



Original Article

Trends in Domestic and Foreign Clinical Research on Ultrasound-Guided Acupuncture



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ABSTRACT

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Background: The purpose of this study was to analyze domestic and foreign clinical research into ultrasound-guided Oriental medicine acupuncture.

Methods: Ultrasound-guided Oriental medicine acupuncture studies were retrieved from PubMed, CNKI, KISS, NDSL, and OASIS.

Results: Of 6,260 articles, 17 articles were selected. There was 1 article in 2004, 1 in 2008, 2 in 2011, 1 in 2012, 4 in 2013, 3 in 2016, 2 in 2017, and 3 in 2018. Of the 17 selected articles 6 articles were studies of omalgia, 4 of knee pain and 2 of peroneal nerve palsy. In addition, there was 1 article of occipital headache, 1 of neck pain, 1 of tarsal tunnel syndrome, 1 of angioma and 1 of hiccup. In these 17 studies the ultrasound frequency range where mentioned, was 5-14 MHz.

Conclusion: This study provided basic data as reference for the design of more diversified and systematic clinical research in the domestic Oriental medicine community in the future.

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Introduction

Oriental medicine procedures such as acupuncture therapy and pharmacopuncture therapy are relatively safe and effective Oriental medicine treatments used with various methods, in various diseases. Interestingly, Oriental medicine procedures performed in high risk areas of the body may result in a risk of injuries being reported, particularly when insertion into a specific anatomical structure is performed. This limits performing Oriental medicine acupressure by palpation with the hand or using needling sensation to determine the accurate location (*de qi*) for the treatment.

Ultrasound imaging diagnostic apparatus are very efficient equipment that can visualize the internal anatomical structure of the human body using a harmless, non-invasive method. As well as diagnosis of disease, ultrasound can be a very useful guide for accurate and safe procedure during acupuncture therapy [1]. However, it is not feasible for Oriental medicine doctors to use ultrasound machines routinely due to limited access, and typically their use is restricted to needle therapy, electroacupuncture, acupotomy, and pharmacopuncture.

Thus, this study analyzed clinical research that used ultrasound-guided Oriental medicine using needle therapy, electroacupuncture, acupotomy and pharmacopuncture, to examine the research trends, both domestically and in foreign countries.

Materials and Methods

Articles searches

Foreign articles were retrieved from PubMed and CNKI, whilst domestic articles were retrieved from NDSL (National Digital Science Library), KISS (Korean Studies Information Service System), and OASIS (Oriental Medicine Advanced Searching Integrated System). "Ultrasound" was combined with "The Oriental medicine acupuncture" to retrieve articles. The Oriental medicine acupuncture was limited to acupuncture, electroacupuncture, acupotomy, and pharmacopuncture. The search was performed using the Boolean operators "AND" and "OR", and a cross-search of "Patient and Intervention" was performed (Table 1). "Patient" was

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Table 1. Example of Search Strategy (MEDLINE via PubMed).

Phase	Search strategy
#1	Ultrasound OR ultrasono OR ultrasonography OR US
#2	Acupuncture OR acupoint OR electroacupuncture OR acupotomy OR pharmacopuncture OR herbal acupuncture OR hydro acupuncture
#3	1 AND 2

English search terms	Korean search terms	Chinese search terms
Ultrasound, Ultrasono, Ultrasonography, USG	초음파	超声波
Acupuncture	침	針 經穴 穴道
Electroacupuncture	전침	电针
Acupotomy	침도 도침	針刀 刀針
Pharmacopuncture, Herbal acupuncture, Hydro acupuncture	약침 수침	葯針 水針

Fig. 1. The search term for English, Korean and Chinese languages.

the search term related to “Ultrasound,” and “Intervention” was the search term related to “The Oriental medicine acupuncture.” Fig. 1 shows detailed search terms in Korean, English and Chinese. In the, Korean, English and Chinese searches used for each database, no limits were put on the year of publication. The search was performed on September 1, 2018, and 6,260 articles were retrieved in total.

Selection of articles

A total of 6,260 articles were retrieved, duplicates were excluded ($n = 4,233$) leaving the titles and abstracts of 2,027 articles. These were examined to exclude those unrelated to Oriental medicine acupuncture using ultrasound ($n = 1,962$). From the remaining 65 articles those with original text that could not be read ($n = 26$) were excluded, as were review articles without clinical cases ($n = 11$), articles using other treatments ($n = 6$) or articles not using ultrasound guided treatments ($n = 5$). Excluding 6,243 articles out of the total of 6,260 articles, 17 articles were selected (Fig. 2).

Results

Distribution by year

The 17 selected articles were categorized by the year of publication and consisted of 1 article in 2004, 1 in 2008, 2 in 2011, 1 in 2012, 4 in 2013, 3 in 2016, 2 in 2017, and 3 in 2018 (Table 3).

Distribution by country

Distribution of articles according to the country of publication

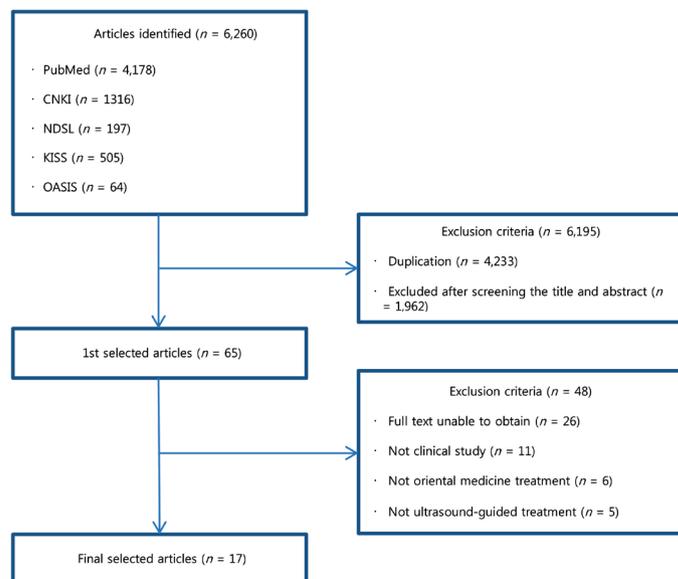


Fig. 2. Flowchart of the trial selection process.

Table 2. Study Design of the Selected Articles by the Year of Publication.

Publication year	Case report	Case series	nRCT	RCT	Total
2004		1			1
2008				1	1
2011	1	1			2
2012		1			1
2013	1		1	2	4
2016	1			2	3
2017		1		1	2
2018		1		2	3
Total	3	5	1	8	17

nRCT, non-randomized controlled trial; RCT, randomized controlled trial.

showed that most articles were Chinese in origin, as previously reported (11), followed by 5 Korean articles and 1 article published in the US.

Study design analysis

The 17 selected articles were divided into case reports, case series, non-randomized controlled trial (nRCT) and randomized controlled trial (RCT). Three were case reports, 5 were case series, 1, was a nRCT, and 8 were RCTs (Table 2).

Diseases by study

Of the 17 articles classified by disease, there were 6 studies of omalgia; 4 of knee pain; and 2 of peroneal nerve palsy. In addition, there was 1 article on occipital headache, 1 on neck pain, 1 on

Table 3. Summary of the 17 Selected Articles.

Author (y)	Study type	Object	Treatment Group/Control Group	Treatment site	Ultrasound Frequency
Zheng M [2] (2004)	Case series	Superficial angioma	<i>n</i> = 861, Electric needle leaded by ultrasound	Superficial angioma lesion	7.5 MHz
Kim HB [3] (2008)	RCT	Knee osteoarthritis	T: <i>n</i> = 21, Intramuscular Bee Venom herbal acupuncture C: <i>n</i> = 24, Intracutaneous Bee Venom herbal acupuncture	T: Deep muscle C: Hakjeong (LE110), Naeseulan (LE201), Dokbi (ST35), Joksamni (ST36), Gokcheon (LR8)	NR
Kim SH [4] (2011)	Case report	Peroneal nerve palsy	<i>n</i> = 1, General oriental medicine therapy (acupuncture, pharmacopuncture, cupping, herbal medicine) and acupotomy	0.5 cun behind and 0.5 cun below the Yangneungcheon (GB34)	NR
Park MY [5] (2011)	Case series	Posterior headache	<i>n</i> = 2, Acupuncture, herbal medicine and ultrasound-guided acupotomy	Superior nuchal line, cervical spinous processes, levator scapula attachment site	NR
Kim SH [6] (2012)	Case series	Peroneal nerve palsy	<i>n</i> = 3, General oriental medicine therapy (acupuncture, pharmacopuncture, moxibustion, cupping, physical therapy, herbal medication) and acupotomy	0.5 cun behind and 0.5 cun below the Yangneungcheon (GB34)	NR
Chen LZ [7] (2013)	RCT	Shoulder pain	T: <i>n</i> = 40, Ultrasound-guided acupuncture C: <i>n</i> = 40, Acupuncture	Rotator cuff, biceps brachii tendon, deltoid muscle, subacromial bursa	NR
Guo Q [8] (2013)	nRCT	Periarthritis humeroscapularis	T: <i>n</i> = 30, Small-needle-knife therapy under ultrasonography guidance C: <i>n</i> = 30, Small-needle-knife therapy	Coracobrachialis, biceps brachii short head, supraspinous muscle, infraspinous muscle, teres minor	12.5 MHz
Roy [9] (2013)	Case report	Supraspinatus tendinopathy	<i>n</i> = 1, Dry needling	Supraspinatus tendon	7-13 MHz
Su H [10] (2013)	RCT	Neck back fasciitis	T: High frequency color Doppler ultrasound-guided little needle knife C: Little needle knife	Neck back fascia	9-14 MHz
Ding Y [11] (2016)	RCT	Knee osteoarthritis	T: <i>n</i> = 30, Ultrasound-guided acupotomy C: <i>n</i> = 30, Electro-acupuncture	T: A-shi point C: Neixiyan (EX-LE 4), Xiyan (EX-LE 5), Xuehai (SP 10), Liangqiu (ST 34), Yanglingquan (GB 34), Yinlingquan (SP 9)	NR
Liang HY [12] (2016)	RCT	scapulohumeral periarthritis	T: <i>n</i> = 115, Knife acupuncture therapy guided with high-frequency ultrasound C: <i>n</i> = 109, Knife acupuncture therapy without high-frequency ultrasound	Supraspinous muscle, infraspinous muscle, teres minor	5-12 MHz
Jeong JK [13] (2016)	Case series	Rotator cuff Disease	<i>n</i> = 4, Ultrasound-guided Bee Venom pharmacopuncture combined with integrative Korean Medicine treatment (acupuncture, herbal medicine, physical therapy)	Gyeonu (LI15), Byeongpung (SI12), Gogwon (SI13), Gyeollyo (TE14), Cheonjong (SI11), Nosu (SI10), Gyeonjeong (SI09), Unmun (LU02), Nohoe (TE13)	NR
Li M [14] (2017)	RCT	Knee osteoarthritis	T: <i>n</i> = 28, Ultrasound guided needle knife C: <i>n</i> = 27, Needle knife	Medial & lateral collateral ligament, patellar tendon, medial&lateral patellar retinaculum, ITB, suprapatellar bursa, quadriceps femoris tendon, suprapatellar bursa	7-12 MHz
Shi ZT [15] (2017)	Case series	Degenerative meniscus disease	<i>n</i> = 77, Ultrasound-guided needle-knife	Patellar ligament, medial&lateral meniscus	5-10 MHz
Lin S [16] (2018)	Case series	Metatarsal tunnel syndrome	<i>n</i> = 43, Needle knife	Posterior tibial muscle anterior region~medial malleolus posterior region tibial nerve posterior inferior region~Calcaneus medial region	NR
Liu J [17] (2018)	RCT	Rotator cuff calcification tendinitis	T: <i>n</i> = 31, Ultrasound guided needle knife treatment with acupuncture therapy C: <i>n</i> = 31, Ultrasound guided needle knife treatment	Rotator cuff lesion tendon	NR
Liu Y [18] (2018)	RCT	Intractable hiccup	T: <i>n</i> = 15, Ultrasound guided acupuncture C: <i>n</i> = 15, Acupuncture	Gyeoksu (BL17) Joksamni (ST36)	NR

C, control group; nRCT, non-randomized controlled trial; NR, not reported; RCT, randomized controlled trial; T, treatment group.

Table 4. Treatment Method by Disease in the Selected Articles.

Disease type	Treatment type				Total
	Acupotomy	Acupuncture	Pharmacopuncture	Electroacupuncture	
Shoulder pain	3	2	1		6
Knee pain	3		1		4
Peroneal nerve palsy	2				2
Posterior headache	1				1
Neck back fasciitis	1				1
Metatarsal tunnel syndrome	1				1
Superficial angioma				1	1
Intractable hiccup		1			1
Total	11	3	2	1	17

Table 5. Research Method by Treatment Method in the Selected Articles.

Treatment	Study type				Total
	Case report	Case series	nRCT	RCT	
Acupotomy	1	4	1	5	11
Acupuncture	1			2	3
Pharmacopuncture		1		1	2
Electroacupuncture		1			1
Total	2	6	1	8	17

nRCT, non-randomized controlled trial; RCT, randomized controlled trial.

tarsal tunnel syndrome, 1 on angioma and 1 on hiccup (Table 4).

Treatment method by study

The 17 selected articles were classified by treatment method. Of the 17 articles, most were studies that performed acupotomy therapy, followed by 3 studies that performed acupuncture therapy, 2 studies that performed pharmacopuncture therapy, and 1 study that performed electroacupuncture therapy (Table 5).

Ultrasound frequency by study

Analysis of the frequency of ultrasound used in the 17 selected studies showed an ultrasound frequency range of 5-14 MHz was used, and there were differences within this range according to the study. The frequency ranges were 5-10 MHz, 5-12 MHz, 7.5 MHz, 7-12 MHz, 7-13 MHz, 9-14 MHz and 12.5 MHz. In 10 articles the frequency was not mentioned.

Discussion

Ultrasound is a sound wave with elasticity, and there is a mechanical interrelationship between this and the body. In the sound wave, a wave is produced along the route of progress, and since energy decreases with distraction and heat, diminution takes

place. Ultrasound imaging is made by detecting an echo reflected in the body tissue or on the interface, and the relative intensity of the reflected sound wave is displayed as the relative brightness of pixels in an image. Ultrasound imaging collects the direction of progress of this sound wave, the time of return after reflection and the echo intensity, and shows them as an image.

Medical ultrasound visualizes muscles, tendons and many internal organs, and their size, structure and pathological damage with a real-time tomographic scan, which provides diagnostic medical imaging [19]. Medical ultrasound measures the reflected wave returning from the interface of tissues using ultrasound frequencies at 1-10 MHz, which is a nondestructive and non-invasive process that allows procedures to be safely performed by locating blood vessels or nerves during acupressure treatments [5].

However, compared to the routine use ultrasound technology in Western medicine, ultrasound has not been widely used in Oriental medicine as studies are based on a theory of anatomical connectivity through the meridian systems and meridian muscles. In addition, Oriental medicine doctors find it difficult to approach the use of ultrasound technology due to accessibility in the clinic compared to Western medicine where ultrasound machines are readily available. This is despite the fact that ultrasound can show visible results throughout the process of patient treatment, and allow comparisons of before and after images. Subsequently, if ultrasound studies based on anatomical theory continue, it would be possible to visualize Oriental medicine therapy in progress. Internal diseases as well as several musculoskeletal diseases treated by Oriental medicine may be performed to a higher quality through ultrasound visualization.

Thus, the aim of this study was to understand the current research directions in ultrasound-guided Oriental medicine acupuncture, both at home and abroad through searching databases (PubMed, CNKI, KISS, NDSL, and OASIS) for clinical research on Oriental medicine acupressure using ultrasound.

The 17 selected articles were analyzed, and showed that research began to be published in China in 2004. Studies have consistently been published each subsequent year showing that there has been an increasing interest in ultrasound-guided procedures. Most studies were published in China, followed by 5 in Korea and one in the US, and since ultrasound was the first phase of search terms used, it was not surprising that most articles selected for this study were RCTs. There have been no studies published in Korea and

the US since 2016, while studies have been published in China up until 2018. When the selected articles were analyzed by condition the most common was omalgia studies (6 articles), followed by knee pain (4 articles). Generally, ultrasound guidance was used to accurately locate, aiding the procedure to avoid side-effects like pneumothorax. The treatment method most commonly used was acupotomy therapy (11 articles) indicating that this therapy requires more accuracy and safety in procedures with deeper and broader regions and benefits from ultrasound guidance.

The range of frequencies of ultrasound in the studies was usually between 5-14 MHz. The range differed depending on the study, but it was found that usually, the ultrasound frequency was between 5-15 MHz to observe musculoskeletal systems or superficial organs whilst a frequency of between 3.5-5 MHz was used to observe abdominal organs. There were 10 articles that did not mention the frequency. Liu et al [18], who performed abdominal ultrasound, did not mention the frequency. To develop accurate methodology the ultrasound frequency used in studies should be published for the reproducibility of research.

Lee [20] observed a safe needling depth and morphological structure of the acupuncture points around the shoulder joint using musculoskeletal system ultrasound, while Kim et al [21] explored the reliability of ultrasound as a system to evaluate safe needling depths for abdominal acupoints and checked reproducibility throughout the study to measure the vertical distance of the Shang Wan-pancreas. Chen et al [22] measured the depth of *jianjing* (GB21) using ultrasound to prevent pneumothorax.

Studies using ultrasound from various fields have been reported in Oriental medicine. However, most are case reports or case series, and there are relatively few studies that systematically discuss these articles. The limitations of this study were that the number of articles was small (17) and that most studies were case reports or case series. However, it was found that ultrasound-guided Oriental medicine acupuncture has a constant effect and that ultrasound related studies have steadily been conducted since 2011. Thus, at this point when there is an increasing medical interest in ultrasound, it seems that it is necessary for the domestic Oriental medicine community to take more interest in it and conduct more studies. It is judged that it would be necessary to conduct studies utilizing various Oriental medicine interventions and research related to ultrasound that can be applied to domestic clinical practice in the future. This study would provide basic data for the design of more diversified and systematic clinical research by the domestic Oriental medicine community in the future.

Ultrasound is an auxiliary medical device used in various noninvasive procedures as well as for diagnostic purposes. This study has highlighted the fact that it is necessary to continue to conduct studies that broaden the range of applications of ultrasound and secure accuracy and safety of Oriental medicine acupuncture.

Conflicts of Interest

The authors have no conflicts of interest to declare.

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