



Contents lists available at ScienceDirect

Journal of Traditional and Complementary Medicine

journal homepage: <http://www.elsevier.com/locate/jtcm>

# Establishment of a basic medical science system for Traditional Chinese medicine education: A suggestion based on the experience of BIOCERAMIC technology

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## ARTICLE INFO

### Article history:

Received 18 August 2018

Received in revised form

16 April 2019

Accepted 21 April 2019

Available online 25 April 2019

### Keywords:

BIOCERAMIC resonance

Meridians

Standing waves

Harmonic sound frequencies

Trigger points

## ABSTRACT

The aim of this review study is to present an integrated and systematic approach to meridian channels and Ashi acupuncture points based on scientific evidence. We herein establish a framework of basic medical science to explain meridian channels based on the (1) Concepts of Traditional Chinese medicine (TCM) approach using physics and physiology: (i) the physical theory of pulse sound and cardiovascular physiology: resonance of harmonic sounds and the specific frequencies arising from heartbeats, which form pathways of different meridian channels to enhance microcirculation; (ii) standing wave hypothesis to explain meridian channels; (iii) Ashi acupuncture or trigger points caused by ischemia due to inappropriate harmonic resonance of standing waves; and (2) the TCM concept strengthened by BIOCERAMIC technology: (i) 'wave-induced flow characteristics of meridians'; (ii) the 'Propagated sensation along meridian' phenomenon; (iii) clinical observations of the different chief complaints of candidates in which sensation was induced along specific meridian channels; (iv) generates 'biofield' phenomenon composed of virtual channels of interconnecting 'feet-hands-ears' to different internal organs/tissues that support the principles of reflexology.

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## 1. Introduction

The fast growing and developing field of medical technology characterized by the application of robotics and artificial intelligence in surgery, medical diagnosis, and decision making for therapy have triggered an on-going revolution in mainstream medical practice. Nevertheless, a formal education of traditional Chinese medicine (TCM) theories and holistic concepts are still provided from ancient text books and case-based learning.<sup>1–3</sup> It is challenging but necessary for us to speed up the integration of TCM and mainstream medical science.<sup>4</sup> Although traditional medical departments are available and open for service at hospitals in

Taiwan, it is difficult to foster an interdisciplinary interaction and academic cooperation between mainstream and TCM doctors. This difficulty may be due to the following reasons: (1) most concepts of TCM are based on assumptions, even though they have very sophisticated theoretical and treatment systems. TCM has not established a basis for scientific validation and its own basic medical science; (2) lack of experience in developing a system which effectively combines education and heritage of its medical skills, as that by Western modern medical societies; (3) TCM considerably depends on ancient experiences, texts and books, and is written in an archaic form of Chinese writing. Different readers may interpret the texts in different ways. There is a lack of quantitatively and qualitatively unified systematic approach. Until now, a book containing the main guiding principles of TCM education is not available; (4) A scientific basis for the assumptions of TCM is unavailable, and the related advanced diagnostic or therapeutic instruments used by TCM are not well developed for data collection.

BIOCERAMIC technology refers to a material able to produce

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Peer review under responsibility of The Center for Food and Biomolecules, National Taiwan University.

**Table 1**

List of published works on different aspects of BIOCERAMIC technology related to TCM with references.

Title of BIOCERAMIC publications	Abstracts	Reference Number
In Vitro and In Vivo Studies of Biological Effects of BIOCERAMIC (Material of Emitting High Performance Far-Infrared Ray) Irradiation	Previous basic medical research data showing the <i>in vivo and in vitro</i> effects by BIOCERAMIC treatment, including the intracellular effects on (1) Nitric oxide, calmodulin, heat shock protein; (1) antioxidant effects on cells and plants under H <sub>2</sub> O <sub>2</sub> -mediated oxidative stress, effects on anti-oxidative stress of myoblast cells were also noted. (2) effect on a chondrosarcoma cell line wherein prostaglandin E <sub>2</sub> production was noted. (3) protective effect against non-ionizing radiation against oxidative stress on human breast epithelial cells. Animal studies associated with BIOCERAMICs include: (1) prevention of fatigue of amphibian skeletal muscles during exercise; (2) anti-inflammatory and pain relief; (3) anti-inflammatory effects on rabbit with arthritis induced by injection of lipopolysaccharides visualized by positron emission tomography; (4) Attenuation of psychological stress induced tachycardia; (5) improvement of high blood pressure and oxidative stress-suppressed cardiac contractility	19.
Physiological effects of BIOCERAMIC material on human, assessment by 'Harvard Step', 'Resting Metabolic Rate' (RMR) and 'Treadmill Running' tests	BIOCERAMIC treatment in humans stimulates parasympathetic responses, which may reduce resting energy expenditure and improve cardiorespiratory recovery following exercise.	18.
Wave-Induced Flow in Meridians Demonstrated Using Photoluminescent BIOCERAMIC Material on Acupuncture Points	A noninvasive PLB treatment on acupuncture points found a significant effect on the electrical conductivity of the skin by comparing the pre- and post- PLB irradiation data measurements. By reviewed the literature and comparing our results, we discuss the 'wave-induced flow characteristics' of meridians.	10.
Application of Photoluminescent BIOCERAMIC Material (PLB) for different chronic illnesses by selecting 'trigger points' and 'propagated sensation along meridians' (PSM) phenomenon	PLB treatment on selected trigger points of candidates with an 80% PSM phenomenon. Our candidates showed different noticeable improvements upon PLB treatment. Subacute stage, 3–5 months illnesses showed the most significant improvements. There conditions showed a 43.8% of clinical improvement. We deduced that PLB treatment provoke fluid/water diffusion along meridian channels. By dredging the meridian channels, PLB is suggested to be capable of relieving stagnation and induce a vital change in the flow of the dynamic patterns of meridians.	12.
The effect of BIOCERAMIC Resonance effect on meridian channels: a pilot study	"Propagated Sensation along Meridians" (PSM) was experienced in all BR treated patients, but not in control patients. BR was believed to enhance the function of the microcirculation through a series of biomolecular and physiological processes and this noninvasive technique may offer an alternative to needle acupuncture and other traditional medical practices with clinical benefits.	6.
The analysis of normalized effects on meridian current level after the photoluminescent BIOCERAMIC treatment on acupuncture points	Patient with benign facial tremor was treated by PLB for 1 month; PLB improved the facial tremor and normalized the effects on meridian current levels in the meridian channels of the gall bladder (GB), lungs, small intestine, bladder, and kidney. A method was proposed to evaluate the normalization effect of a noninvasive PLB technique on the 12 meridians. PLB acupuncture on specific meridian points may normalize the current of specific meridians, especially in GB meridian of the candidates.	11.
The effect of Photoluminescence of BIOCERAMIC (PLB) irradiation on Middle Cerebral Arterial occlusion (MCAO) in Rats	PLB irradiation improved exercise completion rate and average running speed during slow and fast treadmill settings in MCAO rats. After PLB irradiation, the selected MCAO rats successfully completed all the second-round treadmill exercises at the maximum speed setting, and had faster recovery from muscular fatigue. BIOCERAMIC irradiation of rat astrocytes was demonstrated to increase intracellular nitric oxide. Since nitric oxide induction is related to the microcirculation, we suggest that cortical brain stimulation of the microcirculation and enhancement of peripheral muscular activity are the main factors that may be used to explain exercise performance improvement in MCAO rats by PLB.	16.
The applications of BIOCERAMIC technology on alternative therapy under the concept of traditional Chinese medicine,"	Includes our experiments on the effect of BIOCERAMIC technology on different diseases, such as insomnia, migraine, chronic sympathetic nervous system disorders and other autonomic nervous disorders, all of which reported significant improvements. The applications of PLB and BR technology have positive effects on clinical therapy and strengthen the reliability of the 'cardiovascular resonance theory' to explain the phenomenon of meridian channels.	17.
Evaluation of Reflexology by "BIOCERAMIC Resonance" Operation producing Weak Force Field during Simultaneous Acupoint Stimulation of Urinary Bladder Point on Subject's Ear Resulting in Electric Current Change on Urinary Bladder reflex Point on Subject's Hands, and Related New Research Finding	Based on the experimental results associated with using BR to create a biofield and synchronously change skin current levels on the reflex points/areas on the skin surface of the feet, hands, and ears that connect or somehow reflect back to specific internal organs. This study confirms the validity of the virtual channels and mapping on standard reflexology charts. Furthermore, the depicted corona intensities from five zones shown on a computer screen also indicate that the volunteer subjects are affected by the BIOCERAMIC patches. In conclusion, the effect of BR device and BIOCERAMIC patches are able to produce weak force fields throughout the body, which are objectively measurable and thus scientifically integrate the TCM concepts of reflexology, meridian channels and biofield therapy.	13.

**Table 1** (continued)

Title of BIOCERAMIC publications	Abstracts	Reference Number
A Technology Developed from Concept of Acupuncture and Meridian System, the Clinical Effect of BIOCERAMIC Resonance on Psychological related Sleep Disturbance with Findings on Questionnaire, EEG and fMRI	According to a questionnaire (assessment of the psychological and physical causes of sleep disturbances), our participants also received EEG recordings and functional MRI (fMRI) before and after the BR treatments. The study found that sleep quality improved in all patients especially those with sleep disturbances due to psychological reasons; in 91.7% (33/36) of cases treatment was associated with an elevation in the beta spectrum of the EEG (at 15–27 Hz); and the fMRI found corresponding cerebral and cerebellar areas of activation and deactivation. In conclusion, BR can improve sleep disorders due to psychological causes, with transient alterations of brain wave activity and functional activation in specific locations of the brain.	14.
Base on concept of traditional Chinese medicine: Experimental studies on efficacy of BIOCERAMIC Resonance to alleviate Drug Withdrawal symptoms	BR was used in cases of stimulant addiction or overdose with hypnotic drugs, based on the concept of the 12 meridian channels of TCM. Successful withdrawal or dose reduction benefits were found. The possible beneficial effects included relief of depression, improvement of sleep deprivation and other mental symptoms associated with substance abuse and withdrawal effects.	15.

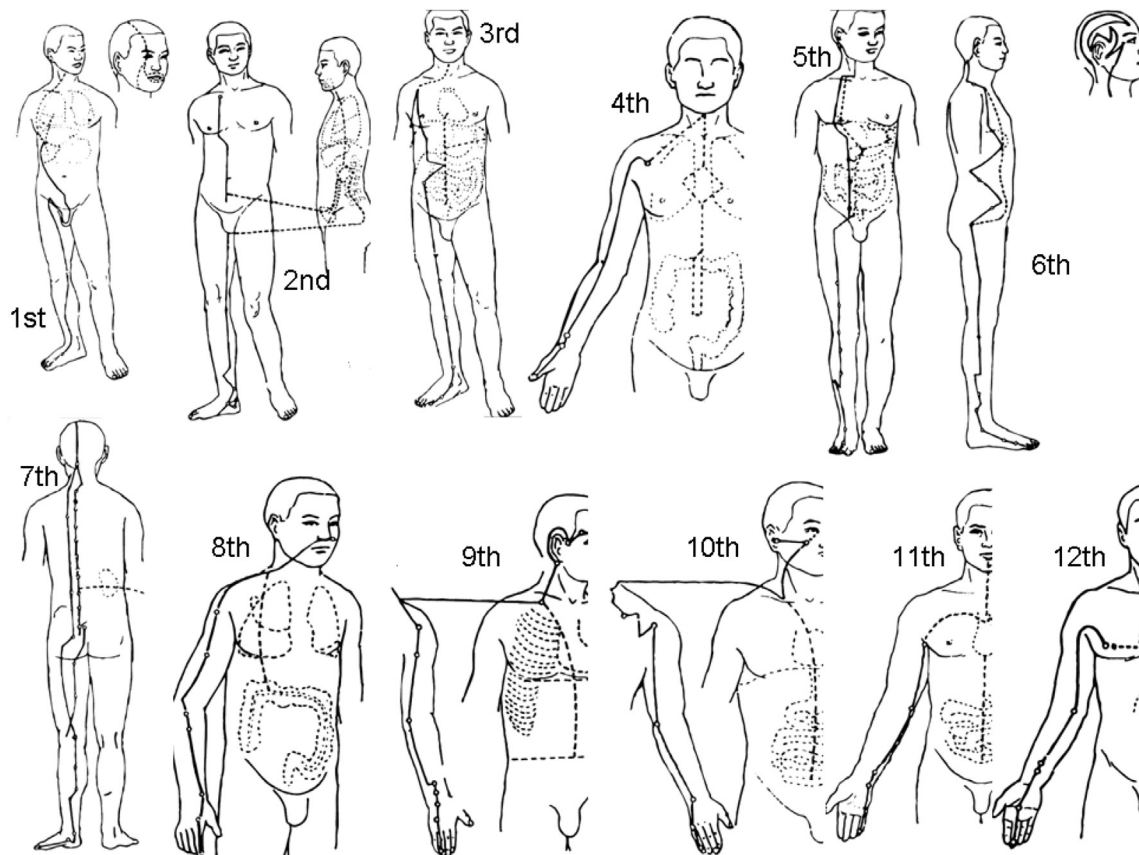
**Table 2**

Harmonic frequencies based on standard heartbeat baseline of 72bpm.

Number of harmonic frequency (HF)	1 <sup>st</sup> HF	2 <sup>nd</sup> HF	3 <sup>rd</sup> HF	4 <sup>th</sup> HF	5 <sup>th</sup> HF	6 <sup>th</sup> HF	7 <sup>th</sup> HF	8 <sup>th</sup> HF	9 <sup>th</sup> HF	10 <sup>th</sup> HF	11 <sup>th</sup> HF	12 <sup>th</sup> HF
Hz estimated by heart rate at 72 bpm	1.2	2.4	3.6	4.8	6.0	7.2	8.4	9.6	10.8	12	13.2	14.4

non-ionized, weak force fields that cause different biophysical and systemic health benefits.<sup>5–19</sup> One of the fundamental effects of this technology is to weaken hydrogen bonds, thus altering the characteristics of water, as well as those of interstitial fluid and the dynamics of the microcirculation.<sup>7,8,16,19</sup> Our previous basic and clinical medical research papers<sup>6,10–19</sup> have shown that the

application of a BIOCERAMIC material as a treatment can promote microcirculatory and cardiovascular health by increasing calcium-dependent nitric oxide and calmodulin.<sup>19</sup> The BIOCERAMIC material treatment has been shown to have antioxidant effects,<sup>19</sup> to strengthen the musculoskeletal system,<sup>19</sup> thus inducing beneficial effects to individuals engaged in exercises or sports performance by



**Fig. 1.** Different harmonic frequencies with their corresponding roadmaps on body.

reducing fatigue and reducing the recovery time from injuries,<sup>18</sup> and other effects. BIOCERAMIC treatment has also been shown to activate the parasympathetic nervous system, which may improve the recovery of resting cardiac and respiratory rates following submaximal exercise,<sup>18</sup> as well as anti-inflammatory and pain relief functions.<sup>5</sup> Different aspects of the BIOCERAMIC technology with their respective references are shown in Table 1.

The TCM application of the BIOCERAMIC technology is based on the beneficial effects on the microcirculation which result in the attenuation of tissue ischemia, hypoxia and muscular tension,<sup>5,19</sup> so as to relieve pain sensation at specific 'Ashi acupuncture points or trigger points(AATP)'.<sup>12</sup> 'Photoluminescence of BIOCERAMICS' (PLB) and 'BIOCERAMIC Resonance'(BR) are the instruments developed from the BIOCERAMIC material technology that increase the intensity of both sound and light waves.<sup>6,10</sup> Through this developing technology and the related experimental results, we were able to identify some of the fundamental concepts of TCM.<sup>6,10–15,17</sup> In this review, we present an integrated and systematic approach on meridian channels, Ashi acupuncture points and reflexology with evidence-based experimental results and scientific concepts, supported by physics, physiology and BIOCERAMIC technology.

## 2. Scientific approach to the TCM concept

### 2.1. Physics of pulse sound and cardiovascular physiology

A question that has not yet been fully resolved involves the mechanical power of each human heartbeat which consumes only ~1.3 W.<sup>20</sup> If the heart functions as a simple pump, how is it able to maintain circulation and microcirculation in the human body with a total vessel length of more than 100,000 km<sup>21</sup>?

In the 1960s, McDonald and his colleagues found that the frequency of the propagated arterial pulse from each heartbeat can be decomposed into multiple harmonic frequencies by Fourier analysis.<sup>6,22</sup>

The equation is as shown below:

$$P(t) = \sum_{n=1}^{11} (b_n \sin(nNt))$$

(P: pressure; t: time; n: number of harmonic sound frequencies;  $b_n$ : pressure of the number 'n'; N: original heartbeat frequency;  $P(t)$ : Pressure change in time;  $\sum (b_n \sin(nNt))$ : Adding from 1st to 12th harmonic sound frequency;  $nN$ : frequency of the number 'n').

According to the experiment conducted by Wang et al., resonance is very important for the propagation of high-frequency blood pressure.<sup>23,24</sup> Factors such as diastolic pressure, position of the attached organ, physical properties of the attached organs affect the resonance necessary to maintain blood pressure wave propagation.

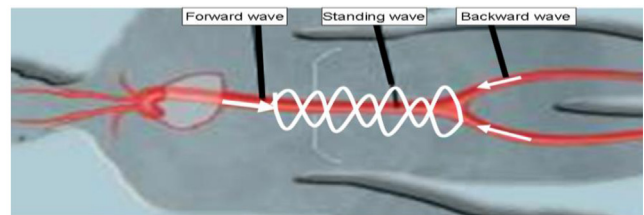
In this regard, W.K.Wang et al. also proposed that the different harmonic frequencies of an individual's original heartbeat produce coupled oscillations in different internal organs, which suggested the presence of a resonance pattern between specific organs and the vascular bed.<sup>23,24</sup> Wang also proposed that the function of the resonance frequencies is to help blood enter specific organs.<sup>23,24</sup> According to his previous publications, Wang suggested that these harmonic frequencies are in the range of 1.2 Hz–13.2 Hz (Table 2) when the heart beat remains constant at 72 beats per minute (bpm).<sup>23,24</sup>

Wang et al.<sup>23,24</sup> recorded animal and human pulse pressure readings and identified the harmonics of the heartbeat in the liver (1st), kidney (2nd), spleen (3rd), lungs (4th), stomach (5th), gall bladder (6th), urinary bladder (7th), large intestine (8th), triple

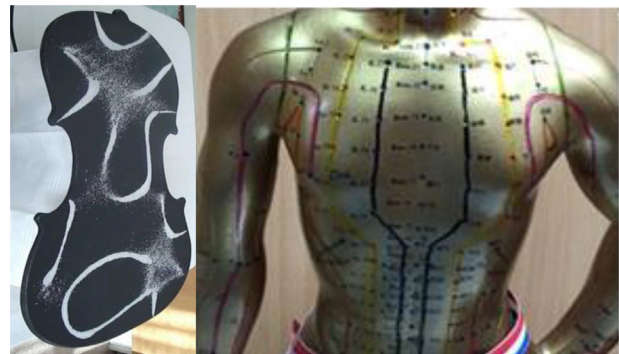
energizer (9th), small intestine (10th), heart (11th), and pericardium (12th). These harmonic frequencies are single frequency resonance channels that may correlate with the TCM concept of "meridians" (Fig. 1).<sup>10–14</sup> The function of resonance frequencies is to compensate for the low mechanical energy consumption of the heartbeat (as low as ~1.3 W), which helps to achieve blood perfusion of specific organs with specific resonance frequencies of different microvascular beds<sup>23–28</sup> (explained below).

### 2.2. Standing wave hypothesis

As aforementioned, the propagated arterial pulse wave from each heartbeat can be decomposed into multiple harmonic frequencies by Fourier analysis. W.K.Wang et al. proposed that the different harmonic frequencies of the waves generated from an individual's original heartbeat produces coupled oscillations to different internal organs. However, this theory does not fully explain the meridian channels and the acupuncture points present on the skin. We previously hypothesized that the three-dimensional meridian channels are 'standing waves'<sup>13,17</sup> which

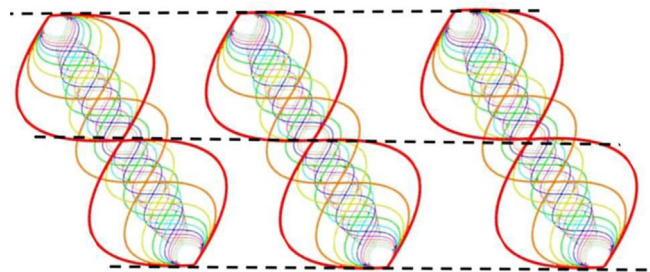


a



b

c



d

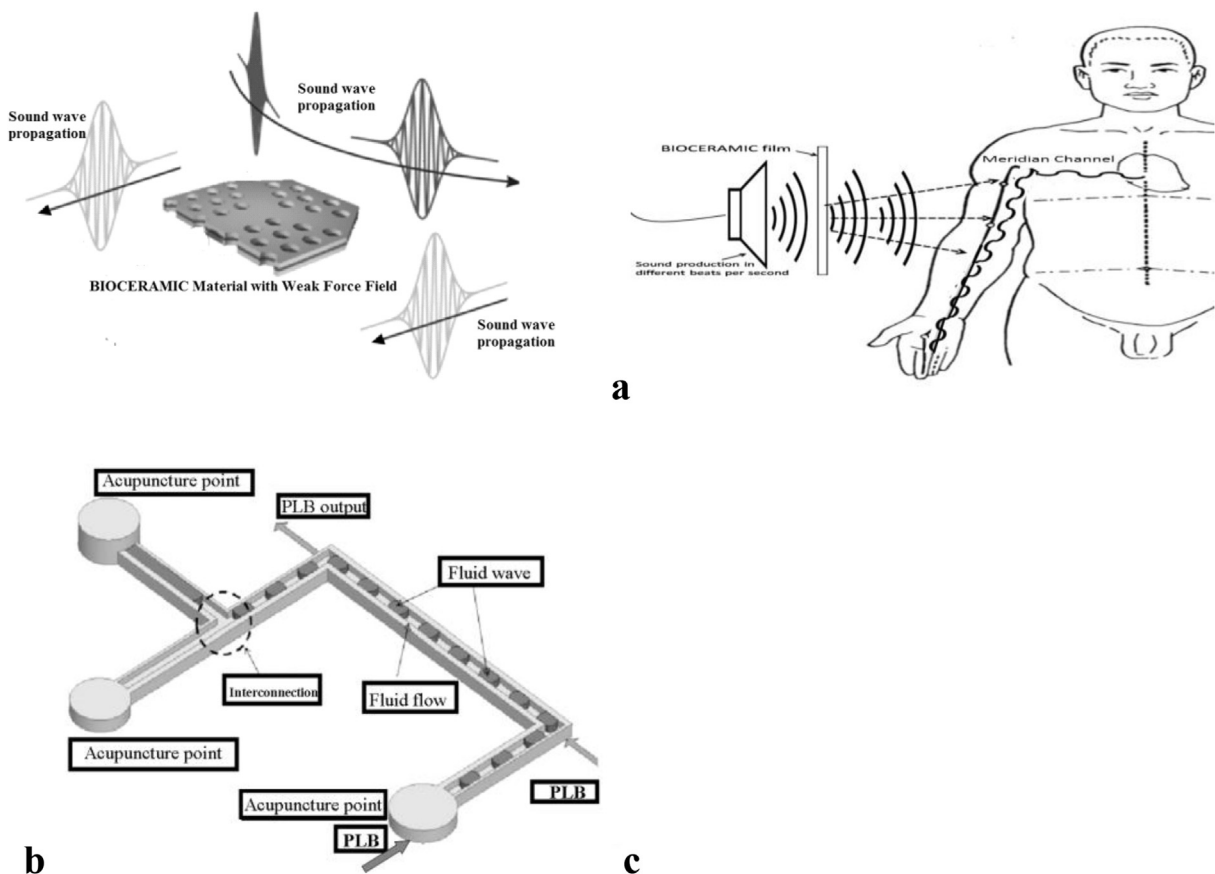
**Fig. 2.** Conceptual drawing demonstrates 'standing wave' which formed by interference after forward and backward traveling waves collide together in phase through aorta(2a); Chladni figure within violin(2b); meridian channels on "Bronze Man"(2c); By assumption, the nodes of the standing waves are conjugated by dotted lines which produce movement of interstitial fluid that represent TCM meridians(2d).

resonated at different harmonic frequencies generated from an individual's original heartbeat and formed by interference between the waves reflected back and forth along the aorta and the main arteries (Fig. 2a). After resonating with different specific harmonic frequencies, the nodes (points of standstill) and the antinodes (fluctuating waves) are constantly located at the same position along the media. Standing waves are two progressive waves from opposite directions that interfere with one another to produce an oscillating wave fixed in space. The phenomenon of standing waves can be demonstrated by oscillating a string on a violin, to produce a specific mapping of “nodes,” or stationary lines on salt particles put on the surface of a “violin” (Fig. 2b). The linear construct shown in the ‘Chladni figure’,<sup>29</sup> a reflection of harmonic resonance with specific frequencies, is similar to the meridian channels shown on the “Bronze Men of Acupuncture”(Fig. 2c). In short, three-dimensional meridian channels are different ‘standing wave’ patterns, established within the human body through media of different densities (skin, fat, bone, cartilage, etc.).<sup>13,17</sup> The function of the resonance frequencies is to help blood enter specific organs and the microvascular bed.<sup>23–28</sup> In our opinion, the different harmonic frequencies of the pulse wave originate from heartbeat and the vibrations are propagated through the arterial vessels in the human body (Fig. 2a).

When a pulse wave reaches the bifurcation between the aorta and common iliac arteries, part of the pulse waves rebound and travel backward to the aorta. Finally, it produces interference patterns of the same harmonic frequency to produce resonance with standing wave formation in the aorta. This phenomenon also

occurs in smaller arteries. Under a three-dimensional view, the constant vibration of antinodes produces an effect on the interstitial fluid channels at nodes and possibly helps to maintain fluid motion, forming the TCM meridians<sup>30</sup> (Fig. 2d). Standing waves increase the motion and fluidity of cells and improve cell metabolism. According to Yung KT, who proposed that the meridian channel is equivalent to an electromagnetic (EM) transmission line and that the ‘Chi’ is the electromagnetic standing wave riding on the line with acupuncture points as its nodes. The standing wave within each segment of the meridian channel separated by acupuncture naturally oscillates until ‘De Chi’ effectively charges the body's capacitor through the transmission line.<sup>31,32</sup>

German scientist Fritz-Albert Popp and Chinese biologist, Chang-Lin Zhang developed a model of a “Standing Wave Superposition Hypothesis” to explain meridian channels.<sup>31,32</sup> They portrayed the overall meridian system as a holographic image of the body, which interconnects the feet, hands and ears. They also explained the interconnectivity of the acupuncture points through a superimposition process, wherein two or more similar waves combine to form a third and more complex one. Interference occurs when two waves start at the same point but approach each other from different directions. When these two waves are in rhythm with each other, the result is constructive interference wherein the resulting wave is amplified. Destructive interference occurs when the waves are ‘out of sync’ and thus cancel each other. They explained the act of ‘acupuncture needling’ to create disturbances in the standing wave pattern and to activate the transformations and influence the ‘biofield’ of the whole body.<sup>31,32</sup>



**Fig. 3.** Conceptual drawing of BIOCERAMIC material producing weak force field and being transmitted via sound waves propagation(3a); Conceptual drawing of BIOCERAMIC material producing weak force field and resonant with different specific waves propagation arises from harmonic rhythmic sound frequency of heartbeat (12 meridian channels)(3b); PLB irradiation of the specific meridian (acupuncture) points may induce a wave-induced flow in the meridians, by using the interconnection of various meridians(3c).

### 2.3. AATP arise from incompetent harmonic resonance

Interestingly, the spatial distribution of the AATP showed a correlation of over 70% with the location of the acupuncture points of TCM.<sup>33</sup> AATP are activated by acute or persistent muscle overload, which is commonly noticed at tissues with increased metabolic demand and ischemia from compromised circulation caused by increased tension of the involved sarcomeres. This process may account for the severe local hypoxia.<sup>32</sup> Biochemicals associated with pain and inflammation are elevated in sites of AATP, thus indicating potential mechanisms of tissue ischemia, hypoxia, increased muscular tension and finally peripheral nervous stimulation of pain.<sup>33,34</sup> On the other hand, intense stimulation of AATP frequently relieves pain, thus resembling the art of acupuncture.<sup>35</sup> As aforementioned, the function of different harmonic resonances of standing waves from specific frequencies of heartbeat is to help the microcirculation. Therefore, we suggest that the AATP is the location of a compromised microcirculation. This may arise from incompetent harmonic resonance of standing waves with different roadmaps based on specific harmonic frequencies of the heartbeat.<sup>13,17</sup>

## 3. BIOCERAMIC technology experiments strengthen the TCM concept

### 3.1. Photoluminescence of BIOCERAMICS (PLB) and BIOCERAMIC resonance (BR)

Photoluminescence of BIOCERAMICS (PLB) is the technique of using BIOCERAMIC materials with sponge-like density materials to absorb a portion of the EM spectrum (including near, middle, and far infrared wavelengths) and emit lower energy wavelengths between 480 nm and 780 nm. The level of illumination was strictly controlled at 500 lux, thus avoiding thermal effects. Since discovering that the effects of a BIOCERAMIC field can be transmitted via sound waves propagation (Fig. 3a), a BIOCERAMIC Resonance (BR) device has been developed which produces weak force field throughout the body and achieves resonance with the body's meridian channels (Fig. 3b) to reinforce the microcirculation. This technique has been proven to weaken hydrogen bonds, alter the characteristics of liquid water and promote the function of the microcirculation.<sup>7,8,19</sup> Many physical, chemical and biological effects can also be induced with BIOCERAMICS at room temperature without the necessity of direct contact.<sup>9,19</sup> BIOCERAMIC Resonance is a device equipped with an electrical circuit and a speaker, which produces non-sinusoidal waveforms similar to pulse waves which then passes through the BIOCERAMIC film to propagate the sound waves by vibration (Fig. 3b), and then penetrates deeply into human tissues. This application is also based on Wang's theory<sup>23–28</sup> and our own experience shows that there are specific resonance patterns in each one of the twelve different harmonic sound frequencies that originate from a human heartbeat (Table 2).<sup>6,10–19</sup> A series of human trials approved by the Human Subjects Committee have been conducted (IACVC Approval LAC-101-0093, TH-IR0014-0001, TMU-JIRB201207024, TMU-JIRB201210029, TMU-IRB-CRC-02-08-08, TMU-JIRB201007004 & TMU-JIRB201105006).<sup>10–14</sup>

### 3.2. The concept of 'wave-induced flow characteristics of meridians'

Our data showed that PLB has beneficial effects on the flow of current of abnormal meridians. Significant interactions have been shown with the current flows of the relative meridians (Fig. 3c).<sup>10</sup>

We also used a noninvasive PLB technique on the skin surface of the 12 meridians to normalize the abnormal electrical measurements at specific acupuncture points. A case of benign facial tremor

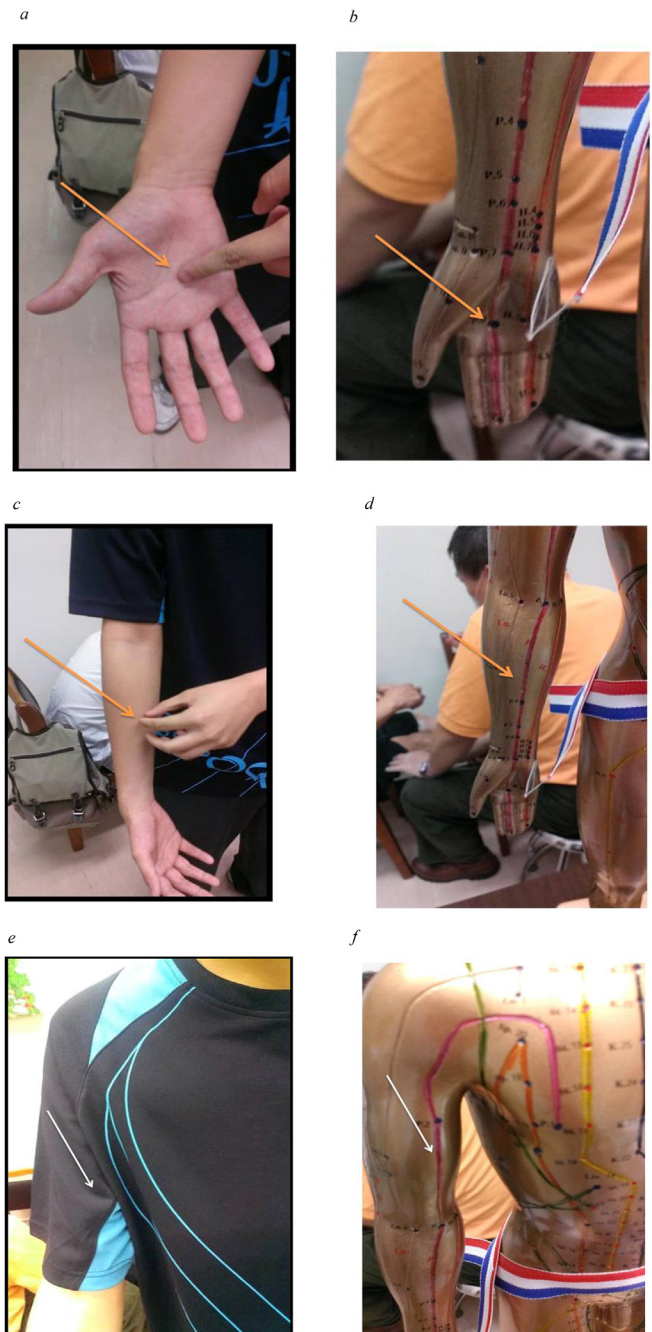


Fig. 4. From hand to shoulder, PSM along 'Pericardial' meridian on right upper limb, compared to the roadmap on acupuncture Bronze man model(4a–4f).

was treated with PLB for 1 month. PLB improved the facial tremor and normalized the effects on the meridian current levels at the gall bladder, lungs, small intestine, bladder, and kidney.<sup>11</sup>

### 3.3. BIOCERAMIC provokes 'propagated sensation along meridian (PSM)'

In our experiments, there was a high percentage of induced sensations along meridians during stimulation with PLB and BR. PLB caused about 20–30% of our candidates to feel or sense a propagated sensation along the skin surface of the meridian lines.<sup>10–12</sup> The locations of the propagated sensation along

**Table 3**  
Results of BR experiment 1 with input sound frequency at 10 Hz

Gender	Recorded area	Corresponding to number of harmonic frequencies (HF) according to heartbeat	Remarks
F	Ventral forearm, bilateral sides	12 <sup>th</sup>	
F	Medial aspects of bilateral lower legs and thighs	1 <sup>st</sup>	
M	Midline at posterior aspect of trunk	Unclassified	
M	Lateral aspects of bilateral lower legs and thighs	6 <sup>th</sup>	
F	Lateral aspect of right lower leg and thigh	6 <sup>th</sup>	
M	Posterior aspect of scalp on head, right side	6 <sup>th</sup>	Previous hemorrhagic stroke with weakness of right upper and lower extremities
F	Dorsal surface of left great toe	3 <sup>rd</sup>	
M	Dorsal aspect of right upper extremity	8 <sup>th</sup>	Previous surgical treatment of colon cancer
F	Dorsal aspect of right upper extremity	8 <sup>th</sup>	Acute shoulder pain at right side
F	Lateral aspect of right lower leg and thigh	6 <sup>th</sup>	
F	Medial aspect at ventral sides of bilateral forearms	11 <sup>th</sup>	
F	Lateral aspect of right lower leg and thigh	6 <sup>th</sup>	
F	Medial aspect at ventral sides of forearm	11 <sup>th</sup>	
F	Dorsal aspect of right upper extremity	8 <sup>th</sup>	Acute shoulder pain at right side
M	Medial aspect of bilateral lower legs and thighs	1 <sup>st</sup>	
M	Lateral aspect of right lower leg and thigh	6 <sup>th</sup>	Right neck pain

**Table 4**  
Under BR, different chief complaints of candidates match with corresponding sensations of specific meridian channels.

Chief complaints	Sex	Age	Sensation on Meridian Channels (Number of Harmonic Frequencies)
Dyspepsia	M	25	Yangming Stomach Channel (5th HF) at bilateral sides of the throat, chest, abdomen, and lower extremities
Poor appetite	F	32	Yangming Stomach Channel (5th HF) at bilateral sides of the throat, chest, and abdomen
Posttraumatic head injury (right side), complicated by intermittent migraine	F	55	Shaoyang Gallbladder Channel (6th HF) at right side of head, posterior neck, and upper lateral chest
Insomnia	M	61	Jueyin Pericardium Channel (12th HF) at bilateral ventral sides of hands and arms
Insomnia	F	36	Taiyang Bladder Channel (7th HF) and Shaoyang Gallbladder Channel (6th HF) at bilateral sides of the head and posterior neck
Migraine	M	62	Shaoyang Sanjiao Channel (9th HF) at the left upper arm
Anxiety and insomnia	M	36	Shaoyang Sanjiao Channel (9th HF) at the bilateral sides of lateral scalp of head
Benign facial tremor, left	F	52	Shaoyang Gallbladder Channel (6th HF) at the bilateral upper arms
Low back pain with bilateral posterior leg radiculopathy	M	45	Taiyang Bladder Channel (7th HF) at the buttock, bilateral thighs and legs
Old hemorrhagic stroke with facial weakness and paralysis of the right upper and lower arm	M	60	Shaoyang Gallbladder Channel (7th HF) at the right posterior neck
Insomnia	F	40	Taiyang Bladder Channel (7th HF) at the occipital head
Insomnia	F	45	Shaoyang Sanjiao Channel (9th HF) at the right hand to arm

meridian(PSM) may allow for the creation of roadmap representing the corresponding TCM meridian channels (Fig. 4). The PSM phenomenon is not an usual sensation and may be explained by external stimulation like heat or pain. A previous publication by our group reported that using PLB to alter the characteristics of liquid water accompanied with irradiation on different acupuncture points induced effects on the corresponding electrical conductivity measurements.<sup>10–12</sup> We also reviewed previous studies on meridian systems to determine their propagation, stimulation, current measurement, fluid characteristics, anatomy, energy consumption, sound and light transportation. We utilized scientific evidence to explain how meridians possess wave-induced flow characteristics.<sup>10</sup> A meridian is a channel of interstitial fluid without an external wall,<sup>12,36</sup> and is important in explaining the phenomenon of PSM. It was previously believed that the mechanisms of neuro-modulation and volume transmission (VT) were related to PSM.<sup>30</sup> Many similarities can be found, a finding which has led to the assumption that PSM is a process of VT in peripheral tissue along meridian channels,<sup>37</sup> the most important component of interstitial fluid under conditions of low hydraulic resistance. Zhang et al.<sup>36,38</sup> conducted a hydro-mechanic study exploring the fundamentals of

acupuncture points and meridians and measuring the transmission of artificial interstitial fluid pressure waves to examine their connection with low resistance points; and a strong connection was confirmed between the points. This indicates that the points form channels along the meridians (low-hydraulic resistance channels), corresponding to the meridian channels.<sup>36,38</sup> During the process, degranulation of histamine from mast cells occurs along the route (meridian channel), which can lead to a dilation of the microvessels, thus increasing blood perfusion and interstitial fluid volume. These changes send a simultaneous continuous sensate signal to the nervous system which can be felt as a PSM.<sup>30,39</sup>

Another experiment was performed on candidates receiving BR set at a sound frequency of 10 Hz for 1 h using a large BR device. The candidates were asked to be especially aware of any changes within their body. Observations and recordings of subjective descriptions were performed immediately following the experiments to find out the possibility of BR-induced sensation(BRIS) on skin, subcutaneous tissue or the muscular part along specific roadmaps that represent specific sites of harmonic frequencies according to the TCM theory. During the experiments, 16 candidates were recorded with a subjective BRIS on the skin, subcutaneous tissue, and muscle groups.

During BR operations, their descriptions and data are shown in Table 3. Our experiment also showed that the different chief complaints of the candidates (such as insomnia and migraine) matched with the BRIS sensation corresponding to specific meridian channels (Table 4). In summary, combining the work and hypothesis by D.A. McDonald et al. and W.K.Wang et al., as well as our BR experimental results, it can be deduced that different propagated waves with different resonance harmonic frequencies arise from heartbeat. This medical physics phenomenon is the basic fundamental concept to explain the presence of different meridian channels on the human body.

### 3.4. BIOCERAMIC to verify reflexology

Using BIOCERAMICS to verify reflexology was done by the application of Electric Current Detection (ECD) to the palmar surface of the hands at reflex points matching specific organs and glands according to standard reflexology.<sup>13</sup> We compared the changes in the electrical current observed before and after a session of BIOCERAMIC Resonance treatment by producing a weak force field on the subjects' soles along with simultaneous stimulation of a specific point on the surface of the ear representing the urinary bladder. The electrical current ( $\Delta\mu$  ampere) on the areas of the hands decreased compared to that recorded at the beginning of the experiment. However, a statistically significant ( $p < 0.05$ ) increase in electrical current was detected on the surface of the ear representing the urinary bladder. Our findings suggest that the existence of virtual channels interconnecting reflex points on the skin surface of the feet, hands and ears somehow reflects the condition of specific internal organs/tissues, as mapped out on standard charts

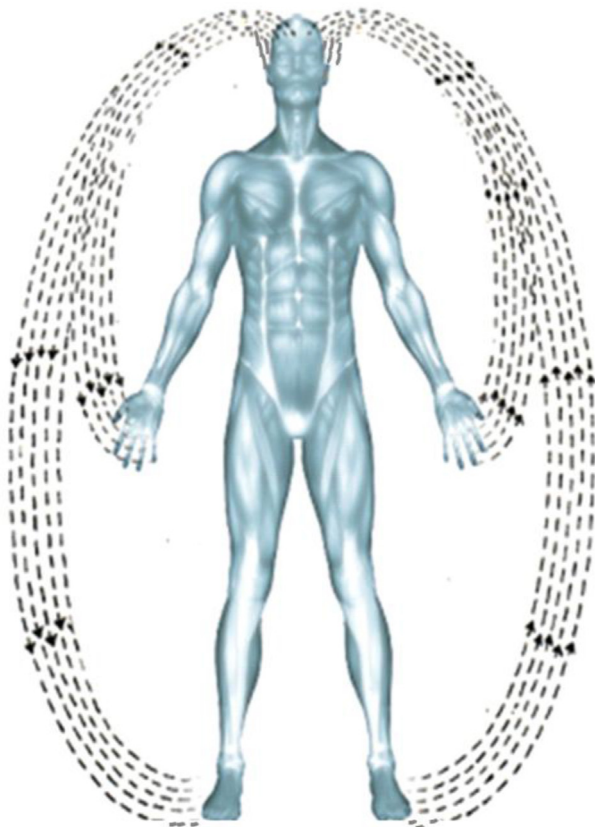


Fig. 5. Schematic drawing of the hypothetical virtual channels of 'biofield' interconnecting human's 'feet-hands-ears'.

found in reflexology<sup>13</sup> (Fig. 5). Our results also support the hypothesis advocated by Popp and Zhang.<sup>31,32</sup>

## 4. Discussion

The concepts of the standing wave hypothesis and those of cardiovascular physiology applied to meridian channels, AATP caused by ischemia due to incompetent resonance of standing waves and the clinical experience associated with the application of BIOCERAMIC technology, are helping TCM practitioners to establish a basic medical knowledge, so as to permit interdisciplinary interaction and academic cooperation between mainstream and TCM doctors. This system has been developed from material science, molecular biology, biochemistry and physiology, integrated with traditional oriental medical concepts based on scientific evidence. Clinical experience may be accumulating like that of Western medicine, thus allowing the development of an effective educational and heritage system of the associated medical skills. Interpretation of the clinical methods and hypotheses may be simplified and unified by the integration of a qualitative and quantitative systematic approach. This system also promotes instrumentalization and the use of a scientific approach of TCM to develop advanced diagnostic or therapeutic devices for future applications and data collection. Clinically the beneficial effects of BIOCERAMICS on psychologically-related sleep disturbances has been proven by experimental findings of sleep pattern and quality of life assessed by questionnaires.<sup>14</sup> Analysis of the electroencephalogram (EEG) of these patients identified an elevation in the beta spectrum of the EEG (at 15–27 Hz) during BR treatment.<sup>14</sup> Furthermore, a functional MRI was used to detect the activation and the deactivation of corresponding cerebral and cerebellar areas during BR treatment.<sup>14</sup> The application of BR was reported successful in the treatment of patients with substance abuse and withdrawal symptoms in clinical cases involving stimulant addiction and overdose of hypnotic drugs, based on the concept of the 12 meridian channels of TCM, an alternative to psychotherapy and physiotherapy. The patients demonstrated beneficial effects of BR such as relief of depression, sleep deprivation and other mental symptoms.<sup>15</sup>

## 5. Conclusion

This literature review was conducted to emphasize the importance of integrating TCM and mainstream medical science. It was also conducted to promote a framework for the basic medical science education of TCM education, which includes: (1) TCM concepts based on physics and physiology: (i) physical theory of pulse sound and cardiovascular physiology: resonance of harmonic sounds with specific frequencies arising from heartbeats to form pathways of different meridian channels to enhance the function of the microcirculation; (ii) standing wave hypothesis to explain meridians; (iii) AATP caused by ischemia due to inappropriate harmonic resonance of standing waves; and (2) TCM concept strengthened by BIOCERAMIC technology: (i) 'wave-induced flow characteristics of meridians'; (ii) provokes 'propagated sensation along meridian (PSM) phenomenon'; (iii) clinical observation of the different chief complaints of candidates with sensation induced on specific meridian channels; (iv) generates 'biofield' phenomenon with virtual channels of interconnecting 'feet-hands-ears' to different internal organs/tissues that confirms the principles of reflexology.

## Acknowledgments

This study was supported by a grant (No. PTH10730) from Taoyuan General Hospital, Ministry of Health and Welfare. Authors



declare no conflict of interest in this study.

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