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Acupuncture

Resolving Old Controversies
and Pointing New Pathways

Edited by Marcelo Saad and Roberta de Medeiros



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Edited by Marcelo Saad and Roberta de Medeiros

Contributors

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Meet the editors



Marcelo Saad, MD, PhD (Brazil), is a physician, board certified in acupuncture. He has a doctorate in the Sciences of Rehabilitation from the Federal University of S. Paulo. He is also current director member of the Spiritist-Medical Association of S. Paulo. He has been invited to the upcoming postgraduate course in Interfaith Hospital Chaplaincy, Santa Marcelina Medical School. Besides his work as a medical acupuncturist in private practice, he is also engaged in scientific publications, editorial collaborations with journals and books, medical lectures, and participation in scholarly tasks. His main interests are religiosity in healthcare, acupuncture, and complementary therapies.



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Preface

Acupuncture may have about 4000 years of history, but it has only been clinically accepted in the West for some 40 years. Acupuncture receives both praise from its users and skepticism from its critics. High-quality scientific studies have advanced, but the technique in health services has stagnated. In this current scenario of contrasts, *Acupuncture—Resolving Old Controversies and Pointing New Pathways* intends to be a modern reference for scholars, without totally exhausting the subject. The editors expect this work to assist with the advancement of the scientific understanding and clinical usage of acupuncture. The authors are well versed in the subject and, along with literature reviews, are able to add their own impressions.

In this book, some traditional fundamentals of ancient Asian medicine are translated into the current scientific knowledge of neurophysiology and mechanisms of action. Specific variations of acupuncture, such as the scalp microsystem technique, are discussed and explained. Practical aspects, such as education on acupuncture, are enriched with descriptions of novel treatments. The therapeutic use of acupuncture and related techniques is explored regarding their incorporation into a comprehensive integrative medicine approach.

The chapter “Acupuncture—What Controversies? What Pathways?” (by the editors) introduces the reader to the nature and purpose of the book, as well as the significance of its contents for readers. The editors describe the clash between strengths and weaknesses (the controversies) of acupuncture as if it were a game. At the same time, they discuss the strategies (pathways) to keep this game going.

The chapter “Functional Imaging and Physiological Modulation with Acupuncture in Parkinson’s Disease and Nonhuman Primate Models of Dopamine Dysfunction” (Zhiming M. Zhang, Jorge E. Quintero, and Yi-Ning Yin) explores the neuropathology of Parkinson’s disease and physiological modulation with acupuncture in a model in rhesus monkeys. It is a source of in-depth knowledge about the neuropathology of Parkinson’s disease, a description of findings in animal models with this disease, and a documentary of effects of acupuncture on this condition. The unprecedented information makes this manuscript unique and the high level of detail has the potential to advance the treatment of this disease with acupuncture.

The chapter “Fu’s Subcutaneous Needling: A Novel Therapeutic Proposal” (Zhonghua Fu and Dejian Lu) reports on an acupuncture system developed and tested by the authors for more than 22 years. The text is well detailed, covering all the complexities of the system: its peculiar terminology, the specially developed needle, the needling and manipulation technique, and the clinical indications. All this is presented in an objective topical format, with very informative figures.

The chapter “Scalp Acupuncture and Mental Disorders” (Chuen Heung Yau and Cheuk Long Ip) is a very comprehensive review of the scientific literature on scalp acupuncture in the treatment of mental diseases. The text covers the history of the procedure, the modern direction for mental disorders, the assumed mechanisms of action, and the limitations of current knowledge due to the paucity of research.

In addition, clinical utility is explored with a description of procedure routines, strategic planning with acupoint selection, indications for which mental disorders may benefit, and contraindications of the procedure.

The chapter “Ultrasound Detection Acupuncture Needling Training: Description of the Method” (Mark C. Hou and Ying-Ling Chen) describes a training method for acupuncture point needling with ultrasound guidance. The method is detailed in a scientifically correct manner, in addition to the evaluation of the training stages. The clinical relevance of this matter is the potential to reduce adverse effects and to inspire other services to adopt such routines.

As editors, we thank the contributing authors for their exquisite work, and we congratulate IntechOpen for its efforts in book production. For you, the readers, we hope to match the trust you put in this work, and we hope you find it useful.

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Introductory Chapter: Acupuncture - What Controversies? What Pathways?

Marcelo Saad and Roberta de Medeiros

1. A constant board game

This is a short chapter, with intention to be introductory for the nature and purpose of the book subject matter, as well as the significance of its contents for the readers. The field of acupuncture as a scientifically accepted therapy in the West is constantly evolving. All proponents of acupuncture are well convinced of the value of this therapy, and they are quite satisfied with the current documentation regarding its safety, efficiency, effectiveness, and cost-benefit ratio [1]. However, there are still many gaps on this knowledge, equally evidenced in the scholar literature. Very often, proponents of acupuncture have to justify all over again and again their point to the academic-scientific community, since critics are always remembering the flaws.

This duality looks like the antagonism in a board game, represented by the clash between the positive and negative aspects of the technique. In this analogy, the pieces of both sides are in a continuous struggle between the forces strengthening the validity of acupuncture and the movements reducing its legitimacy (**Figure 1**). The positive aspects include everything science recognizes and endorses objectively, added to everything the patients who use the technique feel subjectively. The negative aspects include everything acupuncture is objectively owing to science while researches do not provide all the answers, added to everything subjectively derived from prejudice and ignorance against this technique.

Following this analogy, the new pathways are represented by the strategies the proponents of acupuncture will use to strengthen their arguments and weaken the detractors' arguments, to advance beyond this standoff. This chapter will put the reader on the position of a player interested on the acupuncture advancement. The adversary is virtual, embodying all the closed minds focused only on the acupuncture frailties. To win any game, the player must know his own strengths as well as his own weaknesses. Then, the player will identify threats and opportunities on the distribution of pieces along the board. Finally, he will work to keep the maximum amount of pieces, at the same time eliminating the opponent pieces. The lines below will discourse about intriguing this game.

2. The pieces on our part of the board

2.1 A millenary tradition

The longevity of acupuncture already speaks enough for itself. Acupuncture and correlated techniques have been practiced in China and other Asian countries for millennia. The generally accepted history of acupuncture in China can be

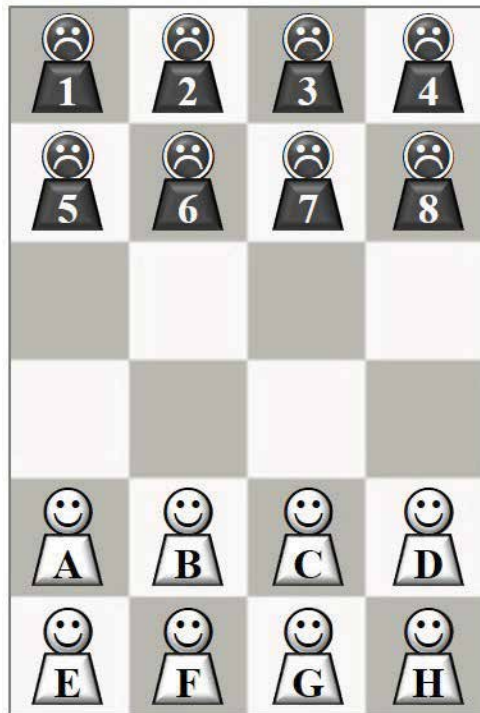


Figure 1.

This board game is an allegory on the constant clash between the elements that sustain acupuncture (the white pieces, on the first-person player's side) and the weaknesses that destabilize acupuncture (the black pieces, on the side of the opponent).

traced back at least 3000 years (the sources diverge, some cite 4000 years), when rudimentary stone needles were used. Besides these archeological clues, the earliest recorded mention of acupuncture is on the classic Yellow Emperor's Inner Classic, written on the second century B.C. Currently, it is routinely practiced in China, Japan, Korea, Hong Kong, and Taiwan as part of the whole healthcare system.

2.2 Worldwide diffusion and acceptance

Acupuncture arrived in Europe in the seventeenth century through the contact of Christian missionaries and European merchants with the Chinese. A resurgent interest among clinicians came only by the nineteenth century in Britain, France, and Germany, when acupuncture arrived also to North America. However, the advances of standard medicine and biological sciences have marginalized acupuncture, and this technique was almost restricted to the Eastern districts of large cities. Acupuncture has gained popularity in the media just about 40 years ago. While in China in 1971, James Reston, a famous journalist and vice president of the New York Times, had an acute appendicitis. Chinese physicians performed an emergency appendectomy, and his postoperative pain was relieved by acupuncture. Reston reported his experience in an historical article in his newspaper [2]. This fact brought great publicity to acupuncture and renewed Western interest in this form of treatment.

2.3 Scientific acceptance through the front door

Scientific publication on acupuncture grew slowly from the 1970s and quickly increased in the last few decades. Some milestones are noteworthy: the

North American National Institutes of Health Consensus Development Panel on Acupuncture, published in 1998 [3], and the World Health Organization (WHO) Review and Analysis of Reports on Controlled Clinical Trials, in 2002 [4]. Today, an extensive bibliography supports the appropriateness of acupuncture use for many defined clinical conditions. Both efficacy and effectiveness of acupuncture have been examined through research with strong methodology. Efficacy is a concept related to mechanisms of action, mainly the effects beyond the placebo. Efficacy measures the impact of an intervention on outcome in ideal conditions, with an emphasis on controlling for placebo effects. Effectiveness is related to how something works in clinical healthcare. This real-world benefit is a measure of the overall impact of an intervention on outcome, as would be expected in routine care. Some trials attempting to address the questions of efficacy and effectiveness are designed with three arms, including true acupuncture, sham procedure, and a comparison treatment.

2.4 East and West can learn with each other

The integration of this strange needling therapy was facilitated with the concept of “Western Medical Acupuncture,” a method of peripheral neural stimulation, adapting the Chinese tradition to the knowledge of physiology and other sciences. In such approach, the classic acupoints are selected considering the best places to stimulate the nervous system, inducing local and distant reflexes and neuromodulation. Old and new approaches need not to be mutually exclusive, since modern Western ideas can complement Eastern millennial wisdom. The Eastern thought has holistic views, nonlinear logic, and empirical observation. The Western reasoning is based on reductionist theories, linear causalities, and scientific endorsement. If opposites attract themselves, this can be a perfect marriage [5].

2.5 Multi-institutional acknowledgement of acupuncture

Since 1979, the WHO has proclaimed acupuncture as a clinical practice. In 1996, the North American Food and Drug Administration (FDA) reclassified the needles to a category of accepted medical instruments. In Brazil, acupuncture is officially recognized as a medical specialty since 1995. In the United Kingdom, acupuncture is used in many National Health Service general practices, as well as the majority of pain clinics and hospices. In 2010, the United Nations Educational, Scientific and Cultural Organization (UNESCO) decreed acupuncture as Intangible Cultural Heritage of Humanity. The World Federation of Acupuncture-Moxibustion Societies is currently one of the non-state actors in official relations with the WHO.

2.6 A respectable complementary therapy (CT)

A CT is a procedure used along with standard treatments, although it is not considered orthodox. On the other hand, an alternative therapy is used instead of standard treatments, which is not the best medical practice. In the last decades, acupuncture left the category of a suspect doubtful alternative therapy to become a respectable complementary therapy. Acupuncture can be offered in full compatibility with conventional treatment, because no conceptual conflict surges if they are simultaneously used. This characteristic is different from some alternative therapies, in which some paradigm conflict with conventional treatment, and even sometimes demands its abandonment. This appraisal boosts acupuncture to figure among treatment options in clinical guidelines for many conditions [6].

2.7 An advantageous treatment in many senses

Respecting the indications and contraindications, the combination of acupuncture with conventional resources tends to lead to more complete and long-lasting results [7]. An important factor for such acceptance is acupuncture is a relatively safe technique. Acupuncture is a minimally invasive procedure with good risk-benefit ratio. Acupuncture is suitable for almost all people (including children), with few exceptions in very specific conditions. Potential harm is generally restricted to minor adverse effects, such as pain at needling site, bruises, drowsiness, and skin irritation. Major harm is rarely reported, and most serious adverse events appear to be related to negligence, recklessness, and/or malpractice.

2.8 *Vox populi, vox Dei* (the voice of the people is the voice of God)

Despite the astonishing advancements of conventional medicine and technology in the last decades, there was also a parallel growing interest in complementary therapies among many people [8]. More and more patients express their desire to consume less medication, as they say pharmacological approach has limited results, many side effects, and high cost. The clinician really engaged on a real patient-centered care has to be updated with modern developments on acupuncture. The contemporary concept of integrative medicine is a healthcare approach that partners the patient and the clinician on a healing journey. This is done through the appropriate use of both conventional and complementary techniques. The priority of this combination is to use, whenever possible, natural and less invasive interventions, provided they are safe and worthy. Such comprehensive approach takes selectively the most beneficial effects from different disciplines; at the same time, it meets the patient's values.

3. The pieces of the adversary

3.1 Acupuncture and TCM are “not to be sold separately”

Acupuncture was validated by conventional science separately from the traditional Chinese medicine (TCM). This oriental medicine is a coherent system to promote health and treat disease. Its resources, besides acupuncture, include lifestyle modification (e.g., Chinese diet therapy), herbal therapy, mind-body disciplines (e.g., qigong and meditation), physical practices (e.g., breathing exercises and tai chi), and manual therapy (e.g., massage and tui-na). By the way, it is very likely that the other disciplines arose much before acupuncture, being this particular technique an outspread of this major knowledge. Some groups of practitioners claim that it is nonsense to use acupuncture disconnected from a complete TCM approach. One of the arguments is that TCM is eminently a health promotion system, focusing on disease prevention. Thus, it would be a Western misrepresentation to resort to acupuncture only when the patient is ill.

3.2 Classical theory has “mystical” and confused elements

TCM is based on the concept that qi (the putative vital energy) flows along supposed network of meridians through the body. The harmony between natural opposing forces of yin and yang modulates the balance of spiritual, emotional, mental, and physical health. Diagnosis of an unbalance state is based on tongue and pulse parameters. The so-called triple warmer has no correspondence with an

organic structure. Ordinary people will have a huge difficulty to understand terms like “fire on the liver.” In addition, most practitioners don’t speak the same terms for acupoints and meridians, with some using an alphanumeric code and others the transliterations from the Chinese alphabet [9]. The WHO scientific group proposed in 1991 a standard international nomenclature on acupuncture; however, it is adopted more by researchers than by practitioners.

3.3 Acupuncture has many and very heterogeneous expressions

There is a dizzying diversity of treatment designs, considering parameters such as number of needles used, the process of acupoint election, the needling technique, the duration of each session, and the weekly frequency of sessions. Besides needling itself, other classical forms of acupoint stimulation include moxibustion (warming), cupping (negative pressure on the skin), pressure (using devices or fingers), gua sha (scraping), and electrostimulation (either over the skin or through a needle). In addition, acupuncture-correlated techniques are other forms of treatment based on the same principles of acupoint stimulation. They include trigger point needling, laser stimulation, injections on acupoint, and the myriad of micro-systems (auricular, scalp, hand, foot, among many others). All this diversity of schools confuses the patients and disrupts the comparison of different papers.

3.4 Mechanisms of action are not totally known

Technically speaking, acupuncture is a method of peripheral neural stimulation by puncturing the skin with a needle on specific anatomical points. It promotes changes in the sensory, motor, autonomic, visceral, hormonal, and immune functions. However, just as physicists seek “The Theory of Everything”, their Holy Grail, acupuncture has not yet been able to fit in all the pieces of the biological puzzle to explain how the whole works. A plethora of neurophysiological pathways is demonstrated in countless researches of the highest quality. However, each finding generally serves to explain a single specific effect. It is as if we could see one tree at a time but could not get away enough to see the whole forest. This difficulty of interconnecting all the accumulated knowledge prevents researchers to explain the differences between good and bad responders, as well as whether the effects observed on healthy populations can be extrapolated for sick people.

3.5 A notion (albeit false) that placebo is the main effect

A recurrent criticism on studies of acupuncture through randomized trials controlled by placebo is that both the sham and real acupuncture lead to positive effects. The hasty conclusion is acupuncture acts mainly through placebo effect. However, this understanding is not appropriate, since the needling is not the only therapeutic element. The lack of difference between real and sham groups may underestimate the total effect of acupuncture treatment. The randomized clinical trial controlled by placebo was designed to test drugs, considering only its pharmacological effects. On acupuncture, the physiological component is intertwined to the non-biological processes, and both can be equally important [10]. The environment in acupuncture (already beginning on anamnesis) surely amplifies the extension of the physiological effects. This limitation to design a research is worsened by an insufficient improvement of placebo models. Attempts for placebo acupuncture could be using a false (sham) acupoint, a superficial puncture

(with skin perforation), or a simulated needle insertion (without skin perforation) using a blunt device. All of them can produce false-positive results.

3.6 Professional competencies are not universally standardized

Questions about the competency to practice acupuncture are discussed worldwide. Today, each country has its local legislation to assign who is allowed to perform acupuncture. Sometimes, anyone with some qualifications or experience is allowed to be called acupuncturist, even people without formal graduation in a healthcare course. In these cases, the practitioner receives education only focusing on acupuncture and/or TCM, and acupuncture will be offered outside a clinical environment. The risk of diagnosis or treatment delay, due to symptoms masking on a serious disease, is increased if clinical red flags are ignored [11]. The patient protection must be the priority when deciding on training standards and licensure requirements for practitioners. In acupuncture, clinical results vary with the level of training and the length of experience of the practitioner.

3.7 A treatment for a few open-minded people

In our consumerist society, most clients seek immediate solutions for their health problems. Compared to drug treatment, acupuncture may seem a boring, tardy, and expensive option to many people. The treatment with acupuncture typically involves several sessions and follow-up, which may be inconvenient for some patients. Many times, a private treatment has to be paid out-of-pocket, when it is not covered by health insurance policies. The cost of a course of sessions varies widely between providers, and the whole treatment can be expensive. Furthermore, it is unpredictable what will happen when the patient reduces the sessions' frequency or stops the treatment. Patients have to be adequately informed on what to expect, in order to be motivated by realistic prospects. They also must understand that the effectiveness of acupuncture cannot be generalized, as its effect varies largely from patient to patient.

3.8 Rejection by a part of clinicians

Some clinicians state they find no reason to indicate stranger therapeutic systems, since the value and success of conventional biomedical science are just enough. For clinicians who think so, having to learn the principles and indications of other practices would be an unnecessary task. Such colleagues would indicate acupuncture only when they have no further resources to offer (or even when they want to get rid of the patient, etc.). In some cases, disregarding acupuncture is actually an excuse (conscious or unconscious) for lack of time (or commitment) to explore everything that could be beneficial to the patient.

4. In short

As the game goes on, acupuncture needs to prove on a daily basis that it has nothing to do with other picturesque therapies. A lot of energy must be spent to unstick acupuncture of weird East prescriptions such as the powder of rhinoceros' horn, a useless pinch of keratin that is leading this animal to extinction. However, this is a fact: acupuncture came to stay. The opposition to this therapeutic modality would never eliminate it from the canon of good complementary therapies. However, such opposition can clutter many advances for acupuncture use, from no

inclusion in clinical guidelines to limitation for reimbursement to health insurance users. More slowly than we would like, the score of this game hangs to the side of the fittest player. It's up to us to continue this game, even though it may not have an end. Anyway, every little advance is a victory.

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Functional Imaging and Physiological Modulation with Acupuncture in Parkinson's Disease and Nonhuman Primate Models of Dopamine Dysfunction

Yi-Ning Yin, Jorge E. Quintero and Zhiming M. Zhang

Abstract

Here we review functional imaging and neurophysiological evidence for the pre-clinical and clinical use of electroacupuncture, a non-pharmaceutical-based therapeutic strategy, to relieve parkinsonian symptoms. Outcomes from those studies provide evidence that the effect of electroacupuncture can be objectively measured in nonhuman primate models of Parkinson's disease and in patients with Parkinson's disease. In addition, the evidence continues to support that electroacupuncture can be used in preclinical and clinical studies simply, safely, and effectively as an alternative and complementary treatment for disorders in Parkinson's disease.

Keywords: acupuncture, pharmacological MRI, glutamate, cortex, electrochemistry

1. Introduction

Acupuncture has been gaining popularity for treatment of various disorders as an alternative therapy and has been used for years as treatment for a wide range of ailments from lower back pain to stroke to osteoarthritis to Parkinson's disease (PD) [1–5]. Classical acupuncture is based on 14 mapped main channels on the body with about 365 acupoints distributed on the channels (meridian system); the flow of Qi (the vital life force or “energy”) maintains the balance and harmony of Yin and Yang. Any blockage of these channels or abnormal movement of Qi will result in illness, and acupuncture, by stimulating these acupoints along the meridian channels with needles, helps to restore movement of the Qi and Qi homeostasis (De Qi), thus modulating the autonomic nervous system and relieving the symptoms of various illnesses [6, 7]. The underlying mechanism of acupuncture has been under intense investigation and many theories have been discussed in the scientific community. For example, connective tissues or perivascular space with decreased electrical impedance and increased electrical conductivity have been suggested to constitute the meridian channels with acupoints along the pathway [7, 8]. Nevertheless, the efficacy of acupuncture remains largely unclear because of a skeptical attitude of how acupuncture works (especially within the framework of Western Medicine),

methodological flaws, and an absence of rigorous studies using objective outcome measures [1]. To date, the clinical outcomes of acupuncture are assessed by empirical observations rather than by objective, quality analysis [1, 3, 5].

Recent, rapid advances in technology, especially the use of functional magnetic resonance imaging (fMRI) to map global and/or target-specific brain regions, have shown great promise and could be extremely helpful for acupuncture studies in human subjects when combined with subjective measurements [8]. Pharmacological MRI (phMRI), a new application of fMRI, is using fMRI methods to map drug-induced activations inside the brain [9]. In this chapter, we discuss how phMRI can be used to map dopaminergic drug-induced changes in the brain before and after acupuncture treatment in parkinsonian monkeys. Similarly, fMRI methods have been used in the PD clinic. As an example, with acute acupuncture stimulations at GB34, analysis of fMRI signals showed activations in the putamen and the primary motor cortex, and these activations induced by acupuncture were correlated with patient self-reported improvements of finger-tapping [10]. Furthermore, phMRI has been used to monitor other treatments associated with PD in a preclinical, translational study [11]. The utility of fMRI/phMRI has even been extended to differentiate dysfunction in the basal ganglia between parkinsonian and aged monkeys [12]. Based on those clinical and preclinical studies, these imaging modalities have the possibility to help untangle the underlying neural mechanisms of acupuncture.

To date, few studies have been conducted *in vivo* to directly investigate the relationship between acute acupuncture stimulation and its effects on modulating neurotransmitters especially in large animals such as the rhesus macaque. In this chapter, to our knowledge, we would be the first to begin exploring whether acupuncture stimulation could suppress, or activate, cortical glutamate in normal and PD monkeys. In addition, we will also review fMRI and phMRI studies to provide some direct evidence demonstrating the relationship between acupuncture and neuronal activity and changes in neurotransmitter signaling in the CNS.

2. Evidence from neuroimaging studies

2.1 Functional/pharmacological MRI study in nonhuman primates

Over the past two decades, our group has been working to objectively and safely monitor anti-parkinsonian effects and brain activity modulated by electroacupuncture (EA) in nonhuman primates modeling human PD. We maintained a group of late middle aged rhesus monkeys with long-term (>5 years) mild to moderate parkinsonism rendered by our standard procedures, unilateral administration of 1-methyl-4-phenyl-1,2,3,6-tetrahydropyridine (MPTP) [13]. This group of parkinsonian rhesus macaques was extensively evaluated by a computerized behavioral testing battery and by phMRI scans [14, 15]. First, stable parkinsonian features were observed in all animals before entering the EA study and all animals showed positive responses to a levodopa (L-dopa) challenge [14]. phMRI activation was then analyzed by our standard procedure. Briefly, while undergoing fMRI scans, animals received a subcutaneous injection of the dopamine agonist, apomorphine (APO). This pharmacological challenge then serves as the basis for assessing the changes in fMRI responses. Second, the phMRI results revealed that compared with the normal, pre-MPTP, status, APO-induced activations were found in all measured ROIs (**Figure 1A and B, Table 1**, described in [14]). The differences between normal and post-MPTP stages in response to the apomorphine challenge were significant ($P < 0.001$), especially in the caudate nucleus, putamen, primary motor cortex

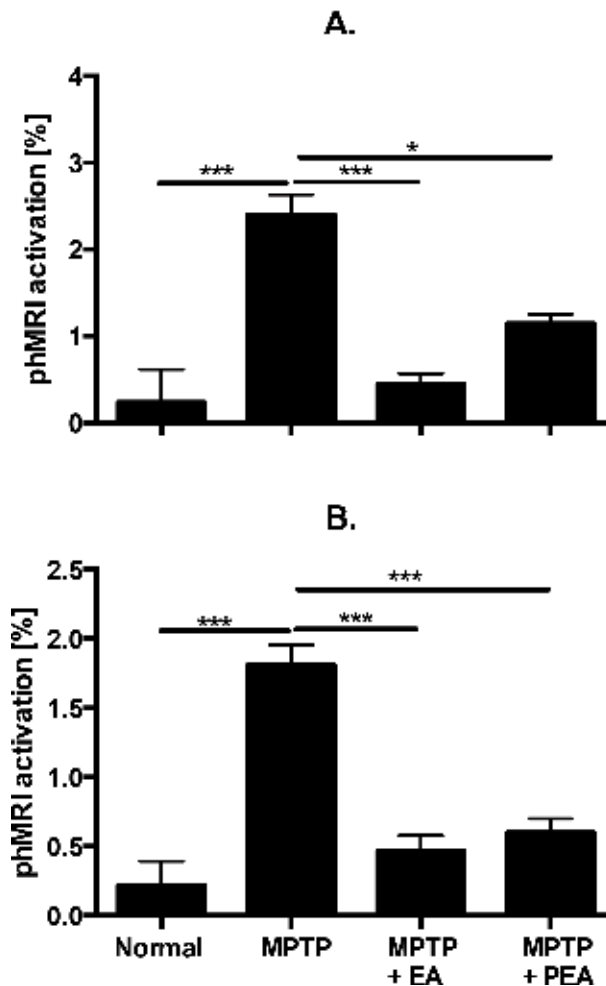
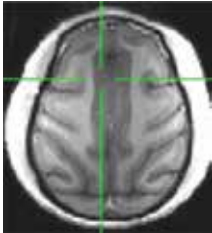
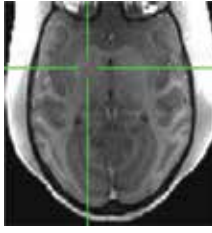
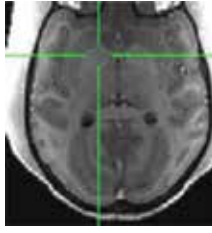


Figure 1. phMRI activation changes of animals following different treatments. phMRI activation changes of caudate nucleus (A) and putamen (B) following MPTP administration, chronic EA treatment or post EA treatment (from [14]).

(M1), cingulate gyrus and globus pallidus externa (GPe). In contrast, blood oxygen level dependent (BOLD) responses in the pre-motor areas and the globus pallidus interna (GPi) were not significantly different (**Table 1**). These findings were in line with previous results [16] that APO-induced activations were seen in the striatum after animals became parkinsonian. In addition to those responses described above, APO-induced activations were also observed in the MPTP-lesioned primary motor cortex and cingulate gyrus (**Figure 2** and **Table 1**).

The chronic EA treatment appeared to alter neuronal activities in some examined areas such as the caudate nucleus, putamen, primary motor cortex, cingulate gyrus and GPe in which strong APO-evoked activations were initially observed after MPTP lesions but then were significantly reduced after the EA treatment. In some cases, the BOLD activations nearly returned to the levels seen in the normal (pre-lesion) stage (**Figure 1A** and **B** and **Table 1**). However, the phMRI responses were relatively mild in the pre-motor cortex and GPi (**Table 1**). As shown in **Figures 1** and **2**, the most affected regions were the caudate nucleus and primary motor cortex. For example, the APO-induced activations were reduced more than 5-fold in the caudate nucleus and 4-fold in the primary motor cortex. Interestingly,

	Cingulate	GPe	GPi
ROIs			
Normal	0.74 ± 0.25	-0.27 ± 0.3	-0.16 ± 0.26
MPTP	2.16 ± 0.09 ^a	1.92 ± 0.13 ^a	0.84 ± 0.41
MPTP + EA	0.58 ± 0.23 ^b	0.54 ± 0.19 ^{d,e}	0.44 ± 0.31
MPTP + PEA	0.85 ± 0.11 ^c	0.69 ± 0.09 ^f	1.11 ± 0.14 ^d

GPe, globus pallidus externa; GPi, globus pallidus interna; ROIs, region of interest; EA, electroacupuncture; PEA, post electroacupuncture (from [14]).
^a*P < 0.001 vs. normal.*
^b*P < 0.001 vs. MPTP.*
^c*P < 0.001 vs. MPTP + EA.*
^d*P < 0.05 vs. normal.*
^e*P < 0.01 vs. MPTP.*
^f*P < 0.05 vs. MPTP + EA.*

Table 1.
BOLD-responses in some cortical and subcortical areas.

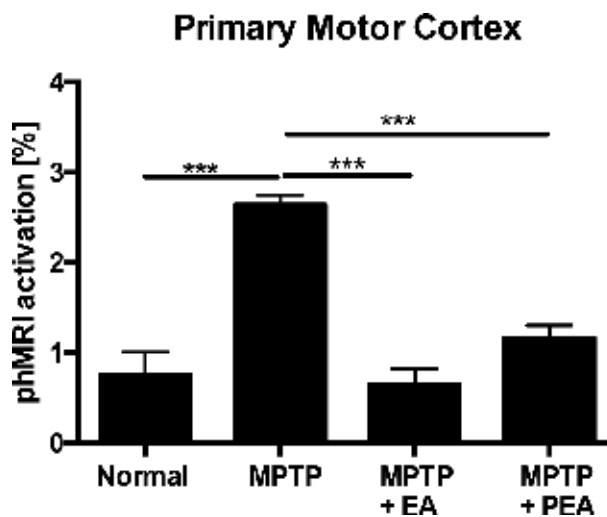


Figure 2.
phMRI activation changes of primary motor cortex following MPTP administration, chronic EA treatment or post EA treatment (adapted from [14]).

residual effects were observed 3 months after the last EA treatment in the caudate nucleus, putamen, primary motor cortex, and cingulate gyrus regions judged by comparing the values of BOLD-activations between MPTP + EA and MPTP + PEA (3 months post EA treatment). A significant difference ($P < 0.05$) between MPTP + EA and MPTP + PEA was also seen in the GPe (Table 1). The results strongly suggest that anti-parkinsonian effects of EA can be objectively assessed, and fMRI/phMRI could be readily translated into the clinic with minor modifications.

2.2 Functional MRI studies in humans

In human studies, acupuncture stimulations that directly modulate brain activity can also be observed [17, 18]. An example of this was carried out by Li and colleagues [17] who used fMRI to investigate the potential neuromechanism of acupuncture on tremor in patients with Parkinson's disease. Li and colleagues compared fMRI signals in patients with Parkinson's disease who were either in the true acupuncture group (TAG) or the sham acupuncture group (SAG). Participants received levodopa for 12 weeks and received the study intervention twice weekly. Participants in TAG were acupunctured on DU20, GB20, and the Chorea-Tremor Controlled Zone. Participants in SAG were given sham acupuncture. fMRI scans of the participant's brains were obtained before and after the 12-week period. As shown in **Figure 3**, acupuncture had specific effects on the activity of the cerebrotocerebellar pathways as shown by a decrease in regional homogeneity (ReHo)—an indication of a decrease in local/regional activity. Other measures of brain activity, degree centrality (DC), and amplitude low-frequency fluctuation (ALFF) values, also showed decreases after acupuncture compared to sham. Meanwhile, increased ReHo values were observed within the thalamus and motor cortex [17]. The results of this clinical study demonstrate that functional imaging can directly detect and measure acupuncture-induced brain activities even at the level of the neural network.

In a separate clinic study to examine the underlying mechanisms of acupuncture in patients with major depressive disorders, Wang et al. [19] investigated the resting state functional connectivity (rsFC) in the left and right amygdala before and after verum acupuncture plus the antidepressant fluoxetine versus sham acupuncture plus fluoxetine. Resting-state fMRI data was collected before the first and last treatments. Participants received the study intervention for 8 weeks. Verum acupuncture treatment participants showed (1) greater clinical improvement than sham participants based on the depression rating scales; (2) increased rsFC between the left amygdala and subgenual anterior

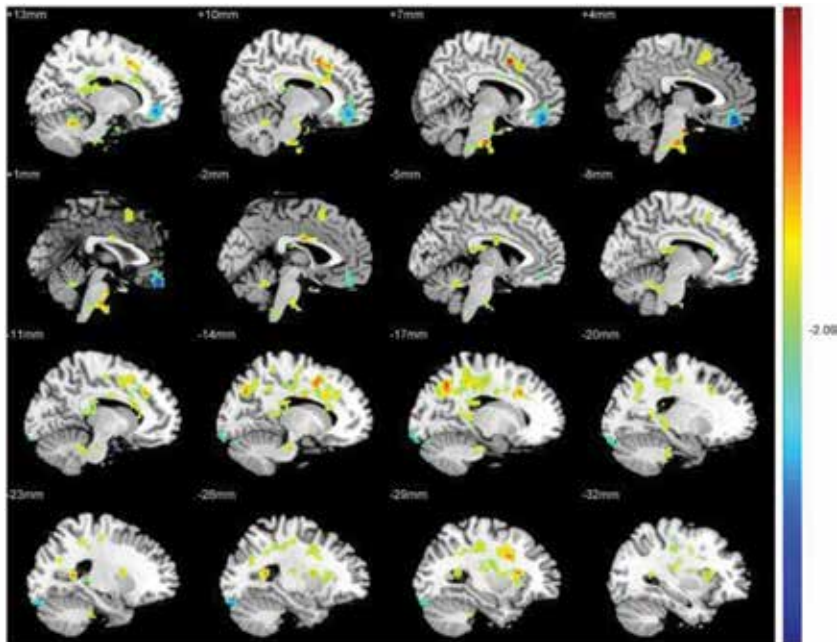


Figure 3. Differences in ReHo values between the TAG and SAG. ($P < 0.05$, AlphaSim corrected). Warm colors represent positive ReHo values; blue (cold) colors represent negative ReHo values (from [17]).

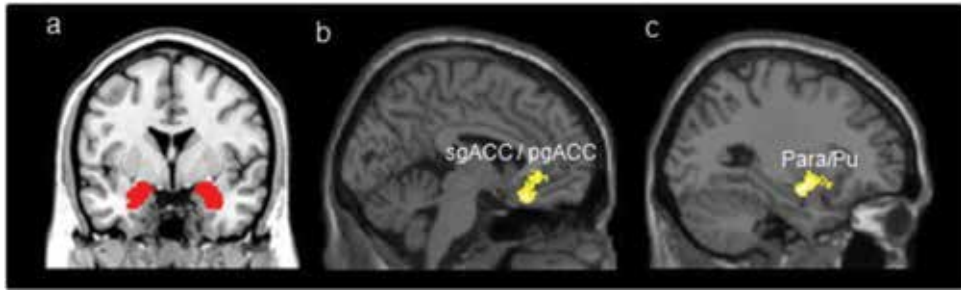


Figure 4. Amygdala seed locations and brain regions with significant changes (post minus pre) of rsFC with the amygdala (a) modulated by the verum acupuncture plus fluoxetine compared with sham acupuncture plus fluoxetine treatment in the left sgACC/pgACC (b) and left Para/Pu (c). Abbreviations: sgACC, subgenual anterior cingulate cortex; pgACC, pregenual anterior cingulate cortex; Para, parahippocampus; Pu, putamen (from [19]).

cingulate cortex (sgACC)/pregenual anterior cingulate cortex (pgACC); (3) increased rsFC between the right amygdala and left parahippocampus/putamen. And finally, the strength of the amygdala-sgACC/pgACC rsFC was positively associated with a corresponding clinical improvement (**Figure 4**). Their findings show the additive effect of acupuncture to antidepressant treatment and suggest that this effect may be achieved through the limbic system, especially the amygdala and the ACC [19].

3. Evidence from electrochemical studies

In the brain, glutamatergic transmission plays a key role in the normal physiology of those systems that modulate motor activity (especially in the basal ganglia). In Parkinson's disease, glutamatergic transmission is considerably affected particularly in the direct and indirect nigrostriatal pathways, which are known to involve glutamatergic hyperactivity. The glutamatergic hyperactive pattern, through a dual role, may exacerbate PD by first promoting excitotoxic events that contribute to the neurodegenerative process and, secondly, by contributing to the pathophysiology of dyskinesias and motor fluctuations that are associated with the chronic use of levodopa [20]. Since excitotoxicity is a glutamate-receptor-mediated phenomenon, growing interest and work have been dedicated to the research for modulators of glutamate neurotransmission that might enable new therapeutic interventions to slow the neurodegenerative process and ameliorate PD symptoms.

To explore the role of glutamate excitotoxicity in both acupuncture and pathogenesis of PD, we designed a study to address the question of whether changes in cortical glutamate levels were one of the underlying mechanisms of EA (previously unpublished results). Based on human acupuncture studies in patients with PD, we trained two rhesus monkeys with mild but stable parkinsonian features (MPTP-induced) including bradykinesia, rigidity on the affected upper and lower limbs. In addition, stooped posture and mild postural instability were also evident [13]. Then, these animals were treated with chronic (intermittent) EA treatments (3 session/week/4 months) at acupoints ST 36, GB34, or LI 4 (**Figure 5**). Subsequently, they were also studied for behavioral changes by a non-biased, computerized testing battery. Results demonstrated that EA significantly improved motor functions measured by increased movement speed after a 4-month EA treatment (data now shown). Following the last EA treatment and behavioral tests, animals were anesthetized and resting levels of L-glutamate were measured in the primary motor areas (upper body) by enzyme-based biosensors [21] with acute EA stimulation at GV14 + EX-B9 or GV14 + ST 36 or LI 4 on both sides, or GV14 + non-acupoints (**Figure 5**). EA-induced

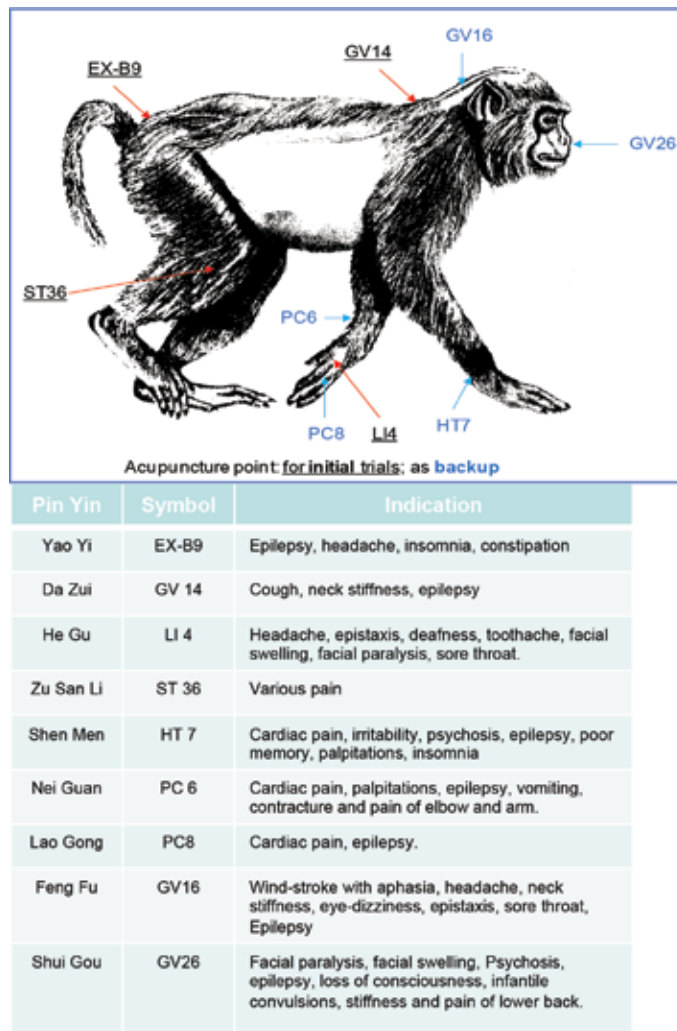


Figure 5.
 Acupuncture points used in the study.

changes in cortical glutamate could be recorded in real time (2 Hz) with glutamate-sensitive biosensors (**Figure 6A**). The EA treatments of GV14 + EX-B9, or GV14 + ST 36 significantly decreased basal levels of glutamate in the primary motor cortex on the hemisphere contralateral to the MPTP-lesion immediately after the stimulator was turned on and returned to baseline levels after it was turned off. By contrast, stimulation of GV14 and a non-acupuncture point produced no fluctuation in basal glutamate activity (**Figure 6B**). These results support the idea that EA can produce transient effects on cortical levels of glutamate that could be a means of providing a potential therapy for PD.

Acupuncture can alter extracellular glutamate as seen in our pilot nonhuman primate study and those results are supported by acupuncture studies in rodents. Lee et al. reported that acupuncture can attenuate extracellular glutamate levels in a global ischemia model in rat. In the study, the authors found that acupuncture at GB34 and GB39 significantly suppressed glutamate function compared to control animals [22]. Later, Kim et al. demonstrated that acupuncture at HT7 can inhibit methamphetamine-induced behaviors, dopamine release and hyperthermia in the nucleus accumbens through the group II metabotropic glutamate receptors [23].

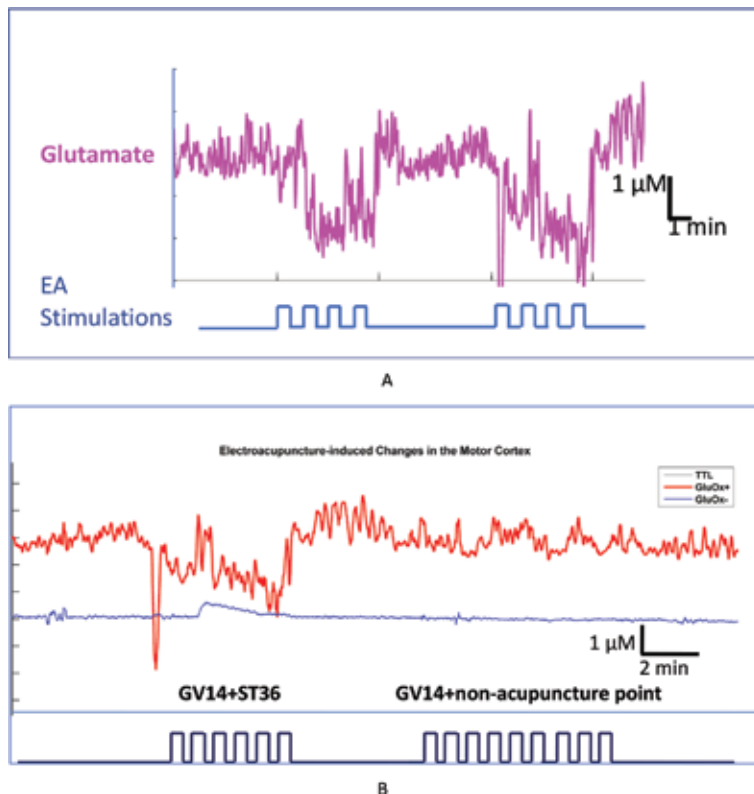


Figure 6. (A) Real-time measurements of the basal glutamate change in the motor cortex with and without acupuncture stimulations. Glutamate changes in the unlesioned motor cortex produced by EA stimulation at GV14 + ST36 (right side). Glutamate biosensors were used to measure glutamate levels. One biosensor recording site is coated with glutamate oxidase and capable of detecting glutamate a reference biosensor recording site lacking glutamate oxidase and incapable of detecting glutamate is used to subtract interfering agents. (B) Real-time measurement of the basal glutamate changes in the motor cortex with and without acupuncture stimulations. Glutamate changes in the unlesioned motor cortex produced by EA stimulation at GV14 + ST36 (right side) and GV14 + nonacupuncture points. TTL: transistor-transistor logic (event marker). GluOx+ (biosensor recording site coated with glutamate oxidase and capable of detecting glutamate), GluOx- (biosensor recording site lacking glutamate oxidase and incapable of detecting glutamate). Note the stimulation induced artifact in the reference channel (GluOx- recording site) during the course of stimulation that subsides when EA stimulation is terminated. Zoomed inset of Figure 6A.

4. Evidence from objective behavioral testing

4.1 Objective behavioral testing in preclinical studies

For years, our group has been developing testing methods to objectively measure behavioral changes before and after intermittent EA treatments in parkinsonian monkeys. Recently, we reported that EA-induced improvement of parkinsonism in rhesus macaques can be effectively measured using a non-biased, non-invasive and computerized behavioral testing battery [14]. The battery primarily includes a videotracking system to measure movement speed, an Actical accelerometer to monitor home-cage activity 24 h a day, 7 days a week, and an upper limb movement analysis panel to measure a subject retrieval time [14, 24]. As shown in **Figure 7**, significantly decreased movement speed (A), and home cage activity (B), and longer performance time of the affected hand (C) were found following MPTP administration. The movement speed and fine motor performance time were markedly

improved with chronic EA treatment (**Figure 7A and C**), and movement speed and fine motor performance times virtually returned to pre-MPTP levels. The cage activity was increased but did not reach statistically significant levels because of large variance (**Figure 7B**). Meanwhile, the fine motor performance time was still

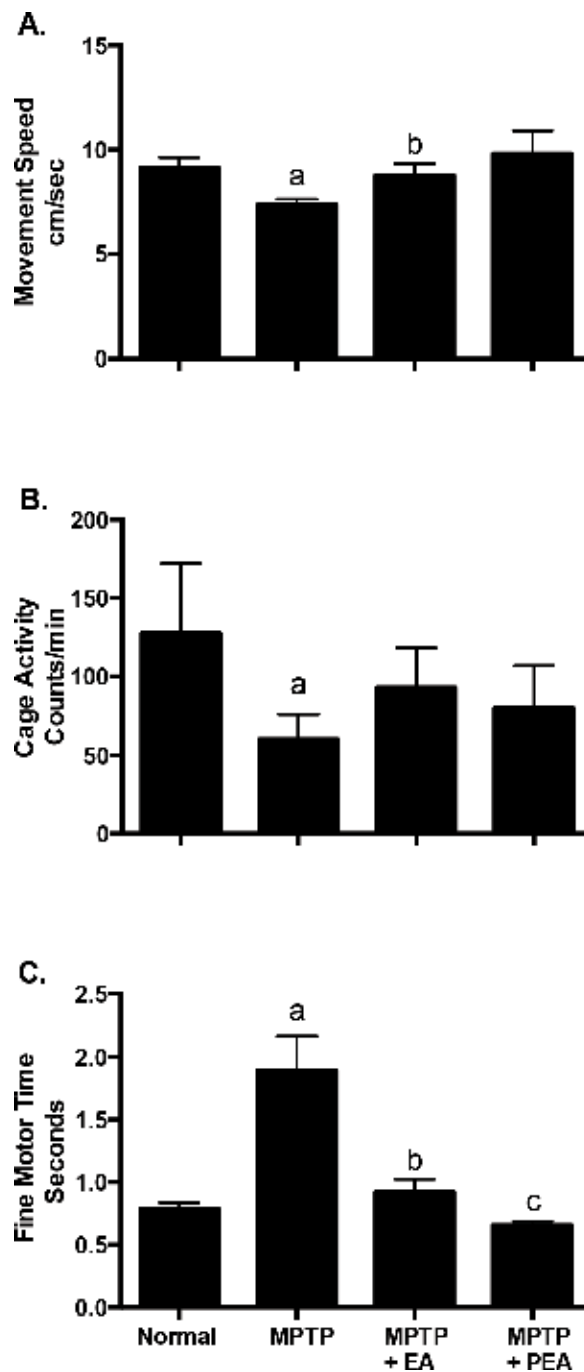


Figure 7. Behavior changes of animals following different treatments. Movement speed (A), home cage activity (B) and fine motor performance time changes (C) following MPTP administration, chronic EA treatment or post EA treatment (at least 1 months after last EA treatment). (a) $P < 0.05$ compared with normal; (b) $P < 0.05$ compared with MPTP; (c) $P < 0.05$ compared with MPTP + EA (from [14]).

improving one-month post EA treatment (**Figure 7C**). In addition, all animals responded positively to levodopa challenge evident by a 261% increase of home-cage activity measured via Actical counts.

4.2 Objective behavioral testing in clinical studies

In the acupuncture clinic, objective assessments using novel computerized technologies are drawing more attention. Lei and colleagues used body-worn sensor technology in patients with PD to measure a variety of gait parameters [3]. The authors found that EA improved gait function and achieved statistically significant improvements in gait speed under a variety of walking tasks including single-task habitual walking, single-task fast walking, and dual-task fast walking. No significant changes were observed in the control group. Meanwhile, gait improvements were correlated with the activities of daily living component of the Unified Parkinson's Disease Rating Scale (UPDRS). This study further indicates that the effectiveness of EA treatment can be objectively measured and while still used with traditional instruments such as the UPDRS.

5. Summary

Current evidence shows that EA generates measurable changes in the brain that are detectable with functional imaging, behavioral responses, and neurotransmitter signaling. The results from nonhuman primates also provides direct evidence between EA stimulations and dynamic alterations in the resting levels of glutamate in the motor cortex, which may at least partially explain a mechanism of action for EA in the nervous system. Nevertheless, we are only at beginning of a quest to better understand the mechanism of action that underlie acupuncture. The few studies with limited number of subjects will have to expand if we are to understand how acupuncture affects the central nervous system.

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Fu's Subcutaneous Needling: A Novel Therapeutic Proposal

Zhonghua Fu and Dejian Lu

Abstract

Fu's subcutaneous needling (FSN) uses disposable FSN acupuncture needle as its tool to stimulate the subcutaneous layer by doing horizontal sweeping manipulation. Needling sites are mainly selected around or near tightened muscles which contain one or several myofascial trigger points and cause pain or other illnesses. FSN therapy is originated from classics and based on clinical practice. Out of inheritance and innovation, it is the scientific research achievement of Fu Zhonghua and his research team over 22 years of hard work. It is the original and innovative technology with independent intellectual property rights. FSN therapy is safe, nontoxic, and has no side effect. This chapter is drafted in order to facilitate clinical study and application, by which the terms and definitions, indications and contraindications, operating procedures, exceptions, and the relative handling as well as precautions are written down.

Keywords: Fu's subcutaneous needling (FSN), FSN therapy, tightened muscle (TM), insertion point, sweeping movement, reperfusion approach

1. Terminology and definition

The following terms and definitions apply to this standard.

1.1 Fu's subcutaneous needling

Fu's subcutaneous needling (FSN) uses disposable FSN acupuncture needle [1] as its tool to stimulate the subcutaneous layer [2] by doing horizontal sweeping manipulation. Needling sites are mainly selected around or near tightened muscles (TM) that cause pain or other illnesses [3–5].

1.2 Tightened muscle (TM)

TMs are the muscles that are still in pathologically tense state when patients are relaxed under the condition that the central nervous system functions normally.

1.3 Pre-muscular diseases

Pre-muscular diseases refer to the diseases that cause chronic ischemia and oxygen deficit, leading to pathological tension of muscle and its subsidiary structure.

1.4 Real-muscular diseases

Real-muscular diseases are caused by pathological tension of the muscle and its subsidiary structure due to chronic ischemia and oxygen deficit.

1.5 Post-muscular diseases

Post-muscular diseases refer to a series of diseases caused by the muscles with pathological tensions that affects other organs (e.g., nerve or blood vessels) which are mostly distributed in or nearby the muscles.

1.6 Needle manipulation

Needle manipulation refers to pushing the needle to a proper depth after the needle is inserted into the subcutaneous layer.

1.7 Sweeping movement

Sweeping movement refers to a series of parallel and left-to-right movements of the needle in the subcutaneous layer after the needle manipulation.

1.8 Reperfusion approach

Reperfusion approach is to make tightened muscles contract vigorously within a short time and then relax in order to supply more blood to the ischemic part. It is suggested to provide equal force back by doctors when the muscles contract.

Reperfusion approach is often used during sweeping movement, and it can also be used separately for treatment of mild illnesses.

2. Basic characteristics of tightened muscle and its clinical evaluation

When patients relax their inspected area and their central nervous systems function normally, practitioners can still feel the “tightness, stiffness, hardness, and slipperiness” feelings when touching the targeting muscles with finger pulps. Patients often have spontaneous discomfort, pains, or obvious abnormal sensations. The joints that are associated with TMs are often weak and lack of strength. The range of joint activities is often reduced.

2.1 The clinical evaluation of tightened muscles

The muscle tension states are divided into five grades in clinical practice, which are defined as follows:

- : Muscles are soft and their activities are normal.
- +: There is mild muscle tension without obvious clinical symptoms.
- ++: Muscles are moderately strained and stiff and are often accompanied by clinical symptoms which can often be reduced after a break.
- +++ : Muscles are tense and stiff with associated pains and other symptoms.
- ++++: Muscles are severely tense and stiff, and if touched with finger pulps, some changes like clumps and abnormal muscular band on the muscle belly can be felt. Severe intolerable painful symptoms are often accompanied. There is no relief after a break, and it even affects normal life.

2.2 Clinical manifestations of tightened muscles

Clinical manifestations of TMs can be divided into five major categories, including symptoms caused by TM directly or indirectly, by muscular internal organs, by dysfunctions of sleep, by emotions, and by those with unknown reasons.

2.2.1 *The first major category*

Clinical chief complaints that are directly caused by TMs: pain, dysfunction, and lack of power.

The main diseases include cervical spondylosis, tennis elbow, lumbar disc herniation, chronic knee pain, ankle sprain, etc.

The characteristics of muscle-induced pains:

- a. Pains that are usually characterized by sourness, swelling, or tingling in rare cases.
- b. Pain positioning is often inaccurate, and patients usually can only point out vague directions.
- c. Peripheral muscle tissues or synergistic muscles are often affected.
- d. Most of the pains can be relieved by hot compress and massage but not by pressure. Simple touching or rubbing the skin has no effect on the pain.
- e. The degree of pain may aggravate when influenced by cool weather, muscle fatigue, lack of sleep, and bad mood.
- f. Pain tends to decrease after using nonsteroidal analgesics, after the related muscles are relaxed, after the weather gets warmer, and after receiving massage and encountering emotional pleasure.
- g. Long-term pain often causes changes in related bones and joints, such as hyperosteo-geny, pseudospondylolisthesis, scoliosis, knee deformity, etc.

2.2.2 *The second major category*

TMs affect the internal or nearby nerves, arteries, and veins:

- a. The main manifestations related to the affected nerves are the downstream symptoms of TMs, such as numbness.
- b. The main manifestations related to the affected arteries are symptoms caused by TMs, such as headache, dizziness, chills, aversion to cold, contact temperature dropping, and even cold feeling of the whole body.
- c. The main manifestations related to the affected veins are the downstream symptoms caused by TMs, such as edema, heaviness, itching, and skin darkening.

2.2.3 *The third category*

Pathological tension of neighboring skeletal muscles and muscular visceral lesions affects the body at the same time, and there is a close relationship between

them; both of them often appear at the same time and disappear simultaneously after treatment. The clinical TM manifestations which belong to different systems of the human body are as follows:

- a. Symptoms related to smooth muscles of the respiratory system include dry cough, chronic cough, asthma, chest short breath, breathing disorders, etc.
- b. Symptoms related to heart muscle include chest tightness, palpitations, shortness of breath, chest pain, etc.
- c. Symptoms related to gastrointestinal smooth muscles include stomach bloating, heartburn, acid regurgitation, belching, loss of appetite, emaciation, habitual constipation, chronic diarrhea, afraid of cold food cold drinks, etc.
- d. Symptoms related to smooth muscles of the urinary system include urinary frequency, urgency, ureteral calculus, urine leakage, etc.
- e. Symptoms related to smooth muscles of the reproductive and urinary system include:
 - i. Female: dysmenorrhea and menstrual abnormalities.
 - ii. Male: impotence, etc.

2.2.4 The fourth category

Symptoms related to mood and sleep, anxiety, insomnia, and mood swings.

2.2.5 The fifth category

A class of symptoms due to unknown causes, related to autonomic nervous dysfunctions and proprioceptive disorders.

Symptoms related to autonomic nervous dysfunction, such as abnormal sweating, continuous tears, continuous catarrhal rhinitis, excessive salivation, and discomfort of chest areas.

Symptoms related to proprioceptive disorders, such as imbalance, dizziness, tinnitus, weakness, and weight perception disorders.

2.3 How to check TMs

- a. Mark the patient's painful positions.
- b. List all possible muscles based on anatomical and biomechanical knowledge.
- c. Use thumb pulp or pulps of index finger, middle finger, and ring finger to touch the muscular tensions of suspected muscles. If the muscular tension of one muscle is higher than its surrounding area, it can be diagnosed as pathological tight muscle.

3. Indications and contraindications

3.1 Indications

All indications of FSN are related to pathological tight muscles (**Figure 1**).



Figure 1.
 The main indications.

3.1.1 Pre-muscular diseases

Ankylosing spondylitis, rheumatoid arthritis, asthma, gout, Parkinson's disease, facial paralysis, frozen shoulder, and so on.

3.1.2 Real-muscular diseases

Cervical spondylosis, tennis elbow, lumbar disc herniation, chronic knee pain, ankle sprain, headache, prostatitis, weak bladder (bladder leakage), hiccups, insomnia, depression, chronic cough, habitual constipation, and so on.

3.1.3 Post-muscular diseases

Dizziness, palpitation, chest tightness, local numbness, local edema, breast hyperplasia, cold disease, macular degeneration, diabetic foot, avascular necrosis of the femoral head, and so on.

3.2 Contraindications

- Patients with infectious diseases, malignant diseases, or patients with acute inflammation and fever.
- People with spontaneous bleeding or coagulopathy, which may result in nonstop bleeding after injury.
- Skin areas with infection, ulcer, scar, or tumor.

4. Operation steps and requirements

4.1 Determine the insertion point

The insertion points are chosen according to the following principles:

- a. In most cases, insertion points are chosen nearby TM. It can be inserted 3–5 cm up, down, left, right, or oblique to the TM.
- b. Insertion points are better to be nearby TMs for small area and less TMs, while insertion points are better to be far away for big area and more TMs.
- c. From far to near, if there are several TMs, such as chronic cervical and lumbar pain, which is usually accompanied by abnormalities of the upper limbs and lower limbs, the insertion points should be chosen from far to near, rather than the opposite.

4.2 Needle selection and body position selection

4.2.1 Needle selection

The FSN inserting device and FSN acupuncture needle should be in accordance with the regulations of national medical device production and sales supervision. In order to prevent needling accidents, the disposable FSN acupuncture needle should be strictly inspected each time before use. If any unqualified conditions such as packaging damage are found, the needle should be eliminated.

4.2.1.1 FSN inserting device

FSN inserting device is a device specifically designed for the inserting of FSN acupuncture needle, which is developed by Nanjing FSN Medical Co., Ltd. It is convenient for the therapist to deliver the needle. It can not only reduce the pain of needle insertion but also ensure the accuracy and safety of the needling. The device consists of four parts, the base, the control button, the needle drive rod, and the groove, as shown in **Figure 2**.

4.2.1.2 FSN acupuncture needle

4.2.1.2.1 The structure of FSN acupuncture needle

The FSN acupuncture needle consists of three components. The combination of the three components is shown in **Figure 3**.

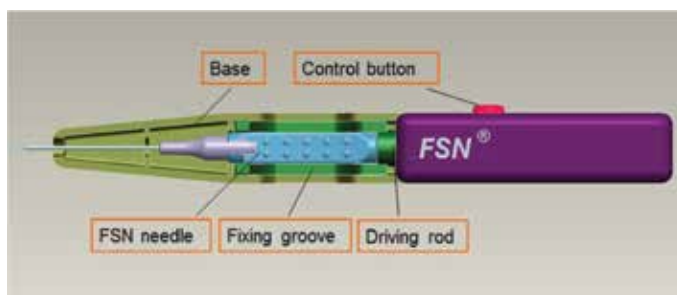


Figure 2.
FSN acupuncture needle in the FSN inserting device.

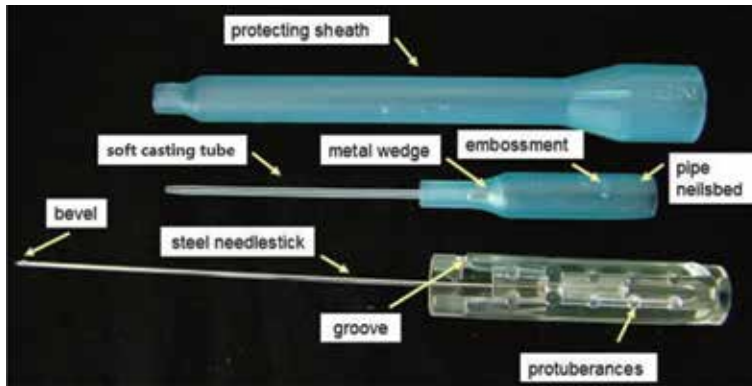


Figure 3.
The three parts of FSN acupuncture needle.

4.2.1.2.2 FSN acupuncture needle core

The needle core consists of a stainless steel needle and a hard-plastic core, as shown in **Figure 2**. This part insures the FSN acupuncture needle to reach enough rigidity to enter the body quickly and to complete sweeping movement. The stainless steel needle tip is beveled. On the base, there are 10 protuberances which are on one side. When the convex protuberances are upward, the beveled tip of the needle is also upward. The surface is in line with the tip of the needle, the front end of the needle has a longitudinal groove, and the front of the groove has a transverse slot on the right side, which is used for fixing the soft casting tube during performing a sweeping movement.

4.2.1.2.3 Soft casting tube and base of FSN acupuncture needle

The soft casting tube covers the stainless steel needle (steel needle inside, soft casting tube outside). The soft casting tube is fixed to the plastic socket through the built-in rivets, as shown in **Figure 2**. The casting tube of FSN acupuncture needle has a bump, which is matched with the grooves in the core seat and the slot. The protuberances on the base are placed at the bottom of the groove when we sweep the needle.

The main function of the soft casting tube:

- a. The tube and the core are anastomosed into one, which is conducive to the stability of the insertion, as well as to the needle manipulation and the sweeping movement.
- b. When performing sweeping movement, the stainless steel needle tip is fully retreated into the soft tube; it can prevent the tingling caused by injuring the blood vessels.
- c. Because of its sufficient softness, the tube which will not affect normal activities of patients can be kept under the skin for several hours after the treatment, and it will not puncture blood vessels and other tissues.

4.2.1.2.4 Protective sheath

To protect the stainless steel needle and soft tube from the impact of the collision, we designed a protective sheath. The protective sheath is used to protect the aseptic state, as shown in **Figure 2**. After the sweeping movement, the solid needle

should not be discarded. It must be put back into the protective sheath to prevent puncturing oneself and others.

4.2.1.2.5 Length, diameter, appearance, and preservation of FSN acupuncture needle

4.2.1.2.6 Appearance of FSN acupuncture needle

FSN acupuncture needle is disposable and can only be used for one time; it is also known as disposable subcutaneous acupuncture needle with plastic tube, as shown in **Figure 2** and **Table 1**.

4.2.1.2.7 Use and storage of FSN acupuncture needles

The FSN acupuncture needle is a presterilized product for disposable use. Please do not use once the package is damaged. After opening the package, you must make sure that the surface of the needle is bright and clean, the needle is not rough and defective, the casting tube is transparent, and the needle is sharp. If any problem is found, please stop using it and notify the manufacturer immediately.

The FSN acupuncture needle should be kept in a dry, cool area.

4.2.2 Body position

Common body positions are as follows:

- a. Supine position: Mainly suitable for the insertion points of the head, chest, abdomen, and upper and lower extremities.
- b. Lateral position: Mainly suitable for insertion points on either side and upper and lower extremities of the body.
- c. Prone position: Mainly suitable for the insertion points on the head, back, hip, and lower extremities. A pillow is placed under the patient's chest; the patient's hands are folded on the forehead.
- d. Orthopnea position: Mainly suitable for the insertion points of the neck, shoulder, upper back and upper extremities, the knees, and the lower extremity regions.
- e. Sitting with head down position: Suitable for the insertion points of the occipital and upper neck regions.

4.3 Disinfection and needle insertion

4.3.1 Disinfection

Sterilize the local skin: Routine skin disinfection.

	Solid needle(mm)	Soft tube (mm)
Length	52	49
Diameter	0.6	1.05

Table 1.

The size of the FSN acupuncture needle.

Sterilize the upper part of FSN inserting device: Use alcoholic cotton to clean the upper part of FSN inserting device.

4.3.2 Needle insertion

After removing the plastic protection tube, place the needle into the inserting device; make sure the side with protuberance (with dots) is facing upward, and then pull the groove back to the load situation. Hold the device with middle finger at the bottom of the device, index finger on the red trigger button, and thumb on the top, as shown in **Figure 4**.

Place the upper part of FSN inserting device on the disinfected skin of inserting point; the angle between the device and the skin should be as small as possible. With the cooperation of the left hand, the operator presses the trigger button, and then the needle penetrates quickly into the subcutaneous layer as shown in **Figure 5**.

With the left index finger and thumb holding the needle, pull the needle out of the groove, and then the right hand withdraws the inserting device as shown in **Figure 6**.

4.4 Manipulation and sweeping

4.4.1 Manipulation

After inserting the needle, if the needle is directly inserted into the muscle, the patient will feel soreness, and the practitioner's hand that is holding the needle may also feel the resistance at the same time. In this case, the practitioner should pull the needle handle with the thumb, index finger, and middle finger slowly backward out of the muscle layer and back to the subcutaneous layer.

After confirming the needle tip is inside the subcutaneous layer, the practitioner can put down the needle body, and then prepare for the manipulation. During which, the practitioner holds the needle with the right hand and pushes the needle forward along the subcutaneous layer. It is better to raise the needle tip slightly up when pushing so that the tip is slightly tilted, making sure the needle does not penetrate into the muscle layer. When the needle is being pushed forward, the skin is lined up. During the process, if the patient feels sudden tingling or the practitioner feels sudden resistance, it is usually because the needle tip penetrates the blood vessel wall. Therefore, the needle manipulation process should be as slow as possible. When the practitioner feels the resistance before the patient feels pains, it is better to quickly withdraw the needle slightly, and then adjust the needle direction upward or downward to avoid causing pains to the patient.



Figure 4.
Gesture for holding inserting device.



Figure 5.
Before inserting the needle, the positional relationship between the inserting device and the skin.



Figure 6.
After inserting, the right hand is fixed, and the left hand pinches the needle.

Generally, it is suggested to go as deep as all soft tube being under the skin. In some other cases, if the needle is inserted near the side of the finger joint or other facet joints, the soft tube need not be fully embedded subcutaneously.

4.4.2 Sweeping movement

4.4.2.1 Manipulation

When the needle is in the correct position, with the left hand fixing the soft tube seat, the practitioner can use the right hand to recede the core needle and fix the protuberance of the soft tube seat in the slot of the core seat. At this time, the needle tip is no longer exposed outside but has returned to the soft tube, almost in line with the soft tube.

Then it is ready to perform sweeping movement. The inner nail margin of the right thumb and the middle finger is used to hold the core base, the index finger and the ring finger are separated on the left and right sides of the middle finger, and the tip of the thumb is fixed on the skin as the fulcrum. The index finger and the ring finger sweep in a seesaw-like sector one after the other. The scope of sweeping movements is better to be as large as possible, with stable speed and enough power, and sweeping rhythm should be slow so as to avoid the feeling of numbness, swelling, and pain. During the sweeping process, it is suggested to use the right hand to operate, while the left hand cooperates with reperfusion approach (**Figure 7**).

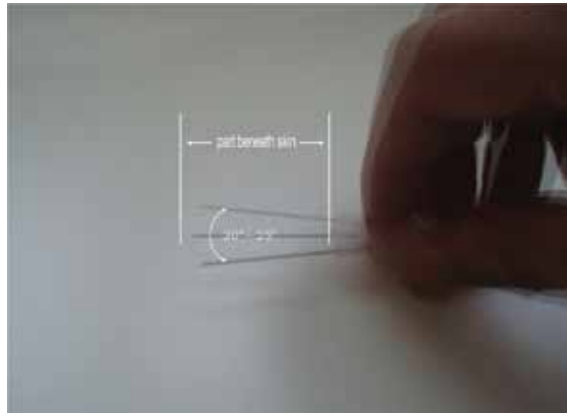


Figure 7.
The swaying movement.

4.4.2.2 Types of sweeping movement

According to different ways of swinging the needle, the sweeping movement is divided into the following two categories:

- a. Horizontal sweeping movement: The sweeping action of the needle tip is at the same horizontal level, which can save strength and is used more often. It can be used in most cases. Right now, with the cooperation of reperfusion approach, horizontal sweeping is mostly used during clinical practice.
- b. Sweeping movement in an elliptical circle: The solid needle moves clockwise or counterclockwise under the skin to perform a circular or oval movement, applicable for intractable diseases (see **Figure 8**).

4.4.2.3 Time and frequency of sweeping movement

Each needling point can be swept for 2 minutes with a frequency of 200 times per minute. Practitioner can check and assess muscle tension after 30 seconds of sweeping.

4.5 Reperfusion approach

During the FSN manipulation, reperfusion approach targeting PTMs is accompanied.

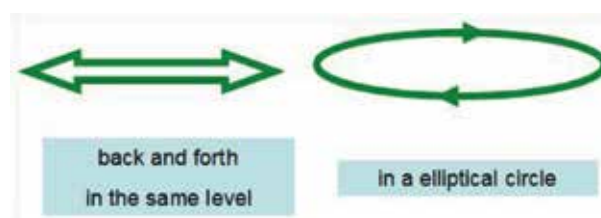


Figure 8.
Types of sweeping movement.

4.5.1 Classification of reperfusion

Active reperfusion refers to a reperfusion approach that is completed by the patient without assistance.

Passive reperfusion refers to a reperfusion approach that is completed by patients through reliance on external efforts.

4.5.2 Operational requirements of reperfusion approach

4.5.2.1 Range (as wide as possible)

According to the anatomy of the muscle and its functional activity, the practitioner should guide the patient to achieve maximum radius of the muscle (isotonic contraction) or maximum intensity of the muscle (equal length contraction).

4.5.2.2 Slow speed

A pause of 1–3 seconds is required during the maximum radius and the maximum intensity and relaxation. It is recommended to complete a reperfusion approach at around 10 seconds.

4.5.2.3 Less number of times

The same group of reperfusion approach, which refers to activity at the same direction and the same angle, should not be repeated more than three times.

4.5.2.4 Length of interval

A half hour interval is required between two groups of reperfusion activities so that the muscles could get enough relaxation.

4.5.2.5 Changes

Some targeted changes could be made in the reperfusion approach for intractable pains.

4.5.3 Operating methods of reperfusion approach

Reperfusion approach is different in different parts of the body. During clinical practice, Reperfusion approach should be designed according to joint features and the distribution of TMs related to targeted diseases:

- a. Neck: Six main movements are recommended, including lowering head, raising head, turning head to the left or right side, revolving head, and so on.
- b. Shoulder: Combing hair, trying to reach scapula of the same side, raising arms, and so on.
- c. Waist: Holding head with hands and bowing forward on the treatment couch, flying fish posture, twisting butt from left to right, stepping movement on the same position, voluntary cough, and so on.
- d. Knee: Flexion and extension, stepping movement on the same position.
- e. Chest, back: Taking deep breath, voluntary cough.

4.6 Retaining and removing of the soft tube

When the sweeping movement is finished, the solid needle can be taken out and placed into the protective sleeve. Put a piece of adhesive tape to cover the tube seat, and fix it on the skin. Make sure that the adhesive tape can cover the entire soft tube so that the soft tube kept under the skin can be fixed.

4.6.1 Time length for retaining the soft tube

It is usually suggested to retain the soft tube for 1 hour, and the retaining time can vary according to different clinical situations. Doctors can decide the retaining time by taking into consideration factors like weather conditions, patient's reaction, and severity of disease. If the weather is hot, the patient sweats easily, or the patient has itching feeling around the needling point or surrounding area due to allergic reaction to the adhesive tape; the retaining time is better not to be long; otherwise, the retaining time can be longer.

4.6.2 Remove the soft tube

To remove the soft tube, use the left thumb and index finger to fix surrounding skin of the needling point, then hold the soft tube seat with the right thumb and index finger, and take it out gently and slowly. Use a sterile cotton ball to press the needling point so as to prevent bleeding. After removal of the soft tube, patients can leave after a short break.

4.7 Time intervals and treatment course

4.7.1 Time intervals

Chronic diseases can be treated on a daily basis for two–three continuous treatment, and then the time interval can be prolonged to 2 to 3 days between two treatments. For other problems, the time interval can be decided according to the treatment effect.

4.7.2 Treatment course

Three times of treatment are usually considered as a course of treatment.

5. Exception and its handling

5.1 Subcutaneous bruises

A small amount of subcutaneous bleeding and local small pieces of bruising will disappear and recover automatically; generally no special treatment is needed. But practitioners need to explain to the patient so as to eliminate the patient's worries and fears.

If the local swelling and pain are obvious or the bruised area is large and affects functional activities, practitioners need to withdraw the needle immediately and apply cold compresses to stop bleeding. After 24 hours, hot compress and mild massage can be applied to promote the dissipation of blood stasis.

5.2 Fainting during the treatment

5.2.1 Prevention of fainting during treatment

It is better to explain thoroughly to the patient so as to eliminate the patient's worries, choose the right position, and treat the patient in a gentle way. If the patient feels hungry and tired, treatment can be given after the patient finishes eating, drinking, and taking a rest. Supine position is recommended when patients feel too nervous. Practitioners should observe the patients' responses and ask about their feelings. If the treatment causes discomfort and the patient shows symptoms of fainting, the practitioner should stop immediately and take some necessary measures in advance.

5.2.2 Management of fainting during treatment

The needling operation should be stopped immediately. The practitioner should withdraw the needle, help the patients lie on bed, and keep them warm. Generally, the patient will recover soon after drinking warm water or sugar water and taking some rest. If the patient is still unconscious or breathing weakly, or his or her blood pressure drops rapidly, other rescuing measures or first aid treatment should be carried out.

6. Precautions

- It is suggested to give a brief explanation to patients about FSN manipulation and its features before giving treatment so as to reduce the patient's fear and doubts.
- For patients who are aged and weak, the first time to receive FSN treatment and patients who are scared of needles, it is suggested to treat them by supine position.
- When giving reperfusion approach, the scope of activity should be from small to large, step by step, and the external force given from outside should be from light to heavy. The external force should be counterforce when patients move actively. A sudden force or vigorous activity is forbidden when giving passive activity. Age, physical, mental state, and other factors of patients should be considered when practitioners design the reperfusion activities. It is better to avoid the situation that one single reperfusion approach takes too much time, too much strength, or is repeated too frequently.
- During the period of retaining the soft tube, patients should keep adhesive tape clean and dry so as to avoid infections. Mild activities are suggested during the retaining of the soft tube, but strong and large movements should be avoided in order not to affect the fixation of the soft tube. In some rare cases, if the retaining tube reaches the blood vessels, resulting in stinging or bleeding, the tube should be taken out immediately. Do not be worried if patients feel itchy around the tube-retaining area, as it is usually due to allergic reactions of patients to the soft tube or adhesive tape. Practitioners can choose other kinds of materials instead to fix the tube, for example, bandages can be used.
- Practitioners should not perform FSN therapy on the abdomen of women within 3 months of pregnancy. Even for women who are pregnant over

3 months, it is better not to conduct needling on the lumbosacral region and abdomen. If pregnant women are nervous, it is forbidden to do needling treatment.

- If patients use safflower oil, massage milk, and other stimulating drugs for external use on their skin or receive treatment of strong plaster, strong cupping, and scraping method, FSN therapy should not be applied in a short time. But if the skin condition has returned to normal after these treatments, then it is suitable to do FSN therapy.
- It is better not to give FSN therapy to people who have recently received steroids injection therapy.

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Scalp Acupuncture and Mental Disorders

Chuen Heung Yau and Cheuk Long Ip

Abstract

While conventional treatments for many mental problems remain problematic and unsatisfactory in therapeutic outcomes, there is great demand for an effective yet economical treatment method that can alleviate the suffering of psychiatric patients. In traditional Chinese medicine, acupuncture on the scalp has been used for centuries. Not until recent decades did acupuncturists and clinicians develop new understandings and theories on the effect of scalp acupuncture. Upon elaboration on the therapeutic value of scalp acupuncture, it shows great potential in treating mental health disorders including depression, anxiety disorders, schizophrenia, and insomnia. Its profound treatment outcome in clinical use has caught clinicians' attention in recent years. However, controlled studies and investigations on its effect on psychiatric problems remain relatively small in number, and determinative evidence has yet to be found. In order to provide conclusive evidence on the use of scalp acupuncture to these disorders, more data from high-quality controlled trials are urgently needed. Since scalp acupuncture has advantages over the use of traditional acupuncture or body acupuncture in clinical and investigation settings, we are expecting a shift of attention from individualized acupuncture to a standardized universal scalp acupuncture treatment in clinical practice and academia.

Keywords: scalp acupuncture, treatment, mental disorder

1. Introduction

Mental disorders have been one of the leading contributors to the global disease burden in the twenty-first century. It has been accounted for one-third of the global disability [1]. Owing to the absence of cost-effective interventions and preventive measures, the prevalence of mental disorders shows no sign of decline. Surveys have shown that the increase in rates of treatments and therefore an even larger demand for mental health services has become an evitable problem for the society [2]. A proportion of patients with mental health problems shift from conventional health service to complementary and alternative medicine (CAM) [3]. Various studies showed the 12-month prevalence of CAM ranging from 10 to 75%, depending on populations and research methods [4]. Among all CAM applicable to patients, acupuncture, as one of the components in traditional Chinese medicine (TCM), has been commonly used in East Asian countries including China and Taiwan [5, 6]. In contrast to traditional body acupuncture, treatments for mental illness are more focused on acupuncture on the scalp. The sole use of acupoints or lines on the scalp in acupuncture deviates from the concept of traditional acupuncture and named

scalp acupuncture. The development of scalp acupuncture has been rapid in the recent decades, and there is emerging evidence in supporting its use in patients with mental illnesses.

2. History of scalp acupuncture

The earliest medical record for the application of acupuncture on scalps can be traced back to around 5 BC [7]. Since then, experiences accumulated with the utilization of acupuncture on the scalp in treating various illnesses. Along with the establishment of TCM theories, it had been a component in traditional acupuncture system. Until the 1950s, acupuncture experts started to observe and recognize the relationship between illnesses and subscalp spots. Inspired by micropuncture systems concepts and influenced by anatomical and physiological knowledge from modern medicine, new theories and new needling techniques had been established [8]. In the 1970s, acupuncturists from different areas of China developed their own schools of theory, and several scalp acupuncture systems have been suggested. Despite variations present in theoretical concepts, sites of acupuncture (acupoints), and nomenclature among different schools, many areas such as the clinical indication and treatment procedures share common ground. Most recognized theories include the adaptation of knowledge in cerebral anatomy, physiology, neurology, and reflexology. Owing to the impressive therapeutic effect of scalp acupuncture in treating brain diseases as well as other illnesses, there was a strong urge to facilitate academic exchange and promote scalp acupuncture to wider communities. Intensive efforts had been made in standardizing the names of the scalp acupoints. By the time the World Health Organization (WHO) set up an international standard scalp acupuncture nomenclature systems in 1989, scalp acupuncture had been already extensively applied by therapists and acupuncturists around the globe [9]. Some places like the USA and Japan had even developed their own understandings in the field of scalp acupuncture [10, 11]. In short, scalp acupuncture is a technique derived from TCM, yet its theory and application involves multiplicity of systems that have been rapidly developing in the recent decades.

3. Modern adaptation of scalp acupuncture in mental disorders

In TCM concepts, all patients can be categorized into different syndrome types despite the diagnosis of disease. Patients will then be prescribed with a unique treatment regimen, i.e., two patients suffering from the same disease might receive prescription of different acupoints since they may vary in syndrome type [12]. This individualized medicine concept has been a feature of TCM since the early establishment of the philosophy of TCM. However, there are few shortcomings for this manipulation. Firstly, the differentiation of syndrome types may not be accurate or definite as the diagnosis procedures are highly dependent to the therapists' clinical experience. Besides, since most patients with mental problems have complicated somatic problems or being masked by the side effects of psychiatric medication, diagnosis of syndrome type according to TCM theories may become exceptionally difficult. Moreover, individualized acupuncture treatment may provide inconsistent therapeutic outcomes. Objective observation and comparisons of the treatment results become impossible as the testing subjects are using different acupoints. As a result, we suggest the use of standardized, identical acupoint regimen for acupuncture treatment on psychiatric patients.

Instead of body acupuncture, scalp acupuncture has been widely used in diseases originated from the brain. The invention of scalp acupuncture has been with accordance to the neurology and reflexology knowledge of the brain and scalp structures. It is perceived that acupuncture stimulation on the subscalpular tissue may exert influences to the respective lesion in the brain [7]. A large proportion of preceding clinical trials of acupuncture on various mental illnesses such as anxiety, depression, and insomnia adopted the essential use of scalp acupuncture, while the collateral use of body acupuncture remains elective [13–15]. The sole use of scalp acupuncture in treating insomnia or other diseases such as intracerebral hemorrhage and Parkinson's disease has been endorsed in literatures [15–17]. Therefore, we are convinced that the use of scalp acupuncture will be sufficient to bring about therapeutic value to the psychiatric patients.

Besides, scalp acupuncture shows superiority over body acupuncture in clinical situations. Unlike body acupuncture, patients receiving scalp acupuncture are not required to retain on bed. They can sit on chairs or carry out static activities during treatment sessions. Another advantage of scalp acupuncture is that since textile sensitivity of the scalp is relatively low, scalp acupuncture would cause less pain and discomfort when compared with body acupuncture. Apart from diminished unpleasant sensation during needle insertion, the manipulation of scalp acupuncture cannot be easily seen by the treatment recipients. This is important especially to those patients who easily feel anxious upon seeing needles.

4. Procedures of scalp acupuncture

In practice of scalp acupuncture, sterile disposable acupuncture needles of the standard size of 0.20×25 mm or 0.22×25 mm are usually used. Acupuncture needles are obliquely inserted onto the selected acupoints with an angle of $15\text{--}30^\circ$ after standard sterilization procedures. The needles should be inserted at a depth of 10 mm lying between aponeurosis layer and loose areolar connective tissue. Needles rest too deep or too shallow at the scalp structure will cause pain and diminished effect. After the insertion, mild stimulation to the needles is recommended. Needles can be swirled at time intervals. A standard session of scalp acupuncture treatment will last for at least an hour before the needles are carefully removed after the treatment.

5. Selection of acupoints in treating mental disorders

According to TCM theories, acupoints are explicit points located at the surface of our bodies. Each acupoint serves its own function and can be joined together to form meridian lines. The selection and combination of acupoints is the most crucial component in acupuncture therapy. For example, it is understandable that the use of acupoints in treating brain diseases is definitely distinct from those for alleviating pain problems such as back pains. In the treatment of mental problems or brain organic problems, acupoints and scalp lines on the scalp including Baihui, Sishencong, midline of the forehead, lateral line 2 of the forehead and posterior lateral Line of the Vertex are commonly used.

Baihui is located at the vertex of the midline of the head, which is the meeting point from apexes of ears. It is one of the acupoints on the governor vessel (GV). The governor vessel is known to have its passage running from the coccyx upward along the spine into the brain. Under the TCM theory, it is the convergence of all Yang meridians and thus stimulation at Baihui can boost the flow of Qi in all the

Yang meridians, benefits brain development, and enhances intelligence. In modern studies, Baihui has been comprehensively studied and applied in treating a variety of brain diseases and mood disorders such as intracerebral hemorrhage, dementia, depression, anxiety, insomnia, etc. [13, 18–20].

Around the site Baihui locates the acupoints Sishencong. Sishencong is the four points located at 1 cun anterior, posterior, and lateral to Baihui. They are excluded from the 12 main meridians. Sishencong is known for its calming effect as well as tranquilizing excitement in mood. Different directions of needle insertion at Sishencong, such as pointing toward or away from Baihui or toward the side of brain lesion, can bring about different therapeutic effects. In general, it facilitates the harmony of Yin and Yang.

The location of the midline of forehead, also known as Shenting is 0.5 cun above the hairline and within the midline. Similar to Sishencong, it has been used to calm emotions and improve poor memory in theory. Lateral line 2 of the forehead are two acupoints located 0.5 cun above the hairline and directly above the pupils. In reference to anatomy, the midline and lateral line 2 of the forehead are the site of the prefrontal cortex (PFC). There are mainly five functions of PFC, which are executive functions, memory, intelligence, language, and gaze control. Because of the rich cortical and subcortical connection, PFC can initiate and perform goal-directed patterns of behavior, short-term memory tasks, planning, problem solving, etc. [21].

Posterior lateral lines of vertex are two points that are 1 cun next to the posterior Sishencong. It is located at posterior parietal lobe, anterior to the occipital lobe, and posterior to primary somatosensory cortex. Together with the close interconnection with frontal premotor area, it serves as a sensory-motor interface [22]. It receives sensory input from somatosensory cortex, and other regions of the brain integrate the information to allow the executive functioning.

6. Mechanism of scalp acupuncture

Acupuncture for treating brain diseases is never mythical or ritual. It has originated from years of clinical experience and scientific proofs. Scalp acupuncture has proven to bring both functional and structural changes to the brain. Study has shown that scalp acupuncture at Sishencong can significantly decrease the heart rate and blood pressure of the test subjects. It is suggested that it exerts its effect through modulation of autonomic nervous system [23]. Another physiological change induced by scalp acupuncture is the regulation of perfusion in the brain. An alteration of perfusion among brain structures is detected under the inspection of single-photon emission computerized tomography (SPECT) [7, 24]. It is suggested to be the action of vasoconstrictor endothelin-1 (ET-1) [25]. The dysfunction of the brain structures in brain diseases and injuries can be detected and depicted by the probe of abnormal brainwaves [26]. Scalp acupuncture has shown its ability in restoring normal waveforms in healthy and depressed patients [27, 28]. In the long term, acupuncture provokes modulation at cortical structures including orbitofrontal cortex and prefrontal cortex and medial temporal lobes, together with limbic regions of hypothalamus, amygdala, cingulate, and hippocampus. The effects of acupuncture on these structures have been strongly supported by neuroimaging data obtained from electroencephalography (EEG), fMRI, magnetoencephalography (MEG), and positron emission tomography (PET) [29].

Altered catecholamine levels are commonly found in patients with mental illness. The use of scalp acupuncture has been suggest to bring about a surge of neurohormones and neurotransmitters in the central nervous system such as adrenocorticotrophic hormone (ACTH), beta-endorphins, γ -aminobutyric acid (GABA)

protein, noradrenaline, and serotonin [30, 31]. Other molecules such as brain-derived neurotrophic factor (BDNF), postsynaptic density-95 (PSD-95) protein, and nitric oxide synthase (NOS) also respond to scalp acupuncture, suggesting their possible participation to the mechanism of action [32, 33].

7. Indication for scalp acupuncture on mental disorders

There has been a long history of utilizing acupuncture in treating mental health problems and “mind-related” syndromes in ancient China. However, scientific literatures and clinical trials on acupuncture for mental problems had not been recorded until 1980s. Despite numerous clinical observations and controlled trials that have been made since then, evidences have remain insufficient to draw a definitive conclusion on the general use of acupuncture on psychiatric patients. More high-quality controlled trials with greater sample size and longer follow-up period are clearly needed in order to advocate the use of scalp acupuncture for treating mental illness.

7.1 Depression

Depression is the most common mental problem [34]. The disappointing response rate and side effects of conventional medication discourage a proportion of patients from complying conventional treatments. Instead, they turn to CAM treatments, including scalp acupuncture. Meta-analysis has shown possible efficacy of scalp acupuncture on major depressive and bipolar disorders and antepartum and post-stroke depressions [14, 35]. Several studies suggested that the effect of scalp acupuncture is comparable to conventional medication, while a study concluded better outcome in somatization and cognitive process disturbances over antidepressant [36]. Despite various clinical investigations that have been carried out, additional high-quality randomized controlled trials are urgently needed to provide conclusive evidence [37].

7.2 Anxiety disorders

Controlled studies have obtained consistent positive results on the use of acupuncture in patients suffering from anxiety disorder. However, most investigations have been focused on preoperative anxiety, generalized anxiety disorder, or anxiety neurosis only, while there is a large vacancy of knowledge about the effect of acupuncture on specific anxiety disorders like panic disorder, phobias, or obsessive-compulsive disorders [13]. A recent meta-analysis advocates the use of acupuncture on patients having post-traumatic stress disorder (PTSD) [38]. It is worth mentioning that a large proportion of studies concerning anxiety have been utilizing auricular acupuncture and body acupuncture, whereas investigations on the use of scalp acupuncture are scarce. We can see a great demand for complementing our knowledge toward the use of scalp acupuncture on various anxiety disorders.

7.3 Schizophrenia and psychotic disorders

Relatively few studies have been made on the use of scalp acupuncture to psychotic patients. Most studies suggested limited evidence on the use of acupuncture as adjuvant treatment along with antipsychotic medication. However, a general significant improvement in sleep quality and extrapyramidal side effects has been observed in psychotic patients receiving acupuncture treatment [35, 39].

7.4 Insomnia

Insomnia and sleep disorders are common mental health problems that have been always overlooked. Poor sleep quality could adversely affect the quality of life and deteriorate mental status. The use of acupuncture and scalp acupuncture may benefit insomnia patients, according to recent systematic review literatures. Since the current results of the clinical studies are promising and consistent, the use of acupuncture may be encouraged as an adjunctive therapy in insomnia [15]. We are expecting more high-quality evidence supporting especially the use of scalp acupuncture in the treatment of insomnia in the near future.

8. Contraindication of scalp acupuncture

The contraindications of scalp acupuncture include infants with unclosed cranial fontanelles and sutures. Patients with cranial infection, ulcer, or scars on scalp are not advised to perform scalp acupuncture. Patients with past history of epilepsy or seizure should be comprehensively evaluated by the therapists before receiving treatment. Patients extremely anxious toward needles should be handled with care. Appropriate counseling and encouragement will be useful in building a good rapport between therapist and the parent. Possible side effect of scalp acupuncture includes discomfort or mild pain by the needle, emotional distress during the treatment sessions, bleeding, sleep disturbance, and increased hyperactivity.

9. Summary

Scalp acupuncture deserves greater concerns on its application on mental disorders. It has advantages over conventional individualized body acupuncture in clinical practice, and its effect could be objectively observed. Evidence from neuro-imaging, biochemical investigations, and clinical trial has been supporting the use of scalp acupuncture on patients with mental disorders. We see great potential in scalp acupuncture to play an important role in alleviating or even preventing mental health problems in the future. Nonetheless, there is an urgent need for quality trials to provide definitive evidence to support the use of scalp acupuncture for various mental disorders.

List of abbreviations

CAM	complementary and alternative medicine
ET-1	endothelin-1
EEG	electroencephalography
fMRI	functional magnetic resonance imaging
GABA	γ -aminobutyric acid
GV	governor vessel
MEG	magnetoencephalography
MRI	magnetic resonance imaging
NOS	nitric oxide synthase
PET	positron emission tomography
PTSD	post-traumatic stress disorder
PFC	prefrontal cortex

PSD-95 postsynaptic density-95 protein
SPECT single-photon emission computerized tomography
TCM traditional Chinese medicine
WHO World Health Organization

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Ultrasound Detection Acupuncture Needling Training: Description of the Method

Ying-Ling Chen and Mark C. Hou

Abstract

Acupuncture is unique to Chinese medicine and is widely used in practice. In order to avoid the complication of pneumothorax due to needle puncture of the lungs, we developed an ultrasound detection acupuncture (UDA) approach to measure the safe needle depth to improve patient safety. This study established a UDA training program and recruited trainees in our hospital to validate the effectiveness of the program. The trainees attended an eight-hour course, and practiced their skills using an acupuncture simulator model of GB21. Pre- and post-test data were analyzed. The level of satisfaction of the trainees was assessed by interview. In total, 16 trainees completed the course. Kendall's coefficient for the program was 0.82, and the average CVI was 0.98, showing good reliability and validity. Trainees exhibited significant improvement in terms of reduction of the incidence of pneumothorax after completing the course ($P < 0.05$), and the trainees were satisfied with the teaching of the ultrasound skill. Feedback from interviews showed that use of ultrasound to measure the safe needle depth may improve the mastery of acupuncture point GB21 and reduce the fear of causing pneumothorax.

Keywords: acupuncture, ultrasound, medical education, patient safety

1. Introduction

Acupuncture is a technique that is unique to Traditional Chinese medicine for treating illness and improving health [1]. Since it was introduced to Western countries in the 1970s, acupuncture has been widely-studied using modern clinical research approaches. In 2000, a large-scale acupuncture clinical trial was conducted in Germany due to controversy over insurance reimbursements for acupuncture treatment. According to the results of the trial, acupuncture was found to be valuable for pain relief, benefiting patients with back pain, knee pain and headache. In 2002, the World Health Organization (WHO) conducted a review of the results of controlled clinical trials, and concluded that the indications for acupuncture can be classified into four groups of disorders. The first group is diseases, symptoms or conditions for which acupuncture has been proved to be an effective management technique through controlled trials. There are 28 disorders belonging to this group, including stroke, lower back pain, headache, and hypertension [2]. In recent years, more clinical trials have been performed in patients with other disorders, such as dysmenorrhea [3]. Although the scientific community does not yet

completely understand the mechanism of acupuncture, its efficacy is widely-accepted worldwide.

As with most medical interventions, acupuncture can also cause varying degrees of side effects. In a study by White [4], the risk of adverse events occurring in association with acupuncture was found to be very low when performed by qualified practitioners. As some serious adverse events may cause life-threatening complications, it is very important to actively prevent serious side effects. Common acupuncture side effects include pain at the punctured region, ecchymosis or hematoma, lightheadedness/dizziness, and pneumothorax [4–7]. With the exception of lightheadedness/dizziness, which is more relevant to the patient's physiological condition during acupuncture, the adverse events are related to the practitioner's technique and the depths of needles at acupoints. Among the major acupuncture-related adverse events, pneumothorax is the most severe, and therefore it is crucial that acupuncture practitioners identify safe depths of insertion of acupuncture needles for individual patients. Studies by Professor Lin and colleagues have extensively investigated the safe needle depth [8–12]. In one study of 11 acupuncture points in the neck and shoulder region, they found that the mean depths for the points around the shoulder in all study subjects, regardless of BMI and gender, were as follows: GB21 = 5.6 cm, SI14 = 5.2 cm, and SI15 = 8.8 cm. Subjects with a higher BMI had greater measured depths for most points [9]. However, the researchers also pointed out that differences between individuals are present, and it is difficult to set a standard. Therefore, study has been performed using modern imaging techniques, such as tomography, nuclear magnetic resonance, and ultrasonography, to directly measure the safe needle depths at acupuncture points in patients [12]. Ultrasound-guided aspiration has been widely-used to remove extra fluid from parts of the body, such as paracentesis of ascitic fluid, thoracentesis of pleural fluid [13], insertion of small-bore chest tubes in patients on clopidogrel [14], and placement of a central venous catheter [15]. Ultrasound-aided procedures are non-invasive, and the device is easy to access and relatively simple to operate. It is therefore the most suitable technique for detecting the needle depth during acupuncture. When practitioners perform acupuncture at dangerous acupoints, ultrasound imaging can help to identify the safe needle depth and prevent damage to organs. We named this technique, which combines acupuncture with ultrasound, ultrasound detection acupuncture (UDA). Taking acupoint GB21 (Jianjing; Gallbladder 21) in the chest area as an example, ultrasound was first used to measure the distance from the skin surface at the acupoint to the pleura, and the safe needle depth at the acupoint was then defined as a distance shorter than the one measured. In this way, pneumothorax can be avoided by preventing the needle from puncturing the lung or pleural cavity, which improves the safety and quality of treatment.

This study aimed to integrate the ultrasound technique into acupuncture training, and developed a course that teaches the use of ultrasound to measure the safe needle depth at difficult acupoints (e.g., GB21). We created a model of an acupoint for the course participants to practice on, and evaluated the efficacy of the training by qualitative and quantitative assessment.

2. Educational efficacy of an ultrasound detection acupuncture program

2.1 Materials and methods

2.1.1 Participants

This study was approved by the Institutional Review Board of our hospital (IRB No.: 151211) before the study was initiated. Residents in our hospital were recruited,

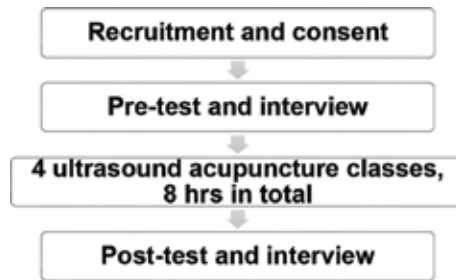


Figure 1.
Study flow chart.

the inclusion criterion being medical residents of the Department of Chinese Medicine who volunteered to participate in the training course. The participants were informed in detail about the training and completed a consent form before the start of the course. As the residents were trainees, which constitute a vulnerable group, and therefore in order to safeguard their rights, the recruitment process was publicly announced, and there was no mentor-trainee or colleague relationship between the recruiter and potential participants in order to ensure that the participants joined the study completely of their own accord.

After enrollment in the study, a pre-test and an interview were carried out for each participant, followed by a program of four 2-h ultrasound acupuncture training classes. After completion of the course, a post-test and another interview were performed to assess the efficacy of the training (**Figure 1**).

2.1.2 Development of the ultrasound detection acupuncture program

2.1.2.1 Design

A preliminary draft of the course was designed by ultrasound clinicians, clinical acupuncturists, and medical education experts, and then reviewed by a committee comprising five Chinese medical physicians qualified to teach in traditional Chinese medicine medical institutions under the regulations implemented by The Ministry of Health and Welfare, Taiwan. Course standards and DOPS (Direct Observation Procedural Skills) were then established to assess trainee skills.

Four experts were invited to serve as lecturers for the program. After the initial course content had been established, two lecturers generated teaching slides, and a test course was taught to two students. The students were then asked to provide feedback in order to improve the course, and the review committee also gave suggestions on the revision of the teaching content, enabling completion of the first draft of the course.

Next, we generated a questionnaire, which was reviewed by the five members of the review committee. The questionnaire was then revised until it passed validity and reliability testing, and the teaching content was modified to obtain the final teaching materials for the program. The classes of the program were taught by four lecturers (**Figure 2**).

Meeting agenda for course planning:

1. Clinical experience of dangerous acupoints.
2. Discussion of the ultrasound technique to be taught in the course.
3. Design of DOPS as the tool to assess the effectiveness of the course (**Table 1**).

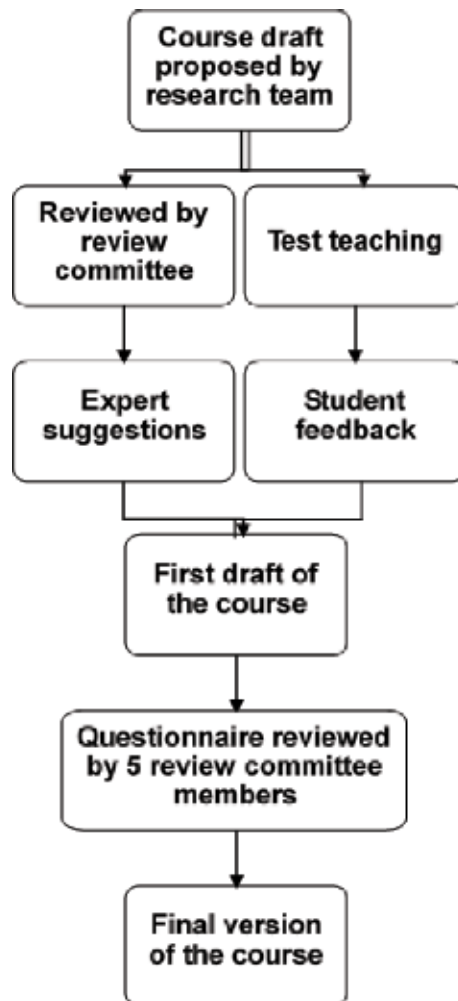


Figure 2.
Establishment of the ultrasound detection acupuncture course.

DOPS is an assessment tool developed by the Royal College of Physicians that is used to evaluate the performance of a trainee in learning a practical procedure in the United Kingdom [16]. This study used DOPS to assess the performance of the students after taking the course.

2.1.2.2 Ultrasound acupuncture course content

1. Principles and operation of ultrasound (2 h): this module of the course introduced the principles of ultrasonography in diagnosis, its use in visualizing different tissues and organs, and advanced medical ultrasound. The trainees learned the configuration and operation of a Sonosite ultrasound machine (model: NanoMaxx; Fujifilm Sonosite Inc), and had hands-on practice on an acupuncture simulator model of GB21 (ASM21), in addition to practice on a human body.
2. Patient safety and safe needle depth (2 h): clinical requirements and precautions for patient safety, introduction to simulation training, and the importance of improving patient safety.

Evaluation items	Under expected standard	Close to expected standard	Achieved expected standard	Over expected standard	Total
1. Ability in acupoint identification and acupoint selection.	<input type="checkbox"/> 1 <input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5 <input type="checkbox"/> 6	<input type="checkbox"/>
2. Ultrasound operation skills	<input type="checkbox"/> 1 <input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5 <input type="checkbox"/> 6	<input type="checkbox"/>
3. Suitable needle length selection before procedure	<input type="checkbox"/> 1 <input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5 <input type="checkbox"/> 6	<input type="checkbox"/>
4. Whether needle is placed in the correct acupoint area (simulator model sensor light on)	<input type="checkbox"/> 1 <input type="checkbox"/>		<input type="checkbox"/> 4		<input type="checkbox"/>
5. Whether needle punctured the lung, causing pneumothorax (simulator model alarm light on)	<input type="checkbox"/> 1 <input type="checkbox"/> 2		<input type="checkbox"/> 4		<input type="checkbox"/>
6. Whether acupuncture procedure was completed within the set test time	<input type="checkbox"/> 1 <input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5 <input type="checkbox"/> 6	<input type="checkbox"/>
7. Overall assessment	<input type="checkbox"/> 1 <input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5 <input type="checkbox"/> 6	<input type="checkbox"/>
				Total score/average	/

Table 1. Scoring standard for acupuncture at GB21 using the direct observation of procedural skills (DOPS) tool.

3. Advanced clinical application for GB21 (2 h): the function and anatomical position of the acupoint GB21, its possible complications and their management.
4. Introduction and practice for ASM21 (2 h): the configuration of the ASM21 model and its function. The benefit and improvement in clinical skills when used in combination with ultrasonography. The importance of implantation of simulation in learning.

In this study, GB21 was used as the target acupoint, and ASM21, an acupuncture simulator model of GB21, was developed to help the trainees to easily manage this acupoint (**Figure 3**). The ASM21 model was designed with a sensor that detected whether the needle was placed in the correct position and within a safe depth, and an alarm sounded when the needle reached the lung. As it was constructed with material that is penetrable by ultrasound, the trainees could also measure the safe needle depth when the model was used together with an ultrasound machine.

2.1.2.3 Reliability of the ultrasound acupuncture course

We used the inter-rater reliability and employed Kendall's coefficient of concordance (W) for statistical analysis according to the scores given by the raters, as shown below:

$$W = \frac{R_i^2 - 1 \frac{(R_i)^2}{N}}{\frac{1}{12} K^2 (N^3 - N)} \quad (1)$$



Figure 3.
Acupuncture simulator model of GB21 (ASM21) equipped with a sensor detector light alarm.

Where R_i^2 = the total sum of the squares of the scores given by the raters; $(R_i)^2$ = the square of the sum of the scores from each rater; N = number of trainees being evaluated; K = number of raters (experts).

We analyzed the W values of the trainees in the four classes. W values greater than 0.8 indicated good reliability.

2.1.2.4 Validity of the ultrasound acupuncture course

The course validity was calculated using the content validity index (CVI). The CVI method determines the ratio of experts who are in agreement with one another, and allows several raters to independently review the test items and evaluate the performance of the trainees. Briefly, for each test item, a scale of 4 was used for the rater response, responses of 1 and 2 indicating items that are 'invalid', and responses of 3 and 4 indicating 'valid' items. During the analysis, the four ordinal response rankings were then collapsed into two dichotomous categories of responses (score of invalid item = 0; score of valid item = 1), and the CVI of individual items was obtained. The CVI of the overall scale (S-CVI) was then calculated as:

$$S - CVI = \frac{CVI_i}{N} \quad (2)$$

where CVI_i is the sum of individual item CVIs and N is the total number of items. An S-CVI of 0.8 or higher indicated an acceptable validity. This study used IBM SPSS version 25 for quantitative statistical analysis.

2.1.3 Effectiveness assessment

2.1.3.1 Evaluation process

1. Pre-test: the trainees conducted acupuncture at the GB21 acupoint using the ASM21 model without ultrasound, and the frequency of occurrence of pneumothorax (needle puncture of the lung) was recorded on the DOPS form.
2. Pre-test interview: interviews were conducted with the trainees, which focused on acupuncture clinical skills and recorded their thoughts on and difficulties in performing acupuncture at the GB21 acupoint.
3. The trainees attended four classes, totaling an eight-hour course. They were asked to complete a satisfaction survey, and undertook two acupuncture practice sections with ultrasound.

4. Post-test: the trainees performed acupuncture at the GB21 acupoint using the ASM21 model without ultrasound, and the frequency of pneumothorax was recorded.
5. Post-test interview: interviews were conducted with the trainees to record their learning experience and thoughts.
6. Ultrasound acupuncture technical operation procedure: (i) identify GB21 on ASM21; (ii) use ultrasound to measure the distance from the surface to the lung, and use a depth shorter than this measurement as the safe needle depth; (iii) select a needle of appropriate length (the needle body must not exceed the above recorded depth); (iv) use a 28-gauge stainless steel acupuncture needle to perform the procedure; and (v) the test duration was defined from the first use of the needle to when the needle reached GB21 or punctured the lung.

2.1.3.2 Analyses of the results

The pre-test and post-test data were compared. Trainee feedback was also analyzed in order to evaluate the efficacy of the course using the methods described below:

1. Test methods: due to the small number of samples, and the fact that the data were not normally distributed, the Mann-Whitney U test and Fisher's exact test were used to determine whether the trainee skills at GB21 improved after taking the course.
2. Comparison of attendance and performance: the number of times that the needle punctured the lung was compared with the attendance rate by Fisher's exact test.
3. Effect of ultrasound class attendance: the number of times that the needle punctured the lung was compared with the attendance rate at the ultrasound class using Fisher's exact test.
4. Effect of ultrasound skills: the number of times that the needle punctured the lung was compared with the trainee's ultrasound skills using Fisher's exact test.
5. Practice and performance: the relationship between practice and performance was examined by comparing the trainees' practice simulations and the number of times that puncture of the lung occurred using Fisher's exact test.
6. Practice and ultrasound skills: whether the improvement in ultrasound skills was correlated with the number of practice sessions was examined using Fisher's exact test.

2.2 Results

2.2.1 Trainee recruitment

The study recruited 17 trainees, all of whom were residents at the Chinese Medicine Department of our hospital. One of the trainees was not able to attend all the classes and complete the test; therefore, a total of 16 participants, 8 males and 8 females (aged 31.63 ± 4.46 years), completed the program and were included in

this study. Of them, one was a dual-licensed Chinese and Western medical physician, and the remaining 15 were all licensed Chinese medical practitioners (Table 2).

2.2.2 Ultrasound detection acupuncture course

2.2.2.1 Expert advice given during course planning meetings and feedback from trainees

During course planning, several experts suggested that more detailed information about the clinical effects of the advanced application of the GB21 acupoint should be introduced to the trainees, and a half-hour practice session for acupoint selection should be added to the course. As ultrasonography is a relatively unfamiliar technique for Chinese medicine practitioners, in addition to the principles taught in class, the experts also recommended that the trainees be given extra time to practice using the ultrasound machine as per the individual needs of the trainees. The identification of suitable teaching staff for the technique was also important and the process of selection of teaching staff needed to be confirmed.

2.2.3 Reliability and validity analyses

Reliability was determined according to the *W* value of the questionnaires from the raters. A *W* value of 0.821 was obtained, and the inter-rater reliability was between 0.71 and 0.9 ($P < 0.05$), suggesting that the five raters had a high degree of consistency in scoring the performance of the trainees. The results indicated that the ultrasound-guided acupuncture course had an excellent reliability and the design of the teaching materials was appropriate.

The S-CVI values of the five experts were 1, 1, 1, 0.9, and 1, all higher than 0.80, with an overall average of 0.98. This demonstrated that the course had an excellent validity, and that the course design achieved a high standard (Table 3).

Based on the results of the course planning meeting, as well as the reliability and validity analyses, the ultrasound-guided acupuncture course was designed to include four modules, which were taught in four different classes: “Introduction and operation of ASM21”, “Advanced clinical application of the GB21 acupoint”, “Patient safety and safe acupuncture needle depth”, and “Principles and application of ultrasonography”.

	<i>n</i>	Percentage (%)
<i>Gender</i>		
Male	8	50
Female	8	50
<i>Age (years)</i>		
21–30	7	43.75
31–40	8	50
>41	1	6.25
<i>Had Western medical license</i>	1	6.25

Table 2.
Demographic information of the trainees in this study

2.2.4 Assessment of student learning effectiveness

In the pre-test, the trainees had not learned the ultrasound technique, and therefore item 2—“Ultrasound operation skills” was not included for evaluation on the DOPS form. The average DOPS score in the pre-test was 3.0 ± 0.6 . After the 16 trainees had attended the four classes, the average post-test score, which included item 2, was 3.8 ± 0.3 . The Mann-Whitney U test (two-tailed) showed that the scores differed significantly between pre- and post-test ($P < 0.05$; **Table 4**). Overall, the use of ultrasound effectively helped the trainees to avoid the complication of pneumothorax when performing acupuncture at the GB21 acupoint.

2.2.5 Pre- and post-test interviews

The pre-test interviews indicated that most of the trainees did not have experience in performing acupuncture at the GB21 point prior to taking this course, and were afraid of causing pneumothorax when performing acupuncture at acupoints near to the chest. To assess the satisfaction of the trainees following the course, they were asked to complete a questionnaire after each class. For the four classes, 8, 10, 14, and 12 completed questionnaires were received.

Feedback was also obtained from the trainees during the post-test interviews, and some useful suggestions were collected as a reference to improve the program, as listed below (**Figure 4**).

2.2.6 Correlations between course attendance and post-test results

In this program, the trainees were free to participate in the classes according to their individual schedules. Due to the fact that the working hours and locations of the hospital residents might change, some trainees were unable to attend the entire course. The attendance rate and frequency of practice using the ultrasound instrument are presented in **Table 5**. When a trainee was not able to attend a class, video recordings and slides were provided for self-learning. Of the original 17 trainees recruited to this study, one withdrew; therefore, the data of 16 trainees were included for analysis.

Expert no.	S-CVI value
1	1
2	1
3	1
4	0.9
5	1
Average	0.98

Table 3.
 S-CVI values obtained from the five experts as raters in this study.

	Pre-test (n = 16)	Post-test (n = 16)	P-value
Average score	3.0 ± 0.6	3.8 ± 0.3	0.00054*

Table 4.
 Comparison of pre- and post-test scores by the Mann-Whitney U test (two-tailed).

Nine trainees attended the “Introduction and operation of ASM21” class (attendance rate = 56%); 12 trainees attended the “Advanced clinical application of GB21” class, but one left early (attendance rate = 69%); 12 participated in the “Patient safety and safe needle depth” class (attendance rate = 75%); and 15 participated in the “Principles and application of ultrasonography” class, but one left early (attendance rate = 88%). The average attendance rate was $75 \pm 0.25\%$. The total number of trainees who practiced using the ultrasound instrument was 12, accounting for 75% of the total number of participants (Table 5).

There was no incidence of puncture of the lung during use of the ASM21 model. To test whether attendance at the course was correlated with post-test performance, Fisher’s exact test was performed, and showed that $P = 1.0$, indicating that class attendance had no significant association with the incidence of lung puncture. Additionally, analysis of the relationship between attendance at Class 4 (“Principles and application of ultrasonography”) and the incidence of lung puncture also demonstrated that no correlation existed ($P = 1.0$). Further analysis indicated that acquisition of a good ultrasound technique reduced the incidence of lung puncture ($P < 0.05$), suggesting that acquisition of ultrasound skills helped to prevent

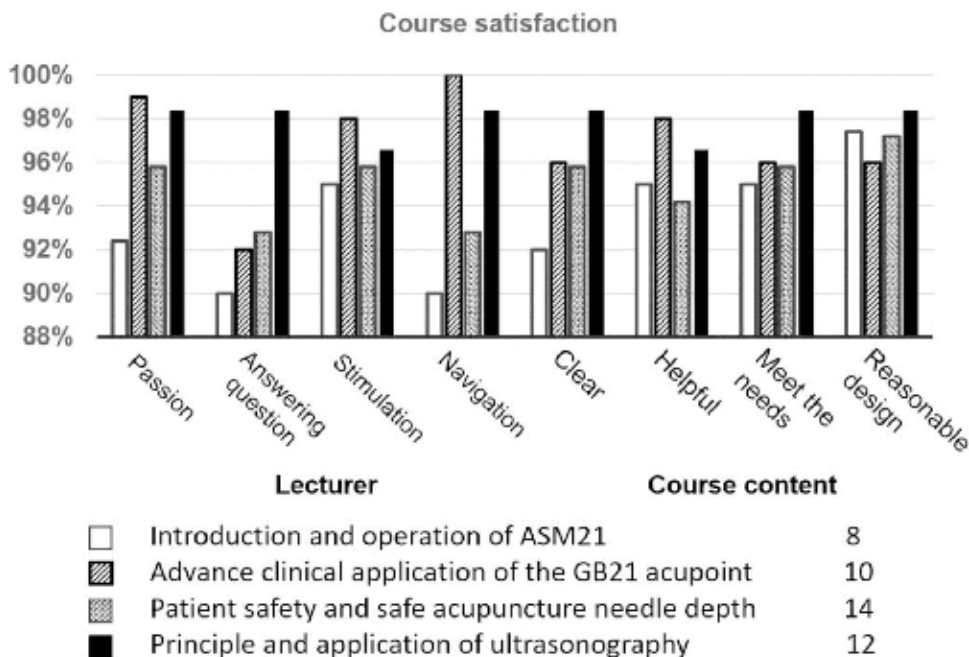


Figure 4. Course satisfaction survey.

Item	P-value
Attending all classes vs. performance	1
Attending ultrasound class vs. lung puncture	1
Acquisition of ultrasound skills vs. lung puncture	1.6121e-05***
Practice using ultrasound instrument vs. lung puncture	1

Fisher’s exact test (*** $P < 0.001$).

Table 5. Correlation analyses of trainee course attendance with post-test results.

pneumothorax post-test. Finally, no significant relationship was found between practice using the ultrasound machine and puncture of the lung.

Correlation between practice using the ultrasound instrument and improvement of ultrasound skills.

According to the second item (ultrasound skills) on the DOPS scale (score range = 1–6), the post-test score distribution of the trainees was 3–5. Three trainees had a score of 3 (2 had practiced using the instrument, 1 had not); 12 trainees had a score of 4 (9 had practiced, 3 had not), and one had a score of 5 (who had practiced). Fisher’s exact test showed that practice using the ultrasound instrument was not correlated with improvement of ultrasound skills. In the post-test, the depth measurements at acupoint GB21 obtained by seven trainees were 3.0, 3.0, 3.2, 3.3, 3.5, 3.8 and 5.0 cm; the average depth was 3.5 ± 0.7 cm, which was very close to the actual depth of 3.5 cm. The depth measurement of 5.0 cm was much larger than the

Class	Case numbers	Interview key content
General	107010818010	I used to utilize oblique insertion and avoid dangerous acupuncture points. Now, I am glad that ultrasound can assist practitioners in precisely placing acupuncture needles, and reduce the fear of performing acupuncture at difficult points. In order to make this course more meaningful, I suggest having a qualifying examination after the course
Class 1: introduction and operation of ASM21	107010918005	Trainees were curious about using the ASM21 model to practice acupuncture ASM21 allows us the opportunity to practice very well at GB21. As GB21 is not often used clinically, performance in reality is rarely seen. I am looking forward to practicing at this point. Patient safety has always been an important principle in medical ethics
Class 2: advanced clinical application of the GB21 acupoint	107020618004	Trainees had the opportunity to further understand the timing of using GB21, and learn how pneumothorax can occur and its management Training helped us to understand that a needle at the acupuncture point GB21 will reach the pleura at a certain depth (about 2–3 cm), and insertion of the needle to a deeper position will penetrate the lung. Studies from Western medicine also showed that even anesthesia cannot block the pain at this point
Class 3: patient safety and safe acupuncture needle depth	107030818012	Trainees improved their knowledge of the safe needle depth, and learned about pneumothorax complications caused by acupuncture from cases of evidence-based medicine Learning of personal experience from the lecturer about acupuncture-caused pneumothorax was impressed. This highlighted that the needle depth is critical during acupoint selection in clinical practice
Class 4: principles and application of ultrasonography	107040918001 107040918012	Following hands-on operation, the trainees gave positive feedback on the use of ultrasound to detect the safe needle depth for acupuncture The ultrasound device is simple and easy to use, and effectively prevents pneumothorax. It was a novel experience to use ultrasound, especially its application in acupuncture in the clinical setting

Table 6.
Interview records from trainees.

other measurements, and the trainee who made this measurement had not practiced using the ultrasound instrument and had a poor ultrasound skills score. If this outlier value was removed, the average depth was 3.3 ± 0.3 cm.

The average duration of operation of the ultrasound instrument by the trainees was 87 ± 42 s (ranging from 45 s to 2 min and 9 s).

2.2.7 Post-test interview

After attending the course, the trainees expressed that it helped them to reduce their fear of performing acupuncture at the GB21 point, and practice using the ASM21 model helped to improve their self-confidence. Some positive feedback received is presented below:

With the assistance of ultrasound, the depth of the GB21 point can be easily identified. It helps to choose the correct length of needle. By using a proper needle, it prevents causing the problem of puncturing the lung (10704201801001) (Table 6).

During the pre-test, I did not know what I was doing as I was full of fear. I never perform acupuncture at the GB21 point, and was therefore very nervous. During the post-test, I felt it was quite an interesting task, as I am more self-confident and can perform it immediately without delay (10704201800901).

When I perform acupuncture at points in the chest, I will double-check by using ultrasound, especially if the patient is elderly, a young woman or a child (10704201801703).

I wish that ultrasound could be more popularized. I will use it in the clinic, especially at those acupuncture points with a high risk of causing an accident. For the common points, I will not use it as it takes time to use it (10704201800203).

2.3 Discussion

UDA is an innovative acupuncture technique. It employs modern ultrasound technology to inject new vitality into this ancient medical system. UDA may reduce the risk of complications at difficult acupoints, such as pneumothorax. It can improve patient safety, and render acupuncture at several important but difficult and less-used acupoints (e.g., Gaohuangshu BL-43, and Back-Shu points) more easily performed by acupuncture practitioners. This will help the advantages of traditional acupuncture to be restored and preserved.

In this study, we developed a program that employed ultrasound technology during training in the use of difficult acupuncture points. In the course described in this study, the focus was the Jianjing point GB21. The course included four 2-h classes: “Introduction and operation of ASM21”, “Advanced clinical application of GB21”, “Patient safety and safe needle depth”, and “Principles and application of ultrasonography”. The design of the course aimed not just to teach trainees to operate the ultrasound instrument and the ASM21 model, but also to educate them about patient safety and the safe needle depth at the GB21 acupoint.

According to the satisfaction survey completed by the trainees who undertook the course, the trainees showed high interest in two of the classes in particular: “Advanced clinical application of GB21” and “Principles and application of ultrasonography”. This might be due to these two classes being directly correlated with clinical application, while the other two classes were related to simulation education and medical quality, which hospital residents are often less interested in. In the post-test interviews, most of the trainees were positive about integrating the ultrasound technique into the teaching of acupuncture. As ultrasound imaging helps

them to clearly identify the position of the lungs, it improved their confidence in performing acupuncture at the GB21 point. Most of the trainees who attended the course expressed that if the hospital could provide an ultrasound instrument at their out-patient clinic, they would be willing to apply the UDA knowledge they had learned from the course in patient practice.

Currently, the largest barrier to Chinese medicine practitioners or acupuncturists using ultrasound is the high cost of the instrument. Even an entry-level new machine will cost more than \$10,000 USD. At this moment, with the exception of large hospitals or medical centers, most small clinics are not able to afford to install this instrument at their practice locations. To solve this problem and enable UDA to be widely-used, the purchase of used ultrasound instruments is an option. Alternatively, the development of a low-cost, small-sized simple ultrasound instrument without an imaging function (such as the Butterfly IQ [17], which can easily detect the needle depth), should be considered.

Education in traditional Chinese medicine is still relatively conservative in comparison with modern medical education. Although acupuncture is considered a less invasive therapy, it does require thousands of hours of training to gain the proper skills. However, education in acupuncture still very rarely uses modern teaching aids to assist learning, and especially rarely uses simulation-based learning. These issues are in urgent need of improvement. This study utilized an innovative method that integrated a simulator that mimicked the chest body part and modern ultrasound technology to help trainees to learn how to safely perform acupuncture at the GB21 point. The UDA approach allows greater application of the traditional acupuncture points in therapy, as many of the difficult points are known to be very important, but it is difficult to master the necessary skills. We used UDA in acupuncture education, emphasizing patient safety, which differed from traditional acupuncture education, which mainly focuses on classroom teaching and observational learning [18, 19]. The outcomes of this study indicated that new teaching methods are required for education in acupuncture, as the conventional education system for acupuncture is known to have many problems and needs to be improved [20, 21].

The introduction of a body part model in acupuncture education is very useful for the learner. Body parts or organ sets have been created, and others have developed a 3-D interactive virtual environment, phantoms or integrated platforms to assist learners in acupuncture training [22–25]. However, such types of models or virtual training simulation systems still cannot provide sensations similar to those felt when practicing on the human body. We developed the ASM21 model using material that could be punctured by stainless steel acupuncture needles and that was penetrable by ultrasound. Integrating this material with a sensor detector and a light alarm, the goal was to allow the learners to practice on an object similar to a patient in clinic, and to measure the needle depth by ultrasound. Using a high-quality simulator with a realistic chest model, learners are able to perform sufficient practice before applying UDA in actual patients. Rehabilitation medicine has attempted to incorporate acupuncture as one of its therapy techniques, and has integrated acupuncture with the ultrasound technique [26]. However, that application mainly focuses on soft tissue-related diseases, such as muscle and tendon disorders. Neither patient safety nor the theory of the Meridians has been paid attention to. From a different aspect, in the present study, we used the theory of traditional Chinese medicine and considered patient safety to promote acupuncture modernization.

Although Chinese medicine has a long history, its modernization has followed a difficult path. In the development of the UDA training course, we had a great

appreciation of the obstacles faced. Modern medicine is closely integrated with modern science; modern medicine keeps pace with the development of science-based technology, and new technology is used to develop new products and treatments to improve patient care. However, the majority of Chinese medicine practitioners do not pay attention to new technology. Many researchers have continued to work hard to improve this dilemma [27–29], while more Chinese medicine peers are still needed to join in the modernization. The ASM21 model developed in this study can be further improved to incorporate ultrasound techniques by collaborating with medical engineering manufacturers, which might create a new path for the development of technology for use in the application of Chinese medicine.

The outcomes of our study show promise. However, there were some limitations. First, this study was an educational study conducted in a single group, i.e., hospital residents, and was not a randomized controlled trial. The small sample size was also a limitation.

However, by using qualitative and quantitative analyses to validate the efficacy, the results are still valuable, and can be taken as a useful reference for developing similar courses. The significant improvement in score after the trainees had attended the course indicated a well-designed course, which can help to reduce the risk of pneumothorax, a complication of acupuncture at difficult chest acupoints. Both the attendance rate and practice of the ultrasound technique were independent of the reduction in the incidence of pneumothorax, suggesting that the use of ultrasound is key to reducing the incidence of this complication. As the operation of the ultrasound instrument is simple, no special repeat practice is required, which is a significant advantage of UDA that should be promoted in the future. The trainees only need to learn to measure the safe depth of the needle, rather than being familiar with diagnostic sonography. Based on the outcomes and the feedback obtained from the trainees, the course could be shortened by focusing on the operation of the ultrasound instrument and practice using the simulator. In terms of satisfaction, the post-test interviews demonstrated that the trainees gave the highest ratings for the course, indicating that the course design was successful.

In conclusion, a course design for acupuncture training needs to include practice using a simulator, which can greatly enhance the interest and motivation of the trainees. In the interviews, several trainees suggested that acupuncture clinical instructors should receive UDA training, which showed that they were not satisfied with the conventional educational approach. Some trainees also had different opinions to those of the lecturers for the classes, suggesting that the new generation no longer fully accepts the arrangements of traditional education. In order to achieve the goal of a high level of education, it is necessary to implement more communication between teachers and students in the current medical education setting.

3. Conclusion

3.1 UDA

UDA, by introducing ultrasound into acupuncture practice, will be a revolution technique for traditional acupuncture. UDA can not only reduce the risk of severe adverse effect when needing dangerous points, but also increase the usage of some important points traditionally, such as GB21 and BL43. We proposed the standard operating procedure for UDA and developed a course for UDA training. A video demonstration could be found at the web www.Dr-Hou.com. We truly hope that UDA would be widely accepted and performed popularly everywhere in acupuncture practice.

3.2 Future work

In order to prompt UDA further, a specific and affordable ultrasound device is urgent needed. All the ultrasound devices available are too complicated and expensive for acupuncturists. We are currently in cooperation with medical engineers to develop a UDA special ultrasound. This ultrasound device for safety depth (USD) will be a handy and useful device specially designed to measure the safe needling distance of dangerous points. We believe that only by introducing and developing new ideas and practices can renew and update acupuncture. Thus an energetic and a fresh acupuncture can be presented to the world.

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Conflict of interest

There is no financial relationship to disclose.

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Edited by Marcelo Saad and Roberta de Medeiros

Acupuncture may have about 4000 years of history, but it has only been clinically accepted in the West for some 40 years. Acupuncture receives both praise from its users and skepticism from its critics. High-quality scientific studies have advanced, but the technique of acupuncture in health services has stagnated. In this current scenario of contrasts, *Acupuncture—Resolving Old Controversies and Pointing New Pathways* intends to be a modern reference for scholars, without totally exhausting the subject. The editors expect this work to assist with the advancement of the scientific understanding and clinical usage of acupuncture. The authors are well versed in the subject and, along with literature reviews, are able to add their own impressions.

In this book, some traditional fundamentals of ancient Asian medicine are translated into the current scientific knowledge of neurophysiology and mechanisms of action.

Specific variations of acupuncture, such as the scalp microsystem technique, are discussed and explained. Practical aspects, such as education on acupuncture, are enriched with descriptions of novel treatments. The therapeutic use of acupuncture and related techniques is explored regarding their incorporation into a comprehensive integrative medicine approach. As editors, we thank the contributing authors for their exquisite work, and we congratulate IntechOpen for its efforts in book production. For you, the readers, we hope to match the trust you put in this work, and we hope you find it useful.

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