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Review Article

Characteristics of Warm Acupuncture Reported in Experimental Studies: A Descriptive Narrative Review

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ABSTRACT

Background: This study aimed to investigate the correlation between heat transmission and intervention factors for warm acupuncture (such as features of acupuncture material and moxa, the treatment method, and clinical symptoms).
Methods: Korean, English, Chinese and Japanese databases were analysed. Experimental studies that explored the association between thermal stimulation delivery and warm acupuncture intervention factors were included. The peak temperature, time to reach the peak temperature, and time of the effective stimulus, were set as the major parameters and analysed.
Results: A total of 12 studies were included. Two studies were associated with the acupuncture needle material, 4 studies associated with the moxa mass, 1 study associated with the moxa density, 2 studies associated with the location of ignition, and 1 study associated with treatment environment were reviewed. The reporting quality of the 12 studies was low.
Conclusion: This study provided limited information because of the heterogeneity of materials and parameters depending on each experiment. Further studies should clarify the correlation between heat transmission and intervention factors for warm acupuncture.

Introduction

Warm acupuncture (WA) is a combination therapy including acupuncture and moxibustion [1]. A needle is inserted in the patient's body, and a moxa cone is fixed on the handle of the needle, which is subsequently ignited [1,2]. WA has the warming effect of moxibustion and the stimulatory effect of acupuncture on patients [3]. Thus, WA intervention factors should be optimised for maximum heat transmission for an effective treatment. Currently, studies on the clinical efficacy and safety of WA are underway. However, there are 2 limitations. Firstly, fundamental studies on the correlation between intervention factors and heat transmission are insufficient in number. Secondly, WA is performed arbitrarily depending on the practitioners, as there are no distinct criteria or guidelines for WA intervention factors and clinical conditions [3-5].

WA intervention factors for effective heat transmission should be understood so that clinical efficacy of WA can be evaluated. Through observation and accumulation of data for each intervention factor, authentic resources could be accumulated for future studies and a unified WA procedure could be designed [6].

In this study, WA intervention factors were reviewed to determine whether there were any correlations between heat transmission and WA intervention factors (features of the acupuncture material and moxa, treatment method, and clinical symptoms).

Materials and Methods

Search method

Database search

To identify and collect the relevant studies, 11 electronic databases, including Korean databases [Korean studies Information Service System (KISS), National Digital Science Library (NDSL), Oriental Medicine Advanced Searching Integrated System (OASIS), Research Information Sharing Service (RISS), DataBase Periodical

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Information Academic (DBpia)], English data bases [Cochrane Central Register of Controlled Trial (CENTRAL), Cumulative Index to Nursing and Allied Health Literature (CINAHL), EMBASE, MEDLINE], a Chinese database [China Academic Journal Full-text Database (CAJ)] and a Japanese database [Japan Science and Technology Agency (J-STAGE)] were used.

Search strategy

The studies were analysed on the intervention factors of WA. To retrieve the relevant studies, search words related to WA were used. No other criteria were included in the search strategy. Table 1 lists the specific search strategy.

Search methods

The studies registered or published up to 1 September 2018, were collected. There were no language restrictions. One researcher retrieved studies and another analysed them. The duplicates were removed. Studies were then selected following an evaluation of the titles and abstracts.

Table 1. Search Strategy.

English database	
#1	Acupuncture[mh] OR Acupuncture needle[mh] OR Acupunctur*[tiab] OR Needl*[tiab] OR Acupress[tiab]
#2	warm*[tiab]
#3	#1 AND #2
#4	"warm acupuncture"
#5	"warm needle"
#6	"warm needling"
#7	"warming needle"
#8	"warm acupress"
#9	#4 OR #5 OR #6 OR #7 OR #8
#10	#3 OR #9
Korean database	
#1	warm needle ∣ warm acupuncture ∣ warm acupress ∣ warming needle ∣ warm needling (∣ =OR)
#2	온침
#3	#1 and #2
Japanese database	
#1	warm needle OR warm acupuncture OR warm acupress
#2	warming needle OR warm needling
#3	温鍼
#4	灸頭鍼
#5	#1 OR #2 OR #3 OR #4
Chinese database	
#1	SU=('warm needle'+'warming needle'+'warm needling'+'warm acupuncture'+warm acupress') and SU=('温针')

Study selection and eligibility criteria

Research type

The experimental studies on WA intervention factors or intervention characteristics, such as clinical environment for heat transmission during WA, were included. Studies on clinical efficacy or safety of WA, and development of WA-improving devices were excluded.

Intervention type

In this study, WA was defined as a modality providing an acupuncture effect by piercing the skin and delivery of a warming effect through ignited moxa, which was fixed on the handle of the needle. There were no restrictions on the types of moxa. All acupuncture needles that pierced the skin were accepted, regardless of the material, length, and diameter.

Thermal change parameter

This study included the experimental studies on the effect of thermal stimulus, depending on intervention factors. According to the studies on thermodynamics [7,8], a steep increase in the heat of moxa during combustion stroke, plays an important role in the warming effect. The warming effect depends on the peak temperature and the rate the temperature rises. In addition, the time of exposure to heat was important because exposure to low temperatures for a long time may cause a thermal stimulus [9]. In this study, the peak temperature, time to reach the peak temperature, and time of the effective stimulus were set as the major parameters and analysed. The studies on other parameters were analysed additionally.

Data extraction

The parameters causing a thermal effect from each study were extracted. Based on the aim of this study, the intervention factors data (acupuncture needle and moxa cone, treatment method, and clinical condition) were analysed.

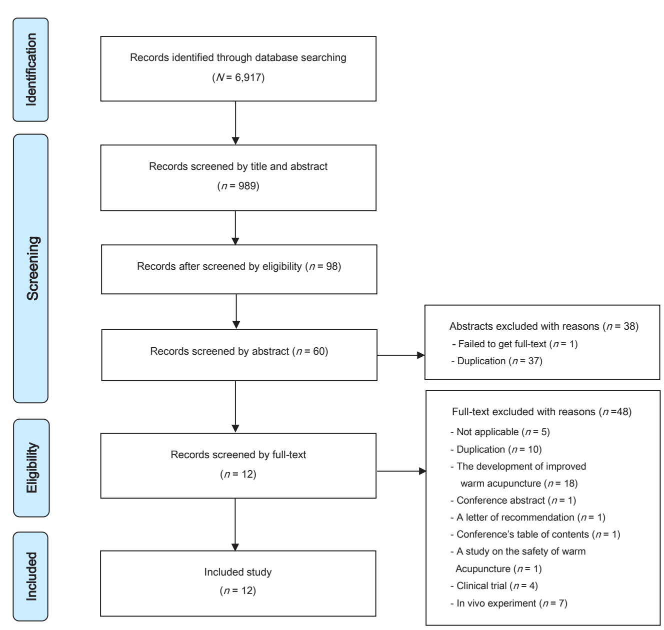

Fig. 1. Flow chart of study selection.

Results

A total of 60 studies were retrieved from the databases. The excluded data included clinical studies, case reports, clinical effectiveness reports, biometric studies (in vivo), improvement in device development studies, and systematic reviews for clinical effectiveness, duplication studies, and conference abstracts. The study sample for this review was 12 publications (Fig. 1).

Characteristics of studies

Tables 2 and 3 summarise the characteristics of the studies included in this review.

Analysis of parameters associated with WA intervention element

Peak temperature

Table 4 summarises peak temperature associated with WA elements.

1. Acupuncture material

In 2 studies [11,12], WA models composed of gold and stainless-steel were used to measure the peak temperature change, associated with the acupuncture material. The results showed that the peak temperature of the gold acupuncture was higher than that of the stainless-steel acupuncture.

One study also used peak temperature as a parameter [10],

Table 2. Classification of Studies.

		Choi (1992) [10]	Lee (2006) [11]	Yeo (2013) [12]	Kim (2008)a [13]	Hong (2009) [14]	Ahn (2010) [15]	Nagaoka (2013) [16]	Kim (2008)b [17]	Zhou (2014) [18]	Lee (2013) [19]	Yang (2017) [20]	Kim (2010) [21]
Specification	Material of acupuncture	O	O	O	-	-	-	-	-	-	-	-	-
	Mass of moxa	-	-	O	O	O	O	O	O	-	-	-	-
	Density of moxa	-	-	-	O	-	-	-	-	-	-	-	-
	Ignition position	-	-	-	-	-	-	-	O	O	-	-	-
	Heat transfer	-	-	-	-	-	-	-	-	-	O	O	-
	Treatment environment	-	-	-	-	-	-	-	-	-	-	-	O
Parameter	Peak temperature	O	O	O	O	O	-	O	O	O	-	-	O
	Time to reach peak temperature	-	O	O	O	-	-	-	O	O	-	-	O
	Effective stimulus time	-	-	O	O	-	-	-	O	-	-	-	O
	Range of temperature rises after ignition	-	-	-	-	O	O	-	-	-	-	-	-
	Mean temperature in effective stimulus	-	-	-	O	-	-	-	O	O	-	-	-
	Temperature difference of measuring position	-	-	-	-	-	-	-	-	-	O	O	-
Temperature measuring position	Acupuncture body (conduction)	O	O	O	O	O	O	-	O	O	O	O	O
	Center of moxa	-	-	-	O	O	-	O	O	-	-	-	-
	External surface of moxa	-	-	-	-	O	-	-	-	-	-	-	-
	Surrounding area (radiation)	-	-	O	O	-	-	-	O	-	-	-	-

O, reported; -, not reported.

Table 3. Summary Characteristics of Included Studies.

First author (y)	Acupuncture type (manufacture, diameter (mm) × length (mm)	Moxa type	Temperature measuring equipment	Ignition position	Temperature measuring position
Choi (1992) [10]	1. Stainless steel (Not reported, 1.0 × 55, 0.8 × 120) 2. Tungsten (Not reported, 0.8 × 80) 3. Copper (Not reported, 1.0 × 60) 4. Silver (Not reported, 0.7 × 67) 5. Gold (Not reported, 0.7 × 82)	- Shape: not reported - Mass: 5 g - Diameter: 20 mm - Height: not reported	Digital Multimeter (Model KETHLEY-175. U.S.A)	Not reported	Connect the positive and negative poles of the thermocouple to both ends of the needle body.
Lee (2006) [11]	1. Stainless steel (Dongbang, 0.25 × 40) 2. Gold alloy (Dongbang, 0.53 × 35)	- Shape: ball type - Mass: 0.50 ± 0.01 g - Diameter: 20 mm - Height: not reported	Thermo couple (Self-made)	Apex ignition	Temperature measured at 1 cm and 2 cm below the head.
Yeo (2013) [12]	1. Stainless steel (Dongbang, 0.25 × 40) 2. Gold alloy (Dongbang, 0.53 × 35)	- Shape: cone type - Mass: 0.2, 0.4, 0.6, 0.8, 1.0 g - Diameter: 11.4, 22.4, 25, 28.5, 33.3 mm - Height: not reported	Thermocouple (K type-TT-40-SLE, Omega, USA) Using labview system	Apex ignition	Temperature measured at 1 cm and 2 cm below the head radiational temperature 1.5 cm far apart from the needle.
Kim (2008)a [13]	1. Stainless steel (Dongbang, 0.25 × 40)	- Shape: cone type - Mass: 0.2, 0.4, 0.6, 0.8, 1.0 g - Diameter: 11.4, 22.4, 25.0, 28.5, 33.3 mm - Height: 10.4, 15.7, 20.4, 23.9, 25.2 mm	Thermocouple (K type-GG-36, Omega, USA)	Apex ignition	Temperature measured at 1 cm and 2 cm below the head. Radiational temperature 1.5 cm far apart from the needle.
Hong (2009) [14]	1. Stainless steel (Dongbang, 0.30 × 40)	- Shape: cone type - Mass: 0.1, 0.3, 0.5, 1.0, 3.0, 5.0 g - Diameter: not reported - Height: not reported	Infra-red thermometer (Testo 845, Korea)	Apex ignition	Temperature measured 1 cm and 2 cm from the apex, and external surface of moxa, central of moxa.
Ann (2010) [15]	1. Stainless steel (Dongbang, 0.30 × 40)	- Shape: cone type - Mass: 0.1, 0.3, 0.5, 1.0, 3.0, 5.0 g - Diameter: not reported - Height: not reported	Infra-red thermometer (Testo 845, Korea)	Apex ignition	Insert the needles 0.5 -1 mm deep into the surface of pork and measure the temperature at temperature point according to each mass.
Nagaoka (2013) [16]	1. Stainless steel (Seirin, 0.20 × 50)	- Shape: ball type - Mass: 0.15, 0.30, 0.60 g - Diameter: 13 ± 1 mm, 16 ± 1 mm, 24 ± 1 mm - Height: not reported	Digital multi-meter (MAS 838, Akizuki Denshi Tsusho, Saitama, Japan) Thermocouple (K type, Akizuki Denshi Tsusho, Saitama, Japan)	Apex ignition	Temperature measured at center of moxa ball.
Kim (2008)b [17]	1. Stainless steel (Dongbang, 0.30 × 40)	- Shape: cone type - Mass: 0.2, 0.4, 0.6, 0.8, 1.0 g - Diameter: not reported - Height: not reported	Thermocouple (K type-GG-36, Omega, USA)	Apex or bottom ignition	Temperature measured 1 cm and 2 cm from the bottom of the moxa, and central of moxa, radiational temperature 1.5 cm far apart from the needle.
Zhou (2014) [18]	1. Stainless steel (无锡佳健, 0.35 × 40)	- Shape: stick type - Mass: 2.5 g - Diameter: not reported - Height: not reported	Infra-red temperature measuring instrument (HEITRONIC CT15.12)	Apex or bottom ignition	Temperature measured 2 cm and 3 cm of the needle body from the bottom of the moxa.
Lee (2013) [19]	1. Stainless steel (An Chi Handy Acupuncture, 1.5 × 32)	- Shape: stick type - Mass: 0.6, 1.0 g - Diameter: 13 mm - Height: not reported	Infrared thermometer (Raytek Corp., CA, USA)	Lateral side ignition	Temperature measured above of acupuncture head, bottom of acupuncture head, acupuncture body, apex of the acupuncture.
Yang (2017) [20]	1. Stainless steel (Woojin, 0.30 × 40) 2. Stainles steel (HLMedical, 0.50 × 40) 3. Stainless steel (Woojeon, 0.80 × 40)	- Shape : stick type - Mass : not mentioned - Diameter: 7 mm - Height: 8 mm	Infra-red camera (Flir E30) and an infra-red thermometer (TESTO 845)	Not reported	Temperature measured 10 mm, 25 mm below the moxa stick.
Kim (2010) [21]	1. Stainless steel (Dongbang, 0.25 × 30)	1. Traditional moxa - Shape: cone type - Mass: 0.28 g - Diameter: 14.6 mm - Height: 15.5 mm 2. Charcoal moxa - Shape: stick type - Mass: 0.19 g - Diameter: 11.1 mm - Height: 5.0 mm	Thermocouple (K-type TT-40-SLE, OKmega, USA)	Not reported	Temperature measured at 7 mm and 15 mm below the acupuncture head. Radiational temperature 5 cm far apart from the needle.

Table 4. Peak Temperature Associated with Warm Acupuncture Elements.

Warm acupuncture elements	First author (y)	Measuring position	Peak temperature (℃)		*p*
Acupuncture material	Lee (2006) [11]	1 cm below the acupuncture head	Gold 111	Stainless steel 63.5	-
	Yeo (2013) [12]	1 cm below the acupuncture head	Gold 0.2 g: 83.0 ± 4.5 0.4 g: 95.1 ± 9.2 0.6 g: 95.1 ± .1.2 0.8 g: 115.7 ± 3.0 1.0 g: 122.3 ± 26.5 (mean ± SD)	Stainless steel 0.2 g: 46.7 ± 4.4 0.4 g: 48.5 ± 6.1 0.6 g: 60.3 ± .9.2 0.8 g: 58.6 ± 3.1 1.0 g: 66.9 ± 8.9 (mean ± SD)	< 0.05
Moxa mass	Kim (2008)a [13]	Center of moxa	0.2 g: 595.9 ± 20.1 0.4 g: 679.5 ± 30.7 0.6 g: 694.0 ± 79.1 0.8 g: 695.8 ± 44.5 1.0 g: 673.9 ± 18.8 (mean ± SD)		0.103 (ANOVA test)
	Hong (2009) [14]	Center of moxa	0.1 g: 485.90 ± 11.87 0.3 g: 518.57 ± 6.10 0.5 g: 575.80 ± 6.21 1.0 g: 555.90 ± 8.16 3.0 g: 619.83 ± 22.25 5.0 g: 646.50 ± 21.61 (mean ± SD)		< 0.01 (t-test)
	Nagaoka (2013) [16]	Center of moxa	0.15 g: 569 ± 26 0.30 g: 606 ± 26 0.60 g: 624 ± 48 (mean ± SD)		< 0.001 (ANOVA test)
	Kim (2008)b [17]	1 cm below the acupuncture head (bottom ignition)	0.2 g: 63.0 ± 8.3 0.4 g: 57.5 ± 7.9 0.6 g: 71.1 ± 16.8 0.8 g: 80.5 ± 2.9 1.0 g: 107.2 ± 31.2 (mean ± SD)		Not reported
Moxa density	Kim (2008)a [13]	1 cm below the acupuncture head	0.11 g/cm^3: 59.7 ± 1.5 0.16 g/cm^3: 58.6 ± 3.1 0.24 g/cm^3: 42.8 ± 2.6 (mean ± SD)		< 0.001 (ANOVA test)
Ignition position	Kim (2008)b [17]	1 cm below the acupuncture head	Apex ignition 0.2 g: 46.7 ± 4.4 0.4 g: 48.5 ± 6.1 0.6 g: 60.3 ± 9.2 0.8 g: 58.6 ± 3.1 1.0 g: 66.9 ± 8.9 (mean ± SD)	Bottom ignition 0.2 g: 63.0 ± 8.3 0.4 g: 57.5 ± 7.9 0.6 g: 71.1 ± 16.8 0.8 g: 80.5 ± 2.9 1.0 g: 107.2 ± 31.2 (mean ± SD)	< 0.05 (Mann-Whitney test)
	Zhou (2014) [18]	2 cm below bottom of the moxa	Apex ignition 47.7	Bottom ignition 40.6	-

ANOVA, analysis of variance.

but it was difficult to analyse the results, as the expression "peak temperature" was used along with the electric current unit (μA).

2. Moxa mass

In 4 studies [13-16], the peak temperature was associated with moxa mass in the WA model that were composed of stainless-steel. The peak temperature of the larger moxa mass, was higher compared with the peak temperature of the smaller moxa mass. However, the moxa mass, and measurement positions used in each study, were different.

3. Moxa density

One study measured the peak temperature associated with moxa density [13]. The peak temperature was measured at the centre of the moxa, and at 1 cm and 2 cm below the acupuncture head, where the 0.8 g moxa was transformed into a cone frame with densities of 0.11, 0.16, and 0.24 g/cm^3. The peak temperature was in the order of 0.11, 0.16, and 0.24 g/cm^3 at 1 cm and 2 cm below the acupuncture head, respectively. When the peak temperature was measured at the centre of the moxa, there were no significant differences between 1 cm, 2 cm and the central positions.

4. Ignition position

Two studies measured the peak temperature associated with ignition position [17,18]. In both the studies, the peak temperature was measured when the ignition positions were at the apex and the bottom. The results showed that the peak temperature of the bottom ignition was significantly higher compared with the apex ignition.

5. Treatment environment

One study measured the peak temperature associated with the treatment environment [21]. The air flow was set differently to measure the peak temperatures at 7 and 15 mm below the acupuncture head for WA, using traditional and charcoal moxa. The air flows were 0.0, 0.4, and 0.7 m/s, and constant air flow was induced using a fan. Although accurate measurements based on the air flow rate were not reported, the temperature change graph showed that the highest temperature corresponded to higher measurement of air flow. Furthermore, the tendency was more pronounced using charcoal moxa compared with traditional moxa.

Time to reach the peak temperature

Table 5 summarises time to reach the peak temperature associated with WA elements.

1. Acupuncture material

One study by Lee reported that the time to reach the peak temperature weakly correlated with the acupuncture material, and that the rise and fall of temperature with gold acupuncture needles was faster compared with the stainless-steel needles [11]. One study by Yeo [12] showed that the time to reach peak temperature in the gold needles was statistically significantly shorter compared with the stainless-steel needles [1 cm below the acupuncture head: 0.2 and 0.4 g ($p < 0.05$); 2 cm below the acupuncture head: 0.2, 0.4, and 1.0 g ($p < 0.05$)].

2. Moxa mass

One study reported that the time to reach the peak temperature in the larger moxa mass was faster than the smaller moxa [13].

3. Moxa density

One study measured the time to reach the peak temperature associated with moxa density [13]. It took less time to reach the peak temperature in the order of 0.11, 0.16, and 0.24 g/cm^{3}.

4. Ignition position

Two studies reported the time to reach the peak temperature was associated with ignition position [17,18]. Kim et al reported that the time to reach the peak temperature in the bottom ignition was statistically significantly shorter compared with the apex ignition [17] [1 cm below the acupuncture head: 0.2, 0.4, and 1.0 g ($p < 0.05$); 2 cm below the acupuncture head: 0.6 and 1.0 g ($p < 0.05$)].

Zhou et al reported that the time to reach the peak temperature was shorter in the bottom ignition compared with the apex ignition [18].

5. Treatment environment

None of the included studies reported the time to reach the peak temperature after altering the WA treatment environment.

Table 5. Time to Reach the Peak Temperature Associated with Warm Acupuncture Elements.

Warm acupuncture elements	First author (y)	Measuring position	Time to reach peak temperature (sec)		*p*
Acupuncture material	Lee (2006) [11]	1 cm below the acupuncture head	Gold 120	Stainless steel 140	-
	Yeo (2013) [12]	1 cm below the acupuncture head	Gold 0.2 g : 107.0 ± 6.0 0.4 g : 129.7 ± 7.0 0.6 g : 146.3 ± 6.4 0.8 g : 161.0 ± 5.3 1.0 g : 170.3 ± 11.1 (mean ± SD)	Stainless steel 0.2 g : 80.7 ± 4.5 0.4 g : 107.7 ± 15.5 0.6 g : 143.3 ± 15.0 0.8 g : 148.7 ± 17.0 1.0 g : 163.7 ± 4.9 (mean ± SD)	0.2 g, 0.4 g < 0.05 0.6 g, 0.8 g, 1.0 g : not reported (Mann-Whitney test)
Moxa mass	Kim (2008)a [13]	Center of moxa	0.2 g : 100.7 ± 11.4 0.4 g : 180.7 ± 27.2 0.6 g : 256.0 ± 43.5 0.8 g : 267.7 ± 14.0 1.0 g : 282.0 ± 30.1 (mean ± SD)		< 0.001 (ANOVA test)
Moxa density	Kim (2008)a [13]	1 cm below the acupuncture head	0.11 g/cm^3 : 141.0 ± 7.0 0.16 g/cm^3 : 148.7 ± 17.0 0.24 g/cm^3 : 187.7 ± 20.6 (mean ± SD)		0.024 (ANOVA test)
Ignition position	Kim (2008)b [17]	1 cm below the acupuncture head	Apex ignition 0.2 g : 80.7 ± 4.5 0.4 g : 107.7 ± 15.5 0.6 g : 143.3 ± 15.0 0.8 g : 148.7 ± 17.0 1.0 g : 163.7 ± 4.9 (mean ± SD)	Bottom ignition 0.2 g : 72.7 ± 1.2 0.4 g : 79.7 ± 16.4 0.6 g : 88.3 ± 15.0 0.8 g : 119.0 ± 11.3 1.0 g: 106.7 ± 8.4 (mean ± SD)	0.2 g, 0.4 g, 1.0 g < 0.05 0.6 g, 0.8 g : not reported (Mann-Whitney test)
	Zhou (2014) [18]	2 cm below bottom of the moxa	Apex ignition 16.25	Bottom ignition 4.44	-

ANOVA, analysis of variance.

Effective stimulus time

Three studies were included, and the effective stimulus time was defined as the duration of moxa combustion leading to a rise in temperature above the skin temperature of 34°C, and then falling below 34°C [12,13,17].

1. Acupuncture material

One study by Yeo reported that gold acupuncture had significantly longer effective stimulus time compared with stainless-steel acupuncture [12].

[0.6 g moxa, 1 cm below the acupuncture head; Gold 234.3 ± 12.5 sec, Stainless-steel 109.7 ± 4.0 sec, ($p < 0.05$)].

2. Moxa mass

None of the studies reported the effective stimulus time, after altering the WA moxa mass.

3. Moxa density

One study measured the effective stimulus time associated with moxa density [13]. The longest effective stimulus time was found in the order of 0.11, 0.16, and 0.24 g/cm^3.

[1 cm below the acupuncture head; 0.11 g/cm^3: 109.3 ± 10.2 sec, 0.16 g/cm^3: 124.7 ± 16.0 sec, 0.24 g/cm^3: 85.0 ± 34.7 sec ($p = 0.181$)].

4. Ignition position

One study by Kim et al [17] reported that the effective stimulus time was significantly longer in the bottom ignition compared with the apex ignition.

[0.6 g moxa, 1 cm below the acupuncture head; Apex 109.7 ± 4.0 sec, Bottom 137.3 ± 17.4 sec ($p < 0.05$)].

5. Treatment environment

None of the studies reported the effective stimulus time after altering the WA treatment environment.

Reporting quality of WA intervention

The purpose of the study was to identify the thermal characteristics of WA intervention. The quality of the reporting associated with WA used in the experiment was evaluated. Table 6 lists the thermal characteristics reported by the studies, which provides a wide range of measurements making it difficult to assess the data together.

Discussion

There were 12 studies included in this review of the characteristics of WA that correlated with heat transmission and intervention factors (acupuncture and moxa material, treatment method, and clinical condition). Changes in parameters depending on the acupuncture material during WA showed different moxa characteristics, temperature measurement times, temperature measuring devices, and different ways to determine results, and it was difficult to compare the results of the objective studies because of different lengths and diameters of acupuncture used

Table 6. Thermal Characteristics Reporting of Included Studies.

Thermal characteristics		Choi (1992) [10]	Lee (2006) [11]	Kim (2008) a[13]	Kim (2008) b[17]	Hong (2009) [14]	Kim (2010) [21]	Ahn (2010) [15]	Lee (2013) [19]	Nagaoka (2013) [16]	Yeo (2013) [12]	Zhou (2014) [18]	Yang (2017) [20]
Details of acupuncture	Acupuncture material	O	O	O	O	O	O	O	O	O	O	O	O
	Manufacture	-	O	O	O	O	O	O	O	O	O	-	O
	Diameter, length	O	O	O	O	O	O	O	O	O	O	O	O
Details of moxa	Moxa mass	O	O	O	O	O	O	O	O	O	O	O	-
	Moxa density	-	-*	O	-*	-	-*	-	-*	-*	-*	-	-
	Moxa type	-	O	O	O	O	O	O	O	O	O	O	O
Ignition position		-	O	O	O	O	-	O	O	O	O	O	-
Treatment environment	Chamber study	-	-	O	O	-	O	O	-	-	O	-	O
	Room temperature	O	O	O	O	-	O	-	-	O	O	O	O
	Room humidity	-	-	O	O	-	O	-	-	-	O	-	O

O, reported; -, not reported; *, can be calculated.

in each study. As the acupuncture treatment should not have side effects, should be resistant to corrosion, and should be suitable for hand techniques, disposable stainless-steel needles have been widely used in the clinics recently, and a group standard for disposable needles was established in 2006 [22]. Although the peak temperature was higher in the gold acupuncture needles compared with the stainless-steel needles, there were 3 studies that reported a high thermal stimulus effect [10-12], therefore, additional experimental studies using stainless-steel needles are required, considering the current frequency of use.

In 4 studies examining parameters based on the mass of the moxa, the peak temperature was higher in the larger moxa compared with the smaller moxa [13-16]. However, in WA, the mass of a safe moxa that produces efficient heat stimulation so that moxa is not eliminated is important [23]. Therefore, in addition to the mass of moxa, variables such as the figuration method, shape, and environmental variants of the moxa should be considered in practice.

Kim et al [13], who measured the parameters after varying the density of the moxa, concluded that 0.8 g moxa were produced at 0.11, 0.16, and 0.24 g/cm^3 and that a moxa of 0.11 g/cm^3 density showed the highest peak temperature, shortest time to reach the peak temperature, longest effective stimulus time, and strongest heat stimulation. Therefore, this study reported that a 0.11 g/cm^3 moxa is the most appropriate model. However, as there is no mention of the reasons behind the 3 chosen densities, and no studies were conducted with densities smaller than 0.11 g/cm^3, the results of Kim et al [13] should be reconsidered.

In 2 studies with changed ignition position, the time to reach the peak temperature was significantly shorter in the bottom ignition [17,18]. In addition, the effective stimulus time was only measured in the study by Kim et al [17]. The effective stimulus time was significantly longer in the bottom ignition. According to the acupuncture medicine textbook [2], the ignition of WA should be made at the bottom, but no evidence supporting this recommendation has been provided. These studies are valuable in that they have provided quantitative proof. However, as there were only 2 studies, and the specifications of the acupuncture and moxa were heterogeneous, the experiment should proceed under the same conditions to enable a comparison of the results.

The quality of reports on the intervention factors that could affect WA was low, although the studies were the ones that examined associations with the characteristics of WA intervention. In cases of acupuncture intervention, the quality of reports has improved in comparative clinical trials since the establishment of the Standards for Reporting Interferences in Clinical Trials of Acupuncture (STRICTA) in 2001 [24]. The Standards for Reporting Interactions in Clinical Trials of Moxibustion (STRICTOM) was published in 2013 based on STRICTA [25]. Since then, randomised controlled clinical trial quality assessments of moxibustion intervention have been conducted using STRICTOM, but the use of STRICTOM has not been routinely accepted [26,27]. In addition, there are items in STRICTOM that can report the use of WA as "warming needle", but they do not reflect the characteristics of WA intervention alone, making it difficult to apply them.

In this study, based on the results of the search, factors were set after considering the characteristics of WA intervention and identified based on whether each study reported good intervention components. Although the studies reported the characteristics of the acupuncture needle in detail, the reporting method was heterogeneous in cases of moxa compared with the acupuncture needle, and the moxa mass was presented in most studies, but the details of the diameter and size of the moxa to determine the density were omitted.

The studies were also incomplete in the figuration method of a moxa and types of moxa. The ignition position was not listed in 3 of the studies [10,20,21], and 6 studies showed that the experiment proceeded with apex ignition [11-16]. In addition, 6 studies were chamber studies that maintained certain experimental conditions [12,13,15,17,20,21], but 6 studies, which were not conducted in the testing device, omitted the environmental variable [10,11,14,16,18,19]. Environmental variables, such as temperature, humidity, and air current, are important in actual WA procedures, and reports should not be omitted from experimental studies.

This review has limitations. It was difficult to generalise the WA intervention characteristics through the results of this study because of the small number of studies searched. Although this study did not impose any other search terms other than those associated with WA to include as many studies as possible, it is a limitation that WA does not have a defined Medical Subject Headings (MeSH) term and is used with various other terms in each country, thereby not enabling all studies to be covered. In addition, when the study was classified based on measured parameters and intervention factors, the number of retrieved studies was small, which is insufficient to generalise the results.

Moreover, this study failed to generate the results because the acupuncture needle, moxa, thermometer, and temperature measurement position were heterogeneous. Further, many kinds of parameters that reflected the thermal stimulus effects were investigated in each study. This is because the thermal characteristics of moxa, a factor of WA intervention, is not well-understood, and it is difficult to quantify the treatment efficacy. The thermal characteristics of WA are insufficient to be described by independent parameters alone, and since there will be differences in the thermal characteristics of the moxa, experimental designs are needed to measure the same parameter changes under the same experimental conditions and compare the thermal stimulus effects.

In addition, the experimental studies included in this review were implemented under controlled experimental conditions. The WA treatment required the patient's safety and effective heat transfer. As this study did not include clinical studies, information of adverse events that may occur in real cases were not recorded. Therefore, further clinical studies are required when applying the results in actual clinical practice.

At present, WA therapy requires further characterization of each intervention element for effective treatment with WA. Understanding of the characteristics of WA intervention for effective treatment must be preceded to continuously use with WA. Therefore, advanced experimental studies on the details of WA intervention should be performed.

Conclusion

Parameters such as peak temperature, time to reach the peak temperature, and effective stimulus time were determined as factors affecting WA. However, this study provided limited information because of the small number of studies, heterogeneity of materials and parameters depending on each study. Further studies should determine the correlation between heat transmission and intervention factors for WA.

Conflicts of Interest

The authors have no conflicts of interest to declare.

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