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Acupuncture and Static Multipolar Magnets: An Emerging Attraction?

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ABSTRACT

Objective: Magnetism has been known for >4,000 years. Recently static multipolar magnets have demonstrated analgesic clinical usefulness. Local application of magnets may be beneficial in reducing musculoskeletal pain, particularly when other modalities have failed. A recent series of clinical cases demonstrates how multipolar magnets may be incorporated as an effective adjunctive treatment in an acupuncture clinic.
Materials and Methods: PubMed database was searched using the key words: magnets, medical magnets, magnets and pain management, therapeutic magnets, multipolar magnets, and history of magnet therapy. In addition, clinical cases were submitted by 4 different medical acupuncturists as examples of how the use of multipolar magnets is incorporated into an acupuncture clinic.
Results: Over the past 20 years, 143 articles fulfilled the search criteria and unfortunately demonstrated considerable variability in research methodology. Magnetic tapes, needles, and beads of various magnetic strengths constituted the stimulating apparatus with durations ranging from minutes to years. This article highlights 10 cases, 9 of which reflected situations in which the use of 1 or more multipolar magnets provided an enhanced analgesic effect, often when traditional acupuncture had either failed to produce a satisfactory response or when the application of acupuncture needles needed to be limited.
Conclusion: Despite the variability of the literature review, it appears that magnetism is related to pain reduction, and when properly employed, it can be an effective and safe modality as demonstrated by a recent series of cases submitted from the practices of 4 different medical acupuncturists. A clinical trial incorporating the latest technology of multipolar magnets with steep field gradients should be initiated for the more formal investigation of magnet-induced analgesia.

Keywords: multipolar magnets, pain, magnetism, magnetic fields, membrane potentials, acupuncture

INTRODUCTION

A RECENTLY PUBLISHED *Medical Acupuncture* editorial[1] described a clinical case in whom the use of 2 static octapolar magnets provided total and sustained pain relief to a patient whose condition was refractory to a variety of therapeutic interventions, to include acupuncture. Intrigued, several medical acupuncturist colleagues sought to explore the topic of static multipolar magnet therapy to determine whether a similar degree of pain reduction could be achieved

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in other patients with clinical conditions not fully responsive to 1 or more of the more common acupuncture techniques.

HISTORIC AND PRESENT-DAY MAGNET TECHNOLOGY

The discovery of magnetism and the magnetic features of certain materials is believed to date back >4,000 years—to observations that Pliny the Elder[2] (23–79 CE) attributed to a shepherd named Magnus.[3,4] Magnetism, as a means of mitigating human illness, and more specifically, to alleviate pain, has been a matter of intense debate for centuries. The Tesla is the most common measurement of magnetism with 1 Tesla = 10,000 Gauss. Unlike household magnets that range from 35 to 200 G (0.0035–0.02 T) and are usually unipolar in nature, the static multipolar magnets that were selected are designed for medical purposes and differ in 2 ways.[5]

First, the magnets used on nonauricular zones tended to be significantly stronger than a typical household magnet, ranging from 4,500 to 13,500 G or 0.45–1.35 T. Second, they are all multipolar in nature—most commonly quadripolar, hexapolar, or octapolar. Moreover, depending on the specific magnet, they reportedly may penetrate soft tissues up to a depth of 50 mm (2 inches).[6] In addition, small auricular magnets can sometimes be used to stimulate points on the external ear. In these cases, the auricular magnets that are typically used tend to range from 600 to 800 G (0.06–0.08 T), but may be stronger.

LITERATURE REVIEW

Curious about the medical applications of magnetic therapy, the authors initiated a literature search focusing on the history and use of magnets. The search was conducted using PubMed and included the following key words: magnets, medical magnets, magnets and pain management, therapeutic magnets, multipolar magnets, and history of magnet therapy. Included in an array of 143 articles that fulfilled the search criteria was a 2005 report[5] published by the National Center for Complementary and Alternative Medicine titled ''Questions and Answers About Using Magnets to Treat Pain.'' Although primarily written for the nonmedical community, the report highlighted the relative paucity of truly rigorous clinical trials and noted that published reports often conveyed conflicting results.

Over the past 20 years, randomized clinical trials focusing on the use of static, unipolar, or multipolar magnets have yielded inconsistent clinical outcomes. That said, a 2008 literature review[7] by Colbert et al. analyzed 42 articles derived from both an English and Chinese language literature search, and addressed the clinical efficacy of applying different types of magnets to select acupuncture points. Although there was considerable variability in the strength and types of magnetic devices used (e.g., magnetic beads, tapes, and needles), the duration of the applied therapies (minutes to years), and the underlying indication(s), 37 of the 42 studies reported favorable outcomes.

Of these, 2 studies[7] involving the use of magnetic pearls in the ears for the treatment of insomnia in elderly patients seemed to be particularly compelling, based on available data and the degree of discernable research rigor. This analysis was consistent with a 2005 review by Eccles[8] that considered the results of 21 randomized controlled studies addressing the use of static magnets for treating an array of conditions ranging from neuropathic and postoperative pain to a variety of painful rheumatic etiologies. Even when factoring in quality control considerations[7] and the potential impact of bias,[5] nearly three-fourth of the analyzed studies (11 of 15 or 73.3%) demonstrated a favorable outcome secondary to the use of 1 or more static magnets.

MATERIALS AND METHODS

A retrospective case review analyzing the clinical efficacy and use of the application of 1 or more multipolar static magnets in a conventional medical acupuncture clinic was reviewed by the Uniformed Services University of the Health Science's Institutional Review Board (IRB) and was determined to be an exempt protocol under the provision of 32 CFR 219.104(d)(4)(iii).

The retrospective review encompassed a 4-month period and included an analysis of the clinical outcomes associated with the use of 1 or more topically applied multipolar static magnets (Fig. 1) in patients seeking treatment for a variety of pain-related conditions at the Acupuncture and Integrative Medicine Center at Joint Base Andrews, Maryland. A total of 10 cases were identified from the combined practices of 4 different physician-acupuncturists. Although treatment efficacy varied from patient to patient, all 10 cases are summarized in the ensuing text and in Table 1.

In most cases, the magnets were applied at the site of the patient's pain, but as noted below, there were some instances in which the magnets were topically applied to select acupuncture points. In all instances, magnet therapy was either applied simply as a matter of clinical expediency—that is, in situations in which a patient did not have time for an extended treatment, or simply as an alternative approach for patients who had not otherwise responded to 1 or more of the more common acupuncture-related interventions.

As the ensuing text will confirm, the resulting cases reflect a variety of presenting conditions. All patients were all treated within a single 120-day period by 1 of 4 different physician-acupuncturists using 1 or more of these topically applied medical magnets. The authors think this is particularly notable, as it increases the likelihood of there being true clinical efficacy and reproducibility, while reducing

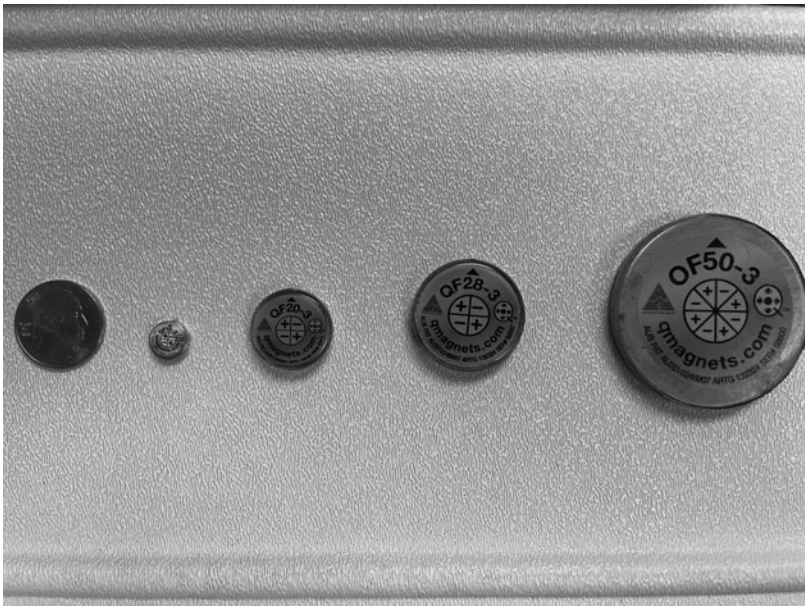

FIG. 1. This image depicts some of the different types of static multipolar magnets used in the described cases. An image of a common coin (a quarter) has been included at the far left for comparison. Photo courtesy of Dr. Pock.

Table 1. Clinical Data

Case	*Age (years)*	*M/F*	*Duration*	*Location*	*Additional treatment*	*Pain before*	*Pain after*
1	60	F	4 weeks	Elbow	Conservative treatment	4/10	0/10
2	18	M	12 years	Head	Extensive medicinal trials	7/10	1/10
3	25	M	4 months	Head	Auricular acupuncture	5/10	2.5/10
4	52	M	2 months	Sciatic nerve	Calmare scrambler device	n/a	0/10
5	26	F	2 years	Head	NSAIDs, anti-depressant medications, Battlefield Acupuncture, auricular acupuncture, and scalp acupuncture	3/10–8/10	Transient complete response, then resistant to further intervention
6	75	F	Decades	Head/neck	Scalp acupuncture, medications, botulinum injections, auricular acupuncture, French energetic treatments	n/a	Pain was substantially reduced
7	66	F	1 year	Heel/ankle	Microcurrent therapy, electroacupuncture, auricular acupuncture, and Interx® neurostimulation therapy	n/a	Temporary improvement
8	28	F	3–4 years	Abdomen	Surgery, multiple pharmacologic trials, electroacupuncture, Battlefield Acupuncutre, Interx® neurostimulation therapy	n/a	Did not show improvement
9	56	F	2 months	Elbow	Battlefield Acupuncture, electroacupuncture, local acupuncture, and Interx® neurostimulation therapy	8.5/10	2.5/10
10	59	M	Weeks	Sciatic nerve	Rest, Chinese Scalp Acupuncture, Battlefield Acupuncture, and electroacupuncture	9/10	1/10

Clinical data of samples patients. Additional treatment information could only be established for patients 4, 6, and 7. Pre- and post-treatment scores used a visual analog score 1–10. Completed pre- and post-treatment scores and were unavailable for patients 4–8.

n/a, not applicable.

(but not eliminating) the possibility of the results simply being due to patient suggestibility or to a placebo effect.

SAFETY CONSIDERATIONS

Although generally safe,[5] there are some safety considerations that should be kept in mind. Most significantly is the need to avoid placing magnets on or near any embedded pacemakers or implantable defibrillators, dorsal column stimulators, or infusion pumps. Although the majority of static magnets can be applied to the surface of the skin without problem, local irritation can sometimes occur. Other side-effects such as dizziness, reduced blood pressure, or nausea or vomiting have been reported, but are exceedingly rare. Aside from being aware of the basic safety considerations noted above and considering some of the suggested treatment guidelines associated with the use of the Q magnets in particular,[6] no other special training is/was required before utilization of these medical magnets.

CLINICAL CASES

Case 1

A 60-year-old woman presented with a 4-week history of near constant soft tissue pain involving the right lateral epicondylar area. There was no history of antecedent trauma or clearly defined repetitive physical activity. Physical examination confirmed that flexion of the elbow as well as flexion of the wrist with the elbow extended exacerbated the patient's baseline level of 4/10 visual analog scale (VAS) pain. The remainder of the examination was otherwise unremarkable. Initial treatment included rest, ice, heat, nonsteroidal anti-inflammatory drugs (NSAIDs) (naproxen), and/or the use of topical liniments, all of which provided only partial and/or transitory relief.

A single octapolar magnet (Q magnets, Neuromagnetics Australia)[6] was applied to the lateral epicondyle, directly overlying the area of greatest pain and tenderness, and secured with a single strip of medical tape. The magnet was left in place for 6–8 hours a day for 3 days after which the presenting pain had completely abated and has not recurred during >6 months of follow-up.

Case 2

An 18-year-old man was referred for acupuncture for treatment of chronic daily headaches and fatigue. The headaches started when he was 6 years old and has been debilitating. In fact, the parents had to engage a tutor as the frequent headaches impacted his development and did not permit attendance at the local school. He spent most of his time at home. The headaches were not accompanied by nausea, vomiting, or photophobia, but were described as throbbing and radiating into the right orbital area.

The father stated that he had taken his son to $\sim$17 different neurologists and behavior specialists, but to no avail. None of the prescribed medications modified the frequency or the intensity of the headaches. Moreover, none of the neurologists had considered the use of acupuncture or alternative therapies with the young man's parents.

Physical examination revealed a well-developed cooperative adolescent complaining of a 7/10 VAS pain focused on the right forehead. The clinical examination did not reveal any pathologic findings. Since the patient was initially somewhat reticent to receive any treatment involving the direct application of needles, it was decided to first try a totally noninvasive approach, using a topically applied magnet. The patient agreed to this approach and had a single octapolar magnet placed on the right forehead, over the area of greatest pain, which was secured with the aid of a topical bandage overnight.

The patient returned the next day stating the headache pain had diminished to a level between 0.5 and 1/10. The patient kept the magnet continuously affixed in this same location for an additional 48 hours, and by day 4, the pain was consistently rated at a level <1/10. As such, the magnet was removed, and the patient was followed clinically. The pain did not recur and after 4 months of follow-up, the patient and his parents reported that debilitating headaches were no longer a major factor leading to school-related absenteeism or to social avoidance.

Case 3

A 25-year-old man was referred with a 4-month history of post-traumatic migraine headaches. The migraines developed after a motor vehicle accident in which he struck his face on the dashboard and experienced a brief loss of consciousness. The impact was significant in that he also lost his right front incisor and cracked the left. The migraine pain was primarily located in the occipital area without radiation, was intermittent in nature, and described as being both sharp and dull. The pain was occasionally accompanied by nausea, but was not associated with any photophobia, phonophobia, vomiting, or dizziness.

The patient was initially treated with auricular acupuncture, using Seirin needles (L-type, No. 3; Lhasa OMS, Weymouth, MA) inserted at Omega 2, Shen Men, and Point Zero bilaterally for 30 minutes. He requested not to have semipermanent needles placed in his ears, so after all the needles were removed, each of these points was treated with the placement of a single adhesive-backed bipolar, 700 to 800 G magnet (hand magnets SJC; Lhasa OMS) on each of these same points. (In this case, the larger physical size and weight of the multipolar magnets made auricular placement impractical.)

The patient subsequently reported that this first use of magnets resulted in 10 days of headache-free pain.

Although his headache pain eventually recurred, it did so with an intensity of 2–3/10 as compared with his usual 5/10 headache pain.

Case 4

A 52-year-old man presented with a several-year history of right-sided sciatic pain that radiated to the right lower leg. It had acutely worsened in the 2 previous months to the degree that ambulation was difficult. Treatment with the Calmare® Scrambler Device[9] 3 times per week for several weeks helped to some degree, but his presenting symptoms kept returning. Octapolar magnets placed at the right BL-36 and BL-40 pain locations for 1 hour on days between Calmare treatments allowed the treatment benefit to persist, and after 2 months he no longer needed either treatment. Follow-up 6 months after his last treatment confirms that the patient was continuing to do well and no longer had the need for any additional treatment.

Case 5

A 26-year-old woman presented with focal frontal (glabellar) head pain, constant and rarely remitting for 2 years. Prior treatments consisted of ice, heat, NSAIDs, a trial of low-dose antidepressant therapy, an applied surface release treatment, Battlefield Acupuncture,[10] auricular acupuncture (focusing on Shen Men, Point Zero, and Omega-2), and a trial of scalp acupuncture. In this case, topical placement of a single Q magnet® (QF 28-3) on the glabellar area for up to 6–8 hours per day for 1 week resulted in 3 additional weeks of near total relief before symptoms recurred and eventually became resistant to ongoing magnet therapy.

Case 6

A 75-year-old woman presented with a several decade-long history of chronic severe migraines coupled with a 20-year history of persistent motor vehicle accident-induced posterior neck pain. The patient had previously undergone an extensive array of pharmacologic treatments to include multiple trials of various analgesics, antidepressants, triptans, and even botulinum injections. Prior acupuncture treatments primarily focused on auricular techniques and were supplemented with periodic use of a Tai Yang-Shao Yin energetic circuit (applied with Seirin® needles, L type, No. 3, coupled with 2 Hz stimulation using an ITO ES-130 device® for 10 minutes) and/or Traditional Chinese Scalp acupuncture.

Although modestly helpful, the patient continued to be plagued with frequent and often severely disabling headaches several times a week. As a result, her treatment plan was augmented by the topical application of a Q magnet (QF 28-3)[6] to 1 or both temples ($\times$1–3 hours in duration, as needed) for a period of 30 days. This combined approach was found to be helpful in alleviating much of the breakthrough migraine and/or posterior neck-related pain. It was also helpful in reducing the postmigraine mental ''fog'' that often accompanied the more severe migraines.

Case 7

A 66-year-old woman presented complaining of a 1 year history of refractory, right sided plantar fasciitis, along with a 1 year history of post-operative right ankle pain, the latter of which resulted from surgical repair of a compound fracture. Previous treatments included the use of Battlefield Acupuncture,[10] local application of Interx®[11] neurostimulation therapy, a course of electroacupuncture (a total of 4 J type Seirin needles® were inserted at the lower ankle and forefoot areas, bilaterally, and connected to an ITO ES-130 stimulator at 5 Hz for 30 minutes), and the application of Acutron Mentor® microcurrent therapy.

In this case, the near continuous use of a Q magnet (QF 28-3) applied and/or rotated to the most problematic areas (i.e., slightly superior to the lateral malleolus or taped to the affected area of the plantar fascia) for a 2-week period resulted in significant, although temporary, improvement. That is, symptoms almost completely abated, then recurred $\sim$6 weeks later at which time they were less responsive to magnet therapy.

Case 8

A 28-year-old woman presented with a 3–4 year history of refractory endometriosis and severe perimenstrual pain. Previous treatments included 2 laparoscopic surgical resections and multiple trials of pharmacologic agents, including various NSAIDs and several different hormonal and/or oral contraceptive formulations. Prior acupuncture treatments included 2 scar deactivation treatments, the application of Battlefield Acupuncture,[10] abdominal electroacupuncture, and a trial of Interx® neurostimulation therapy.[11]

In this case, 3 Q magnets (QF 28-3)[6] were taped to the lower abdomen in accordance with the protocol suggested by the manufacturer of these particular magnets (https://qmagnets.com/abdominal-and-menstrual-pain-treatment-with-magnetic-therapy/) and were left in place near continuously for 1 week, but did not produce any significant change in her presenting symptoms.

Case 9

A 56-year-old woman presented with a 2 month history of a painful right lateral epicondylitis. The patient was treated with Interx® neurostimulation, Battlefield Acupuncture,[10] local acupuncture, and electroacupuncture. Near continuous application of a locally placed Q magnet (QF 28-3) for a total of 3 weeks resulted in marked improvement, with the reported pain decreasing from a level of 8–9/10 $\rightarrow$ 2–3/10. Sustained relief continued for at least 30 days of follow-up.

Case 10

A 59-year-old man actively engaged as a referee in multiple athletic events presented with the acute onset of right-sided sciatica radiating to the posterior knee. The patient was initially treated conservatively, first with trials of rest, then with trials of Chinese scalp acupuncture, Battlefield Acupuncture,[10] and lumbar electroacupuncture, with only partial relief. Two Q magnets (QF 50-3) were then applied to areas corresponding to the right-sided BL-24 and BL-25, as these were the areas that were associated with the greatest degree of patient discomfort.

After applying the magnets for a total of three 1-hour treatments, the patient's pain was significantly and sustainably reduced from a VAS of 9/10 to 0–1/10. A course of twice weekly applications of these same 2 magnets for 1 hour at a time for an additional 3–4 weeks led to a complete remission that has been sustained for at least 6 months after his last magnet-related treatment. This is particularly significant given the patient's ongoing activity as a sports referee.

DISCUSSION

Historically, magnets have been a source of fascination given their invisible and seemingly mysterious ability to attract certain metals. Healers were skilled with knowledge of certain substances that appeared to be magical because of possible healing powers.[12] Many of these practices were combined with rituals that added to the ambiguity of the technology. In fact, the therapeutic effect of magnetic energy was cited as early as 2,000 BC, in *The Yellow Emperor's Book of Internal Medicine*—a renowned text that ultimately formed the basis of Traditional Chinese Medicine and acupuncture.[13] Chinese healers were said to use magnetic lodestones on the body to correct unhealthy imbalances in the flow of systemic energy or qi, a practice that is described in the Yellow Emperor's classic text.

One of the key precepts of Traditional Chinese Medicine is that qi (the body's life force) flows through the body, helping maintain the balance of yin and yang, of health and illness. Acupuncture presents an opportunity to influence the flow of qi as it courses through 1 or more meridians.[14] Thus, the contemporary discovery that all living cells have, by virtue of their transmembrane potentials, a degree of electrical dynamic properties,[15] makes these ancient associations of magnetism with healing somewhat more plausible, particularly from a scientific perspective.

To best understand the underlying electrochemistry, it is important to recognize that the cell membrane electrical potential can provide substantial information about the state of the cell, events that are taking place in the cell, as well as external factors affecting the cell. The movement of charged ions across a cell membrane creates an electrical gradient that produces an oscillating transmembrane potential, reflective of the dynamics of ongoing cellular metabolism.[16,17]

Ligands—which can be positively, negatively, or neutrally charged—can attach to cellular membranes and may also exert influence on the transmembrane potential. In short, the movement of charged ions across a cell membrane creates a voltage gradient that produces a ''resting'' transmembrane potential. This potential is constantly changing as it reflects the dynamics of ongoing cellular metabolism. As a result, as electrically charged ions or even ligands move in and out of the cell or attach to the cell membrane, it is quite possible that there is the production of an associated, although miniscule, magnetic field.[15] The magnetic field from a multipolar magnet may modulate the ''resting'' transmembrane potential that impacts on the cell metabolism causing changes in pain threshold.[18]

Albert Roy Davis (1915–1984) took things further, by noting that positive and negative magnetic polarities have different effects upon biological systems. Philpott et al.[19] published study suggesting that a magnet's negative pole is more beneficial than the positive pole, noting that negative magnetic fields seem to produce more effective relief of pain caused by local edema, acidosis, and/or systemic toxicity. Contemporary studies are increasingly focused on the use of multipolar magnets to reduce pain, which were, in fact, the most common modality used to treat the patients referenced in this article.

One of the reasons that multipolar magnets may be more effective than common bipolar magnets could be attributed to the production of a magnet field gradient, which, in turn, has different effects on moving charged particles transported across the cell membrane. For example, a quadripolar magnet produces a magnetic void in the center of its array. This steep field gradient may, in turn, elicit a localized physiological effect that could influence the firing rate of neurons, changing the rate of enzyme-mediated reactions, thereby affecting calcium channels and/or increasing local blood circulation.[17,19,20]

Note, however, that in the third case, bipolar static magnets were employed simply because the standard multipolar versions were too large and too heavy to secure to the external ear. Although still beneficial, bipolar magnets do not produce the steep magnetic gradient that is more characteristic of multipolar static magnets.

Although far from conclusive, the initial experience with multipolar magnets suggests that they may indeed provide therapeutic benefit in select conditions, as 9 out of the 10 patients evaluated in this clinical series exhibited favorable responses to this intervention. That said, the authors recognize that in some cases, patients had received multiple treatments with differing modalities, so whether the clinical improvement was solely due to the effect of the magnets or due to a combination effect is not fully known. Although the precise mechanism of action remains unclear, research suggests that magnets may modulate changes in cellular metabolism.

Resting cell membrane potentials may even influence the manner in which pain signals are processed—not only in excitable cells such as muscle, neurons, and some endocrine cells, but also nonexcitable cells such as neuroglia and almost all other cells in the body. Abdul et al.[21] discuss the potential influences of cellular resting membrane potentials on cellular proliferation, muscle contraction, wound healing, etc. In particular, they noted that resting electrical membrane potentials in electrophysiology equated to action potentials found in muscle cells. And although nonexcitable cells may not have action potentials, they often have steady-state resting potentials.[21,22]

Static magnetic therapy is not strong enough to initiate an action potential, but static magnetic therapy is probably able to modulate resting potentials, thereby eliciting various favorable physiological changes that could include upstream regulation of pain signalization. This was further supported by the study of Weintraub et al.[23] who suggested that it might be possible that magnetic fields may also target ectopically firing nociceptors.

Throughout history, medical professionals, and laypersons alike have attempted to use the power of magnets for a wide range of diagnostic and therapeutic purposes. In some cases, their application has been recognized as an outright form of quackery, but there are other situations—such as Bryan Frank's article focusing on the use of biomagnetic pair therapy for the treatment of typhoid fever in a remote village in Kenya[24]—that could cause us to reconsider some longstanding views on pathophysiology and mechanisms of injury and disease. There are relatively few contraindications and no known pharmaceutical interactions, and as Frank noted, biomagnetic pair therapy may not be as ''extreme'' or as unusual a technique as one might presume, as it is apparently recognized as a ''certified medical subject…by medical colleges in Mexico, Ecuador, Chile, and Spain.''[24]

CONCLUSION

The use of static multipolar magnets as an adjunct in the acupuncture clinic represents a novel area for further research as acupuncture points and local areas of pain appear susceptible and may benefit from magnetic field stimulation. In this case series, the analgesic effects were either absent, transient, or more sustained. Although the initial experiences are encouraging, future treatment recommendations would benefit from analyzing the results of well-designed randomized clinical trials using placebo devices that are not only authentic in appearance but also devoid of a magnetic field—something that was somewhat lacking in previous magnetic clinical research.

In short, although there are still many questions yet to be answered, it appears that multipolar magnets may provide beneficial results in certain conditions. Used appropriately, they are safe,[5,8] highly portable,[7,20] and could even have potential utility in austere and/or resource-constrained conditions.[20]

DISCLAIMER

The views expressed are those of the author and do not reflect the official policy or position of the Uniformed Services University of the Health Sciences, the Department of Defense, or the United States Government.

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REFERENCES

1. Niemtzow RC. Static magnetic stimulation and acupuncture. Med Acupunct 2022;34(2); doi: 10.1089/acu.2022.29203.rcn
2. Pliny the Elder; Britannica. Available from: https://www.britannica.com/biography/Pliny-the-Elder [Last accessed: March 27, 2022].
3. Magnes the Shepherd. Available from: https://en.wikipedia.org/wiki/Magnes_the_shepherd. [Last accessed: March 27, 2022].
4. Macklis RM. Magnetic healing, quackery, and the debate about the health effects of electromagnetic fields. Ann Intern Med 1993;118(5):376–383.
5. National Center for Complementary and Alternative Medicine. Questions and answers about using magnets to treat pain. J Pain Palliat Care Pharmacother 2005;19(2):59–72.
6. Q Magnets. Available from: https://qmagnets.com [Last accessed March 20, 2022].
7. Colbert AP, Cleaver J, Brown KA, et al. Magnets applied to acupuncture points as therapy—A literature review. Acupunct Med 2008;26(3):160–170; doi: 10.1136/aim.26.3.160
8. Eccles NK. A critical review of randomized controlled trials of static magnets for pain relief. J Altern Complement Med 2005;11(3):495–509.
9. Calmare Scrambler Device. Calmare Pain Therapy Treatment (www.calmarett.com) [Last accessed: April 10, 2022].
10. Niemtzow RC. Battlefield acupuncture. Med Acupunct 2007; 19(4):225–228.
11. InterX Technologies. InterX Technologies—InterX®. Available from: https://interx.com/ [Last accessed: January 28, 2023].
12. Magnetic Healing Through the Ages. Available from: https://theness.com/neurologicablog/index.php/magnetic-healing-through-the-ages/ [Last accessed November 13, 2022].

13. History of Magnetism. Available from: https://magneticosleep.com/about-magnetism/history-of-magnetism/ [Last Accessed November 13, 2022].
14. Li F, He T, Xu Q, et al. What is the acupoint? A preliminary review of Acupoints. Pain Med 2015;16:1905–1915.
15. Niemtzow RC. Transmembrane Potentials of Human Lymphocytes. In: Transmembrane Potentials and Characteristics of Immune and Tumor Cells (Niemtzow RC. ed.) CRC Press: Boca Raton, LA, USA; 1985; p. 70.
16. Marhl M, Schuster S, Brumen M, et al. Modelling the interrelations between calcium oscillations and ER membrane potential oscillations. Biophys Chem 1997;63(2–3):221–239.
17. McLean MJ, Holcomb RR, Wamil AW, et al. Blockade of sensory neuron action potentials by a static magnetic field in the 10 mT range. Bioelectromagnetics 1995;16(1):20–32.
18. Burtscher V, Hotka M, Freissmuth M, et al. An electrophysiological approach to measure changes in the membrane surface potential in real time. Biophys J 2020;118(4):813–825.
19. Philpott WH, Kalita DK, Lothrop L. Magnet Therapy: A Natural Solutions Definitive Guide. Linwood Lothrop Square One Publishers: Garden City Park, NY, USA; 2012.
20. Cavopol AV, Wamil AW, Holcomb RR, et al. Measurement and analysis of static magnetic fields that block action potentials in cultured neurons. Bioelectromagnetics 1995;16(3):197–206; doi: 10.1002/bem.2250160308
21. Abdul KL, Stacey M, Barrett-Jolley R. Emerging roles of the membrane potential: Action beyond the action potential. Front Physiol 2018;9:1661; doi: 10.3389/fphys.2018.01661
22. Jacob R. Calcium oscillations in electrically non-excitable cells. Biochem Biophys Acta 1990;1052(3):427–438; doi: 10.1016/0167-4889(90)90152-4
23. Weintraub MI, Wolfe GI, Barohn RA, et al.; Magnetic Research Group. Static magnetic field therapy for symptomatic diabetic neuropathy: a randomized, double-blind, placebo-controlled trial. Arch Phys Med Rehabil 2003;84(5):736–746; doi: 10.1016/s0003-9993(03)00106-0
24. Frank BL. Biomagnetic pair therapy and typhoid fever: A pilot study. Med Acupunct 2017;29(5):308–312.

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