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Does Grounding to the Earth Reduce Subjective Experience of Pain?

Adam Umbro
Philadelphia College of Osteopathic Medicine

Does grounding to the earth reduce subjective experience of pain?

Adam Umbro, PA-S

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Philadelphia College of Osteopathic Medicine
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Abstract

OBJECTIVE: The objective of this selective EBM review is to determine whether or not grounding to the earth reduces subjective experience of pain.

STUDY DESIGN: This paper evaluates one double-blind, randomized placebo-controlled trial, one randomized placebo-controlled trial, and one prospective cohort trial investigating the efficacy of grounding in reducing subjects' experience of pain.

DATA SOURCES: All articles were published in English language peer-reviewed journals and accessed through PubMed.

OUTCOMES MEASURED: The outcome measured in this review is the subjective experience of pain by study participants. Pain levels are measured using a visual-analog pain scale or pain survey.

RESULTS: Two studies showed a reduction in pain and one did not show a significant difference between grounding and control groups. The Ghaly et al., prospective cohort study showed 10/12 subjects reported decreased pain when sleeping and 7/11 subjects reported pain interfering less with activities. Brown et al., showed pain ratings at each interval in the grounded group were at least 80 percentage points lower than the ratings of the placebo group. Chevalier et al. did not show significant difference in pain between the grounded and placebo groups. The grounded groups showed higher percent change in pain from baseline at each interval.

CONCLUSIONS: Based on these three studies, grounding shows promise in reducing subjects' subjective experience of pain. Due to one study being inconclusive and the small sample sizes of the others, more data needs to be collected in order to more definitively answer the question proposed by this review. Due to its safety and affordability, health care providers still may consider recommending using grounding as an adjunct therapy for their patients.

KEY WORDS: Grounding, pain

Introduction

Throughout history humans have naturally been in direct contact with the earth. Whether with bare feet, leather or textile shoes, or sleeping on mats and mattresses made of natural materials there was not an interruption in the flow electricity from the Earth to our bodies. Only with the relatively recent advent of rubber-based shoes and insulated housing has our contact with the earth been interrupted. When not grounded to the Earth, our bodies equilibrate with the atmosphere and are also influenced electromagnetic fields created by electrical wiring and appliances, leading to an overall positive charge relative to the Earth.[1] Grounding "refers to maintaining the body at the natural electrical potential (voltage) of the earth."[2] While inside grounding can be achieved by being in contact with conductive patches or bedding which are physically connected to the earth using a wire and stake.[3] It has been theorized that while grounded, our bodies equilibrate to the electrical potential of the Earth through the flow of the Earth's abundant free electrons.[1] These electrons act as a potent anti-oxidant which affects our physiology and can lead to improvements in sleep, stress, cortisol levels, wound healing, and pain.[3]

It is hypothesized that many of the benefits from grounding are due to the electrons ability to rapidly conduct through extra-cellular tissue matrix and reach sites of injury much more readily than any medical or dietary anti-oxidant source.[3] At sites of injury, there is typically an inflammatory blockade of collaterally damaged healthy cells and connective tissue fibers that prevents the cause of the injury from entering the blood, but also prevents healing cells and substances from reaching the injury.[3] This blocked-off site may not be able to fully heal and continuously seep toxins that cause a chronic cycle of inflammation.[3] Grounding provides a

continuous source of electrons to neutralize damaging oxidation and prevent prolonged inflammation.[3]

Both acute and chronic inflammation have been implicated as contributing to the experience of pain. The prevalence of chronic pain in adults in the US is estimated to be 20% or 50 million people.[4] Pain is correlated with anxiety, depression, drug dependence, disability, and reduction in quality of life.[4] It is estimated that $560 billion per year in spending is related to chronic pain. This includes direct medical costs, lost productivity and disability programs.[4] Pain patients are 2.6 times more likely to visit the ER, 5 times more likely to be hospitalized, and 3.4 times more likely to visit an outpatient clinic than non-pain patients[5]

The causes of pain are highly variable and can be acute or chronic. Some common causes of chronic pain include injury, degenerative or auto-immune disease, and nerve impingement. Due to the variety of causes and possible co-morbidities, treatment of pain must be individualized to each patient. Unfortunately, our choices of treatment modalities are limited. First-line treatment is often medical therapy which includes opioids, SSRI/SNRI, NSAIDs, acetaminophen, gabapentin, pregabalin, and lidocaine patches. However, many of these medications come with bothersome or potentially dangerous side-effects along with abuse potential. Patients with pain that is musculoskeletal in origin are often referred for treatment with physical therapy. If pain is intractable to several treatments, patients may be candidates for surgical intervention. While most chronic pain conditions do not have cures, the treatment methods listed usually provide some relief. This is not always the case though. When patients do not experience relief after numerous tests and attempts at treatment, they are left feeling frustrated and desiring of alternative treatment modalities. Grounding may be relevant as an adjunct to current pain treatment regimens as it is inexpensive, non-invasive, and without

adverse effects. The goal of grounding therapy would be to reduce patient's pain levels and increase their quality of life.

Objective

The objective of this systematic review is to determine whether or not grounding to the earth reduces subjective experience of pain.

Methods

Articles were searched via PubMed database and Cochrane Library was referenced to ensure none had been included in any meta-analysis or systematic review. Key words used to search for the articles were grounding and pain. All of the articles were published in English in peer-reviewed journals. Studies were included for consideration if they were published 2004 or later and used participants 18 years or older. The intervention used in the studies was grounding to the earth using conductive patches or bedding. One double-blind, randomized-controlled trial (RCT), one RCT, and one prospective cohort study were used in this review. The two RCTs used placebo-controlled groups who were prepared with similar materials but "sham grounded." Studies meeting all of these criteria were then included in the review if they involved pain levels as one of their outcome measures. Statistics reported include mean-change from baseline, SD, and p-value.

Table 1: Demographics and characteristics of included studies

Study	Type	# Pts	Age (yrs)	Inclusion Criteria	Exclusion Criteria	W/D	Interventions
Brown[6] (2010)	Double blind RCT	8	20-23	Male, age 20-23, weight 150-175 lbs., BMI 18.5-24.9	Any injury or disease	0	Grounding to the earth using conductive patches on gastrocnemius and soles of feet and with conductive bed sheets. Subjects wore patches and slept with the sheets for 3 nights.
Chevalier[1] (2015)	RCT	32	18-24	Male, age 18-24, weight 66-84 kg., height 171-185 cm. Active at least 1 hour, 4 days per week	Surgeries or musculoskeletal problems. Practicing half squats on consistent basis. Alcohol use.	0	Grounding patches attached to both quadriceps and feet on grounding pad for 4 hours
Ghaly[2] (2004)	Prospective Cohort	12	24-72	Presence of chronic sleep, stress, and pain problems	Corticosteroid, antidepressant, narcotic, or oral sleep aid use	0	Conductive mattress pads with ground line attached to ground rod driven into the earth. Subjects slept on these pads for 8 weeks

Outcomes measured

All three studies measured pain levels as reported by the subjects. In the Brown et al. pilot study, pain was measured using Visual Analogue Soreness Scale (VAS) each day at 8:00 am and 5:30 pm on each of the four days of the study.[6] In the Chevalier et al. RCT, pain was measured using the same 20cm VAS as in the aforementioned Brown et al. study with left extreme labeled as "no quadriceps soreness" and the right extreme labeled as "maximum quadriceps soreness."[1] Measurements were taken on each of the four days of the study.[1] The Ghaly et al. prospective cohort study used a weekly pain survey to measure their participants subjective experience of pain.[2] Subjects filled out a survey prior to the start of the study and then once per week for each of the eight weeks of the study's duration.[2]

Results

Two RCTs and one prospective cohort study investigated the effect of grounding on pain levels in adults. Ghaly et al. conducted a prospective cohort study that evaluated eight female and four male subjects who ranged in age from 24 to 72, each of which admitted to having chronic sleep, stress, and pain problems.[2] Subjects slept in their own beds using conductive mattress pads every day for eight weeks with no subjects dropping out or failing to complete surveys and questionnaires.[2] Table 2 shows results of reported outcomes related to pain. The denominator represents the number of subjects at the start of the study who admitted to having the respective problem. Ten subjects (83%) reported decreased pain with sleep, one (8%) had no change, and one (8%) had worse pain.[2] Of subjects who had pain interfere with activities, seven (64%) reported less interference and four (36%) had no change.[2] Three (100%) subjects reported

having less TMJ pain.[2] Since this study did not have any control groups, there were no p-values, confidence intervals or other statistical measures reported.

Table 2: Ghaly et al.[2] Report of Subjective Pain Levels

	Decreased pain with sleep	**Pain interfered less with general activities**	**Decrease in TMJ pain**
Number of subjects	10/12	7/11	3/3

Both RCTs were conducted by the same research team. The first of which was the double-blinded pilot study Brown et al., that evaluated the effect of eccentric gastrocnemius exercises on eight men, who were free of any injury or disease, over the course of four days.[6] They were randomized 1:1 into two groups. Each would wear conductive patches and sleep on conductive bedding but one group, the control, had the connections modified to prevent grounding.[6] The study was conducted at a motel with one subject at a time.[6] Each subject had the same room, meals, eating, sleeping, and waking times.[6] They were all grounded for the same amount of time and all outcome markers were collected at the same time each day.[6] Subjects completed the VAS at 8am and 5:30pm each day of the study.[6] The exercises were performed on Day 1 after all baseline data was collected.[6] Due to the small sample size of the study, the authors did not report traditional statistical markers and instead determined that a difference between grounded and ungrounded groups of 10% or more was notable for further investigation by future studies.[6] As shown in Table 3 and 4, the ungrounded group had a higher perception of pain compared to the grounded group at each measurement interval. Table 4 shows that the ungrounded group had perceived pain levels at nearly twice the level of the grounded group for most intervals, much greater than the study's 10% cutoff for significance. This continuous data was not able to be converted to dichotomous as the authors did not report individual VAS scores

for each group, only the mean-change from baseline. There were no adverse events or withdrawals from the study reported.[6]

Table 3: Brown et al.[6] PM Pain Scale VAS Differences, % Change from Day 1

	Day 1	Day 2	Day 3	Day 4
Placebo	0.00	113.79	172.41	127.59
Grounded	0.00	28.26	89.13	41.30

Table 4: Brown et al.[6] Percent Group Differences: Pain Evaluation

	Day 1	Day 2	Day 3	Day 4
AM scale	0.00	-95.08	-179.21	-101.19
PM scale	0.00	-85.53	-83.28	-86.28

In Chevalier et al., 32 male subjects who were active for at least four days per week, an hour per day were randomized into four groups of eight.[1] Each subject was given a colored card which corresponded to receiving working, or sham grounding equipment.[1] Subjects performed 200 knee bends and then used their grounding equipment for four hours.[1] They were then told to limit physical activity and return to the clinic the next day at 9am for another 4-hour grounding session.[1] A VAS was filled out upon arrival to the clinic each day.[1] On day 3 and 4 there was no grounding session and subjects only came to the clinic to complete the VAS and have blood drawn.[1] Every subject was able to properly complete the exercises and there were no adverse events or withdrawals from the study.[1] Table 5 shows that there was significant change in soreness on each day from baseline for both control and experimental groups. The difference in muscle soreness between groups was not significant for any of the four days. The grounded group actually experienced a greater percentage change in pain perception from baseline on each day compared to the control group. The numbers reported correlated to mild levels of pain overall and the standard deviations show that there was decent variability in pain levels despite

the small window, ranging from almost no pain to moderate levels. The authors did not specify any cutoff point for treatment success based on VAS scores. With only a mean-change from baseline it is not possible to calculate event rates or numbers needed to treat.

Table 5: Chevalier et al.[1] Avg. Score on 20cm VAS

	Day 1	**Day 2**	**Day 3**	**Day 4**
Placebo	1.52 (0.00)	5.73 (377)	2.47 (163)	4.94 (325)
SD	1.32	1.83	1.46	2.04
Within group		$p < 0.01$	$p = 0.02$	$p < 0.01$
Grounded	1.02 (0.00)	6.00 (588)	3.44 (337)	4.69 (460)
SD	.80	2.04	2.28	2.57
Within group		$p < 0.01$	$p < 0.01$	$p < 0.01$
Between groups	$p = 0.29$	$p = 0.36$	$p = 0.16$	$p = 0.38$

Note: % change from Day 1 within same group listed in ()

Discussion

Grounding as a therapy is safe and as easy as walking barefoot through a park. There are many commercial products available online including mattress pads, blankets, versatile mats, bands, and patches. This makes grounding accessible to those who remain inside for most of the day or live in urban areas without near-by green spaces. They are relatively inexpensive when seen as a one-time investment. For the millions of people struggling with chronic pain and inflammatory conditions, grounding therapy could be an effective adjunct to their medical regimen. Since grounding has various physiological effects, patients should consult with their health care providers before and after starting in order to track biomarkers and adjust medication as needed. Grounding therapy has not been evaluated by the FDA and Lexi-Comp does not contain any information regarding grounding, or it's alternate name earthing. None of the reviewed studies reported any adverse effects of grounding treatments. Only one subject in

Ghaly et al., reported worsening of pain, however, this study was not controlled, and subjects had no restrictions or monitoring of their daily activities.[2]

There is a very limited number of articles published in peer-reviewed journals on the subject of grounding and even fewer RCTs. Small sample size is the major limitation of each of these studies. Despite being an RCT, the design of Chevalier et al., left far too many variables in play as it allowed subjects to go about their daily lives during the trial.[1] This means that exertion, nutrition, sleep, etc. were not monitored despite having an effect on muscle recovery. The control of variables in Brown et al. was much more rigorous and leads to more confidence in those results[5]. In future studies it would be beneficial to not only have larger sample sizes, but also report results in a dichotomous format. This way it would be possible to calculate treatment effects and have a more reliable evaluation of the risks/benefits to grounding therapy.

Conclusions

Based on these three studies, grounding therapy shows promise in reducing subjective experience of pain. Due to the small sample sizes of the studies and one study with no significant change between grounded and ungrounded groups there needs to be more data collected in order to offer a firm answer to the question posed by this review. In fact, an RCT investigating grounding and pain relief was published just prior to the writing of this review and hopefully more will follow[7]. In addition, future research could investigate the efficacy of grounding in treating patients with specific chronic inflammatory conditions. Pain relief is often only one component of an individual's disease burden so in order to tailor treatment it would be beneficial to see it measured in the context of various disease states. Due to the apparent lack of adverse effects and affordability of treatment, grounding should be investigated further as an adjunct therapy health care providers can recommend for pain relief.

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