Static magnet therapy for pain relief: a critical review

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Abstract

Introduction
Interest in magnet therapy has its roots from several millennia ago. Despite the lack of evidence for benefit we, patients and physicians alike, seem to want them to work. There are numerous historical accounts that have called into question the benefit of static magnetic therapy. Recently, scientific rigor has been applied to answer whether magnet therapy should become proven medicine that works or remain unproven medicine that may or may not work. This review is focused on the critical appraisal of the literature regarding static magnets in the treatment of pain and discomfort.

Materials and methods
PubMed, EBSCOhost, Natural Medicine Comprehensive Database and SCOPUS database were searched with the key words ‘static magnetic’, ‘magnet’ and ‘pain’. English language studies including randomised trials, case series, case reports, observational studies, systematic reviews and meta-analyses were included. All human disease categories were considered, but studies were excluded if the evaluation of pain or discomfort was not a primary or secondary outcome. Studies not involving static or permanent magnets were excluded.

Results
Thirty-seven original research studies and 10 review articles were included for discussion.

Discussion
Systematic reviews of the topic have reached differing conclusions by analysing similar studies. The most comprehensive review and meta-analysis found no evidence to support the benefit of magnets. Subsequent research studies have, also, failed to demonstrate a benefit.

Conclusion
There is a lack of scientific evidence to support the use of static magnetic therapy for pain when compared to placebo.

Introduction
Interest in Magnet Therapy has its roots from several millennia ago. Despite the lack of evidence for benefit we, patients and physicians alike, seem to want them to work. This can be a powerful driver as revealed in a systematic review noting 15 of 16 studies evaluated illustrated the point that what patient’s expect has an effect on health outcomes.

The power of a magnet is invisible but we can experience that power in its attractive force. Magnets take their name from Manges, a shepherd living in the area of present day Turkey, who described the pull of iron to stone as his sandals walked over the lodestones. The mystical characteristics of magnets led the Greeks (ca. 200 A.D.) to try magnetic rings as a treatment for arthritis and medieval practitioners to purify wounds and cure arthritis and gout. Paracelsus, in the 16th Century hypothesised the ability for magnets to push or pull disease from the body depending on whether the north or south pole of the magnet was used. With the rise in popularity of these treatments, sceptics such as Thomas Browne, an English Physician in the 17th Century, suggested that the chemical properties of magnetic potions may more likely be the reason for effect, rather than the attractive forces. Further cycles of increasing popularity continued in the 18th Century including applications of electricity to paralytics (Benjamin Franklin) and a technique referred to as ‘mesmerism’ whereby an ill patient was placed near a magnetic field, inducing a crisis from which the individual would be cured. The latter technique was debunked of its validity by a panel including Antoine Lavoisier, JI Guillotine and Benjamin Franklin in blinded experiments using sham-magnets as controls. It appears Franz Anton Mesmer was describing a technique of hypnosis (mesmerising) instead. In the late 19th Century, despite investigators in Edison’s laboratory demonstrating a lack of electromagnetic effect, numerous purveyors advertised their wares. Examples of insoles (see Figure 1), magnetic corsets and bracelets are similar in concept to those studied today.

We utilise a variety of electromagnetic procedures, both in the therapeutic and diagnostic realms. Examples include pulsed electromagnetic field, repetitive transcranial magnetic stimulation, transcutaneous electrical nerve stimulation and of course magnetic resonance imaging. This review will focus on static magnet therapies, but the public safety concerns span the broader spectrum of electromagnetic applications. In the case of magnetic resonance imaging, the Food and Drug Administration felt the name change for the procedure from nuclear magnetic resonance would alleviate public fears about the ‘nuclear’ term and thereby improve marketing. Likewise, public safety...
issues surrounding magnetic therapy surfaced in the latter quarter of the 20th Century. Currently, it is generally accepted that exposure to therapeutic magnets do not impart harmful effects with the exceptions of the contraindications for use in patients with implantable devices such as pacemakers or insulin pumps.

Entering into legitimate scientific investigation of the therapeutic effects of magnets may have been held back by the inertia of these two forces; the association with quackery and safety concerns. This began to change in the 1990s with calls to investigate the merits or lack thereof for complimentary medicine. This coincided with calls from articles in 1998 by Fontanarosa and Angell stating, “There is no alternative medicine. There is only scientifically proven, evidence-based medicine supported by solid data or unproven medicine, for which scientific evidence is lacking”, and that “It is time for the scientific community to stop giving alternative medicine a free ride. There cannot be two kinds of medicine—conventional and alternative. There is only medicine that works and medicine that may or may not work.” Excitement was building in the early 2000’s as many scientific studies were being published on the effects of magnets to treat medical ailments. This review is focused on the critical appraisal of the literature regarding static magnets in the treatment of pain and discomfort.

Materials and methods

In order to survey the scope of the existing literature evaluating the efficacy of static magnet therapy for the relief of pain, a search of multiple databases (PubMed, EBSCOhost, Natural Medicine Comprehensive Database and SCOPUS) through the end of July 2013 was performed. In addition, reference lists of published reviews were evaluated. The
key words employed in the search were ‘static magnetic’, ‘magnet’ and ‘pain’. English language studies were included if the experimental design was a randomised trial, case series, case report or observational study. In addition, systematic reviews and meta-analyses were included. All human disease categories were considered, but studies were excluded if the evaluation of pain or discomfort was not a primary or secondary outcome. Studies not involving static or permanent magnets were excluded.

Data were extracted from each article to include: year of publication, country of subject participants, disease entity, magnet location and strength, study design and outcome.

**Results**

The search yielded 731 potential articles for review (719 from databases and 12 from reference lists). Six hundred and thirty-nine did not meet inclusion criteria and the remaining 92 were evaluated in detail. Following initial review an additional 45 were excluded for various reasons (acupressure, electromagnetic, non-pain, duplicate or incomplete studies). The remaining 47 were included for discussion in this review.

Thirty-seven original research studies were identified including 33 randomised trials, two case series and two observational studies. In the randomised trials; 31 studies utilised sham magnets as the control; four used lower dose magnets in the control group; and three employed a non-magnet, which in some cases was copper.

One single-study article was published prior to 1997. Thereafter, through 2012, the number of publications identified, ranged from one to four per year. The exception was 2006 for which no articles were published (see Figure 2). Ten reviews were identified and included nine systematic reviews. One meta-analysis was included within one of the systematic reviews. Seven of the 10 systematic reviews were published in 2007 or later.

The countries where studies were performed were Columbia, Germany, Hungary, Japan, Taiwan, the UK and the USA. Conditions studied included back pain; joint pain (rheumatoid arthritis [RA], shoulder, hip, knee); myofascial pain; pelvic pain and dysmenorrhea; diabetic neuropathy and plantar fasciitis. The strength of individual magnets in the experimental arms ranged from 150 to 2700 gauss (note some studies used multiples of the single magnets for treatment). The magnet location in all but four studies was placed directly over the site of pain. The remaining studies utilised whole body exposure such as a mattress pad or a remote body location such as a bracelet (see Figure 3).

![Figure 2: Publishing timeline of trials included in this review (number per year).](image)

![Figure 3: Examples of magnet placement (clockwise from the upper left): Magnet attached to underwear for treatment of pelvic pain; Magnets embedded in a Mattress pad; Magnets surrounding the lower lumbar, sacroiliac joints and sacrum; Magnets surrounding a surgical scar; Magnets overlying vertebral vertebrae and sacrum; Magnet placed in a wrist band (human figures created with SmithMicro’s Poser 10 software).](image)
The results in most studies were determined using a pain scoring system such as the Visual Analog Scale (VAS) or the Western Ontario and McMaster Universities Osteoarthritis Index. Only a few studies utilised physiology parameters as their primary endpoints. Nearly two thirds of the studies reported non-statistically significant results but the direction of the result was not always stated. Fourteen studies reported statistically significant results and in this group there were no negative studies reported.

Discussion

Interest in static magnet therapy for pain, based on publications, seems to be waning after peaks in 2002 and 2004 (see Figure 2). Explanations for this could include less interest in conducting trials following the publication of Pittler, Brown and Ernst’s systematic review and the lone meta-analysis regarding the treatment of pain with static magnets in 2007. This review suggested there was no benefit to static magnet therapy for pain. Interest continues, however, in the way of systematic reviews on the topic. This may be in an attempt to better understand the parameters on which to focus future study, such as on specific disease entities or in an attempt to shed light on the continued popularity of use in the face of weak scientific evidence to support them.

The systematic reviews fall into two main categories. One including studies involving static magnets in the greater context of reviewing complementary and alternative medicine therapies for a particular entity. These may cover the broad topic of pain or be more focused on specific conditions such as RA, osteoarthritis of the knee, plantar fasciitis, diabetic neuropathy or pelvic pain. These reviews contain few articles relating to magnet therapy, which limits the types of conclusions that can be drawn. The other category focused on magnet therapy inclusive of multiple painful conditions. In these reviews, there are heterogeneous variations in the study groups that make it difficult to draw more than qualitative conclusions, but they do allow for a more thorough analysis of magnet therapy.

Eccles’s review from 2005 included 21 studies from which the author concludes that static magnetic fields can induce analgesia when lesser quality studies were excluded. The author’s conclusion notes that analgesia was obtained in 11 of 15 studies. Breaking down the studies in a different manner could lead to an alternate conclusion, however. When looking at all 21 studies, six results were found to be non-significant; six results were reported as significant for both the treatment and control groups, but not between groups; and 11 results reported a significant benefit favouring the magnet treatment groups over the control groups (note two studies reported two outcomes each). When only the higher quality studies are considered, the distribution reveals three with non-significant results, five with significant reduction in pain in treatment and control groups and seven with significant reduction in the treatment group compared to the control group. The alternate interpretation would then be that the magnet groups did have a decrease in pain but in a large minority of the studies this was not significant when compared to the control group; only seven of 15 studies favoured magnet therapy when compared to placebo (see Figure 4).

The 2011 review of Salomonowitz et al. concluded that static magnetic fields are ineffective with respect to pain therapy. The complete review (published in German) was not examined for inclusion or exclusion criteria, but the references listed contained eleven studies in common with Eccles’ review. The remaining articles were reviewed and six of the seven reported non-statistically significant results. Nine of the studies included in both reviews were the higher quality studies considered by Eccles. Only three of the studies that overlapped reported results suggesting no change with magnet therapy.

Conclusions

The systematic reviews fall into two main categories. One including studies involving static magnets in the greater context of reviewing complementary and alternative medicine therapies for a particular entity. These may cover the broad topic of pain or be more focused on specific conditions such as RA, osteoarthritis of the knee, plantar fasciitis, diabetic neuropathy or pelvic pain. These reviews contain few articles relating to magnet therapy, which limits the types of conclusions that can be drawn. The other category focused on magnet therapy inclusive of multiple painful conditions. In these reviews, there are heterogeneous variations in the study groups that make it difficult to draw more than qualitative conclusions, but they do allow for a more thorough analysis of magnet therapy.

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Figure 4: Distribution of studies in three meta-analyses: Pittler (blue), Salomonowitz (red) and Eccles (yellow). Higher quality studies described by Eccles are depicted by the inner yellow oval, bordered in black. Non-statistically significant studies are represented by a ‘×’ sign. Studies with significant reduction in pain in both magnet-treated and control arms are represented by a ‘–’ sign. Studies where the magnet arm result was statistically significant when compared to the control arm are represented by a ‘+’ sign. The circled individual-studies represent those included in the meta-analysis by Pittler.

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either alone or compared to control. The differing conclusions appear to be related to the method of categorisation of the studies that showed similar benefit in both the treatment and control groups (see Figure 4).

Pittler's 2007 review contains two additional studies that were not referenced in either of the two previously mentioned reviews. It does not include four studies present in one or the other of those reviews. In addition, Pittler's review contains a meta-analysis of nine studies (see Figure 4). This quantitative addition to the literature reported a trend minimally favouring magnet therapy, which did not reach statistical significance. Only one of the nine studies was reported to have statistical significance in the meta-analysis. This was a study in patients with osteoarthritis leading the authors to suggest there may be possible benefits for this condition. For all other conditions, the question was raised as to whether further study is warranted given the convincing lack of evidence for benefit.

Several main themes exist in the design development of magnet therapy studies. There is a lack of standardisation in magnetic field strength and polarity. Location of the magnets is also varied. Most studies place the magnet over the site of pain. The proximity to the target tissue varies, however, when placement of a magnet is over a joint compared to deeper tissues when treating pelvic pain. Other studies attempt to demonstrate a more general enrichment in the body by testing magnets remote to the painful site. Mattresses, bracelets, and necklaces are the predominant locations (see Figure 3).

In the nine randomised controlled trials published since Pittler's review, only one reported statistically significant results. This trial included three patient sub-groups and while the temporalmandibular joint sub-group had a significant reduction in pain (~2 on a VAS) compared to the sham magnet group (~0.5 on a VAS) those subjects with stomatitis (alveolitis or aphta) did not. In the aphta group both treatment and sham groups reported pain reduction in a similar range of the temporalmandibular joint treatment group (~2.1 and 1.75, respectively). The authors suggest that anecdotal observations have demonstrated less reliable results when infection or fever is involved. However, this does not seem to explain the apparent benefit of the sham treatment of aphta. In two studies, though the results were not statistically significant, the control group reported slightly more benefit when compared to the magnet treatment group.

Blinding is frequently described as problematic in static magnet studies. Several recent studies have attempted to address this creatively. End-of-study surveys give some insight into the patient's views on blinding. Some raise concerns regarding the adequacy of blinding. A survey of the active treatment group in one study revealed that 45% of the participants either deliberately or inadvertently discovered the magnetic properties of the bracelet. In another, when two strengths of magnetic belts were compared to sham, 60% correctly identified which group they were assigned to based on pain relief while 32% incorrectly identified their treatment. A study design regarding blinding was suggested in other studies. In a study using magnet-embedded mattresses, 80% of participants felt they were not able to determine which was the test or sham mattress. This included an inability to detect a difference in texture. In a study of magnetic knee wraps, a large majority was unable to determine whether their knee wrap was active or not and 26% in the sham group believed they had active magnets. Richmond et al. designed a study to further mask the identity of the active magnet group using an active, weak and deactivated magnetic bracelet along with a copper bracelet in four different study groups. This design was intended to confound the definition of the placebo. Interestingly, decreases in pain were described similarly in each of the three ‘magnet-bracelet’ groups with neither group being statistically better than the other, whereas the copper bracelet group noted an increase in pain.

By narrowing their study to participants with osteoarthritis, Richmond et al. were building on the recommendation of Pittler that further study in subjects with osteoarthritis may be helpful since previous studies were insufficient to exclude benefit in that group. The negative study results led the authors to recommend that patients should be informed that magnetic bracelets may not be helpful. This study design tested the principle of remote placement of the magnets from the site of pain, leaving open the question for further studies testing local placement of magnets in osteoarthritis patients. Of interest, Richmond's group did a similar study in RA patients, and results are anticipated soon.

It has been suggested that there seems to be an active effect of placebo or expectation that may confound the final conclusions surrounding magnet therapy. Recent surveys have shown that physicians have some acceptance of the use of placebo and a recent study demonstrated that a placebo may be effective even when it is fully disclosed as a placebo. Future study should be designed to help in appreciating the poorly understood placebo effect.

**Conclusion**

Without evidence that there is a benefit to static magnets for pain, it should be considered whether...
future resources should be devoted to the topic. Which side of this debate one is on will likely be grounded in how one views uncertainty. On one hand, the certainty of benefit is not supported by the many studies failing to prove the hypothesis of pain being reduced. At some level of certainty, scientists will accept the evidence available and determine that further study is not warranted. Contrary to this, others keep the window open if there is any level of uncertainty; keeping open the possibility that there is something not yet understood about the anecdotal benefits patients describe, part of which may be a beneficial placebo or expectation effect. Since beneficial health outcomes can be impacted by positive expectations there is likely much more for us to understand about harnessing those attributes.

Lack of standardisation of study design leads some to believe in the need to continue to pursue the key to unlock the mysteries hidden about the power of magnets. That may be true, but the fact that many of the published studies fail to demonstrate benefit should drive research in a different direction rather than repeating the same centuries-old studies. If there is a mechanism that will impart benefit, it hasn’t yet been found. Or has it? Given the apparent assumption that magnets must work, despite the evidence; and knowing that physicians have some acceptance of the use of placebo; and that placebos may be effective even when it is fully disclosed as a placebo, what can we offer in response to patients’ questions? Harlow’s suggestion that magnet therapy is poorly understood, but that there seems to be an active effect of placebo or expectation and that the final conclusion is unknown, may be the alternate recommendation that evidence provides us at the present. This is the most honest answer to the composite question posed by Fontanarosa and Angell when the current analysis leaves the benefits of static magnets unproven; they may or may not work.

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