing tight muscles stemming from muscle guarding, muscle spasms, myofascial pain syndrome, fibromyalgia, fascial restrictions, and trigger points, my clinical nod goes to IFC first. It has earned the right to be chosen frontline through its long and uncomplicated history of providing reliable pain reduction through reduction of muscular tension levels.

IFC is comfortable and well tolerated when patients are

selected properly. Patients with a low pain/pressure tolerance do not do very well with IFC. Therefore, fibromyalgia patients need to be individually screened for this treatment. IFC involves applying 2 medium-frequency currents in a diagonal pattern criss-crossing at the intersection site or target area.

Strength of Treatment

IFC treatment uses patient-specific feedback and is controlled with an intensity dial by the provider. Like most forms of electrostimulation, it suffers from “accommodation,” whereby the provider often needs to increase the intensity to counteract the physiological tolerance that develops during a treatment session. Any time the brain can figure out the stimulation pattern, accommodation is likely to follow and be a consideration in treatment effectiveness.

Ease of Treatment

An IFC treatment setup is not intuitive because of the diagonal pattern required for this treatment mode. Despite providers being taught/trained in the correct way to set up an IFC placement, it is often performed incorrectly. There is no standardization in electrode color (red/black) from one company to the next, which creates confusion. For example, some companies have 2 of the same colors for a given channel while others have different colors for the same channel. Something as simple as electrode color can cause provider confusion and lead to incorrect electrode placement. This can potentially render the overall treatment less effective, with possible adverse effects. Also, more clarity regarding spinal electrode pad placement would be useful to improve safety and help prevent adverse effects. So it’s comforting to have an old standby such as IFC in this top 10 list, but even classic technology should continue to get even better.

Patient Adherence

Well-selected patients enjoy their IFC sessions as well as any treatment. With well-placed electrode pads, the session can be very soothing as the currents penetrate deep into muscle/fascial tissue and massage away end plate hyperactivity. Few modalities can rival the stress-reducing effects of IFC and since the electrode pads can be spaced quite far apart, the treatment area coverage can be vast providing more cost-effectiveness.

Cost-Effectiveness

The affordability of an IFC unit is an advantage, and, as a result, it provides good value for the provider. A good case can be made for IFC for adjunctive electrotherapy as part of the care plan for many soft-tissue conditions involving pain

and muscle tightness. It has limitations, however, including a limited capacity to treat a small area, such as a hand or wrist or ankle. IFC is more suited for larger treatment sites, such as the spine.

Research Base

This form of electrotherapy has not been extensively studied. When application of a treatment feels this comforting, perhaps it doesn’t lend itself to a randomized clinical trial. After all, it has been used long enough to know that it feels really good and it doesn’t appear to cause any harm; borrowing electrotherapy research findings from other more studied waveforms and combining these with accepted principles of biology and physics provides a research by proxy validation of IFC. The superior properties of IFC have not been validated by research, however, there is no denying that IFC continues to be one of the most used forms of electrotherapy every day.

6. Class IIIb Cold Laser-Auriculotherapy

What do you get when you combine the ancient wisdom embodied in acupuncture with conventional laser technology applied within the context of auricular therapeutics?

Auricular LASAC, or laser acupuncture, is performed using a class IIIb device with a pencil-like probe that creates a very small irradiation zone, such as required for the treatment of the face or ear. For this therapy, class IV lasers would be overkill. One requires a surgeon-like precision best applied with a laser device in the 50 to 200-mW power range.

Auriculotherapy is reflexogenic medicine. The premise is that certain ear points are associated with the various organs and body parts, as observed using a homunculus representation in the ear. In effect, the external ear point becomes a rheostat-like mechanism that can control flow of vital energy to a sick body part, increasing or decreasing the flow of vital energy that, ultimately, controls the health and balance of that specific body area or organ (Figure 1).

The entire concept of mechano-transduction challenges our mechanistic schemas and reductionist beliefs and provides alternative explanations about why energy-based treatments restore function and improve health.

Strength of Treatment

Auriculotherapy using a class IIIb laser usually is a subtle



treatment, with most patients not experiencing a sensation per se. There are some associated effects, such as light-headedness, that often occur. However, these are transient and self-limiting. Auriculotherapy programs can target specific pathologies, such as sciatica, or more general pain syndromes, such as back pain. In addition, auriculotherapy is a popular treatment technique used at many addiction centers, since pain often is associated with dependencies. There is no doubt that there is a subset of the population that responds optimally to this genre of treatment, and belief and expectation is an important part of therapy, as it is with any pharmacotherapy.

Ease of Treatment

This mode of treatment is a powerful adjunct to other forms of therapy, whether for addiction or pain symptoms. The best part of this technique (outcomes aside) is that it can be performed relatively quickly and as often as necessary. There is no overdosing on auriculotherapy.

Patient Adherence

For the vast majority of patients treated with this therapy, adherence is very high with virtually no adverse effects expected or documented in many years of application. In many cases, patients develop an affinity to this treatment believing and expecting positive changes in their condition. When a patient builds loyalty to a therapy, believes it is working, and expects to get better as a result, discontinuing it can be a challenge.

Cost-Effectiveness

This therapy is being practiced all around the globe and especially in countries that have very limited financial resources. The laser is the most expensive part of the treatment equation and an adequately powered infrared laser with the pencil probe apparatus can be purchased for under \$2,000. U.S. facilities that use auriculotherapy for detoxification purposes usually will charge \$100 to \$250 per session. Our internal success rate (published in *American Journal of Acupuncture* 1994) for complete and total smoking cessation after 3 months post treatment was then, and remains now, circa 50% of patients undergoing LASAC.

Research Base

The relatively low score I gave this technology (6) reflects 2 things: first, that the quantity of research is miniscule in comparison to some of these other therapies described, but the research that does exist is intriguing. I am referring to the outcome studies performed and published showing impressive results, especially with addictions (nicotine and alcohol). Even more impressive are the functional magnetic resonance imaging (MRI) studies that support a very specific effect when stimulating a certain

ear point. Studies support the neurophysiological connection between specific ear points and corresponding regions of the brain. Functional MRI has helped to validate not only connections between ear points and the human brain, but also the differences between real and sham acupuncture.

7. Shortwave Diathermy

When a deep heating effect is the desired physiological goal, then shortwave diathermy (SWD) is the logical choice. Since the 1940s, SWD has been a part of a standard physical therapy and one of the most popular forms of high-frequency electromagnetic radiation treatments. Included in this category of diathermy are ultrasound and microwaves, both of which have their own specific medical/surgical and rehabilitative applications. SWD is known to significantly increase temperature of deep soft tissues by increasing metabolic activity of collagen-based structures. The 1990s saw an enormous decline in the use of SWD, with fewer commercially available units being sold. With more recent research focusing on tissue oxygen saturation levels as being a critical indicator of tissue viability and an important predictor of optimal function, therapies that effectively increase tissue perfusion and O₂ levels will be in demand.



Strength of Treatment

There is no mistaking a diathermy session for anything else, and precautions and contraindications must be adhered to for safety reasons. This is a high-energy session that can cause tissue burns if dosimetry is not monitored carefully.

Ease of Treatment

There are some new or modern SWD configurations available in the application of diathermy, but the first- and second-generation units were rather cumbersome, with large plastic/metal electrode pads attached to swinging arms resembling the robot from *Lost in Space*. Those devices required special attention to EMF shielding of the coils, which led to the need for environmental precautions including distance requirements from pad to patient and pad to provider. Contemporary units are much safer and more user friendly.

Patient Adherence

Therapies that can be “felt” by a patient tend to have better adherence/compliance than those that are subliminal and perhaps require a greater leap of faith. It has been our

observation that when patients are selected well for this treatment, they tend to stay with it and complete the course of therapy.

Cost-effectiveness

Diathermy units are not inexpensive by any means but generally cost under \$10,000. Cost effectiveness will vary based on a number of factors, not the least of which will be practice type. Deep heating sessions tend to work well with more senior patients, who tend to have more deeply set conditions, including tendinopathy and arthropathies. As with any therapy, the cost-benefit ratio needs to be considered to justify the expense.

Research Base

The research support for SWD tends to be older work that appeared in the literature; not much analysis has been done over the past 20 years. The clinical trials that exist seem to support a beneficial effect(s) for SWD, but clearly more research is needed. The empirical or observational evidence is vast, supporting excellent potential for improving perfusion and blood flow in the treated area. This would help explain the longevity of SWD usage despite a dearth of scientific evidence in the form of clinical trials.

8. Microcurrents

The use of subliminal level currents, or microcurrents, for application in human injury and disease was introduced to the public by orthopedic surgeon Robert Becker, who discovered “currents of injury” when experimenting with amputated salamanders and/or other creatures that demonstrated spontaneous abilities to re-grow injured or missing body parts. This led to speculation that even humans may have had, or even may still have, some vestigial remnant of a similar physiological capability.

The scientific thrust came from Becker et al, but the popularity and demand for microcurrent electrical neuromuscular stimulation (MENS) was almost entirely driven by track and field superstar Carl Lewis in the 1990s. In mass media reports, the public saw Lewis apply MENS to recover from injury and even for performance enhancement, and later watched as he set world records. As a result, at the time our Detroit-based community hospital outpatient



physical therapy clinic was inundated with requests for and queries regarding MENS.

The underlying premise for MENS application still focuses on some early research showing that the application of millionths of amperes of current to tissue could re-power or re-energize distressed cells by ramping up the production of adenosine triphosphate. MENS became the popular choice for tissue healing and was used for all types of musculoskeletal problems involving tissue repair.

Additionally, 2 early observations were later borne out by research: 1) MENS application to the head for frontal and parietal head pain symptoms (headache) might be a safe and effective treatment, and 2) after several MENS applications, especially in the facial area for the treatment of neuralgias and palsies, an unexpected “smoothing” out of skin was observed. MENS facials are quite popular at salons and spas due to the collagen/elastic stimulation effects of the treatments. There also now is better understanding that MENS application can accelerate bone healing, and MENS is the basis for several European bone stimulators.

Strength of Treatment

There is no doubt that this form of electrotherapy sets the standard for subtlety and often is referred to as subliminal for that reason. This is not the treatment for patients who have to “feel” the treatment. For those more interested in the treatment effect, that’s a different story. The wide-ranging application of MENS is testimonial that it can have some profound effects on living tissue, including bone, muscle, nerve, and the various forms of collagen.

Ease of Treatment

A MENS treatment is straightforward, and set up is intuitive, with each channel having 2 lead wires and each wire terminating into a pigtail plug that inserts into a sticky pad for skin application. Generally the pad is placed or located directly over the painful area or target tissue, unless a probe stimulator is used instead of the pads; in this case, the practitioner will follow a meridian (acupuncture-like) approach, or a myofascial (trigger point) approach. Older technology will use a dispersive pad or electrode, but newer units might not.

Patient Adherence

When a patient with chronic migraine, cluster, occipital, or cervical tension-induced headache is responsive to MENS, it usually leads to provision of a home unit. Most of our patients will pay for these units 100% using their own funds and not through insurance reimbursement. That is a strong indicator of efficacy and how important this treatment can be for a patient.

Cost-effectiveness

MENS technology is quite inexpensive to own from a patient standpoint, but clinical and professional units can cost in the few thousand dollar (\$2,000-\$3,000) range. As a result, many facilities will use home units for clinical applications, since the end product can be identical. Practitioners have been using this technology for 20 years, and it has had time and opportunity to establish itself as a staple treatment in the domain of musculoskeletal medicine.

Research Base

As with many other treatment forms and techniques in medicine, solid and convincing research is not in abundance. Practitioners who use this modality often do so in the absence of evidence and must rely on empirical information.

9. Infrared Phototherapy

The use of infrared light as a healing treatment for skin-related problems (acne) and diabetic neuropathy has become popular in clinical settings. Arguably the most popular device in the market place is the Anodyne system, the primary target of which is amelioration of diabetic foot-related numbness/paresthesia (neuropathy). This company boasts over 18 studies related to their product and has a global customer base.

The difference between laser and infrared therapy primarily is one of coherence, but there can be a few more differences, depending on the products being compared. Infrared devices come in a variety of forms and with differing features that affect parameters such as the number of wavelengths emitted (spectral bandwidth). Lasers tend to be monochromatic (single wavelength), whereas light-emitting diodes can be multichromatic, offering emissions at various wavelengths to create a broader treatment effect. Phototherapy devices emit at different wavelengths, depending on the primary physiological goal.

Near infrared (632 nm) devices emit a visible red beam and can be used for skin lesions and superficial pain/inflammation disorders. The far infrared devices (800-940 nm) penetrate more deeply. Testing showed 2 species of infrared phototherapy to be of particular use in our centers: LED phototherapy, such as used by Dynatronics with the flexible twin pads that are comfortably applied to a painful area such as a foot with diabetic neuropathy. The LED emission increases blood perfusion in the area, which helps to re-establish peripheral nerve sensitivity. It is recommended that any patient experiencing



painful foot burning, tingling, and numbness should at least try this form of treatment prior to more invasive and risky procedures. The second form of infrared therapy that has been very useful is the Nanobeam 940, a hand-held device that emits in the 940-nm range and distinguishes itself from an engineering standpoint as a device that can comfortably deliver more energy per defined area. This device is manufactured in such a manner that it deflects the excessive heat build-up that inevitably occurs at greater power levels and can become the rate-limiting factor in a treatment regimen. The Nanobeam 940 is designed to deflect heat, allowing more healing energy to be delivered to the target area.

Strength of Treatment

Phototherapy can be delivered in many forms, so it is difficult to assign a score that is representative for all devices. Generally, a treatment session is rather mild from a sensation standpoint, but patients can feel the after effects a few hours later; this can help verify that the patient has received an active treatment. The treatment effect can be very powerful when the right patient is selected for treatment. Because this treatment can sometimes produce gradual resolution of infected and non-healing ulcerations on long-standing diabetic patients who have become unresponsive to other treatments and are being considered for amputation, this therapy qualifies as a top 10.

Ease of Treatment

There is some set-up time with these LED devices, which when applied to feet require some infection control precautions for the involved body part, as well as the device pads because they are re-used for other patients. Used like a hand-held device, such as a laser, the Nanobeam 940 has a convenient touch button display and control on the hand piece.

Patient Adherence

In many cases, practitioners are treating severe problems with a high potential for grave consequences (loss of limbs, amputation) if the problem is not controlled. In such cases, when a patient can experience positive change, they tend to become very compliant and follow instructions well and adhere to treatment requirements. When patients can see the healing effect via serial measurements of the lesion, it becomes very motivating.

Cost-Effectiveness

Although the clinical effects can be very positive, the cost for these clinical devices can be prohibitive based on low reimbursement rates. The third-party reimbursement for infrared therapy is dismal to non-existent, with different insurance

carriers having different policies. Many carriers choose to label infrared as investigational to push the device into reimbursement limbo. It would make more sense to let the clinicians choose their tools of choice and make their payment decisions based on outcomes, not on their internally biased opinions of whether a clinical tool is valid or not.

Research Base

Having reported on these technologies in the past, I am aware of the research base that is available supporting the use of infrared therapy for various conditions. Evidence comes in many forms, and despite having a number of taxonomies available to evaluate the quality of the research, I have found that no amount of research is enough to convince someone that something works if their belief is that it does not. People tend to become slaves to their beliefs and, unfortunately, our patients might not be the benefactors. In other words, never let your personal beliefs interfere with the prospect of a good treatment. Absence of evidence is not evidence of absence—the two are not the same.

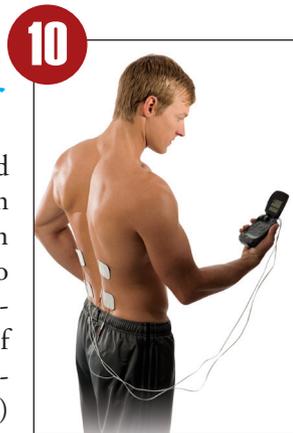
10. Transcutaneous Electrical Neuromuscular Stimulation

Electroanalgesia has been used since 63 AD, when ancient Roman Scribonius Largus would stand on electric fish (eels presumably) to relieve physical pain. The development of the modern version of the transcutaneous electrical neuromuscular stimulation (TENS) unit generally is attributed to C.

Norman Shealy. The efficacy of TENS, like that of many of the other devices, is debated and still controversial. However, the most powerful evidence to date supporting the validity of TENS is that of functional MRI. These studies have for the most part supported the idea that high-frequency TENS decreases pain-related cortical activation in patients with carpal tunnel syndrome. Low-frequency TENS also decreases or modulates the pain-induced cortical activation of shoulder impingement syndrome. Studies using evoked potentials also supported TENS efficacy by showing that TENS stimulation suppressed A-delta fiber nociceptive processing (gate control). At this point, I should think it's safe to move forward in an affirmative manner regarding the efficacy of TENS.

Strength of Treatment

The use of TENS continues to be a popular choice as front-line therapy, as adjunctive therapy, and when all else fails.



There is a favorable benefit/risk ratio, if for no other reason than the risk to the patient is minimal to nil. The provider can control the key parameters of frequency, intensity, and pulse width. A TENS session is unlikely to cause adverse effects, and the strength of the current is controlled by the patient at all times. This form of treatment works well when the goal is to interrupt a pain/spasm cycle, which in itself might be a worthwhile endeavor and an important factor in preventing the hardwiring (centralization) of pain in the CNS.

Ease of Treatment

The TENS treatment protocol is simple and forms the basis for application of the other electrotherapy devices, which tend to have a more elaborate set up than a TENS device. The basic analogue units (non digital) continue to be very useful for home care regimens, especially for patients who find complicated instructions and memory tasks challenging.

Patient Adherence

TENS treatments are relatively comfortable, and the devices can be worn during the course of a regular workday, with many patients being unaware that the units are even turned on most of the day. Units should not be worn during sleep. When patients are selected properly, the greatest operational drawback of TENS application is that of accommodation or tolerance, whereby a few minutes into the stimulation, the intensity of the current will need to be increased. It is not uncommon to have patients “max out the intensity” of a TENS unit because of this phenomenon. Units, such as the Codetron TENS device, have an anti-accommodation feature to counteract this limitation.

Cost-Effectiveness

The TENS machine is a pain-masking device and does not typically have much contribution beyond this objective. However, having said that, I don't want to minimize the value of pure non-pharmacologic analgesia. After all, opioid analgesics and lesser potency analogues exist simply for pain relief. Sometimes, pain relief is all that is desired, and when that's the case, conservative approaches should always be attempted first. TENS is the standard electrotherapy choice for electroanalgesia.

Research Base

There have been numerous systematic reviews performed using various databases and the response results have been mixed. Arguably, the more important research was cited previously, including functional MRI and brain evoked potential studies that support the use of TENS application for suppressing cortical A delta activity in the parts of the brain involved in pain processing.

Conclusion

I hope this summary of contemporary electromagnetic therapies is helpful to readers who might be searching for conservative techniques in the treatment of pain. I chose to apply a very liberal definition of electro-magnetic therapy, including devices in which EM is either propagated or generated directly and those that cause activation of the natural biological currents that exist from cell to cell and tissue to tissue. In both types of scenarios, there is an electromagnetic component in the biological field that action potentials create and that is exchanged within the extracellular matrix. This device summary did not have as an intent, the endorsement of one treatment type over another, or the recommendation of a specific brand of device. I did include brand-specific pictures so readers can get an idea of what some of these

technologies might look like, but they do not represent a product-specific endorsement, and readers should know that most of these products are made by various manufacturing companies around the globe. With the exception of the H-wave device, which is proprietary, all other products represent technology categories. Readers are encouraged to sample different brands.

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Florida #1 in Opioid Prescribing But Legislative Changes Appear To Have Reversed the Trend

In the last decade, the 10 states that prescribed the most opioid prescriptions were located in the South, led by Florida. Many factors may have contributed to these prescribing patterns, noted Joseph Pergolizzi, Jr, MD, of Johns Hopkins University School of Medicine, Baltimore, but along with wider appropriate use of prescription opioids has been the appearance of “pill mills,” pain clinics that inappropriately prescribe and dispense large quantities of opioids.

Florida has historically been known for its lax regulation of opioids, including allowing dispensing of opioids from clinics, rather than pharmacies. From 2003 to 2009, prescription overdose deaths in Florida increased by 84%.⁴ In 2009, four times as many people in Florida died from a prescription drug overdose as from an illicit drug overdose.⁵

But from 2010 to 2012, both the prescription of opioids and the occurrence of opioid overdoses significantly decreased. Dr. Pergolizzi and colleagues investigated what steps were taken by Florida to dramatically decrease the epidemic of overdoses from opioid medications. The investigators identified the following steps:

- Extensive legislative interventions of pain clinics, including requiring all pain clinics to register with the state.
- In July 2011, the Florida Surgeon General prohibited dispensing Schedule II and III substances from offices and clinics, but physician offices still could write prescriptions for medications.
- Implementation of a prescription drug monitoring program (PDMP). In September 2011, a mandatory dispenser-reporting program was associated with the new PDMP.

According to Dr. Pergolizzi, “implementation of the regulatory requirements resulted in a number of positive outcomes.” For example, between 2010 and 2013, 250 pill mills were shuttered and the number of high prescribing clinics decreased from 98 to 0. “This was a significant change since this removed a major source [of opioids] used by dealers.” In addition, the number of drug overdose deaths decreased by 16.7%—from 3,201 in 2010 to 2,666 in 2012.

The reduction in opioid misuse, diversion, and deaths represents “an impressive success story, which demonstrates that informed policy-level interventions by state governments can be an important element in reducing prescription opioid abuse,” he concluded.

Dr. Pergolizzi disclosed that he is a Consultant for Iroko Pharmaceuticals, LLC; has received Grant/Research support from Inspirion Pharmaceuticals, INSYS Therapeutics, Inc., Johnson & Johnson Services, Inc., and Purdue Pharma, L.P. Dr. Pergolizzi is also on the Speakers Bureau for AstraZeneca, Grunenthal USA Inc., Iroko Pharmaceuticals, LLC., Janssen Pharmaceuticals, Inc., and Purdue Pharma, L.P.

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